

PUBLIC WORKS MANUAL

CITY OF CRAIG



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DIVISION 1



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INTRODUCTION

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PART 1 GENERAL**1.01 INTRODUCTION.**

This Public Works Manual for the City of Craig has been authorized by Ordinance No. ____.
This document shall be known as the "City of Craig Public Works Manual."

1.02 PURPOSE

The purpose of this Public Works Manual is to act as a guide for the uniform design and construction of infrastructure including roads, water and sewer facilities, drainage conveyance structures, and other municipal infrastructure and appurtenances within the City of Craig. This Manual identifies the minimum standards, specifications, and processes necessary to achieve public safety, functional effectiveness, ease of maintenance, uniform materials and consistent lines of communication.

1.03 SCOPE AND APPLICATION

These regulations apply to lands within the city limits of the City of Craig and adjacent lands served or impacting the City.

1.04 WAIVER.

No waiver of these regulations, standards and specifications shall be valid unless approved by the City or representatives of the City in writing. A waiver shall be project specific and shall not establish a precedent for any other proposed waiver. A request for a waiver must be made in writing and identify a detailed explanation of why the proposed waiver is warranted by site-specific conditions. No public hearing is required for determination of a waiver by the City Manager or City Engineer.

1.05 KEY PLAYERS

1. City of Craig
 - a. City Council
 - b. Planning & Zoning Commission
 - c. City Manager
 - d. City Staff
 - e. City Engineer

1.06 KEY DOCUMENTS

1. City of Craig Municipal code
2. Establishing Contract
3. City of Craig Public Works Manual

1.07 DESIGN REVIEW PROCESS KEY CONCEPTS

1. The City will review all civil infrastructures within its jurisdiction through the City Engineer for compliance with the Public Works Manual.
2. The City will ask the Owner's Engineer to submit during the land use process, a report, which discusses compliance with the Master Plan and the trigger points for expansion of the wholesale infrastructure if needed.

DIVISION 2



Division 2 Submittal Requirements

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SUBMITTAL REQUIREMENTS

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2.01 EASEMENTS

All utilities shall be located in the right-of-way or an approved easement. Minimum easement width shall be 30 feet for water, sewer and drainage facilities. Over-depth installations shall require wider easements. Electric, telephone, TV cable, gas and future utilities shall be located completely within the right-of-way or easements approved by the respective utility provider.

2.02 DRAINAGE.

Drainage easements and improvements shall be designed by a registered engineer to accommodate expected run-off as determined by the drainage plan. Improvements shall be installed to specification by the City Planning and Zoning Commission through their designated representative. All drainage improvements described herein shall be the financial responsibility of the sub-divider, subject to provision of City Code and this Public Works Manual.

2.03 DRAINAGE CRITERIA.

Project specific requirements should be discussed with the City Engineer as early as possible in the application process. The rate of runoff from any developed area shall not exceed the historic rate of runoff based on a ten (10) year and one hundred (100) year rainfall event.

The following methods of runoff estimation may be utilized for determining the rate of runoff from a particular site as applicable:

1. Rational Method. Used for Drainage Basins less than 200 acres in size and for minor system design.
2. SCS TR 55 Methods. Used for drainage basins up to 20 square miles in size for flood flow determination and design in minor and major systems. Also used to compute flood storage volumes.
3. Unit Hydrograph. Advance approval of method and application required. Used for drainage basins up to 1,000 square miles in size. Also used for flood flow determination and design in minor and major systems. Also used to compute flood storage volumes.

2.04 GENERAL UTILITIES

In the event oversized utilities are required, arrangements for reimbursements shall be made, whereby the developer shall be allowed to recover the cost of the utilities that have been provided by him beyond the needs of his development and standard City specification. The method and time of payment under the reimbursements shall be established in accordance with the current policies of the City relating to the placement of such oversized utilities.

2.05 WATER DISTRIBUTION

The water main distribution system shall be designed to connect with the City water system and make water available to each lot in the proposed subdivision. Fire hydrants shall be located to insure protection to each lot in accordance with International Fire Code

requirements. Design of the system shall be the responsibility of the sub-divider with all plans subject to approval of the City Council through their designated representatives. Installations of the system shall be to City specifications and at the direction of the City Council through their designated representatives. Financial responsibility for the water distribution system shall be subject to existing City regulations and agreement relating thereto between the City Council and the sub-divider, subject to provision of the City of Craig Public Works Manual.

2.06 SANITARY SEWAGE COLLECTION.

The sewage collection system shall be designed to connect with the City system and provide service to each lot in the proposed subdivision. Design of the system shall be the responsibility of the sub-divider with all plans subject to the approval of the City through their designated representatives. Financial responsibility for the sanitary sewage collection system shall be subject to existing City regulations and agreements relating thereto between the City and the sub-divider, subject to the provisions of the City of Craig Public Works Manual.

2.07 ALL OTHER UTILITIES.

All utilities, except major power transmission lines, should be underground if feasible. Facilities necessary and appurtenant to underground facilities or other installation of peripheral overhead electrical transmission and distribution feeder lines, or other installation of either temporary or peripheral overhead communications, distance, trunk, or feeder lines may be above ground.

2.08 SIDEWALKS

Sidewalks are required on both sides of all streets, unless special circumstances warrant the City Council to specifically waive the installation in writing. Sidewalks shall be at least four feet (4') wide in residential areas and eight feet (8') wide in commercial areas. Collector streets shall have vertical curb and gutter and attached sidewalk. In residential areas, sub-arterial streets shall have a vertical curb and detached sidewalk at least four feet (4') in width separated from the curb by a minimum of four and one-half feet (4½'). Design of streets in commercial and industrial areas shall be approved by the Planning and Zoning Commission.

Construction of sidewalks shall be to specifications set by the City Council through their designated representatives.

All sidewalks shall be ramped at all street intersections or other pedestrian crossing areas. The design and construction of sidewalk ramps must meet the applicable requirements of the "Americans with Disabilities Act" (ADA).

2.09 SIGNING AND STRIPING PLANS

A complete signing and striping plan shall be submitted as part of the construction drawings. This plan shall include all project streets and intersections and all intersections with existing streets. The design of these improvements shall be in accordance with the latest version of the Manual on Uniform Traffic Control Devices (MUTCD) and shall include all necessary traffic control signage. Street name signs shall be installed at all intersections. The developer will be responsible for their installation.

2.10 BICYCLE PATHS.

Developers, when required, shall install a bicycle path at least eight feet (8') in width along the right-of-way of any sub-arterial street and any arterial street which is not bordered by a frontage road. The initial site of the path along any street shall be determined by the Planning Commission and the City's Engineer. Each developer who extends the path shall keep the path continuous and with as little change in grade as possible. If topography necessitates that the path change from one side of the street to the other, or if the path intersects with another arterial or sub-arterial street, crossways shall be provided. All bicycle paths shall be ramped at intersections. Paths and crossways shall meet construction and design standards set by the City Council through their designated representatives.

2.11 STREET LIGHTING.

The developer shall install streetlights at points designated by the City or electric company. The design of both poles and the lights themselves shall meet specifications established by the City Council through their designated representatives.

2.12 CONTROL OF EROSION AND SEDIMENTATION.

A. Purpose and Applicability.

1. Purpose: The goal of these requirements is to minimize the water quality impacts resulting from construction, clearing, grading, excavation and other land disturbing activities. Siltation is often a cause of water quality impairment in waterbodies in Colorado.
2. Applicability: These regulations apply to any land development and or disturbing activities. Land disturbing activities include grading, excavation, clearing timber or vegetation, and construction
3. Exemption: Single Family Construction
4. Construction of single-family residential units shall be exempt from these regulations if:
 - a. Less than ½ acre.
 - b. The Planning Department determines that exempting construction will not have a significant impact on water quality.
5. Other:

Occasions may arise where these minimum standards are either inappropriate or cannot be practically implemented. In these cases, a variance to these criteria shall be considered. Written requests for each variance should be directed to the City of Craig Building Official or designated representative.

B. Erosion and Sediment Control Requirements

6. Minimize Erosion on The Site.
 - a. Phase construction - Stage and schedule the timing of earth disturbing construction activities, such as clearing, grading, road construction, and utilities installation to minimize soil exposure.
 - b. Install erosion and sediment control measures before site grading or other construction, to the greatest extent practicable.
 - c. Soil stabilization - Disturbed areas and soil stockpiles shall be stabilized or protected to effectively control erosion. These areas should be surface roughened, mulched, or seeded and mulched, or otherwise protected from erosive forces if they will remain exposed and inactive for periods longer than 14 days. This requirement also applies if soil is expected to be exposed over winter to minimize erosion from

- occurring during spring snowmelt. Disturbed areas should be mulched, or seeded and mulched within 7 days after final grade is reached, weather permitting.
- d. On slopes steeper than ten percent (10%), or within one hundred feet (100') of any waterbody, exposed soils shall be stabilized using appropriate techniques.
 - e. Temporary and permanent revegetation - Disturbed areas that will not be built upon for one (1) year shall incorporate a temporary cover crop to promote soil stability. Areas exposed for two (2) or more years must be revegetated with a perennial, native grass mix (or other grass mixtures as recommended by the local Natural Resources Conservation Service office). Within two (2) full growing season of project completion, vegetative site coverage shall have a perennial herbaceous component equal to or greater than seventy percent (70%) of the adjacent undisturbed areas.
 - f. Cut and fill slopes - Where cut and fill cannot be avoided, slopes shall be designed for long-term stability. Permanent vegetation should be used as the priority approach to stabilization of cut and fill areas where slopes are less than or equal to 3:1. On steeper cut and fill slopes, stabilization may be attained by utilizing a combination of retaining walls, rock walls, up slope runoff diversions, terracing, slope drains, soil nailing, mulch binders, erosion control blankets, vegetation or other measures appropriate for the specific situation. Retaining walls over four feet (4') in height or step retaining walls shall be designed by a Colorado registered engineer. The soil surface of cut and fill slope shall not remain exposed without an approved method of soil stabilization.
 - g. Construction in or directly adjacent to any waterbody, such as culvert or bridge installation, shall require measures to protect water quality and channel stability. This requirement may include stream isolation through the use of cofferdams, complete containment of the stream in the area of the disturbance, stream crossing structures, or limitations on the dates when in-stream work can be performed. In all cases construction shall conform to applicable USACE Section 404 permitting requirements and Colorado, Division of Wildlife.
 - h. Protect new or re-routed irrigation ditches, swales, receiving channels and streams from accelerated erosion until conveyance section has established vegetation and is stable under flows for which the feature was designed. The minimum recurrence frequency storm during active construction for channel stability design is the 2-year event for the entire drainage area served by that flow conveyance feature. Diverting off-site flows around construction sites can effectively reduce the design flow. Must have approval from Ditch Company.
 - i. Protect culvert outlets from erosive flows by installing velocity reducers such as gravel dikes, riprap or similar measures.
1. Minimize Sediment Leaving the Site
- a. Manage stormwater runoff flows to minimize erosion and sediment transport off-site. Divert concentrated flows away from disturbed slopes and minimize length and steepness of disturbed slopes or use slope drains.
 - b. Minimize sediment and mud from leaving the construction site by protecting access routes by either immediate placement of street base or construction of vehicle tracking pads. Vehicle tracking pads shall be at least fifty feet (50') in length, if available, and comprised of angular rock and/or a wheel washing facility.
 - c. Protect adjacent properties from sediment-laden runoff by using sediment fences, and sediment or silt traps or other appropriate control options.
 - d. Storm sewer inlets shall be protected from entry of sediment-laden water. Straw bales, supported silt fence structures, dumped rock or other barriers may accomplish

this.

- e. Divert off-site runoff around construction site when practical.

2. Detention and Treatment

- a. When the contributing drainage area, including off-site area (unless bypassed), is greater than five (5) acres, one or more sedimentation basin(s) shall be constructed to provide a total of 1800 cubic feet of basin volume for every acre contributing runoff into the basin. The outlet of the sediment basin should be designed to empty the storage volume in no less than 12 hours. The basin's length should be no less than twice the basin's width; otherwise a baffle may be installed to minimize short-circuiting. If the discharge from the basin is passed through a filtration device (i.e. a vegetated field, forested area, or a constructed wetland) the basin volume requirements may be reduced.
- b. Where the contributing drainage area is less than five (5) acres, a specific engineered design for sediment trapping facilities is not necessary. Silt traps may be used to detain and treat runoff if the contributing drainage area is less than 5 acres.
- c. Sedimentation basins will be removed after successful revegetation of the site. Embankments to be left as permanent facilities shall have a capacity to safely pass the 100-year flood and meet any relevant dam and diversion requirements of the Colorado State Engineer's Office.

3. Construction De-watering

- a. Construction dewatering activities will conform to the State's NPDES construction dewatering permit requirements.
- b. Discharges from construction dewatering operations shall be done in a manner which minimizes erosion and utilizes best management practices such as velocity reducers, sediment basins, straw bales or other measures.

4. Inspection and Maintenance of Erosion and Sediment Control Devices

- a. Inspection The applicant or the applicants designated representative shall inspect all erosion and sediment control devices and make repairs at a minimum, of every 14 days, or after precipitation or snowmelt event that causes surface erosion. An inspection log shall be kept on site for review by the City until the project is complete and submitted to the City upon request.
- b. Maintenance Erosion and sediment control devices shall be maintained in a manner to support their effectiveness. Accumulated sediment should be periodically removed from sediment basins and traps; straw bale and silt fence barriers should be checked for undermining and bypass and repaired or expanded as needed; and mulched soils shall be re-mulched where mulch has been lost or damaged.

C. SUBMITTAL REQUIREMENT

- 1. Erosion and Sediment Control Plan - Must be submitted for review and approval. The Erosion and Sediment Control Plan shall be prepared by a Colorado registered engineer, or if not needed for building plans a Colorado registered architect. This information may be included as part of a Stormwater Quality Control Plan, if required. A concise erosion and sediment control plan shall be submitted that addresses site-specific issues and contains the following information:
 - a. A site map showing construction site boundaries, locations of any existing structures, waterbodies or hydrologic features on the site, including intermittent water features, springs, landscape irrigation return flows, wetlands and the 100-year floodplain boundaries.
 - b. Locations of existing and proposed drainage structures or natural drainage features on the land adjacent to the site and within a minimum of 100 feet of the site boundary line, including as examples: Street gutters, storm sewers, drainage

channels, other water conveyance structures, wetlands or other waterbodies receiving storm runoff from the site.

- c. Existing topography at reasonable contour intervals, 2-foot or less if possible, to provide necessary detail of the site. The map should extend a minimum of 100 feet beyond the property line and show the location of the property line.
- d. Proposed development plan and grading plan. The proposed topography at reasonable contour intervals that provide necessary detail of the site shall be submitted. The map should show elevations, dimensions, location, extent and slope of all proposed clearing and grading including building site, areas of cut and fill, and driveway grades.
- e. Probable locations of soil stockpiles and snow storage areas.
- f. Proposed drainage plan
- g. Location of storage areas designated for equipment, fuel, lubricants, fertilizers, chemical and waste storage with an explanation of spill containment structures.
- h. Location of temporary roads designed for use during construction period.
- i. Areas of steep slope locations must be shown for the following conditions:

Existing Site:	areas greater than or equal to 10%
	areas greater than or equal to 30%

Developed Area:	areas greater than or equal to 10%
	areas greater than or equal to 30%

- j. Construction schedule indicating the anticipated starting and completion time periods of the site grading and/or construction sequence including the installation and removal of erosion and sediment control measures, and the estimated duration of exposure of each area prior to the completion of temporary erosion and sediment control measures.
- k. Permanent stabilization - A brief description of existing vegetation at the site including an estimate of the percent vegetative ground cover and a description of how the site will be stabilized after construction is completed.
- l. Plan view drawings of all erosion and sediment control measures (such as sediment traps, silt fence, inlet protection, etc.) showing approximate locations and site drainage patterns. Text may be necessary to accompany and explain the drawings.
- m. Detail drawings - For those measures that are not typical erosion control practices or require specific engineering design, such as sediment basin outlet works.
- n. Estimated total cost (installation and maintenance) of the required temporary soil erosion and sediment control measures to assist the City to determine performance guarantees, if any, for the proposed plan.
- o. Calculations - Any calculations made for determining rainfall, runoff, sizing any sediment basins, diversions, conveyance or detention/retention facilities.
- p. Other information or data as may be reasonably required by the local jurisdiction.
- q. Signature block for owner or legal agent acknowledging the review and acceptance of responsibility, and a signature and stamped statement by the qualified individual acknowledging responsibility for the preparation of the Erosion and Sediment Control Plan.
- r. A copy of the required NPDES Construction Permit, if required. State and federal law mandates a Stormwater Permit for construction sites disturbing one acre or more even where the disturbance is phased. In most cases the

information required herein will meet state submittal requirements.

DIVISION 3



Division 3 Water and Wastewater

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WATER AND WASTEWATER

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SECTION 1**WATER TRANSMISSION AND DISTRIBUTION LINES****PART 1 SCOPE****1.01 SCOPE**

This section shall include all materials, labor, equipment and miscellaneous items necessary to install all raw water, potable water transmission and distribution pipelines and appurtenances as specified herein for the City of Craig.

1.02 PROTECTION OF WORK

All pipe, fittings, valves and equipment shall be carefully handled, stored and protected to prevent damage to materials, protective coatings and linings. At no time shall such materials be dropped or dumped into the trench.

Precautions shall be taken to prevent foreign matter from entering the pipe, fittings and valves prior to and during installation. No debris, tools, clothing or any other material shall be placed in the pipe during installation. Whenever pipe installation is suspended, either temporarily or overnight, the open end of the pipe shall be sealed with a watertight plug to prevent the entrance of trench water, debris or foreign matter into the pipeline system.

Under no circumstances shall trench water be allowed to enter the pipeline. When water is present in the trench, the plug shall remain in place until the trench is pumped dry. Whenever trench water becomes evident, measures shall be taken to prevent pipe flotation.

If, in the opinion of the Engineer, the Contractor is incapable of keeping the pipe free of foreign matter during installation, the Engineer shall require the Contractor to protect the pipe ends with water tight plugs until the start of the joining operation.

PART 2 MATERIALS**2.01 GENERAL**

This item covers the types of materials that will be required for the construction and installation of water lines. All materials used shall be new, of the best quality available, and conform to applicable standards as indicated herein.

2.02 POLYVINYL CHLORIDE (PVC) PIPE AND FITTINGS**A. PVC Pipe**

1. Materials - ASTM D1784, Type 1, Grade 1, PVC 1120, 2000 psi design stress.
2. Reference Standard - AWWA C900, latest edition, 4" - 12".
3. Class - 200 (DR-14), 4" - 12".
4. Reference Standard - AWWA C905, latest edition, 14" - 48".
5. Class - 235 (DR-18), 14" - 48".
6. Markings - Manufacturer's name, nominal size, class pressure rating, PVC 1120, NSF logo, identification code.
7. Specialties - Tracing wire, 10-gauge stranded copper insulated wire with bolt type splices.
8. Size - Shall conform to outside diameter of PVC.

B. Fittings

1. Type - All fittings shall be mechanical joint except where specifically shown or detailed otherwise.
2. Reference Standard - ANSI/AWWA C110/A.21.10 or C153/A.21.53, latest edition.
3. Pressure Rating - 250 psi for C110; 350 psi for C153.
4. Gasket Reference Standard - AWWA C111, latest edition.
5. DIP fittings, sleeves and valves shall be polyethylene encased and epoxy coated inside and out.
6. Mega Lugs are required on all fittings.
7. Core Blue bolts to be used on all fittings.

C. Joints

1. Push-on rubber gasket.
2. Gasket Reference Standard - AWWA C111, latest edition.

PART 3 INSTALLATION**3.01 GENERAL**

All transmission and distribution lines to be dedicated to the City of Craig, shall be located a minimum of ten feet inside a public easement. The location of water lines within side lot line easements or rear lot easements is discouraged. Refer to Detail W09.

When site conditions allow, the water line should be located outside Concrete/paved areas. At all times, water lines shall be located so that City maintenance personnel can easily maintain and operate those lines.

Easements or rights-of-way used during installation of water mains shall be a minimum width of 30 feet. In dredge areas and other special conditions, a wider easement may be required.

3.02 PIPELINE DEPTH

The minimum depth of bury of water mains shall be as follows: (Depth of bury equals depth to top of pipe).

- A. Mains shall be buried a minimum depth of 6 feet (below existing or proposed grade) in all locations.
- B. When water mains are to be located underneath storm drains, culverts or any other submerged air space, the required depth of bury shall be 6 feet deeper than crossing elevation. This is necessary to ensure that the water line is beyond the frost depth associated with the storm drain culvert, etc. In some cases, the City engineer may allow insulation in place of increased depth where water lines cross under one of the above. Of the Ratio that 1-inch insulation is equal to 1 foot of bury.

3.03 CLEANING AND INSPECTION

Clean all pipe, fittings, valves and related materials thoroughly of all foreign material; inspect for cracks, flaws, or other defects prior to installation. Mark all defective, damaged or unsound materials with bright marking crayons or paint and remove from job site. Of

particular concern should be the gasket groove in the pipe bell. All spurs, excess paint, and any other defects within the gasket groove shall be either removed or repaired, or the pipe shall be deemed unacceptable.

The Contractor shall take all necessary precautions to prevent any construction debris from entering the water lines during construction of water lines and appurtenances. If debris shall enter the distribution system, the Contractor shall furnish all labor and materials necessary to clean the system. Under no circumstances will the Contractor flush the debris into an existing distribution system.

3.04 INSTALLATION

Pipe shall be laid in straight sections with bell ends facing the direction of laying unless otherwise directed by the City. Where pipe is laid on grade of 10% or greater, the installation shall proceed uphill with the bell ends facing upgrade. The pipeline shall be installed so that a continuous positive or negative grade is maintained between high and low points to avoid air pockets. At no time will a high point in the line be acceptable unless an air and vacuum valve is installed to relieve air pockets. Jointing of the pipe shall be made in accordance with the directions of the manufacturer of the pipe and the manufacturer of the couplings. The allowable pipe deflection per joint shall not exceed the maximum deflection tolerances specified by the manufacturer.

Pipe shall be lowered into the trench with ropes, slings or machinery. Under no circumstances should the pipe be pushed off the bank and allowed to fall into the trench. In joining the pipe, the exterior four inches of the pipe end (at the spigot), and the inside of the adjoining bell shall be thoroughly cleaned to remove oil, grit, tar and other foreign material. The gasket shall be placed in the bell so it will spring into its proper position inside the pipe bell. A thick film of the non-toxic NSF approved joint lubricant shall be applied over the entire surface of the gasket. The spigot end of the pipe shall then be wiped clean and inserted into the bell to contact the gasket. The pipe shall be pushed all the way into the bell by crowbar or by jack and choker slings. Extreme care shall be exercised when joining the pipe to avoid damaging the bell or rolling the gasket. The bell end of the pipe shall be protected by a piece of wood when pushing the pipe. Generally, every pipe has a depth of insertion stripe on the spigot end. The pipe shall be inserted to the full depth of the stripe. Check bells for rolled gasket with feeler gauge.

The cutting of pipe for fittings or closure pieces shall be done in a neat and workmanlike manner to prevent damage to the pipe or lining. All cuts should leave a smooth end at right angles to the axis of the pipe. Once a pipe is cut, the cut end shall be beveled free of spurs, which may damage rubber gaskets.

3.05 ALLOWABLE PIPE DEFLECTION

- A. If permitted by the City, gasket-joined pipe may be deflected with the following limitations as defined in the most current version of AWWA C605.
 - 1. Contractor shall block or brace pipe joints to ensure bending of pipe does not result in joint offset that exceeds the manufacturer's published limits as damage may occur.
 - 2. Deflection shall not exceed limits shown in table below.

PVC HORIZONTAL & VERTICAL DEFLECTION		
Size of Pipe	Deflection in One 20-Foot Length	Approx. Radius of Curve Produced by Succession of 20-Foot Joints
4"	24"	100'
6"	16"	144'
8"	13"	189'
10"	11"	231'

3.06 CONNECTION TO EXISTING WATER FACILITIES

All main line connections between existing and proposed piping shall be made during non-business hours or at a time, which is acceptable to the City. All shut-offs shall be planned 72 hours in advance and all persons affected by the shut-off shall be given a 24-hour notice. Special circumstances may exist calling for evening or weekend shutoffs. Shutoffs will not be allowed on Fridays or weekends or holidays unless pre-approved. Take all precautions to prevent contamination when making connections to existing potable water lines. No trench water, mud, or other contaminating substances shall be permitted to enter the pipeline.

3.07 FUTURE CONNECTIONS

At intersections, dead-end runs, or other locations where the possibility may exist for a future connection, a tee or cross and a valve should be provided. In addition, the stub out must extend to the property line. This procedure allows a future connection to be made while keeping the existing main line in service at all times. In each case, the valve shall be properly restrained to the tee or cross, using restraining rods with eyebolts. In addition, a concrete reaction block will be placed on the plugged end of the valve. Valve box shall not be extended to surface grade.

3.08 PROTECTION OF WATER SUPPLIES

Water lines shall be located a minimum of 10 feet horizontally from existing or proposed sewer mains. Wherever the sewer line crosses above or within 18 inches beneath the water lines, the sewer line shall be made impervious by the following method listed below also refer to Detail W11:

- A. Twenty feet of AWWA DR18 C-900 PVC, shall be used for sewer pipe and centered over the water main. The joints between the sewer pipe and the placement pipe (PVC) shall be sealed with solid sleeves with transition gaskets. All work should be in strict conformance with the current Colorado Department of Public Health and Environment and Environment's "Design Criteria for Potable Water Systems".

3.09 REACTION ANCHOR AND BLOCKING

Concrete thrust blocks shall be provided as shown in Detail W01 for all tees, elbows, plugs, reducers, valves, fire hydrants, and crosses if one or more sides of the cross are plugged. The bearing area of the block shall be at least equal to that stated on the attachment. The bearing surface shall be against undisturbed earth. The block shall be placed normal to the thrust as show on the drawings. Concrete for thrust blocks shall have a 28 day 4,000 psi compressive strength. (NOTE: No other materials other than concrete may be used in thrust blocks and ready mix or bagged concrete is not allowed).

If the concrete has not had sufficient time to cure (e.g., restoring water service), the

Contractor shall be required to use temporary bracing for added strength. Use of additional wood bracing will help prevent fitting and valves from leaking or "blowing off" when water pressure is restored to the main line.

Whenever a concrete thrust block is placed, wood or plastic sheets shall be used to prevent concrete from adhering to nuts and bolts. Any concrete splattering onto a nut or bolt will be removed before the line is backfilled.

3.10 TRACER WIRE

Electrical tracing wire shall be required on all water mains. The wire shall be taped to the top of the pipe at 10 foot intervals to prevent dislocation of the wire during backfilling. The tracer wire shall be extended to the surface at all valves and fire hydrants. The wire shall be extended towards the ground on the outside of the valve box until the wire is within 4 inches of the top of the lid, at which point it shall be brought back inside the box and securely fastened. Sufficient slack in the outside of the wire shall be provided to compensate for any future adjustment to the valve box. The tracer wire shall be continuity tested prior to acceptance of the pipeline.

3.11 DETECTABLE UNDERGROUND MARKING TAPE

Underground marking tape shall be a 3 inch width detectable marking tape, with a minimum 5.0 mil overall thickness. Tape shall be manufactured using a 0.8 mil clear virgin polypropylene film, reverse printed and laminated to a 0.35 mil solid aluminum foil core, and then laminated to a 3.75 mil clear virgin polyethylene film. Tape shall be printed using a diagonally striped design for maximum visibility, and meet the APWA Color-Code standard for identification of buried utilities.

PART 4 SIZING OF MAINS

4.01 GENERAL

All main water lines shall be sized for peak hour flow plus fire flows required by the Craig Fire Rescue at a 20 psi residual flow. Minimum size shall be 8 inches in diameter.

SECTION 2

WATER SERVICE LINES AND APPURTENANCES

PART 1 GENERAL

1.01 SCOPE

This section shall include furnishing all materials, labor, equipment and miscellaneous items necessary to install all water service lines and appurtenances as specified herein for the City. Note: The City will own and maintain that portion of the service line from the main line up to and including the curb valve. The curb valve shall be placed on the property line; however, at all times, it will fall on the City side of the property line. All work and materials from the curb valve to the building shall be in conformance to the most recently adopted Uniform Plumbing Code.

PART 2 MATERIALS

2.01 COPPER SERVICE PIPE

- A. Reference Standard - ASTM B88, latest revision, Type K soft or HDPE of equal inside diameter (ID) to type K Copper. If HDPE is used, tracer wire must be used with service line.
- B. Size - 1.0 – 2.0 inches.
- C. Do not use any pipe lubricants for service line fittings.

2.02 CORPORATION STOPS

- A. Material - Brass or bronze.
- B. Size - Same as copper service line.
- C. Reference Standard - AWWA C800, latest revision.
- D. Inlet - Threaded CC type.
- E. Outlet - Compression fittings.
- F. Manufacturer Reference-Mueller 300-B25029

2.03 SERVICE SADDLES

- A. Materials - Bronze service clamp, 'O' ring gasket, double strap, brass, CC thread.
- B. The City will require saddles to be installed on all service connections.
- C. Manufacturers reference – Mueller or Ford.

2.04 CURB STOP

- A. Materials - Cast bronze body, resilient 'O' ring seals, standard tee head operator, Teflon ball valve type.
- B. Riser rods – Stainless steel
- C. Inlet - Compression fitting.
- D. Outlet - Compression fitting.
- E. Standard reference AWWA C800, latest revision.
- F. Manufacturer's reference - Mueller or McDonald.

2.05 CURB BOX

- A. 1.0 inch to 1.25 inch, Manufacturer's reference - Mueller H-10314 or equal.
- B. 1.5 inch to 2.0 inch, Manufacturer's reference - Mueller H-10336 or equal.
- C. Curb box must be traffic rated when located within traffic areas.
- D. Material type – Cast Iron

2.06 COUPLINGS

- A. Couplings are not allowed for services less than 100 feet long from the curb stop to the main and curb stop to house. In the case of a service line exceeding the available length of copper piping, couplings may be used. If a coupling is used the service line must be tested to 1.5 times normal working pressure or 150 psi minimum with the coupling exposed so a City representative can verify.

PART 3 INSTALLATION

3.01 SERVICE LINE INSTALLATION

All trenching, backfilling and compaction shall conform to Section VI of these regulations. All service lines shall be disinfected and pressure tested as per Sections VII and VIII of these regulations. Refer to Detail W03.

3.02 SERVICE LINE DEPTH.

A depth of bury for all service lines shall be a minimum of 6 feet.

3.03 TAPPING PRESSURIZED MAINS

All 1.0 – 2.0 inch taps on pressurized mains shall be made by the City. Services greater than 1.5" shall be PVC C900. Services greater than 2.0" shall be disinfected as main lines.

3.04 PERMITS

A road cut permit for excavation in Craig streets, alleys and easements must be completed prior to tap. 72 business hour notice is required by the City prior to making taps and locating

lines. Taps and locations will not be done without a water application filled out by Customer. Permits can be obtained from 8:00 am to 1:00 pm, Monday through Thursday.

3.05 SERVICE LINE SIZING

Service lines are to be sized by Customer but the maximum copper service line allowed will be 2.0 inches. The customer is encouraged to have an engineer size the service line. The City will not provide this service.

3.06 EXTENDED SERVICE CONNECTIONS OVER 100 FEET

Extended service connections 1.0 to 2.0 inch in size shall be of k type soft copper or HDPE, pipe unions shall be connected with curb stop valves.

3.07 FINAL INSPECTION

The final inspection shall be scheduled with the City 72 business hours in advance. The inspection will include inspection of the service connection, water meter, backflow device, PRV, curb valve and sewer cleanout.

PART 4 METERS

4.01 TYPE

Magnetic drive, sealed register, radio read meter interface unit. Turbo meters for 3 inch and larger.

4.02 MANUFACTURER'S REFERENCE

Sensus T10 Brass Meter with E-coder and Radio Read MXU
Sensus Ipearl
Neptune Brass meters in some cases as approved.

4.03 INSTALLATION

Install all meters in a horizontal position with a suitable holding device to support piping, meter and provide electrical bond when meter is taken out for testing. Pre-manufactured holding devices or yolks are available which cut down labor time to install meter. Install in building where meter and pressure reducing valve will not freeze. Upon final inspection, if the meter is not able to be read by radio from the street, the MXU may need to be relocated on an outside wall at least 36-48" above grade where it is freely accessible and where falling or melting snow will not cover it (stucco construction can prevent the meters from being read by radio). MXU shall be easily accessible and located near the other utilities.

Turbine meters should be installed with five pipe diameters upstream or downstream of bends, valves, PRV's, check valves or any other fitting that causes turbulence.

4.04 METER INSPECTION

The water meter must be inspected by the City at final inspection after it is installed and before the Certificate of Occupancy is issued.

4.05 METER PITS. ARE NOT ALLOWED

PART 5 PRESSURE REDUCING VALVE (PRV)(REQUIRED IN-HOUSE)

5.01 MANUFACTURER'S REFERENCE

Watts U-5-B or equal.

5.02 INSTALLATION

Install downstream on all meters Allow for easy access to strainer and cleanout plug.

5.03 PRESSURE TESTING

Downstream pressure to be set at 70 psi for single family and 90 psi for multi-story.

5.04 INSPECTION

PRV will be inspected during final inspection.

PART 6 BACKFLOW PREVENTION DEVICES

A backflow device is required on all new construction. Residential construction will require at a minimum a non-testable double check device. Non-testable devices must be replaced every five years and notice of replacement sent to the City. Commercial complexes (low risk) and residential complexes that have a common water line are required to install a testable double check device. Testable devices must be tested every year and the results sent to the City. Commercial and industrial complexes that use hazardous materials are required to install a reduced pressure assembly (RP). The RP device must be tested every year with the results sent to the City.

A single backflow device may be insufficient to protect the water supply. Irrigation systems that use potable water must have a separate vacuum breaker. Most of the secondary installations are addressed in the plumbing code.

Because backflow devices prevent pressure from bleeding back to the water main, an expansion tank will need to be installed to prevent damage to the buildings water system.

6.01 TYPE

Double check backflow preventer or as required by state law

6.02 MANUFACTURER'S REFERENCE

Febco/Watts

6.03 INSTALLATION

Backflow prevention device must be installed after the meter and before the pressure reducing valve.

6.04 INSPECTION

Backflow preventer will be inspected during final inspection.

PART 7 ABANDONMENT OF SERVICES

7.01 WATER SERVICES

Shall be abandoned at the main. Abandonment will consist of removing the service from the corporation valve and closing the corporation valve and/or tapping valve.

7.02 WATER WELLS

All wells located on the subject property must be properly plugged and sealed as required by Rule 15 of the Colorado State Engineer's Regulations, or any amendment or revision of that rule. There shall be no direct connection between a private well and the City's water system. It is the ultimate responsibility of the well owner to have a well properly plugged and sealed. Water rights associated with such wells must be assigned to the City of Craig before water service will be extended to such property. Evidence of well abandonment must be provided to the City of Craig prior to issuance of Certificate of Occupancy. Additionally, a recorded copy of the Colorado State Well Abandonment filing must be provided to the City of Craig within 90 days of abandonment.

SECTION 3

FIRE PROTECTION FACILITIES

PART 1 GENERAL

1.01 SCOPE

This section shall include furnishing all materials, labor, equipment and miscellaneous items necessary to install fire hydrants as specified herein for the City of Craig.

PART 2 MATERIALS

2.01 FIRE HYDRANTS

- A. Type - Dry barrel, traffic model with breakaway flange bolts and coupling.
- B. Reference Standard - AWWA C502, latest revision
- C. Outlet Size - One 4.5 inch NST, two 2.5 inch NST
- D. Hydrant Size – 6 feet or greater, from bury line to top of pipe
- E. Inlet Size - 6 inch
- F. Operation – 1.5 inch pentagonal national standard operating nut, open counterclockwise, lubricating reservoir.
- G. Depth of Bury – 6 feet minimum
- H. Additional Requirements - Furnish hydrant complete with pipe and tee, 6 inch restrained mechanical joint gate valve and thrust blocks. Hydrant shall be restrained to the hydrant tee by 0.75 inch Core Blue bolts protected from corrosion by the use of an approved bituminous coating. Furnish hydrant with bronze seat and lubrication reservoir. Either all thread or mega lugs can be used.
- J. Manufacturer's Reference - Mueller Centurion or Kennedy K81A
- K. Color - Hydrant to be painted red above the bury line.
- L. Pressure Rating - 250 psi

PART 3 INSTALLATION

3.01 HYDRANT SPACING

The development density and type of development shall determine the spacing of fire hydrants that each hydrant is to serve. In a low-density residential area, the maximum spacing of fire hydrants shall not exceed 500 feet. In medium to high-density residential areas, the maximum spacing shall not exceed 400 feet. In commercial and high-risk areas, the spacing shall not exceed 300 feet. The maximum distance from commercial buildings to hydrants shall be 150 feet, and shall be based on hose length.

3.02 LOCATION

Fire hydrants shall be located whenever possible at an intersection and in a public right-of-way or a utility easement. There shall be a minimum of 1.5 feet between outlet nozzle and back of curb or sidewalk. In all cases, hydrants shall be located out of the direct flow of pedestrian and vehicular traffic. Wherever possible, hydrants located consecutively along a street shall be placed on opposite sides of the street so that stringing fire hoses across a street during a fire can be kept to a minimum. Hydrants shall be placed at all intersections, at end of cul-de-sacs and at all dead-end runs. Hydrant location shall be approved by Craig Fire Rescue.

3.03 INSTALLATION

The bury line shall be located at finished grade. If the previously mentioned conditions are not met after the hydrant is installed and the street is at final grade, the hydrant must be brought to proper grade by installing extensions or other modifications as required. Bag all hydrants that are not in service. If the hydrants have been accepted by the City and the hydrant needs to be raised due to Homeowner landscaping problems, then the cost of the hydrant raising will be the responsibility of the homeowner. All hydrants shall be plumb. Refer to Detail W04.

3.04 HYDRANT APPURTENANCES

All fire hydrants shall be connected to the main line by means of a mechanical joint tee with 6 inch branch piping to hydrant. Each fire hydrant shall have a 6 inch valve on the branch pipe conforming to standards as outlined under Section V of these standards. The 6 inch gate valve shall not be located in the sidewalk, curb line, or gutter of the proposed street and shall be rodged to the main tee. Refer to Detail W04.

3.05 HYDRANT RESTRAINT

The hydrant shall be restrained to the main line with 0.75 inch all-thread rod extending from the main line tee to the 6 inch valve and then from the 6 inch valve to the hydrant. The 0.75 inch rods shall be tied to each joint with the use of eyebolts. A bitumastic coating (to prevent corrosion) shall be liberally applied to the all thread rod and eye bolts. In addition, the hydrant and main line tee shall be provided with concrete thrust blocks. Refer to Detail W01.

3.06 DRY BARREL TYPE DRAINAGE

All hydrants shall be provided with a minimum of 0.33 cubic yard of 0.75 inch screened, crushed rock and shall be placed under the weep hole outlet to assure proper drainage. The crushed rock shall be encased in separator fabric to prevent the mitigation of fines. Prior to the screened rock being placed under the weep hole outlet, the area around the weep holes on the hydrant will be covered with plastic sheeting allowing enough room under the sheeting for the hydrant to drain and also preventing concrete from entering the weepholes and covering any hardware.

3.07 INSPECTION

Prior to backfilling around the hydrant, a visual test shall be conducted to ensure the proper operation of the weep holes. The hydrant shall be partially opened and then closed. Water trapped in the hydrant barrel section should begin to drain. If water is not draining, the weepholes should be cleared of any obstructions restricting the flow of water.

SECTION 4

VALVES

PART 1 GENERAL

1.01 SCOPE

This section shall include furnishing all materials, labor, equipment, and miscellaneous items necessary to install gate valves, butterfly valves, air release and vacuum valves, and valve boxes as specified herein for the City of Craig.

PART 2 GATE VALVES

2.01 MATERIALS

A. Resilient seat.

1. Size - As shown on plans up to 12 inch (14 inch and larger shall be butterfly valves as approved by City).
2. Reference Standard - AWWA C509, latest revision.
3. Style - Iron body, resilient seat.
4. Pressure Rating - 250 psi.
5. Wrench Nut - Two-inch square, open by turning to the left (counterclockwise).
6. Stem - Non-rising.
7. Epoxy coated.
8. Manufacturer's Reference – Mueller.
9. All bolts shall be Core Blue

2.02 LOCATION

Whenever possible, water main valves shall be located at street intersections. Valves must be placed on all runs of a tee or cross. For instance, each cross shall have four valves located at the intersection while tees shall have three valves located at the intersection. Valves shall be located at the intersection. Valves shall be located at the end of all dead-end intersections for future connections.

2.03 VALVE SPACING

Valves on cross-connecting or looped mains shall be spaced such that no single break shall require more than 500 feet of line to be out of service at one time. All distribution mains connecting to transmission mains must be valved at the tie-in. Valves shall be required every 1,000 feet on transmission mains where service is limited.

2.04 INSTALLATION

All gate valves shall be installed with the 2 inch operating nut plumb and true with the vertical and centered within the valve box. City personnel will inspect the valve and valve box after installation to ensure that a valve key can easily be set on the operating nut. The operating nut shall be within 6 feet of finished grade or an extension must be provided attached to the nut. Refer to Detail W05.

PART 3 BUTTERFLY VALVES

3.01 MATERIALS

- A. Reference Standard - AWWA C-504, latest revision.
- B. Type - Rubber-seated, tight closing type.
- C. Ends - Both ends shall be mechanical joint for direct bury. Valves in vaults shall be flanged.
- D. Valve Body - Shall be high strength cast iron ASTM A 126, Class B with 18-8 type 304 stainless steel body seat.
- E. Operator - Valve operator shall be of the traveling nut type, sealed, gasketed and lubricated for underground service. Operating nut shall be two-inch square and shall open left (counter clockwise).
- F. Rated Working Pressure - Class 150B, 150 psi. Above 150 psi working pressure, use Class 250B or equal.
- G. Manufacturer's Reference - Mueller Line Seal III.

PART 4 AIR RELEASE AND VACUUM VALVES

4.01 GENERAL

This specification covers all air release, vacuum valves or combination air release valves. The type of valve used shall be dependent upon the conditions under which it will operate.

4.02 MATERIALS

- A. Size - To be designed by Engineer for proper application.
- B. Body - Cast iron.
- C. Float - Stainless steel.
- D. Seat - Buna-N.
- E. Pressure Rating - 200 psi.

4.03 LOCATIONS

Air release, vacuum valves or combination air release valves shall be installed on transmission and long distribution lines to permit efficient filling or draining of long pipelines. In addition, they should provide protection against vacuum and shall continuously vent pockets of air accumulated in the pipeline. The type of valve shall depend upon the intended use of operation.

4.04 INSTALLATION

Air release, vacuum valves or combination release valves shall always be installed at the extreme high point of the distribution or transmission line. These valves shall be installed in a precast manhole vault with the fittings as shown in Detail W06.

PART 5 VALVE BOXES

5.01 MATERIALS

- A. Material - Cast iron.
- B. Type - Two piece, screw type.
- C. Size – 5.25 inch diameter.
- D. Cover - Deep socket type with the word "Water" cast in the top.
- E. Base - No. 160 type with 20.5 inch wide oval base.
- F. Valve Markers - For valves that fall outside of road pavement and shoulders, install a 6 foot long, green "carsonite" marker or green metal "T" stake on all new valves. Marker shall have valve decal at top.
- G. Debris caps are required on all valve boxes.
- H. Manufacturer's Reference - Tyler.

5.02 INSTALLATION

Valve boxes shall be installed plumb and true, and centered over the 2 inch operating nut. Bricks shall be placed under the flange of the valve box bottom so that at no time loadings on the valve box will be transmitted to the valve. Valve box lid to be placed 0.5 inch below grade when located in asphalt or concrete. A debris cap shall be installed as close as possible to the cast iron cap without interfering with the operation of the cap. Refer to Detail W05.

SECTION 5

PRESSURE TESTING AND FLOW TESTING

PART 1 GENERAL

1.01 SCOPE

This section shall include furnishing all materials, labor, equipment and miscellaneous items necessary to perform pressure and leakage tests all distribution, transmission and service lines as specified herein for the City as defined in latest version of AWWA 605.

1.02 HYDROSTATIC TESTS

Pressure and leakage tests shall be conducted on all newly laid pipe and service lines. Contractor to furnish all the necessary equipment and materials to conduct the test. Contractor shall test through fire hydrants if possible and will be responsible for installing the appropriate taps as approved by the City engineer if a hydrant is not available used.

The test shall be conducted between valved sections of the pipeline, or as approved by the City. Water service lines will be tested up to the closed curb stop. A visual inspection of the water service connection, at the water main and at the curb stop, will be performed to check the leakage; thus, Contractor shall not backfill the corporation and curb stop connections until inspection by City representative has been completed and accepted.

Furnish the following equipment and material for the tests:

<u>Amount</u>	<u>Description</u>
2	Approved graduated containers.
2	Pressure gauges.
1	Hydraulic force pump approved by the City.
1	Additional 0.75 inch pressure tap for City's gauge.
1	Suitable hose and suction pipe as required.

Conduct the tests after the trench has been backfilled or partially backfilled with the joints left exposed for inspection, or when completely backfilled, as permitted by the City. Where any section of pipe is provided with concrete reaction blocking, do not make the pressure tests until at least 5 days have elapsed after the concrete thrust blocking is installed. If High-Early cement is used for the concrete thrust blocking, the time may be cut to 2 days.

Conduct pressure test in the following manner unless otherwise approved by the City: After the trench has been backfilled as specified, fill the pipe with water, expelling all air during the filling. The test pressure shall be 1.5 times normal static system working pressure of the pipe at the point of lowest elevation (test minimum 165 psi).

A. Duration

1. The duration of each pressure test shall be two hours, unless otherwise directed by the City.

B. Procedure

1. Slowly fill the pipe with water and allow to stand for 24 hours. Expel all air from the pipe. Apply and maintain the specified test pressure by continuous pumping in necessary for the entire test period. The test pressure shall be calculated for the point of lowest elevation, or as specified by the City. The pump suction shall be in a barrel or similar device, or metered so the amount of water required to maintain the test pressure may be measured accurately.
2. Before the line is pressurized, the City shall verify that all the necessary main line valves are open or closed with regard to the section of line being tested. In addition, the City shall verify that all hydrant valves are open.

C. Leakage

1. Leakage shall be defined as the quantity of water necessary to hold the specified test pressure for the duration of the test period. No pipe installation will be accepted if the leakage is greater than the number of gallons per hour as determined by the following formula:

$$Q = \frac{LD\sqrt{P}}{148,000}$$

In the above formula:

Q = Allowable leakage (gallons per hour)
L = Tested length of pipe (feet)
D = Nominal diameter of pipe (inches)
P = Average test pressure during the test (psi)

D. Correction of Excessive Leakage

1. Should any test of pipe laid disclose leakage greater than that allowed, locate and repair the defective joints or pipe until the leakage of a subsequent test is within the specified allowance.

E. Flow Test

1. After new main has been leak tested, the line shall be flushed by opening 1 or more fire hydrants for approximately 10 minutes or until sediment has been flushed from system.

SECTION 6

DISINFECTION OF POTABLE WATER LINES

PART 1 GENERAL

1.01 DISINFECTION

The following procedure shall apply to all main extensions within the City service area. Pipe extensions shall be chlorinated in accordance with AWWA C600 and C651 *Standard for Disinfecting Water Mains*. *The intended high chlorine with any method of chlorination is to be 25 mg/l.*

Before filling the pipe with water, the pipe shall be clean and free of debris to the satisfaction of the City.

Disinfecting by chlorination of the pipe shall be performed prior to acceptance by the City. The chlorinating agent and method of application shall be in accordance with AWWA C651. The Contractor shall provide material for disinfecting of water mains.

If the tablet method of chlorination is used, during construction, calcium hypochlorite granules shall be placed at the upstream end of the first section of pipe, at the upstream end of each branch main at 500 foot intervals. The quantity of granules shall be as shown in the table below.

This method may be used only if the pipes and appurtenances have been kept cleaned and dry during construction. This method is not to be used on solvent welded plastic or on screwed joint steel pipe because of the danger of fire or explosion from the reaction of the joint compound with the calcium hypochlorite.

- A. 1.0 Method. Placing of calcium hypochlorite tablets. During construction, 5-g calcium hypochlorite tablets shall be placed in each section of pipe. Also, one tablet shall be placed in each hydrant, hydrant branch, and other appurtenance. Table 1 shows the number of tablets required for commonly used sizes of pipe. The tablets shall be attached by a food-grade adhesive. There shall be adhesive only on the broadside of the tablet attached to the surface of the pipe. Attach tablets inside and at the top of the main, with approximately equal numbers of tablets at each end of a given pipe length. If the tablets are attached before the pipe section is placed in the trench, their position shall be marked on the section to indicate that the pipe has been installed with the tablets at the top.

Table 1 Number of 5-g calcium hypochlorite tablets required for dose of 25mg/L*

Pipe Diameter <i>in.</i>	Length of Pipe Section, <i>ft</i>
	20
Number of 5-g Calcium Hypochlorite Tablets	
4	1
6	1
8	2
10	3
12	4
16	7

*Based on 3.25-g available chlorine per tablet; any portion of tablet rounded to the next higher integer.

2.00 TESTING

CITY WILL PERFORM ALL CHEMICAL TESTING ON WATER SYSTEM

After the pipe is filled with water and chlorine, and unless approved otherwise by the City, the chlorinated water shall be held in contact with the pipe for 24 hours. At the end of the 24-hour period, the water in the pipeline shall be tested by the City to ensure a residual chlorine content of not less than 25 mg/l. The pipeline shall then be tested by the City thoroughly flushed to remove the heavily chlorinated water and/or debris. Care shall be taken in flushing the pipeline to prevent property damage and danger to the public. Discharge of highly coordinated water shall not be released to any stream or watercourse. Samples of water will be collected for bacteriological examination and residual chlorine content testing before the pipeline is put into service. Testing of residual chlorine and bacteriological sampling and testing will be done by the City.

No main which has been disinfected and flushed shall stand stagnant for more than 15 days without being re-flushed and a new disinfecting test performed, passed and approved by the City.

3.00 DISCHARGING CHLORINATED WATER

After the applicable retention period, heavily chlorinated water should not remain in prolonged contact with pipe. In order to prevent damage to the pipe lining or to prevent corrosion damage to the pipe itself, the heavily chlorinated water shall be flushed from the main fittings, valves, and branches until chlorine measurements show that the concentration in the water leaving the main is no higher than that generally prevailing in the distribution system or that is acceptable for domestic use. The environment to which the chlorinated water is to be discharged shall be inspected. If there is any possibility that the chlorinated discharge will cause damage to the environment, a neutralizing chemical shall be applied to the water to be wasted to thoroughly neutralize the residual chlorine. Where necessary, federal, state, local, or provincial regulatory agencies should be contacted to determine special provisions for the disposal of heavily chlorinated water. The chlorinated water shall not be discharged to the City's sewer collection system.

4.00 DISINFECTION PROCEDURES WHEN CUTTING INTO OR REPAIRING EXISTING MAINS

The following procedures apply primarily when existing mains are wholly or partially dewatered. After the appropriate procedures have been completed, the existing main may be returned to service prior to the completion of bacteriological testing in order to minimize the time customers are without water. Leaks or breaks that are repaired with clamping devices while the mains remain full of pressurized water may present little danger of contamination and therefore may not require disinfection.

1. Trench treatment. When an existing main is opened, either by accident or by design, the excavation will likely be wet and may be badly contaminated from nearby sewers. Liberal quantities of hypochlorite applied to open trench areas will lessen the danger from this pollution. Tablets have the advantage in this situation, because they dissolve slowly and continue to release hypochlorite as water is pumped from the excavation.
2. Swabbing with hypochlorite solution. The interior of pipe and fittings (particularly couplings and sleeves) used in making the repair shall be swabbed or sprayed with a 1 percent hypochlorite solution before they are installed.
3. Flushing. Thorough flushing is the most practical means of removing contamination introduced during repairs. If valve and hydrant locations permit, flushing toward the work location from both directions is recommended. Flushing shall be started as soon as the repairs are completed and shall be continued until discolored water is eliminated.
4. Slug chlorination. Where practical, in addition to the procedures previously described, the section of the main in which the break is located shall be isolated, all service connections shut off, and the section flushed and chlorinated as described in previous section. The dose may be increased to as much as 300 mg/L and the contact time reduced to as little as 15 min. After chlorination, flushing shall be resumed and continued until discolored water is eliminated and the chlorine concentration in the water exiting the main is no higher than the prevailing water in the distribution system or that which is acceptable for domestic use.

5.00 BACTERIOLOGICAL TESTS

After final flushing and before the new water main is connected to the distribution system, 2 consecutive sets of acceptable samples, taken at least 24 hrs apart, shall be collected from the new main. (NOTE: The pipe, the water loaded into the pipe, and any debris exert a chlorine demand that can interfere with disinfection.) At least one set of samples shall be collected from every 1,200 ft of the new water main, plus one set from the end of the line and at least one set from each branch. Samples shall be tested for bacteriological (chemical and physical) quality in accordance with Standard Methods for the Examination of Water and Wastewater; and shall show the absence of coliform organisms; and, if required, the presence of a chlorine residual. Turbidity, pH, and a standard heterotrophic plate count (HPC) test may be required at the option of the purchaser because new material does not typically contain coliforms but does typically contain HPC bacteria.

1. Special conditions. If trench water has entered the new main during construction or if, in the opinion of the Engineer, excessive quantities of dirt or debris have entered the new main, bacteriological samples shall be taken at intervals of approximately 200 ft, and the location shall be identified. Samples shall be taken of water that has stood in the new main for at least 16 hr after final flushing has been completed.

2. Sampling procedure. Samples for bacteriological analysis shall be collected in sterile bottles treated with sodium thiosulfate, as required by Standard Methods for the Examination of Water and Wastewater. No hose or fire hydrant shall be used in the collection of samples. (NOTE: For pipe repairs, if no other sampling port is available, well-flushed fire hydrants may be used with the understanding that they do not represent optimum sampling conditions.) There should be no water in the trench up to the connection for sampling. The sampling pipe must be dedicated and clean and disinfected and flushed prior to sampling. A corporation cock may be installed in the main with a copper-tube gooseneck assembly. After samples have been collected, the gooseneck assembly may be removed and retained for future use.
3. Sample results. If sample results from the lab indicate a measured HPC greater than 500 colony-forming units (cfu) per mL, flushing should be resumed and another coliform and HPC set of samples should be taken until no coliforms are present and the HPC is less than 500 cfu/mL.
4. Record of compliance. The record of compliance shall be the bacteriological test results certifying that the water sampled from the new water main is free of coliform bacteria contamination and is equal to or better than the bacteriologic water quality in the distribution system.

6.00 REDISINFECTION

If the initial disinfection fails to produce satisfactory bacteriological results or if other water quality is affected, the new main may be re-flushed and shall be Re-sampled. If check samples also fail to produce acceptable results, the main shall be Re-chlorinated by the continuous-feed or slug method until satisfactory results are obtained—that being two consecutive sets of acceptable samples taken 24 hr. apart.

NOTE: High velocities in the existing system, resulting from flushing the new main, may disturb sediment that has accumulated in the existing mains. When check samples are taken, it is advisable to sample water entering the new main to determine the source of turbidity.

7.00 DISINFECTING:

All water piping installed under this Contract shall be disinfected in accordance with AWWA C601 after all construction work has been completed. Chlorine shall be added to the water at the necessary locations in the amount to form a 25 mg/l or ppm free chlorine residual. The chlorine solution shall be left in the pipelines for not less than 24 hours, during which time all valves and fire hydrants shall be operated in order to disinfect the appurtenances. After that length of time, the chlorine residual of the solution at any place in the system shall not be less than 10 ppm. As required, the Contractor shall make all necessary taps for inserting the chlorine solution in the pipeline and venting and draining pipelines using approved corporation stops. After the disinfection has been completed and approved, the corporation stops shall be closed, left in place, and sealed with a cap. All chlorination work must be done under the supervision of the Engineer.

After approval of the disinfection operations, the Contractor shall flush the new system until the chlorine residual is less than 1.0 ppm and a clear water test made. After flushing a bacteriological test is to be performed and must be passed by the local health authority to insure adequate disinfection prior to the line being placed into service and approved.

SECTION 7

SPECIAL CONSTRUCTION

PART 1 GENERAL

1.01 SCOPE

This section shall include the design and construction of aerial crossings, river crossings, storage tanks, pressure reducing vaults and booster stations. Because each of these structures will require an engineered design to meet field conditions and individual design criteria, this section will not attempt to provide complete design guidelines and specifications. Rather, it will provide a general listing of guidelines that must be followed unless the City approves an equivalent alternative.

PART 2 AERIAL CROSSING

2.01 GENERAL

This section shall cover the design criteria to be used on aerial crossings, including water lines suspended from existing and proposed bridges, and lines aerially supported over steep canyons and arroyos. In both of the above crossings, an underground or river crossing will be required unless special circumstances render the below grade alternative prohibitive. If it is determined that a bridge crossing is acceptable to the City, and then the following design criteria shall be followed.

2.02 PIPE SUPPORTS

If pipe is to be supported from an existing bridge, a structural analysis shall be performed to determine if the bridge can withstand the additional loading. If being installed on a new bridge, then additional pipe loading should be included as a dead load consideration.

Pipe shall be supported with a pipe hanger that allows longitudinal movement. Support shall be an adjustable steel yoke pipe roll or approved equal. In addition, a horizontal support from pipe hanger to the bridge shall be provided so that the pipe assembly will not move horizontally due to wind loads, etc. The spacing of the pipe hangers shall depend upon the maximum recommended load of hanger.

2.03 PIPE INSULATION

Aerial pipelines shall be prevented from freezing by pipe insulation. The insulation R-value and thickness shall be designed to a generally accepted standard for the City of Craig area. The insulation should have a minimum R-value of 20. The insulation shall be non-absorbing to water.

2.04 INSULATION PROTECTION

Provide an aluminum jacket with moisture barrier strapped with stainless steel bands. Jacketing thickness shall be a minimum of 16 mil. Provide insulation protection shields.

2.05 PIPE

Provide PVC C900.

2.06. EXPANSION COUPLING

Provide a restrained expansion coupling between each rigidly supported point of the pipe. Follow all manufacturers' recommendations when installing. Expansion couplings shall be accessible to water department personnel for maintaining and making adjustments in couplings.

2.07 AIR AND VACUUM VAULTS

If bridge crossing is at a high point in line, install all air and vacuum valves appropriate for design conditions.

2.08 ISOLATION VALVES

An isolation valve shall be provided on either end of the bridge.

2.09. ACCESSIBILITY

Generally, the pipe should be placed in a location where personnel can easily access and maintain the pipe.

PART 3 RIVER CROSSINGS

3.01 GENERAL

This section covers the design criteria to be used on river crossings.

3.02 ENCASEMENT

Pipe shall be encased in concrete for the length of pipe underneath high water mark.

3.03 PIPE

For river crossing, the pipe joints shall be push-on joints with joint restraint, PVC C900 or approved equal by City Engineer.

3.04 BEND RESTRAINT

All vertical bends shall be restrained with mega lugs and vertical reaction blocks and all thread rods between bends or between bends and concrete thrust tie.

3.05 PERMITS

Generally, a river crossing will require a 404 Permit or Nationwide Utilities Permit from the Army Corps of Engineers. The Applicant should begin the permit process as soon as possible, as the process can take from 30-90 days to secure the permit. A Colorado DOW permit may also be required.

PART 4 STORAGE RESERVOIRS

4.01 GENERAL

This section covers the design criteria to be used on storage reservoirs. The City may allow either a buried concrete or aboveground steel reservoir. The City reserves the right to require either a concrete or steel tank depending on the field conditions, size and location of the tank. The City shall determine the size and location of the storage tanks.

4.02 FOUNDATION DESIGN

A soil and geological report shall be provided which makes recommendations on the required foundation.

4.03 STRUCTURAL DESIGN

Complete structural design, with calculations and shop drawings submitted by a professional engineer shall be provided. If a welded steel tank is provided, it shall conform to AWWA D100, latest revision.

4.04 CDPHE REQUIREMENTS

All Colorado Department of Public Health and Environment, Water Quality Control Division "Design Criteria for Potable Water Systems" shall be followed.

4.05 TANK INSULATION

Not Applicable.

4.06 STEEL TANK PAINTING

Use an AWWA approved paint system for tank interior and exterior coating on all steel tanks. Painting shall conform to AWWA D102, latest revision.

4.07 RE-CIRCULATION PUMP

A recirculation pump will be required.

4.08 TELEMETRY, SCADA

The reservoir shall be fitted with telemetry that will communicate with the City's existing SCADA system.

4.09 OVERFLOW

Needs to discharge to adequately sized, non-destructive location.

PART 5 PRESSURE REDUCING VAULTS (PRV) – DETAIL W08

5.01 GENERAL

This section shall cover the design criteria to be used on pressure reducing vaults. The City shall determine the location of PRV's.

5.02 PRV VALVE

The PRV valve shall be a Clayton valve as manufactured by the Cla-Valve Company. The main valve shall be a single seated, hydraulically operated, pilot controlled, diaphragm-type globe valve.

5.03 PILOT CONTROL SYSTEM

Cast bronze ASTM B62 with 303 stainless steel trim. Install isolation cocks, closing and opening speed control and strainers on pilot controls.

5.04 PRESSURE GAUGES

Install two stainless steel, liquid-filled, hermetically sealed pressure gauges with pressure snubbers, and isolation cocks. Locate at main inlet and outlet of vault so that if one PRV is isolated, gauges will still register.

5.05 BYPASS PIPING

Install a bypass around main PRV valve so that mainline can be filled and service maintained with PRV valve out of service. Bypass shall be installed with an isolation valve.

5.06 PRESSURE RELIEF VALVE

If damaging downstream pressure can result when PRV is stuck in open position, then a pressure relief valve, that drains to an acceptable location, shall be installed on downstream side of PRV on either the main line or bypass line. Pressure relief valve shall be piped to daylight and appropriate flow dissipation.

5.07 ISOLATED VALVES

Install isolation resilient seat gate valves inside of vault so that main PRV valve can be isolated outside of vault.

5.08 AIR RELEASE.

Install an air release and vacuum valve on both inlet and outlet of pipe in vault. Each air release valve to have an isolation valve.

5.09 PRV VAULT

All valves, appurtenances and pipe to be enclosed in a concrete or steel vault. Install link seal or equivalent between pipe inlets, outlets and vault wall. Provide frost-proof aluminum manhole lid marked "Water" on concrete vaults. Plastic covered steel MH rungs shall be provided on concrete vault with the first step not being greater than 18 inches from finished grade. Install concrete supports under PRV and tees. All vaults to be provided with one 110-volt outlet and a drain that daylights or a sump with a pump.

5.10 FITTINGS

All main line fittings shall be ductile iron flanged fittings with Core Blue bolts.

5.11 RISING STEM WHERE TELEMETRY EXISTS.

PART 6 WATERLINE INSULATION – DETAIL W10

6.01 GENERAL

This section shall cover the installation to be used on water lines when insulation is required. The City engineer will approve the use of insulation on waterlines if the conditions will not allow the waterline to be buried deep enough to obtain 6 feet of depth below the lowest storm drain pipe.

6.02 INSTALLATION

In areas where 6 feet of depth is unable to be obtained between the waterline and the lowest storm drain pipe insulation can be approved by the City engineer. The insulation shall encase the waterline 4 feet in either direction of the crossing. Four inch thick polystyrene (Blue Trustee's) shall be installed 1 foot away from the pipe on both sides and the top. Contractor shall provide a minimum of 18 inches between the top of the insulation and the invert of the storm drain. See Detail W10.

6.03 TRANSMISSION LINE TAPPING

Not allowed.

6.04 PIPE JACKING/BORING

6.05 GENERAL

This section shall cover the installation of utilities within a pipe casing that has been jacked or bored. Refer to Details W12 and W13 for design and installation details.

6.06 MANUFACTURE'S REFERENCE. CASCADE CST – EX

Pipe Jacking/Boring – Details W12 and W13.

PART 7 WATER METER VAULT – DETAIL W14

7.01 GENERAL

This section shall cover the design criteria to be used on water meter vaults. Refer to Detail W14 for water meter vault details.

END OF SECTION

SECTION 8**CROSS CONNECTION CONTROL ORDINANCE
Adopted by Ordinance 1055 (2016)****PART 1 GENERAL****1.01 THE CITY OF CRAIG'S AUTHORITY TO IMPLEMENT AND MAINTAIN A CROSS-CONNECTION CONTROL PROGRAM is contained in the following legislation.**

1. Colorado Revised Statutes (CRS) Section 25-1-114 and 25-1-114.1.
2. Colorado Primary Drinking Water Regulations (CPDWR) Article 12 Control of Hazardous Cross-Connections.
3. Colorado Cross-Connection Control Manual, Colorado Department of Public Health and Environment, latest addition.
4. Code of Federal Regulations Occupational Safety and Health Administration.
5. The City of Craig Ordinance #
6. Regional Plumbing Code.
7. Colorado Plumbing Code.
8. Uniform Plumbing Code of the International Plumbing and Mechanical Officials/International Plumbing Code.
9. Uniform Swimming Pool, SPA and Hot Tub Code.
10. Colorado Swimming Pool and Mineral Bath Regulations.
11. Uniform Solar Code.

2.01 REFERENCE MANUALS ADOPTED FOR GUIDELINES ON CROSS-CONNECTION CONTROL.

1. Colorado Cross-Connection Control Manual, Colorado Department of Public Health and Environment, latest addition. Definitions of terms used in these regulations are located in this manual.
2. Other reference materials may include:
 - a. American Society of Sanitary Engineering, Backflow Prevention Assemblies Standards Program.
 - b. Foundation for Cross-Connection and Hydraulic Research, University of Southern California, Manual of Cross-Connection Control.
 - c. American Water Works Association, Recommended Practice for Backflow Prevention and Cross-Connection Control Manual M14.
 - d. The Environmental Protection Agency, Cross-Connection Control Manual.

3.01 GENERAL REQUIREMENTS.

All commercial buildings must have an approved reduced pressure zone (RPZ) backflow prevention assembly installed just after the meter before any water piping delivers water to the premises. Any commercial property that does not currently have a backflow device must purchase and have one installed within 180 days from the final reading and approval of this ordinance. All residential buildings shall have an approved double check valve installed under the same installation requirements as the commercial buildings within five (5) years from the final reading and approval of this ordinance. A non-testable double check valve may be used on residential services but must be replaced every (2) two years to ensure protection of the city's water system. Separate CITY OF CRAIG approved containment backflow preventors are required for any fire or irrigation systems located within the internal plumbing of any premises where the city's potable water system provides the water for said

system.

- 3.1 All building plans must be submitted to the City of Craig's Planning and Zoning Department/Commission and approved, prior to the issuance of a water tap permit/or service. Building Plans Must Show:
 - 3.1.1 Water service type, size and location.
 - 3.1.2 Meter size and location.
 - 3.1.3 Backflow prevention assembly size, type and location
 - 3.1.4 Fire sprinkling system(s) service line, size and type of backflow prevention assembly if applicable.
- 3.2 Backflow prevention assemblies are to be installed in an accessible location to facilitate, testing and repair. Drawings specifying this information must be provided.
- 3.3 All backflow prevention assemblies shall be installed immediately downstream of the water meter
- 3.4 Installation of backflow prevention assemblies must be done by a certified cross-connection control technician or city approved licensed plumber. Pipelines shall be thoroughly flushed prior to the installation.
- 3.5 In no case will it be permissible to have connections or tees between the meter and the service line backflow prevention assembly.
- 3.6 Backflow prevention valves are not to be used as an inlet or outlet valve of the water meter. Test cocks are not to be used as supply connections.
- 3.7 In order to insure that backflow prevention assemblies continue to operate satisfactorily, it will be necessary that they be tested at the time of installation and on an annual schedule thereafter. Such tests will be performed by a certified and approved cross-connection control technician, and conducted in accordance with ASSE and/or USC-CCC and HR performance standards and field test procedures as directed by the Colorado Department of Public Health & Environment.
- 3.8 The City of Craig requires inspection of all containment installations.
- 3.9 All costs for design, materials, installation, maintenance, repair, and testing will be at the expense of the customer.
- 3.10 No "grandfather" exemption clause exists. All laws and regulations apply regardless of the age of the facility.
- 3.11 All fire sprinkling lines shall have a minimum of an approved double check valve. The city reserves the right to require and RPZ device if it feels additional protection is needed.
 - 3.11.1 All glycol (ethylene or propylene), or antifreeze systems shall have an approved Reduced Pressure Zone (RPZ) assembly for containment.
 - 3.11.2 Dry fire systems shall have and approved double check valve installed upstream of the air pressure valve.
 - 3.11.3 Single family residence with lawn irrigation systems shall have an approved reduced pressure zone assembly between the domestic water line and the beginning of the lawn irrigation system.
- 3.12 All fire sprinkler systems shall conform to the following sections of the National Fire Protection Association Standard 13 and 25.

4.01 STANDARDS FOR BACKFLOW PREVENTION ASSEMBLIES:

- 1. Any backflow prevention assembly required herein shall be of a model and size approved by the City of Craig Water Department. The term "Approved Backflow Prevention assembly" shall mean an assembly that has been manufactured in full conformance with the standards established by the latest version of the Colorado Department of Public Health and Environment (CDPHE) "Cross Connection Control Manual" and by the CITY OF CRAIG Water Department. Final approval shall be

evidence by a certificate of approval by and approved testing laboratory certifying full compliance with the CDPHE standards and ASSE, or USC FCCC & HR specifications.

“Only approved backflow prevention assemblies shall be used.”

The following testing laboratories are qualified to test and certify backflow prevention assemblies and being listed on their periodic approved list shall meet all the above requirements.

- a. American Society of Sanitary Engineering (ASSE), 901 Canterbury, Suite A, Westlake, OH 44145
 - b. USC Foundation for Cross Connection Control and Hydraulic Research, University of Southern California, KAP-200 University Park MC-2531, Los Angeles, CA 90089-2531
Exception: Residential containment may be accomplished with an assembly Not approved by USC FCCC & HR, but must be approved by the ASSE.
2. Backflow preventors currently installed which are not approved shall be replaced with an approved assembly within 90 days.
 3. Backflow Assemblies used on fire lines shall have outside stem and yoke (O.S. & Y) valves and be listed by the National Fire Protection Association.

5.01 INSTALLATIONS:

1. Backflow prevention assemblies shall be installed in accordance with the City of Craig requirements.
2. Backflow prevention assembly installations shall be done by a city approved licensed plumber and be inspected/approved by the City of Craig.
3. All backflow assemblies shall be installed in the horizontal position. Vertical installations shall only be acceptable if approved by ASSE or USC FCCC & HR specifications. A variance may be granted by review.
4. A pressure vacuum breaker shall be used where the assembly is never subjected to backpressure and must be installed a minimum of twelve (12) inches above the highest piping or outlet downstream of the assembly in a manner to preclude backpressure.
5. An atmospheric vacuum breaker shall be used only where the assembly is:
 - a. Installed as an isolation assembly.
 - b. Never subjected to continuous pressure (more than 12 hours continuous).
 - c. Installed with an air inlet in a level position and a minimum of six (6) inches above the highest piping or outlet it is protecting.
6. The single check valve is NOT considered a backflow prevention assembly.
7. Double check valve assemblies may be installed in below grade vaults when these vaults are properly constructed in accordance with the City of Craig. They must be insulated to protect from freezing.
8. Reduced pressure backflow preventors will be installed above ground. The unit shall be placed at least twelve (12) inches above the finished grade to allow clearance for repair work. Proper drainage shall be provided with the drain line being a minimum of twice the diameter of the supply line.

6.01 TESTING AND MAINTENANCE:

1. At least once per year, it is the responsibility of the customer/building owner where any backflow prevention assemblies are installed to have a certified test made of these assemblies. In situations where the City of Craig deems the potential hazard to be great enough, certified inspections and tests at more frequent intervals may be required. These tests shall be at the expense of the water user/customer and shall

- be performed by a certified cross-connection control technician who has been approved by the CDPHE, ABPA, or ASSE, and the City of Craig. An inspection of an assembly may be performed at any time in compliance with 7.0 of this ordinance.
3. As necessary, the assembly(s) shall be repaired or replaced at the expense of the customer/user whenever the assembly is found to be defective. Records of any tests, repairs, or replacement must be submitted to the City of Craig Water Department as a record of compliance with this ordinance.
 4. Existing assemblies shall be sealed by the CCC technician performing the test once the test has been completed.
 5. All testing equipment used in testing of backflow prevention assemblies shall be checked for accuracy yearly, and proof of compliance shall be submitted to the CITY OF CRAIG Water Department.
 6. The CITY OF CRAIG reserves the right to test or inspect any backflow prevention assembly or installation and operation of any assembly at any time to insure proper operation.

7.01 RIGHT OF ENTRY:

1. A representative of the CITY OF CRAIG will carry proper credentials of his/her position with the city. By previously arranged appointment and presentation of proper credentials. The CITY OF CRAIG representative shall have the right of entry to inspect any and all buildings and premises for cross-connections relative to possible hazards to the city's public water system. This right of entry shall be a condition of water service in order to protect the health, safety, and welfare of the people throughout the CITY OF CRAIG's water distribution system. Where building security is required, the backflow prevention assembly(s) shall be located in an area not subject to security. Any questions regarding proper credentials shall be directed to the CITY OF CRAIG.

8.01 VIOLATIONS:

1. Failure of a customer to cooperate in the installation, maintenance, testing or inspection of backflow prevention assemblies required by this ordinance shall be grounds for discontinuance of water service to the premises or the requirement for an air-gap separation from the public water system.
2. Service of water to any premises may be discontinued by the CITY OF
3. Craig if unprotected Cross-connections exist on the premises. When any defect is found in an installed backflow prevention assembly, or if the assembly has been removed or bypassed, the water service may be discontinued. Service will not be restored until such defects or conditions are corrected.
4. Discontinuance of service may be summary, immediate, and without written notification whenever, in the judgment of the CITY OF CRAIG, such action is necessary to protect the public potable water supply or the distribution system.

END OF SECTION

SECTION 9**SANITARY SEWER LINES****PART 1 GENERAL****1.01 SCOPE**

- A. Work under this section shall include furnishing all materials, labor and tools necessary to perform all installation, cleaning and testing of all sanitary sewer lines and appurtenances as specified herein and shown on the Drawings.

1.02 PROTECTION OF WORK

- A. All pipe, fittings and equipment shall be carefully handled, stored and protected in such a manner as to prevent damage to materials. At no time shall such materials be dropped or dumped into trench.
- B. Precaution shall be taken to prevent foreign matter from entering the pipe and fittings prior to and during installation. Place no debris, tools, clothing or other materials in the pipe during installation.
- C. At such time as pipe installation is suspended, either temporarily or overnight, the open end of the pipe shall be sealed with a watertight plug to prevent entrance of trench water, debris or foreign matter. A mechanical-type fitting shall be used for this seal. At no time shall duct tape or any other tape be used for this seal.
- D. Under no circumstances shall trench water be allowed to enter the pipeline. When water is present in the trench, the seal shall remain in place until such time the trench is pumped dry. Whenever trench water becomes evident, adequate measures shall be taken to prevent pipe flotation. Contractor shall bear all costs associated with keeping trench free of liquids.
- E. If, in the opinion of the Engineer, the Contractor is incapable of keeping the pipe free of foreign matter during installation, the Engineer shall require the Contractor to protect the pipe ends with water tight plugs until the start of the joining operation.

PART 2 MATERIALS

- A. This item covers the types of materials that will be allowed for the construction and installation of sewer lines. All materials used shall be new, of the best quality available and conform to applicable standards as indicated herein.

2.01 POLYVINYL CHLORIDE (PVC) PIPE AND FITTINGS (GRAVITY MAIN)

- A. PVC Pipe, through 15-inch diameter
 1. Material Reference Standard - ASTM D1784
 2. Pipe Reference Standard - ASTM D3034
 3. Class – SDR-35
 4. Markings - Manufacturer's name, nominal size, PVC classification, Type PSM, SDR-35, PVC gravity sewer pipe, ASTM D3034 and code number, green coloring dyed

into PVC.

- B. PVC Pipe, 18 inch to 27-inch diameter
 1. Material Reference Standard - ASTM D1784
 2. Pipe Reference Standard - ASTM F679
 3. PS 46 PVC Sewer Pipe and ASTM F679. Green coloring dyed into PVC.
 4. Variance - PVC piping meeting the stiffness requirement of ASTM F679 but not meeting wall thickness requirement will be allowed under specification. Manufacturers will be required to provide a list of at least 5 similar projects with references in which pipe has been successfully used and laboratory testing data showing the pipe meets the structural requirements of ASTM F679.
- C. Restrained Joint PVC Pipe, through 16-inch diameter
 1. Material Reference Standard - ASTM D1784
 2. Class – SDR-32.5
 3. Manufacture's Reference – CertainTeed - Certa-Lok Yelomine
 4. Markings - Manufacturer's name, nominal size, PVC classification, SDR-32.5, PVC gravity sewer pipe.
- D. Fittings
 1. Type - PVC push-joint
 2. Materials - ASTM D1784
 3. Reference Standard - ASTM D3034 or ASTM F679
- E. Joints
 1. Type - push-on rubber gasket
 2. Gasket reference standard - ASTM F477

2.02 FORCE MAIN

- A. PVC Pipe
 1. Materials - ASTM D 1784, Type 1, Grade 1, PVC 1120, 2000 psi design stress.
 2. Reference Standard - AWWA C-900.
 3. Class - 150 (DR-18), (or, dependent upon internal pressure, may require Class 200).
 4. Markings - Manufacturer's name, nominal size, class pressure rating, PVC 1120, NSF logo, identification code.
 5. Specialties - Electrical tracing wire, 12 gauge stranded copper insulated wire.
 6. Size - Shall conform to outside diameter of DIP.
- B. Fittings
 1. Type - All fittings shall be restrained mechanical joint except where specifically shown or detailed otherwise. Fittings in a vault shall be flanged.
 2. Reference Standard - AWWA/ANSI C153/A 21.53
 3. Pressure Rating - 350 psi
 4. Gasket Reference Standard - AWWA C-111
 5. Fittings shall be coated with Permafuse epoxy coating inside and out.
- C. Fittings
 1. Type - All fittings shall be mechanical joint.
 2. Reference Standard - ANSI/AWWA C153, latest edition, for mechanical "compact" joints.

3. Material - Ductile iron
4. Pressure Rating - 350 psi
5. Fittings shall be coated with Permafuse epoxy coating inside and out.

D. Joints

1. Mechanical, Reference Standard - ANSI A. 21.53/AWWA C153, latest edition.
2. Push-on, Reference Standard - ANSI A 21.15/AWWA C115, Class 125.
3. Flanged, Reference Standard - ANSI B 16.1, Class 125

E. Gaskets

1. Type - Rubber-ring gasket for gravity main.
2. Type - Rubber-ring Field-Lok gasket, or equal, for force main shall be suitable for the specified pipe sizes and pressure
3. Reference Standard - AWWA C111, latest edition.
4. Lubricant - A non-toxic vegetable soap lubricant shall be supplied with the pipe.

F. Protective Coating

1. Underground Service - Manufacturer's standard bituminous coating - minimum 1 mil thickness.
2. Polyethylene Film Envelope - Polyethylene encasement shall conform to AWWA C105, latest edition, or ANSI A.21.5. Film shall be Class C with a nominal thickness of 8 mils. Tape for securing the film shall have a minimum thickness of 8 mils and a minimum width of 1 inch. The polyethylene film shall be free of streaks, pinholes, tears or blisters
3. Epoxy coating inside and out of any metal fittings.

2.03 SMALL DIAMETER, LOW PRESSURE SEWERLINE LESS THAN 4 INCH

A. Pipe Materials

1. High density Polyethylene pipe & fittings, HDPE 3408 Plastics Pipe Institute, DR9
2. Polyvinyl Chloride pipe (PVC) ASTM D-1784 & D-2241, DR21, 200 psi

B. Joints

1. Butt fusion for HDPE
2. Gasketed for PVC, 2 inch and larger

C. Appurtenances

1. Air/Vacuum valve - Crispin SU20 sewage air/vacuum or approved equal
2. Isolation valve - PVC ball valve or approved equal.

2.04 CONCRETE FOR THRUST BLOCKS AND ENCASING OF PIPE

Concrete for thrust blocks and for encasing the sewer pipeline shall have 28-day compressive strength of not less than 4000 psi.

2.05 MANHOLES. DETAILS S01 AND S02

A. Concrete Rings/Cones

1. Type - Precast
2. Reference Standard - ASTM C478
3. Size - Four-foot or five-foot inside diameter

- B. Manhole Bases
 - 1. Shall be precast or cast-in-place for special circumstances, with integrally cast-in water stops. Tee tops of base shall be at least 12 inches above top of pipe.
 - 2. Reference Concrete Standard – ASTM C478
- C. Manhole Steps

Manhole steps shall conform to ASTM C478-94 and shall be steel reinforced copolymer polypropylene with materials conforming to the following:
- D. Materials:
 - 1. The deformed steel reinforcing bar shall be 2 inch conforming to ASTM A-615 Grade 60.
 - 2. The copolymer polypropylene shall conform to ASTM D4101-92b PP0344B33534Z02.
 - 3. Manufacturer's Reference: M.A. Industries Model PS1-PF, or approved equal.
- D. Joints
 - 1. Type - Rub'r Nek preformed gasket as manufactured by K.T. Snyder Co., Inc, Houston, Texas, or equal.
 - 2. Cement Mortar Material Reference Standard - One part Portland cement, Type II, modified with three parts of sand. Cement mortar to be used with concrete grade rings only.
- E. Grade Adjustment Rings
 - 1. Type - Precast ASTM C150 Type II modified concrete.
 - 2. Size - Not less than 6 inch wide x heights to allow for two-inch adjustments.
 - 3. Alternate - HDPE grade rings.
 - 4. Manufacturer's reference: Ladtech, Inc., or approved equal.
 - 5. Total maximum height not to exceed 1 foot.
- F. Frame and Cover.
 - 1. Material Reference - Grey Iron, ASTM A48-83, Class 35B, traffic bearing.
 - 2. Cover - Stamped with "SEWER", "machined bearing surface with ring.
 - 3. Type - Heavy, weight of cover greater than 140 pounds.
 - 4. Manufacturer Reference -Castings MH-400-24CI.

2.06 SEWER SERVICE LINE MATERIALS

- A. Full Body Wyes - Required for all new construction.
 - 1. Material - ASTM D3034 PVC
 - 2. Strength - for use with SDR-35
 - 3. Joint - Slip-on rubber gasket
- B. Saddles-Allowed for existing construction
- C. Cleanouts – All sewer services shall have a two way cleanout located within 5 feet of the residence and every 100 feet and every horizontal fitting. See detail S09.

2.07 TRACER WIRE

- A. Electrical tracing wire shall be required on all sewer mains. The wire shall be taped to the

top of the pipe at 10 foot intervals to prevent dislocation of the wire during backfilling. The tracer wire shall be extended to the surface at all manholes. The wire shall be extended towards the ground on the outside of the manhole rim until the wire is within 4 inches of the top of the lid, at which point it shall be brought back inside the manhole and securely fastened. The tracer wire shall be continuity tested by the City prior to acceptance of the pipeline.

2.08 DETECTABLE UNDERGROUND MARKING TAPE

- A. Underground marking tape shall be a 3 inch width detectable marking tape, with a minimum 5.0 mil overall thickness. Tape shall be manufactured using a 0.8 mil clear virgin polypropylene film, reverse printed and laminated to a 0.35 mil solid aluminum foil core, and then laminated to a 3.75 mil clear virgin polyethylene film. Tape shall be printed using a diagonally striped design for maximum visibility, and meet the APWA Color-Code standard for identification of buried utilities.

2.09 BACKWATER VALVE

- A. Required on all services less than 20feet in length from collector line to foundation. Manufacturers reference: Zurn model #Z1095.

PART 3 METHODS AND PROCEDURES

3.01 CLEANING AND INSPECTION

- A. Clean all pipe, fittings and related materials thoroughly of all foreign material and inspect for cracks, flaws or other defects prior to installation. Mark all defective, damaged or unsound materials with bright marking crayon or paint and remove from job site.
- B. The Contractor shall take all necessary precautions to prevent any construction debris from entering the sewer lines during construction. If this debris should enter the pipeline system, the Contractor shall furnish all labor and materials necessary to clean the system. Under no circumstances will the Contractor flush the debris into an existing sanitary sewer system.

3.02 PLACEMENT OF PIPE

- A. Laser Beam. All sanitary sewer pipes must be installed with a laser. If bending of the beam due to air temperature variations becomes apparent with "in pipe" units, a fan shall be provided to circulate air in the pipe. Air velocity shall not be so excessive as to cause pulsating or vibrating of the beam. If, in the opinion of the Engineer, the beam cannot be accurately controlled, this method of setting line and grade shall be abandoned.

3.03 PIPE EMBEDMENT Detail S03

- A. Placing embedment material - Refer to Section XII for placement methods.
- B. Embedment Classes - Refer to Section XII for embedment materials for each class listed below:
 - 1. Class A - Use of all PVC, DIP, CMP and Concrete pipelines.
 - 2. Class B - Use where indicated on the Drawings and where improper trenching or unexpected trench conditions require its use as determined by the Engineer.

3.04 PIPE INSTALLATION

- A. Installation of Polyvinyl Chloride (PVC) Pipe.
 - 1. Pipe Handling. Pipe should be carefully lowered into the trench to avoid pipe falling into trench.
 - 2. Pipe Laying. Pipe shall be laid true to line and grade, in an uphill direction, with bell ends facing in the direction of laying. When pipe laying is not in progress, a watertight plug shall close the open end of the pipe.
 - 3. Joining the Pipe. The outside of the spigot and the inside of the bell shall be thoroughly wiped clean. Set the rubber ring in the bell with the marked edge facing toward the end of the bell. Lubricate the spigot end using a thin film of the manufacturer-supplied lubricant. Push the pipe spigot into the bell. Position the completed joint so that the mark on the pipe end is in line with the end of the bell.
 - 4. Pipe Cutting. The cutting of pipe for manholes or for fittings, or closure pieces shall be done in a neat and workmanlike manner without damage to the pipe or lining and so as to leave a smooth end at right angles to the axis of the pipe. Bevel the end of the pipe with a beveling tool after the pipe is field cut. Place a clearly visible position mark at the correct distance from the end of the field-cut pipe.
 - 5. Solvent Weld or Butt Fusion Joints. All cutting and field fabrication shall be done according to printed recommendations of the pipe manufacturer or associated pipe manufacturer organizations. Piping shall be cleaned to the extent required for joint completion.
 - 6. All service lines shall be installed with no bends from the tap to the service connection.

3.05 SEWER MANHOLE INSTALLATION. DETAILS S01 AND S02.

- A. General. Manholes shall be furnished and installed to depths and dimensions shown on the Construction Drawings and/or staked in the field. Manholes shall be constructed of precast concrete rings in accordance with details shown on the Construction Drawings.
- B. Connections to Manholes. Connection of manhole with pipe shall be made with flexible connector detail. In addition, extra care shall be taken by grouting or other means of sealing to assure positive watertight manholes around the inlet or outlet pipes.
- C. Manhole Floor and Inverts. Manhole bases shall be constructed to conform to the details shown on the Drawings. The invert channels shall be smooth and semi-circular in shape, conforming to the inside of the incoming and outgoing sewer pipelines. Changes in direction of flow shall be made with a smooth curve of as large a radius as the size of the manhole will permit. Changes in size and grade of the channels shall be made gradually and evenly. Where large differences in invert elevations exist, sloped flow channels shall be formed so the wastewater does not undergo a vertical drop. The invert channels may be formed directly in the concrete of the manhole base. The floor of the manhole outside the channel shall be smooth and shall slope toward the channels.
- D. Finish Grade and Adjustment. To bring the manhole cover to the correct elevation, the top section of each manhole shall be constructed of pre-cast concrete grade adjustment rings. These rings shall be not less than 6-inch-wide and furnished in heights to allow for 2 inch adjustments. Grade adjustment with rings shall be 8 inch maximum and 2 inch minimum. All rings shall be grouted in place with non-shrink grout.

- E. Finish Grade and Adjustment HDPE Alternate. High-density polyethylene grade rings may also be used to bring manhole cover to correct elevation. Grade rings shall be molded from HDPE as defined in ASTM Specification D1248-84. Available thicknesses are 1.25 inch, 1.50 inch, 2.00 inch 4.00 inch and a sloped thickness 0.75-inch x 1.50 inch. When this alternate is used, pavement slope should be matched using one or more sloped rings. Manufacturer's reference - Ladtech, Inc., or approved equal.
- F. Grade rings shall be a combined maximum height of 1 foot. If more than 1 foot of grade rings are required, then a 1-foot manhole section shall be installed along with grade rings.
- G. Manhole Stubs. Stubs shall extend approximately 24 inch from the outside face of the manhole and shall be capped or plugged with manufactured fittings to form a watertight installation.
- H. Manhole Steps. Manholes steps shall be installed so that the first step is a maximum of 18 inches from finished grade. The steps below the first step shall be installed within 1 inch horizontally of the first step. This will be measured by hanging a plumb bob from a corner of the top step and measuring from that line to the same corner of each step.

3.06 CONNECTION TO EXISTING SEWER FACILITIES

- A. Connections to existing sewer facilities where live flows exist shall be made only after prior consultation with and receipt of written permission from the City Engineer. No bypass of sewage to the surface will be allowed in the completion of this connection. All connections between pipes of different materials shall be made with approved manufactured connectors.

3.07 PROTECTION OF WATER SUPPLIES

- A. Sewer lines shall be located a minimum of 10 feet horizontally from existing or proposed water mains. Where the sewer line crosses above the waterline, or is less than 18 inches vertically below the invert of the water line, or is less than 10 feet horizontally from the water main, the sewer line shall be made impervious by either of the methods listed below or as shown in Detail W11.
- B. Install one piece of C-900 PVC pipe centered over the waterline with a solid sleeve coupler with transition gaskets.

3.08 SERVICE CONNECTIONS

- A. Customer service connections shall be installed in accordance with Detail S09. After the service connection is installed, the end shall be plugged watertight with a manufactured plug and marked with a stake except as shown otherwise on the Drawings.
- PART 4 FIELD QUALITY CONTROL

4.01 LEAKAGE TEST

- A. Sewerlines shall be tested using a low-pressure air test only; water tests will not be allowed. Only after the sanitary sewers, including appurtenances and sanitary laterals, water mains

and water services have been installed and backfilled to finish grade, shall the Contractor proceed with an air test on the installed facilities.

- B. Low Pressure Air Test Procedure. The section of sewerline to be tested should be flushed and cleaned prior to conducting the low-pressure air test. This serves to clean out any debris, wet the pipe, and produce more consistent results. Isolate the section of sewerline to be tested by means of inflatable stoppers or other suitable test plugs. One of the plugs should have an inlet tap, or other provision for connecting a hose to a portable air control source.
- C. If the test section is below the groundwater level, determine the height of the ground water above the spring line of the pipe at each end of the test section and compute the average. For every foot of groundwater above the pipe spring line, increase the gauge test pressure by 0.43 pounds per square inch. Connect the air hose to the inlet tap and a portable air control source. The air equipment should consist of necessary valves and pressure gauges to control the rate at which air flows into the test section and to enable monitoring of the air pressure within the test section. Also, the testing apparatus should be equipped with a pressure relief device to avoid the possibility of loading the test section with the full capacity of the compressor. Locate valves and gauges above ground.
- D. Add air slowly to the test section until the pressure inside the pipe is raised to 5.0 psig greater than the average backpressure of any groundwater that may be over the pipe. After a pressure of 5.0 psig is obtained, regulate the air supply so that the pressure is maintained between 4.5 and 5.0 psig (above the average ground water back pressure) for a period of 2 minutes. This allows the air temperature to stabilize in equilibrium with the temperature of the pipe walls. The pressure will normally drop slightly until temperature equilibrium is obtained.
- E. Determine the rate of air loss by the time/pressure drop method. After the 2-minute air stabilization period, the air supply is disconnected and the test pressure allowed decreasing to 4.5 psig. The time required for the test pressure to drop from 4.5 psig to 4.0 psig is determined by means of a stopwatch and this time interval is then compared to the required time in the attached table to determine if the rate of air loss is within the allowable time limit. If the time is equal to or greater than the times indicated in the tables, the pipeline shall be deemed acceptable.

MINIMUM DURATION FOR AIR TEST PRESSURE DROP

Pipe Size		Time
<u>Inches</u>	<u>Minutes</u>	
4	2.5	
6	4.0	
8	5.0	
10	6.5	
12	7.5	
15	9.5	

- F. Upon completion of the test, open the bleeder valve to allow air to escape. Plugs should not be removed until all air pressure in the test section has been released. During this time, no one should be allowed in the trench or manhole while the pipe is being decompressed. Air test shall also include service lines and appurtenances.

4.02 MANHOLE INSPECTION

- A. During the construction of the manholes, the Contractor shall, in accordance with good practice, ensure that no earth, sand, rocks or other foreign material exists on the joint surfaces during assembly of the section. The Engineer shall check each manhole to determine whether the manhole fulfills the requirements of the approved Drawings and Specifications.
- B. Visual Examination. The Engineer shall visually check each manhole, both exterior and interior, for flaws, cracks, holes, or other inadequacies that might affect the operation or watertight integrity of the manhole. Should any inadequacies be found, the Contractor, at their own expense, shall make any repairs deemed necessary by the Engineer.
- C. Leakage Test. All manholes shall be tested for leakage and all tests shall be witnessed by the Engineer. The leakage test shall be conducted after the manhole has been backfilled to finished grade and shall be carried out in the following manner:
 1. Stub-outs, manhole boots and pipe plugs shall be secured to prevent movement while the vacuum is drawn.
 2. Installation and operation of vacuum equipment and indicating devices shall be in accordance with equipment specifications for which performance information has been provided by the manufacturer and approved by the Engineer.
 3. A measured vacuum of 10 inches of mercury shall be established in the manhole. The time for the vacuum to drop to 9 inch of mercury shall be recorded.
 4. Acceptance standards for leakage shall be established from the elapsed time for a negative pressure change from 10 inches to 9 inches of mercury. The maximum allowable leakage rate for a 4 foot diameter manhole shall be in accordance with the following:

MANHOLE DEPTH	MINIMUM ELAPSED TIME FOR A PRESSURE CHANGE OF 1 INCH Hg
10 ft. or less	60 seconds
> 10 ft. but < 15 ft.	75 seconds
> 15 ft. but < 25 ft.	90 seconds

5. For manholes 5 feet in diameter, add an additional 15 seconds and for manholes 6 feet in diameter, add an additional 30 seconds to the time requirements for 4-foot diameter manholes.
6. If the manhole fails the test, necessary repairs shall be made and the vacuum test and repairs shall be repeated until the manhole passes the test or the manhole shall be tested in accordance with the standard exfiltration test and rated accordingly.

4.03 PRESSURE TESTING OF FORCE MAIN AND LOW PRESSURE, SMALL DIAMETER SEWERLINE.

Make pressure and leakage tests on all newly laid pipe. Furnish all necessary equipment and material, make all taps in the pipe as required, and conduct the tests. The tests shall be conducted between valved sections of the pipeline, or as approved by the Engineer. The Engineer will monitor the tests.

Furnish the following equipment and material for the tests:

<u>Amount</u>	<u>Description</u>
2	Approved graduated containers
2	Pressure gauges
1	Hydraulic force pump approved by the Engineer
1	Additional 0.5-inch pressure tap for Engineer's test gauge
	Suitable hose and suction pipe as required

Conduct the tests after the trench has been completely backfilled. Where any section of pipe is provided with concrete reaction blocking, do not make the pressure test until at least 5 days have elapsed after the concrete thrust blocking is installed. If high-early cement is used for the concrete thrust blocking, the time may be cut to 2 days.

Conduct pressure test in the following manner, unless otherwise approved by the City Engineer: after the trench has been backfilled, fill the pipe with water, expelling all air during the filling. The test pressure shall be 1.5 times normal working pressure at the point of lowest elevation of the test gauge.

- A. Duration.
 1. The duration of each pressure test shall be 2 hours, unless otherwise directed by the City Engineer.
- B. Procedure.
 1. Slowly fill the pipe with water and allow to stand for 24 hours. Expel all air from the pipe. Allow and maintain the specified test pressure by continuous pumping if necessary for the entire test period. The test pressure shall be calculated for the point of lowest elevation, or as specified by the City Engineer. The pump suction shall be in a barrel or similar device, or metered so that the amount of water required to maintain the test pressure may be measured accurately.
 2. Before the line is pressurized, the Engineer shall verify that all necessary main line valves are open or closed with regard to the section of line being tested.
- C. Leakage.
 1. Leakage shall be defined as the quantity of water necessary to hold the specified test pressure for the duration of the test period. No pipe installation will be accepted if the leakage is greater than the number of gallons per hour as determined by the following formula:

$$Q = \frac{LD\sqrt{P}}{148,000}$$

In the above formula:

Q = Allowable leakage, in gallons per hour
 L = Length of pipe, in feet
 D = Nominal diameter of pipe, in inches

P = Average test pressure during the leakage test, in pounds per square inch gauge.

D. Correction of Excessive Leakage.

1. Should any test of pipe laid, reveal leakage greater than that allowed, locate and repair the defective joints or pipe until the leakage of a subsequent test is within the specified allowance.

4.04 TELEVISIONING MAIN

All sewer connection lines 8 inches or larger shall be televised by the City prior to acceptance and start of warranty period.

Installed sewer line shall be re-televised at the end of the warranty period to verify that no movement has occurred.

END OF SECTION

SECTION 10

CURED IN PLACE (CIP) PIPE

PART 1 GENERAL

It is the intent of this specification to provide for the reconstruction of sanitary sewerlines by the installation of a resin impregnated, flexible felt tube inverted into the existing sewerline and cured in place. Curing shall be accomplished by circulating hot water or other approved method to cure the resin into a hard impermeable pipe. When cured, the pipe should extend over the length of the inversion in a continuous tight fitting watertight pipe-within-a-pipe. The installation procedures shall meet industry standards as defined by the applicable ASTM standards referenced.

The gravity sewer line piping consists of vitrified clay pipe in sizes 15" (contractor to field verify).

The CIPP liner system shall consist of a liner with a minimum nominal thickness of 5 mm to 6mm. The resin system shall be the "enhanced resin" with a modulus of elasticity of 400,000 psi. Fabrication and installation shall follow the applicable ASTM standard including but not limited to ASTM F1216-09 and ASTM F1743 or latest edition.

1.01 SCOPE

- A. Work under this section shall include furnishing all materials, labor and tools necessary to perform all installation, cleaning and video inspection of all sanitary sewer lines and appurtenances, as specified herein and shown on the Drawings.

1.02 RELATED WORK SPECIFIED ELSEWHERE.

This specification references American Society for Testing and Materials (ASTM) standard specifications, which are made a part hereof by such reference and shall be the latest edition and revision thereof.

The referenced standards for this project are from the American Society for Testing and Materials, such as: ASTM F1216 (Rehabilitation of Existing Pipelines and Conduits by the Inversion and Curing of a Resin-Impregnated Tube), ASTM F1743 (Rehabilitation of Existing Pipelines and Conduits by Pulled-in-Place Installation of Cured-in-Place Thermosetting Resin Pipe (CIPP); which are made a part hereof by such reference and shall be the latest edition and revision thereof. In case of conflicting requirements between this specification and these referenced documents, this specification will govern.

1.03 SUBMITTALS

Product data including catalog sheets and descriptive literature shall be submitted for all materials and equipment specified or proposed for use for the City of Trinidad work. Submittals shall state manufacturer's compliance with all published standards referenced herein.

1.04. PRODUCT, MANUFACTURER AND INSTALLER QUALIFICATION REQUIREMENTS

Submitted products and product manufacturer must have a proven track record of at least 10 similar projects and have been commercially manufacturing and providing resin impregnated, flexible felt tube liner systems (CIPP) meeting these specifications for at least 7 years.

- A. The installing contractor must have at least 5 years active and verifiable experience installing CIPP liners. The installer's project superintendent shall have a minimum of 2 years experience installing CIPP and must be on-site during the installation of CIPP products. Prior to the award of a contract the selected contractor shall provide a list of similar projects and contact information regarding those projects to the City. The City will use this information to verify contractors experience and work history.

1.05 PROTECTION OF WORK

All pipe, fittings, liner materials and equipment shall be carefully handled, stored and protected in such a manner as to prevent damage to materials.

PART 2 CIPP MATERIALS

This item covers the types of materials that will be allowed for the construction and installation of CIPP. All materials used shall be new, of the best quality available and conform to applicable standards as indicated herein.

- A. The CIPP shall be fabricated to a size that when installed neatly fits the internal circumference of the sewer line as shown on the Drawings and field verified by video inspection by the contractor prior to fabricating tubes. Allowances shall be made for circumferential stretching during insertion.
- B. The minimum length shall be that deemed necessary by the Installer to effectively span the distance from the inlet to the outlet of the respective manholes unless otherwise specified. The installer shall verify the lengths in the field before impregnation. Individual inversion runs can be made over one or more manhole sections as determined in the field by the Installer and approved by the Engineer. Runs that span through manholes shall have the CIPP tops cut out to expose the sewer invert.
- C. The complete process and materials shall meet the applicable ASTM standard including ASTM F1216 - 09 "Standard Practice for Rehabilitation of Existing Pipelines and Conduits by the Inversion and Curing of a Resin-Impregnated Tube.

PART 3 INSTALLATION PROCEDURES

The following installation procedures are general in nature, contractor shall provide a submittal for approval outlining their installation procedure based on manufacturer or industry standards.

3.01 CLEANING OF SEWERLINE.

- A. Cleaning, root removal, measuring lengths and video inspection shall be performed prior to fabrication of liner materials. Contractor shall verify pipe diameters at this time.

3.02 INSPECTION OF PIPELINES

- A. Inspection of pipelines shall be performed by experienced personnel trained in locating breaks, obstacles and service connections by closed circuit television. The interior of the pipeline shall be carefully inspected to determine the location of any conditions, which may prevent proper installation of CIPP into the pipelines, and it shall be noted so that these conditions can be corrected. A video and suitable drawing shall be kept for later reference by the Owner.

3.03 BYPASSING SEWAGE

The Installer, when required, shall provide for the flow of sewage around the section or sections of pipe designated for CIPP. The bypass shall be made by plugging the line at an existing upstream manhole and pumping the flow into a downstream manhole or adjacent system. The pump and bypass lines shall be of adequate capacity and size to handle the flow. This work shall be included in the CIPP liner costs.

3.04 LINE OBSTRUCTIONS

It shall be the responsibility of the Installer to clear the line of obstructions such as solids, dropped joints, protruding service connections or collapsed pipe that will prevent the insertion of CIPP. If inspection reveals an obstruction that cannot be removed by conventional sewer cleaning equipment, then the Installer shall make a point repair excavation to uncover and remove or repair the obstruction. Such excavation shall be approved in writing by the Owner's representative prior to the commencement of the work and shall be considered a separate pay item, as defined in the bid schedule.

PART 4 INSTALLATION OF CIPP

- A. CIPP installation shall be in accordance with ASTM F1216, Section 7, or ASTM F1743, Section 6, with the following modifications:

Resin Impregnation - The quantity of resin used for tube impregnation shall be sufficient to fill the volume of air voids in the tube with additional allowances for polymerization shrinkage and the potential loss of resin during installation through cracks and irregularities in the original pipe wall, as applicable.

Tube Insertion – The wet out tube shall be positioned in the pipeline using either inversion or a pull-in method as defined within relevant ASTM standards previously stipulated. If pulled into place, a power winch or its equivalent should be utilized and care should be exercised not to damage the tube as a result of pull-in friction. The tube should be pulled-in or inverted through an existing manhole or approved access point and fully extend to the next designated manhole or termination point.

Temperature gauges shall be placed between the tube and the host pipe's invert position to monitor the temperatures during the cure cycle.

Curing shall be accomplished by utilizing hot water under hydrostatic pressure or steam pressure in accordance with the manufacturer's recommended cure schedule. A cool-down process shall be conducted that complies with the resin manufacturer's specification.

4.01 SEALING CIPP AT MANHOLES

If due to broken, misaligned or for other reasons the CIPP at the manhole wall fails to make a tight seal, the Installer shall apply a seal at that point. The seal shall be of a resin mixture compatible with the CIPP.

4.02 SERVICE LINE CONNECTIONS

It is the intent of these specifications that branch connections to buildings be re-opened without excavation, utilizing a remotely controlled cutting device, monitored by a CCTV. The Contractor shall certify a minimum of two complete functional cutters plus key spare components are on the job site before each installation or are in the immediate area of the jobsite and can be quickly obtained. Unless otherwise directed by the Owner or his authorized representative, all laterals shall be reinstated as soon as possible. No additional payment will be made for excavations for the purpose of reopening connections and the Contractor will be responsible for all costs and liability associated with such excavation and restoration work.

Missed service connections shall be re-instated and property cleaned up by the Contractor at no additional expense to the City.

4.03 SEAL SERVICES TESTING

The water-tightness of the CIPP shall be gauged while curing and under a positive head. After the work is completed, the Installer will provide the Owner with a videotape showing the completed work, including the restored conditions.

END OF SECTION

SECTION 11**SLIPLINING SANITARY SEWERS****PART 1 GENERAL****1.01 SECTION INCLUDES**

- A. Sliplining existing sanitary sewers.

1.02 PERFORMANCE REQUIREMENTS

- A. Maintain flow of sewage by diversion pumping or other method approved by the Owner's Representative.
- B. Clear existing sewer of debris, obstructions, or other material and make point repairs to existing sewers.
- C. Install sliplining according to this Section.
- D. Test and televise lines.

1.03 SUBMITTALS

- A. Submittals shall conform to requirements of all provisions and sections of these specifications.
- B. Submit manufacturer's product data with complete information on pipeline materials, physical properties, and dimensions pertinent to this job. Furnish a certificate of compliance with specifications for materials to be supplied.
- C. Submit test reports prepared by an independent testing laboratory certifying that polyethylene pipe conforms to the requirements of ASTM D1248 and ASTM D3350 or that FRP pipe conforms to requirements of ASTM D2992 and ASTM D3681, as applicable.
- D. Submit grouting plan showing where grout is to be injected, materials, and chemicals to be used in grout, anchoring methods, and planned grouting pressure.
- E. Submit DVD's at standard play showing the initial condition of sewer, if needed, and tapes showing completed installations.

1.04 Submit a Quality Control Program defining Contractor's and material supplier's field quality control procedures. Owner's Representative may request evidence that work is progressing or has been done in compliance with the submitted quality control program. TESTING

- A. The Owner may run tests on field samples following applicable ASTM specifications at an independent laboratory to verify the required physical properties and characteristics of supplied materials. Provide product samples as requested by Owner's Representative.
- B. The Owner will pay for tests on liner material which meets specification requirements. Contractor shall pay for failed tests and retesting of failed materials.

PART 2 PRODUCTS

2.01 MANUFACTURERS

- A. Liner pipe systems shall be polyethylene products as approved by the City.
- B. Polyethylene liner manufacturers shall be Chevron Phillips, or approved equal.

2.02 POLYETHYLENE LINER PIPE AND FITTINGS

- A. A. The polyethylene liner pipe shall be solid wall, high density, high molecular weight, polyethylene compound conforming to ASTM D1248, Type III, Class C, Grade P-34, Category 5, with a PPI rating of PE 3408. The polyethylene material shall have a minimum cell classification of 3454 34D or E (inner wall shall be light in color) under ASTM D3350. A higher numbered cell classification limit which gives a desirable higher primary property, according to ASTM D3350, is also acceptable. Hydrostatic design value shall not be less than 1600 psi when tested according to ASTM D2837. Dimensions and workmanship shall be in accordance with ASTM F714 and ASTM D2122.
- B. The maximum Standard Dimension Ratio (SDR), the ratio of outside diameter of pipe to wall thickness, shall be as specified below. SDR shall be selected for the deeper of the two manholes in a particular pipeline segment between two adjacent manholes.

Maximum	
Liner SDR	Maximum Depth (Feet)
26	10
21	15
19	20
17	Over 20

- C. Minimum outside diameter of liner shall be as shown in the following table:

Existing Sewer Nominal Diameter (Inches)	Minimum O.D. Of Liner (Inches)
8	8.625
12	10.75
15	12.75
18	16.00
21	18.00
24	22.00
27	24.00
30	28.00
36	32.00
42	36.00
48	42.00

- D. Liner Acceptance: Liner material shall be homogeneous without defects and shall be manufactured to the standards and dimensions specified. Cause for rejection includes physical defects of the polyethylene liner, such as concentrated ridges, discoloration, excessive spot roughness, pitting, visible cracks, foreign inclusions, and varying wall thickness.

2.03 MANHOLE SEAL

- A. A manhole seal between liner pipe and existing host sewer shall be formed with oakum strips soaked in Scotchseal 5600 as manufactured by 3M Corporation, or an approved equal.

2.04 CLAMPS AND GASKETS

- A. Clamps shall be stainless steel, including bolts and lugs as manufactured by JCM Industries, Type 108. Furnish full circle, universal clamp couplings with 1/4-inch thick grid gasket. Select clamps to fit outside diameter of liner pipe. Use minimum clamp width as specified in the following table:

Linear Pipe O.D. (Inches)	Minimum Width Of Clamp (Inches)
7.125	15
8.625	18
10.750	30
or greater	

PART 3 EXECUTION

3.01 DELIVERY, STORAGE, AND HANDLING

- A. A. Prevent injury or abrasion to pipe during loading, transportation, and unloading. Do not drop pipe from cars or trucks, nor allow pipe to roll down skids without proper restraining ropes. Use suitable pads, strips, skids, or blocks for each pipe during transportation and while awaiting installation in the field.
- B. B. Pipe with cuts, gashes, nicks, abrasions, or any such physical damage which may have occurred during shipping, storage, or handling, which are deeper than 10 percent of the wall thickness shall not be used and shall be removed from the construction site.

3.02 OBSTRUCTION REMOVAL AND POINT REPAIR

- A. A. Make point repairs and remove obstructions such as roots, rocks or other debris, prior to installing liner pipe. Water jetting of debris downstream of project limits shall not be permitted.
- B. Obstruction removal may be effected as a point repair or by use of a remote device. For removal by remote device, obtain prior approval of Owner's Representative.

3.03 DIVERSION PUMPING

- A. Install and operate diversion pumping equipment to maintain sewage flow and to prevent backup or overflow. Obtain approval for diversion pumping equipment and procedures from Owner's Representative.
- B. Design all piping, joints and accessories to withstand twice the maximum system pressure or 50 psi, whichever is greater.
- C. In the event of accidental spill or overflow, immediately stop the overflow and take action to clean up and disinfect spillage. Promptly notify Owner's Representative so that required reporting can be made to the Texas Committee on Environmental Quality and Environmental Protection Agency.

3.04 INSERTION OR ACCESS PITS

- A. Locate pits so that the total number is minimized and footage of liner pipe installed in a single pull is maximized. Use excavations at point repair locations for insertion pits, where possible.
- B. Before excavating, check with various utility companies and determine the location of utilities in the vicinity of the work area. Arrange for temporary construction easements and rights-of-way. Damage done to utilities and the resulting repair, temporary service, and other such costs shall be borne by Contractor.

3.05 TESTING OF HOST SEWER

- A. The Contractor shall provide a rigid, solid wall, cylindrical mandrel with a maximum length equivalent to two times the host sewer inside diameter and outer diameter 1.5-inch larger than the actual sliplining pipe. The Contractor shall pull this mandrel through the entire length of sewer to be sliplined prior to liner insertion in order to test the inside diameter of the host pipe, to locate undersized or obstructed sections of the host sewer, and as a method of removing accumulated debris.
- B. If a section of host pipe is discovered which will not allow the mandrel to pass, the Contractor shall record the physical position of the mandrel and removed it from the sewer. He shall then insert the mandrel from the other end of the section and record the position at which it will not pass. This will define both ends of the undersized section of host sewer.
- C. The Contractor shall excavate the undersized portion of the host sewer as located above, remove the crown of the host sewer, and enlarge the host sewer sufficiently to allow the liner to be laid in the half section (invert to springline) of the host sewer with the liner pipe resting fully on the invert of the host sewer.

3.06 POLYETHYLENE LINER INSTALLATION

- A. Preparation: After completing insertion pit excavation, remove top of existing sanitary sewer line down to the spring line. Connect a power winch cable to the end of liner by use of a suitable pulling head equal to the outside diameter of liner. Secure pulling head to liner and attach to power winch cable so that liner can be satisfactorily fed and pulled through sanitary sewer main. Provide proper bumpers in insertion pit to prevent ragged edges of existing

pipe from scarring liner pipe. Refer to insertion procedures given in ASTM F585. Do not allow sand or other debris to enter the liner.

B. Joints:

1. Assemble and joint sections of polyethylene liner pipe on site above the ground. Make joints by heating and butt-fusion method in strict conformance with manufacturer's instructions.
2. Use operators who are experienced with the butt-fusion method for pipe jointing in the field. Operators should be trained in fusing polyethylene pipe with similar equipment using proper jigs and tools per standard procedures outlined by pipe manufacturer.
3. Form joints with a smooth, uniform double rolled back bead made while applying the proper melt, pressure, and alignment. Joints shall be inspected by Owner's Representative before insertion.
4. The maximum length of continuous liner which may be assembled above ground and pulled at any one time is 500 linear feet. Limit length of liner pulled in any one segment to prevent backup in service lines which may result due to restricted flow through the annular space.
5. Prevent damage to liner or breakage of butt-fused joints. Allow sufficient time for liner to return to its normal length.

C. Pulling Liner:

1. Limit pulling force exerted on liner to that indicated below for the appropriate outside diameter of the polyethylene liner:

O.D. (Inches)	Force (Tons)
6	3.5
8	4.0
10	7.5
12	10.5
15	12.0
18	21.5
21	35.0
24	52.0

2. Use a suitable pulling head so that pulling head and liner will separate from each other when pulling force exerted on liner reaches the specified amount.
3. As an alternate, use of a measuring device, such as a spring gauge, will be permitted when approved in advance by the Owner's Representative. Connect the device to pulling cable so that it registers the pulling force being exerted on liner. Do not exceed pulling force indicated above for applicable outside diameter of polyethylene liner.

- D. Alternate Installation Techniques. Pushing the liner as an insertion method, or a combination of pulling and pushing, may be used subject to Owner's Representative's approval. Avoid liner buckling by limiting the stroke of the pushing implement. Cut out and remove any portion damaged during insertion process.

3.07 CLAMP INSTALLATION

- A. Where excavations for liner insertion are made between two manholes, cut ends of the liner smooth, square to axis of the liner. Join liners with appropriately sized stainless steel universal clamp couplings.

3.08 FIELD QUALITY CONTROL

- A. After liner installation, perform the following tests:
 - 1. Low-pressure air test before liner has been sealed in place at the manholes, and before any service reconnections have been made to the liner. Check integrity of joints that have been made and verify that liner has not been damaged by inserting it into sanitary sewer.
 - 2. Service lateral connection test; after all service laterals have been completed for a particular sewer section. Verify integrity of connections at points where they join the liners and existing service lines.
- B. Inspection: Perform a visual and closed-circuit television inspection of lines.

3.09 SEALING LINER IN MANHOLE

- A. Allow liner pipe to normalize to ambient temperatures as well as recover from imposed stretch before cutting to fit between manholes, sealing at manholes, and manhole invert shaping. Normalization usually takes 8 to 10 hours for polyethylene.
- B. Cut liner so that it extends 4 inches into manhole. Make a smooth, vertical cut and slope area over top of exposed liner using non-shrink grout.
- C. Seal the annular space between liner and sanitary sewer main at each manhole with a chemical seal and nonshrink grout. Place a strip of oakum soaked in sealer in a band to form an effective watertight gasket in the annular space between liner and existing pipes in manhole.
- D. Make width of the sealing band a minimum of 12 inches or one-half the diameter of pipe, whichever is greater. Finish seal with a non-shrink grout placed around annular space from inside manhole. Apply grout in a band not less than 6 inches wide. Sealing method, including chemicals and materials, shall be approved by Owner's Representative.
- E. Use cementitious grout to form a smooth transition with a reshaped invert and a raised manhole bench to eliminate sharp edges of liner pipe, concrete bench, and channeled invert. Build up and smooth invert of manhole to match flow line of new liner.

3.10 GROUTING ANNULAR SPACE

- A. Obtain approval of grouting plan from Owner's Representative before proceeding with the Work.

3.11 POST-TELEVISION OF COMPLETED WORK

- A. Provide Owner's Representative with a quality color DVD at standard play showing completed Work including condition of restored connections prior to requesting payment.

3.12 FINAL CLEANUP

- A. Upon completion of installation work and testing, clean and restore project area affected by the Work.

END OF SECTION

PART 12**DESIGN CRITERIA - GRAVITY SEWER****PART 1****1.01 SIZING**

All collection sewer lines shall be designed to flow approximately half full at peak flow. One hundred gallons per capita day shall be used as the per capita contribution for average daily flow. A peaking factor of 4.0 shall be used for peak flow. Minimum line size shall be 8 inches.

1.02 VELOCITIES

All velocities shall be maintained between 2.5 fps and 15 fps. Minimum velocity shall be 2 fps.

1.03 SLOPE

Minimum sewer line slopes shall be as follows:

8"	0.4%
10"	0.3%
12"	0.22%
15"	0.15%
18"	0.12%
21"	0.10%
24"	0.09%
27"	0.08%

1.04 DISTANCES

The distance between manholes shall not exceed 400 feet unless approved by the City Engineer. Manholes shall be required on all changes in grade or alignment.

1.05 CURVED SEWER

Allowed only with prior approval from City.

1.06 SMALL DIAMETER PRESSURE SEWERLINES

Under special conditions, such as low tributary population, or areas where it may be determined by the City, that central lift stations are not applicable, small diameter pressure sewer technology may be used. Small diameter technology may include pressure, vacuum and small diameter, gravity sewers.

The Engineer shall submit an integrated plan for review and approval. That plan shall include the design of main line sewers and their appurtenances, service lines and on-site pumping systems. Components of the integrated design shall include, but not be limited to, the following:

- A. The City will maintain a list of acceptable manufacturers for these integrated systems. Those manufacturers' lists may be obtained from the City office.

- B. The on-site pumping system shall include a simplex or duplex, effluent or grinder pump, alarm and monitoring controls, an effluent pipe check valve, a means to isolate the on-site pumping systems during maintenance and a minimum 20-foot usable access easement to allow inspection by City personnel.
- C. The service line shall include a shutoff means to allow extension of the service line onto individual properties after the main system is in operation.
- D. The main line sewer system shall include air and vacuum release valves with vaults at high points, pressure cleanouts at high points (in combination with air release and vacuum valve vault), pressure cleanouts at intersections and pressure cleanouts at minimum 1,000 foot intervals. Pressure cleanouts shall be installed in a standard manhole for access.
- E. The system design shall provide for minimum cleansing velocities of 2 fps at design conditions. Minimum cleansing velocities shall be maintained at less than design flow conditions where excessive headloss at design flows are not introduced. It is recognized that minimum cleansing flows may not be maintained during the early stages of build-out. A plan shall be prepared to address operations during the times when cleansing velocities cannot be maintained. This plan should investigate multiple main lines, odor control facilities and increased maintenance requirements.

PART 2 GREASE INTERCEPTORS OR PRETREATMENT PROGRAM

2.01 GENERAL

Because of the impact of grease on the City's lines and treatment plant, grease interceptors are required on all establishments preparing or serving food.

All grease interceptors shall be new and the interceptor and its installation shall be in conformance with the latest edition of the Uniform Plumbing Code except as modified herein.

2.02 REQUIREMENTS FOR GREASE AND SAND/OIL INTERCEPTORS

An approved type grease interceptor complying with the provisions of this section shall be installed in the waste line leading from sinks, drains and other fixtures or equipment in the following establishments: Restaurants, cafes, lunch counters, cafeterias, bars and clubs; hotels, hospitals, factory or school kitchens, or other establishments where grease may be introduced into the drainage or sewage system. A grease interceptor is not required for individual dwelling units or for any private living quarters.

All carwashes shall have a sand and oil separator.

2.03 SPECIFICATIONS AND PROCEDURES FOR GREASE AND SAND/OIL INTERCEPTORS

- A. Plans shall be submitted to and approval obtained from the City prior to the installation of any grease interceptor in any establishment set forth in Subsection 6.02.
- B. No grease interceptor shall be installed which has an approved rate of flow of more than 55 gallons per minute, except when specially approved by the City.

- C. No grease interceptor shall be installed which has an approved rate of flow of less than 20 gallons per minute.
- D. Each plumbing fixture or piece of equipment connected to a grease interceptor shall be provided with an approved type flow control or restricting device installed in a readily accessible and visible location in the tail piece or drain outlet of each such fixture. Flow control devices shall be so designed that the total flow through such device or devices shall at no time be greater than the rated capacity of the interceptor. No flow control device having adjustable or removable parts shall be approved.
- E. Each grease interceptor required by this section shall have an approved rate of flow which is not less than that given in the City's EQR schedule for the total number and size of fixtures connected thereto or discharging thereunto. The total capacity in gallons from fixtures discharging into any interceptor shall not exceed 2.5 times the flow rate of the subject interceptor.

Any grease interceptor installed or located in such a manner that the inlet is more than 4 feet lower in elevation than the outlet of any fixture discharging into such interceptor, shall have an approved rate of flow which is not less than 50 percent greater than that given in the City's EQR schedule.

- F. No more than 4 separate fixtures shall be connected to or discharged into any 1 grease interceptor.
- G. For the purpose of this section, the term "fixture" shall mean and include each plumbing fixture, appliance, apparatus or other equipment required to be connected to or discharged into a grease interceptor by any provision of this section.
- H. Each grease interceptor shall be vented as required by the Uniform Plumbing Code and each fixture discharging into a grease interceptor shall be individually trapped and vented in an approved manner, except that an approved type grease interceptor may be used as a fixture trap for a single fixture when the horizontal distance between the fixture outlet and the grease interceptor does not exceed 4 feet and the vertical tail pipe or drain does not exceed 2 feet.
- I. Each grease interceptor shall be installed and connected so that it shall be at all times easily accessible for inspection, cleaning and removal of the intercepted grease.
- J. Interceptors shall be maintained in efficient operating conditions by periodic removal of the accumulated grease. No such collected grease shall be introduced into any drainage piping, public or private sewer and it shall be disposed of in an environmentally safe manner. Maintenance and inspection shall occur every 6 months or as approved by the City and the records shall be provided to the City once a year.
- K. Each grease interceptor shall be constructed of durable material satisfactory to the City and shall have a full size, gas tight cover that can be easily and readily removed.
- L. No water-jacketed grease interceptor shall be approved or installed.
- M. Each grease interceptor shall have an approved water seal of not less than 2 inches in depth or the diameter of its outlet, whichever is greater.

- N. No grease interceptor required by this section shall be installed until the type and model of each size thereof has been approved by the City.
- O. The City may require such tests as may be necessary to determine the grease collecting efficiency of the various types and kinds of grease interceptors to establish the rate of flow or other rating thereof. Such test requirements may be revised or modified from time to time as may be deemed necessary by the City. A list of approved and acceptable interceptors shall be kept on file in the office of the City.
- P. No grease interceptor shall be installed which does not comply in all respects with a type or model of each size approved and accepted by the City. Whenever it shall come to the attention of the City that any grease interceptor does not so comply, the City shall immediately suspend or revoke such approval.

PART 3 CLEANOUTS

All service lines shall have a minimum of 1 two-way cleanout, and then 1 cleanout per 100 feet of pipeline length. A cleanout consisting of a wye the diameter of the service line shall be provided at the property line between the building being served and the main line. The upper 24 inch of the vertical riser shall be cast or ductile iron and at grade in unimproved areas, finished driveways, sidewalks, etc., and be plugged with a water-tight cast iron plug (see Details S09).

PART 4 ABANDONMENT

Abandonment of Taps shall be abandoned at the main. Taps are to be exposed and service line severed and capped with a glued fitting. For iron pipe a circular clamp shall be installed.

END OF SECTION

SECTION 13

TRENCHING, BACKFILLING AND COMPACTION

PART 1 GENERAL

1.01 SCOPE

Work to be performed under this section shall include all labor, equipment, materials and miscellaneous items necessary to perform all excavation, backfilling and compaction of underground pipelines, conduits, cables and appurtenances shown on the Drawings and specified herein.

All work within the rights-of-way of the Federal Government of the Colorado Division of Highways, County Governments or Municipal Governments shall be done in compliance with requirements issued by those agencies. All such requirements shall take precedence over these Specifications. It shall be the Contractor's responsibility to secure all required excavation permits and pay all costs thereof. Contractor will be required to obtain necessary road cut permits.

1.02 FIELD CONDITIONS

- A. Existing Utilities. Underground utilities, except service lines, known to the Engineer have been shown on the Drawings. Locations are approximate only and may prove to be inaccurate. The Contractor is responsible for verification of the existence, location and protection of all utilities within the construction area.

Before commencing with work, the Contractor shall notify all public and private companies who may have utilities within the project limits. The Contractor shall coordinate with these entities all excavation performed. The Contractor shall obtain all permits required by utility owners.

In the event of damage to any existing utility, the Contractor shall be solely responsible for the repair and payment for repair of all such damage.

The Contractor shall make arrangements for and pay all costs for relocation of utilities requiring relocation as indicated on the Drawings. Should utility obstructions, not shown on the Drawings, be encountered and require relocation, the Contractor shall notify the Owner and the Engineer and shall make arrangements necessary for such relocation. The Owner shall pay the costs for such relocation.

- B. Existing Improvements. The Contractor shall restore or protect from damage all existing improvements encountered in performance of the work. Improvements damaged, as a result of this work shall be restored to original condition or better, as determined by the Engineer.

Adjacent property shall be protected by the Contractor from any damage. The Contractor shall be held solely liable for any damage to adjacent property and shall be responsible for all costs resulting from repair of such damage.

- C. Soil Conditions. It shall be the responsibility of the Contractor to examine soil conditions and characteristics, including the presence of groundwater that will be encountered within the limits of construction.

1.03 PROTECTION OF WORK

- A. Safety. All excavation shall be protected by barricades, lights, signs, etc., as required by governing federal, state and local safety codes and regulations.
- B. Sheet piling, Shoring and Bracing. Where trench walls are not excavated at a stable slope, the Contractor shall provide and maintain support sufficient to prevent caving, sliding or failure and property or bodily damage. Any damage due to inadequate support shall be repaired at the sole expense of the Contractor.

Under normal construction conditions, support shall be removed as work progresses. Support shall remain installed if directed by the Engineer or if pipe does not have sufficient strength to support backfill based on trench width as defined by the sheet piling. Sheet piling shall not be removed after the start of backfilling.

Use of a movable trench shield or coffin box will not be allowed where pipe strength is insufficient to support backfill as defined by the trench width after the trench shield is removed.

The Contractor shall be held solely responsible for any violation of applicable safety standards. Particular attention is called to minimum requirements of OSHA and Colorado Occupational Safety and Health (COSH).

- C. Site Drainage. Excavation to be protected from surface water at all times. At no time shall excavated area be allowed to fill with storm water runoff. Contractor shall provide proper, temporary drainage structures at their cost to detour runoff from excavated areas.

1.04 BLASTING

No blasting shall be permitted without written consent of the Engineer. Blasting shall be done only after Engineer receives permission from the appropriate governmental authority(ies). Blasting shall be performed only by properly licensed, experienced individuals and in a manner such that no damage to any property or persons will occur due to either the blast or debris. Contractor shall provide proof of insurance as required by these Specifications, the governing authority or as required by Engineer prior to any blasting. All damage, as the result of blasting shall be repaired, at the Contractor's expense, to the satisfaction of the Engineer. All earth or rock loosened by blasting shall be removed from excavations prior to proposed construction.

1.05 CONSTRUCTION IN STREETS

When construction operations are located within streets make provisions at cross streets and walks for free passage of vehicles and pedestrians. Do not block streets or walks without prior approval.

1.06 SUBMITTALS

- A. Bedding Material
 - 1. Submit sieve analysis.
- B. Select Fill
 - 1. Submit sieve analysis.

PART 2 MATERIALS

2.01 EMBEDMENT MATERIAL

Pipeline embedment material shall comply with the appropriate classes as listed below and as illustrated in the approved Construction Drawings:

- A. Class A - Use for all PVC, CMP and concrete pipe under normal construction conditions.
 - 1. Characteristics - Densely compacted Class 6 aggregate granular foundation of depth shown on Typical Details with densely compacted Class 6 aggregate 12 inches above top of pipe.
 - B. Class B - Use where improper trenching or unexpected trench conditions require its use as determined by the Engineer.
 - 1. Characteristics - Concrete cradle foundation with densely compacted Class 6 aggregate base backfill to 12 inches above top of pipe, or densely compacted Class 6 aggregate granular foundation with concrete arch cover to 6 inches above top of pipe.
- * 3/4-inch screened rock shall not be used unless approved by the City Engineer.

2.02 SELECT MATERIAL

- A. Subject to approval by the Engineer, select material shall be allowed in place of the aggregate backfill for Class A when excavation and soil conditions allow, but only if approved by Engineer.
- B. Contractors shall bid project based upon Class A. If Class B or select material is used, price adjustments shall be made.
- C. Characteristics - Soil materials free from rocks, clods, and organic material.

2.03 CONCRETE FOR EMBEDMENT

Shall be 2,000 psi concrete (28- day compressive strength).

2.04 BACKFILL MATERIAL

- A. Characteristics - Native materials free from debris, organic matter and frozen material. Uniformly graded sufficient to allow proper compaction.
- B. Gradation - No boulders greater than 6-inch diameter in top 12 inches of backfill. Generally, no boulders greater than 12-inch diameter in remainder of trench.

PART 3 METHODS AND PROCEDURES

3.01 SITE PREPARATION

- A. Clearing. Remove all vegetation, stumps, roots, organic matter, debris and other miscellaneous structures and materials from project site. Dispose of off-site.
- B. Topsoil Removal. Strip existing topsoil from all areas to be disturbed by construction. Topsoil to be stockpiled separately from excavated materials.

3.02 TRENCH EXCAVATION.

- A. Limits of Excavation. Trenches to be excavated along lines and grades shown on the Drawings, or as modified in the field by the Engineer. Trench widths for pipe loading to be measured 12 inches above top of pipe.

Minimum trench width to be the outside diameter of the pipe or conduit plus 16 inches.

Maximum trench width to be the outside diameter of the pipe or conduit plus 24 inches for all pipes or conduits with outside diameter of 24 inches or less, and plus 30 inches for all pipes or conduits with outside diameters greater than 24 inches.

If maximum trench width is exceeded, Contractor will provide at their expense, higher strength pipe or special bedding including concrete at the direction of the Engineer.

Trench excavation not to be completed more than 100 feet in advance of pipe installation. Backfill to be completed within 100 feet of pipe installation.

- B. Groundwater Control. Contractor to maintain facilities on-site to remove all groundwater from trench and keep water at least 12 inches below the trench bottom, to a point such that a firm base for pipe or conduit installation exists.
- C. Facilities shall be maintained until all concrete is cured and backfilling is in place at least 24 inches above anticipated water levels before water removal is discontinued; all water removal shall be subject to approval by the Engineer.
- D. Stockpile Excavated Material. Excavated material to be stockpiled so as not to endanger the work or public safety. Maintain existing vehicular and pedestrian traffic with minimum disruption. Maintain emergency access and access to existing fire hydrants and water valves. Maintain natural drainage courses and street gutters.

Backfill material to be segregated from stockpiled topsoil and unusable backfill materials.

- E. Excavation for Appurtenances. Excavation to be done in accordance with these Specifications and as shown on the approved Drawings. Adequate working clearances to be maintained around appurtenances. Provisions for base and bottom preparations shall apply to all appurtenances.

Precautions to be taken to maintain trench widths in the vicinity of adjacent pipelines and conduits.

3.03 BOTTOM PREPARATION

- A. Undisturbed Foundation. Where soils are suitable and have adequate strength, bottom to be graded and hand-shaped such that pipe barrel rests uniformly on undisturbed soil. All rocks or stones that may result in a point bearing on the pipe shall be removed.

Undisturbed grades shall be within 0.1 feet tolerance. Soils for final pipe grade placed within these limits shall be fine granular (100% passing No. 4 sieve) or may be native materials, hand compacted to 95% maximum density.

- B. Bell Holes. Material to be removed to allow installation of all fitting and joint projections without affecting placement of pipe.
- C. Over excavation. Whenever trench is over-excavated to eliminate point bearing by rocks or stones or when undisturbed grade tolerances of 0.1 foot are exceeded, the Contractor is to re-establish grade using Class 6 aggregate bedding material. Compaction shall be 95% maximum density. All work to re-establish grade shall be at the Contractor's expense.
- D. Unstable Materials. Materials that are not capable of supporting super-imposed loadings are defined as unstable materials. Should unstable materials be encountered during excavation, immediately notify Engineer. If, in the opinion of the Engineer, unstable soil excavation is required and the Contractor could not have reasonably been expected to discover the existence of such materials during their site investigation, then a contract price for Unstable Soil Excavation shall be negotiated between Owner and Contractor. No payment shall be made for materials excavated prior to notification of the Engineer and negotiation of payment for extra work.

Inclusion of a bid item for Unstable Soil Excavation indicates such excavation is anticipated. The Contractor is to notify the Engineer prior to any unstable soil excavation; no payment shall be made for excavation prior to authorization of Engineer.

- E. Rock Excavation. Rock excavation shall be defined as removal of boulders in excess of 3 cubic yards of solid or fractured rock, which makes hand shaping of the bottom impossible and which requires techniques, such as blasting or jacking for removal, other than those which are being employed by the Contractor or are normally used in trench excavation, such as use of backhoes, trenchers, draglines, etc. Should unanticipated rock conditions be encountered, immediately notify the Engineer. If in the opinion of the Engineer, rock excavation is required and the Contractor has in fact made a diligent and determined effort to remove the material using normal excavation procedures as stated above, and the Contractor could not have reasonably been expected to determine the existence of such material during their site investigation, then a contract price for rock excavation shall be negotiated between the Contractor and the Owner. No payment shall be made for excavation performed prior to determination of a negotiated price.

Rock shall be removed to a 4-inch depth below grade. Additionally, all rock loosened during jacking, blasting, etc., shall be removed from the trench. For payment purposes, maximum trench width to be paid for shall be as defined in Subsection 3.02,

- F. Maximum depth to be paid for shall be 12 inch below required grade. All over-excavation shall be replaced as specified in Subsection 3.03, C.

Inclusion of a bid item for rock excavation indicates such excavation is anticipated. Contractor to notify Engineer prior to any rock excavating; no payment shall be made for excavation prior to notification.

3.04 BACKFILLING

- A. Tamping Equipment. Except immediately next to the pipe, mechanical or air operated tamping equipment to be used. Hand equipment, such as T-bar to be used to pipe if necessary. Care to be taken when compacting under, alongside and immediately above pipe to prevent crushing, fracturing shifting of the pipe. The Contractor is to note densities required for materials are or being backfilled and shall use appropriate approved equipment to obtain those densities.

Wheel rolling is not considered to be an adequate compaction technique to meet these Specifications and will not be allowed. Where 85% compaction is required, wheel rolling may be considered. Before acceptance, the Contractor shall backfill a portion of the trench and pay for density testing to verify adequacy of the proposed backfill techniques.

A hydro hammer may be allowed to obtain the specified density up to 4 feet in depth. The Contractor will be required to re-excavate those areas that have been tamped so that density tests can be taken to insure that the specified density is being obtained full depth.

- B. Moisture Control. Generally, maintain moisture of backfill material with 2% of optimum moisture content as determined by ASTM D698. Maintain closer tolerances as needed to obtain densities required.
- C. Compaction. Maximum density (100%) based on ASTM D698 or AASHTO T99.
1. Bedding Material, including material used for over-excavation of any kind: 95%.
 2. Select Material: 95%
 3. Backfill beneath existing or proposed pavement, roadways, sidewalks, curbs, utility lines and other improvements or within 5 feet horizontally of such improvements: 95%.
 4. Backfill within public or designated right-of-way: 90% or as shown on the approved Drawings.
 5. Backfill within undeveloped, green or undesignated area: 85%.
 6. Backfill for any fill over overcut grading in areas of lot/home construction: 95%.
- D. Placing Backfill. The maximum loose lifts of backfill material to be as follows: use smaller lifts where necessary to obtain required densities:
1. Bedding and select material: 6 inches (or see Section 3.03A).
 2. Backfill Material: 12 inches where 95% compaction required; 24 inch where less than 95% compaction required.
- E. Backfilling Appurtenances. Backfilling to be done generally at the same time as adjacent pipelines. Backfilling procedure to conform to this section. Use special techniques or materials as shown on drawings.
- F. Disposal of Excess Excavation. Contractor to dispose of excess excavation off site. The Owner shall have the right to elect to have the excess excavation disposed of at a

designated site within the project limits. Excavation may be wasted on-site only if approved by the Engineer. Disposal in any case shall be the sole responsibility of the Contractor.

- G. Jetting. Jetting and water inundation are generally not permitted methods of compaction. The Engineer may allow jetting under certain field conditions. Techniques including depth of lifts, amount of water to be used, penetration of hose jet, etc., shall be at the direction of the Engineer. No jetting will be allowed on materials with a 200 minus gradation of greater than 15%. Contractor shall pay cost of all water used, soil classification testing and retesting or recompaction required. No jetting shall be done prior to written approval and direction of the Engineer.
- H. Maintenance of Backfill. Contractor to maintain all backfill in a satisfactory condition during the extent of the contract and warranty period. All surface deterioration determined to be the responsibility of the Contractor and the Contractor upon notice by the Owner shall repair all settlement at once. All costs for repair and all liability, as a result of surface deterioration or settlement, shall be the responsibility of the Contractor.
- I. Clay Barrier Water Stops. Because of the presence of ground water, a clay barrier may be required to be installed full depth in trench in place of all bedding material and backfill. This barrier shall be full depth and two feet thick and installed every 100 linear feet of trench. Clay barrier installation shall be considered incidental to the pipe installation and not paid for separately.

3.05 SURFACE RESTORATION

All existing surface improvements and site conditions disturbed or damaged during construction to be restored to a condition equal to pre-construction condition. All restoration costs are considered incidental to excavation and backfill.

- A. Improvements. Replace, repair or reconstruct all improvements as required. Work will not be accepted until restoration is accepted by Engineer and all affected property owners. Improvements include, by example, other utilities, culverts, structures, curb and gutter, mailboxes, signs, sprinkler systems, etc.
- B. Final Grading. The Contractor is to re-establish existing final grade or finish final grades as modified and shown on the approved Drawings. The Contractor is to backfill to proper subgrade elevation with backfill material to allow placement of surface improvements or materials.
- C. Roadways. All roadways to be restored to original condition with material types removed. Materials and methods to conform to applicable portions of current Colorado Department of Transportation (CDOT) specifications. Additional requirements are:
 - 1. Minimum base course material on gravel roadways or minimum depth gravel on hard surface roadways to be 8 inch, unless shown otherwise on approved Drawings.
 - 2. Minimum bituminous surfacing to be 3 inch unless shown otherwise on approved Drawings.
 - 3. Minimum concrete pavement surfacing to be 6 inch, unless shown otherwise on approved Drawings.

PART 4 QUALITY CONTROL - FIELD**4.01 COMPACTION**

It should be fully understood that it will be the sole responsibility of the Contractor to achieve the specified densities for all embedment and backfill material placed. Contractor will be responsible for ensuring that correct methods are being used for the placement and compaction of said materials. Correct backfill methods include, but are not limited to:

- A. Use of proper equipment for existing soil condition encountered.
- B. Moisture content of existing soils; determination if water should be added or if soil should be air dried to reduce moisture content.
- C. Thickness of backfill lift. Contractor may, at their own expense, have an approved geotechnical engineer monitor the methods of backfill and compaction used to ensure that the desired densities are being obtained. Inspection and testing will be performed as directed by the City. Testing will be conducted as a quality control check to verify the Contractor's compliance with the standards indicated the Specifications.

4.02 INSPECTION AND TESTING

Inspection and testing to be performed at the direction of the Engineer. Contractor to cooperate fully with all persons engaged in testing. Contractor to excavate as required to allow testing. Contractor to backfill all test excavations in accordance with these Specifications. Any areas, which require a specified density, including fill, backfill, trenches, embankments, road base, hot bituminous pavement, backfill for structures, shall be tested.

4.03 DENSITY TESTING AND CONTROL

- A. Reference Standards. Density/moisture relationships to be developed for all soil types encountered according to ASTM D698 or AASHTO T99. B. Field Testing. Testing for density during compaction operations to be done in accordance with ASTM D2922 using nuclear density methods.
- C. Frequency of Testing. Minimum of 1 test every 250 feet trench per lift or as directed by Engineer. Contractor to excavate to depths required by City for testing and backfill test holes to density specified.
- D. Retesting. In the event of failure to meet compaction criteria, Contractor shall re-excavate and re-backfill at direction of City. All retesting to be paid for by Contractor and to be performed by soils testing firm approved by the City.

END OF SECTION

SECTION 14

OPERATION AND MAINTENANCE OF WATER AND SEWER SYSTEMS

PART 1 GENERAL

1.01 SCOPE

- A. The following general regulations shall apply to the City's potable water and sanitary sewer systems:

1.02 RESPONSIBILITIES OF CITY

- A. Except as otherwise provided by this public works manual, the City is responsible for the operation and maintenance of the sewer and/or water systems in accordance with these Public Works Manual.

1.03 UNAUTHORIZED CONNECTION AND FEES

- A. No person shall be allowed to connect onto the sewer or water systems or to enlarge or otherwise change equipment, service, or use of property without prior payment of Capital Investment Fees, approval of a permit for service, and adequate supervision and inspection of the tap by City employees or the City Engineer. Any such connection, enlargement, or change without payment, approval, supervision, and inspection shall be deemed an unauthorized connection.
- B. Any violation of this section shall result in the assessment of an unauthorized connection fee as further described below. The City shall take those steps authorized by these Public Works Manual and Colorado law regarding the collection of said fees.
- C. Upon the discovery of any unauthorized connection, the then-current Capital Investment Fee and accrued service charge, if any, shall become immediately due and payable, and the property shall be fined per the current fee schedule in the municipal code for each unauthorized use or connection. This fine shall be in addition to the City's right to charge for all services used, and to any and all other remedies which the City may have. The City shall send written notice to the customer benefited by such connection stating that an unauthorized connection has been made between the customer's property and the City facilities. The customer shall have 20 days from the date the notice is mailed to pay the then-current Capital Investment Fee and accrued service charges, if any. If not paid within this period, the City shall proceed in accordance with Revocation of Service.

1.04 INSPECTION REQUIRED

- A. Any customer believed to have changed equipment, service, or use of his property, in violation of this section, shall be notified of such belief by the City, and shall be afforded 20 days from the date upon which the notice is mailed in which to respond to the City's notice. Failure to respond may result in the City discontinuing service to the property.

1.05 AUTHORITY TO INSPECT

- A. Authorized representatives of the City, upon presentation of a work order and proper credentials, shall be permitted to enter upon all properties served by the City at all reasonable times for the purpose of inspection, observation, measurement, sampling, testing, inspection of records of the water or sewer system, and repairing of any water or sewer mains or service lines, whether public or private, in accordance with the provisions of these Public Works Manual. Failure to permit such inspections, observations, measurements, samplings, testing, and/or inspection of records upon the request, in writing, of the City Manager may result in a finding that permission is being denied to avoid discovery of a violation. Such finding may result in the disconnection of service to the property occupied by the party failing to permit the desired access, or other remedies as allowed under these regulations.

1.06 NOTICE OF CHANGES AND REDETERMINATION OF CAPITAL INVESTMENT FEES

- A. The customer shall notify the City (1) prior to any expansion or addition to the service, (2) prior to any change in the use of the property served by the City, (3) upon any change of ownership of said property and/or, (4) upon any substantial change in water demand or sewage characteristics. Any of the above described changes which, in the opinion of the City, will increase the burden placed on the City's system by the customer shall require a redetermination of EQR's, Capital Investment Fees and monthly service charges, and a payment by the customer of any additional Capital Investment Fee and monthly service charge resulting from the redetermination. When an expansion or change in use occurs that results in additional fees due, a credit for the existing use shall be given. Capital Investment Fees based on the current rate for the specific use as stated in the original permit shall be credited against the redetermined Capital Investment Fee so that only the unpaid portion of any redetermined Capital Investment Fee shall be due. However, if the redetermination results in a conclusion that the Capital Investment Fee, if assessed currently, would be in an amount less than the Capital Investment Fee originally paid, the redetermined fee shall not result in a refund to the customer.
- B. If it is discovered, as a result of an inspection, that alterations or additions have been made or the use of the property has changed, the City shall make a determination as to the change in the customer's equipment, service or use of the property in question, and shall redetermine any additional Capital Investment Fees and service charges in accordance with current EQR Schedule.

1.07 REVOCATION OF SERVICE

- A. Service shall be revocable by the City upon non-payment of any valid fees or charges owed to the City. In the event of non-payment, within 20 days after receipt of notice of the same, the customer shall be then given not less than 20 days advance notice in writing of the revocation. The notice shall set forth:
- B. The reason for the revocation;
- C. That the customer has the right to contact the City, and the manner in which the City may be contacted for the purpose of resolving the obligations.

1.08 SUSPENDED SERVICE

- A. When a building is moved or destroyed and/or water and or sewer services are suspended to any property, the original tap authorization shall remain, provided that a written request is made to, and approved by the City Manager prior to cessation of payment of service charges. No refunds or credits shall be given to the customer due to temporary or permanent suspension of service.
- B. When a service line is abandoned permanently, the customer shall valve the water supply off at the main line (corporation stop valve), and plug the sewer service connection at the main. If the customer is not responsive within a reasonable time period as determined by the City Manager, the City will valve the water supply and plug the sewer service line and shall bill the cost to the customer and file a lien on the customer's property. Variances to this requirement may be considered on a case-by-case basis.

1.09 UNAUTHORIZED USE

- A. No person shall uncover, alter, disturb, make any connection with, make an opening into, or backfill prior to inspection the water or sewer system without a written authorization from the City. Unauthorized uses of or tampering with the City's systems include, but are not limited to, change in customer's equipment, service or use of property, an unauthorized turn-on or turn-off of water service or a water main; burying valve boxes; modifying any water meter; and discharging prohibited sewage even though the same may be performed on a privately owned and maintained service line. All water use must be metered. Any unmetered use is considered to be unauthorized use, unless approved by the City.

1.10 CUSTOMER RESPONSIBILITY

- A. Each customer shall be responsible for all costs associated with the maintenance of the water service line from the building to the curb stop including riser and rod or edge of easement or property line, whichever is closer to the main. For sewer, the entire service line from the building to the main line is the property of the customer who is responsible for its maintenance.

1.11 REPAIR OF SERVICE LINE

- A. Leaks, breaks and general maintenance of the water service line shall be the responsibility of the customer. The customer shall be given notice by first-class mail, that the water service line is defective and in need of repair. Customer shall institute repair or maintenance immediately after receipt of such notice. If satisfactory progress toward repairing the service line has not been completed in a timely manner or the City determines that environmental or property damage is being caused, the City shall shut off the water service until the service line has been repaired. In addition, the City shall have the right to affect the repair, and the costs therefore shall constitute a lien on the property as provided for by C.R.S., 32-1-1001.

1.12 TURN ON/TURN OFF OF SERVICE

- A. All routine turn on and turn off of water service at a curb stop shall be performed only by City personnel. During emergencies, a customer may turn off the water service at the curb stop valve. The City shall be notified of the turn off and the circumstances at the earliest time. Only City personnel shall turn on the water service.

- B. When initial service is provided and when the turn off/turn on service is performed for a customer requiring maintenance to his service line, a service fee will not be charged. In other circumstances the City shall assess a single turn off/turn on charge each time a turn off or turn on is performed.
- C. The City will provide turn on service for a tap for new construction only one time prior to the occupancy of the building served. At the time the water meter is set, metered service charges begin unless the City is requested to perform the turn off.

1.13 DAMAGE TO CITY PROPERTY

- A. No person shall, whether maliciously, willfully, negligently or otherwise, break, damage, destroy, uncover, deface, make any connection without permit, or tamper with any structure, appurtenance or equipment of the water or sewer system, including fire hydrants.

1.14 PROPERTY DAMAGE

- A. No claim for damage shall be made against the City by reason of any damage to real or personal property resulting from turning on or shutting off of service or a variation in system pressure. No claim shall be made against the City for operational maintenance such as sewer line jetting.

1.15 OWNERSHIP OF AND LIABILITY FOR FACILITIES

- A. All existing main lines and treatment works connected with and forming an integral part of the water or sewer system are the property of the City, unless a contract with customer provides otherwise. Ownership will remain valid whether the main lines and treatment works were constructed, financed, paid for, or otherwise acquired, by the City or by private parties. Transfer of ownership of main lines shall be in accordance with Section IV, Line Extension Policies. The developer is responsible for correction of construction deficiencies for a period of two years from the date of acceptance of the facilities by the City, or July 1st of the year following the second winter after the acceptance of the facilities occurs.
 - 1. Liability of City
The City shall not be liable or responsible for inadequate treatment or interruption of service brought about by circumstances beyond its control.
 - 2. Conditions of Ownership-Service Lines
The customer's ownership of the service line shall not entitle the customer to make unauthorized uses of the City's systems or to make alterations to the service line and the system once the service line has been connected to a City main line. All uses or changes in use of the service line, any appurtenances thereto, or changes in use of the property served at any time after the initial connection to the City system shall be subject to these Public Works Manual.
- B. Conditions of Ownership-Lift Stations
 - 1. A lift station associated with customer service lines shall be the property of the customer(s) served by such lift station. Maintenance of such lift station is the sole responsibility of customer(s) and shall not be the responsibility of the City.
- C. Private Main

1. "Private Main" is any sewer interceptor, collection line, or main line, or any water distribution line or main line that is connected to the City system but not owned or maintained by the City. Private Mains have not been accepted by the City, generally due to: (1) non-conformance with these Public Works Manual, the Craig Water and Sanitation City Minimum Design and Construction Standards for Water Distribution and Collection Sewer Systems, and/or other approved standards of construction; (2) it is not in the best interest of the City to accept the mains because of special and/or mitigating circumstances; or (3) if the title of the mains cannot be transferred free and clear to the City.
2. Water Meter. Meter sizes for all applications shall be determined by the City. All connections to the City's water system shall include a water meter. All water meters shall have devices for remote reading as well as a Meter Interface Unit (MXU) for automated radio-meter reading. The type of water meter and location of the meter shall be subject to the approval of the City and accessible for maintenance. The customer shall install the initial meter by way of an approved licensed plumber and the City shall have the right to test, remove, repair, or replace any and all water meters. Any meter not installed in accordance with City specifications shall be immediately replaced upon notification by the City. The customer shall be subject to a fine for illegal tampering of the water system. Each customer is responsible for notifying the City if his water meter is operating defectively. If any meter is suspected to be defective, the City shall diligently pursue repair or replacement of said meter at the City's expense unless the defect is a result of negligence or tampering by the customer. In this case the cost for repair or replacement shall be added to the service charge bill.
3. During the interim period prior to repair, the following procedure shall be enforced. The customer shall be given notice, by first-class mail, that the City suspects that the water meter is defective. The customer shall be given thirty (30) days in which to respond, which response shall include scheduling with the City an appointment for a meter inspection and replacement. If the customer fails to respond, the customer will be placed on the Base Water unmetered rate, effective with the following billing cycle.
4. The customer shall be given a second notice, by first-class mail, that the City suspects that the water meter is defective. The customer shall be given thirty (30) days in which to respond to the second notice, which response shall include scheduling an appointment for a meter inspection and replacement. If the customer fails to respond to the second notice, the City may disconnect the water service and charge the customer the base water rate and unmetered sewer rate while the service is disconnected. Service will be restored only upon payment of all fees and repair of the water meter.
5. Pressure Reducing Valve. A pressure-reducing valve (PRV) shall be installed in all service lines upstream of every water meter, ensuring that the water meter and the building plumbing system, including any fire sprinkler system, are protected from fluctuating water main pressures in areas required by the City. The pressure setting of the PRV shall not exceed 70 psi without written permission from the City.

1.16 WATER SYSTEM

The following general regulations shall apply to the City water system:

- A. Purpose. City water system is intended to provide potable water for municipal uses.

B. Regulation of Usage

Whenever there is a shortage of water, system operating failure, system repair or emergency, the Council shall have the power to regulate and curtail water usage.

C. Ownership of Water Facilities

For water, the City generally shall own and be responsible for the maintenance of the water service line up to and including the curb stop valve or the customer's property line or edge of easement, whichever is closer to the water main. The customer shall be responsible for the maintenance of the remaining portion of the service line serving his property. This principle of ownership shall not be changed by the fact that the City may construct, finance, pay for, repair, maintain, or otherwise affect the customer's service line.

1. Fire Hydrants

2. Purpose.

It is the express policy of the City that fire hydrants are for emergency use only by emergency personnel. No other connections shall be made to City fire hydrants without first obtaining a permit and paying applicable fees to the City. It is unlawful for any person to operate City valves or fire hydrants without prior written authorization by the City. Law enforcement officers, personnel of the City, or personnel of a fire department are authorized to confiscate any hydrant wrench or valve shut-off key found to be used without written City authorization. Any violation shall be considered "Unauthorized Use" and will be subject to all fines and fees therein.

3. Installation

Fire Hydrants may be installed on private water service lines subject to the following conditions:

- a. approval of the Council is obtained in writing; and
- b. the City has no obligation for repair and maintenance of the private fire hydrant.

4. Clearances Around Hydrants.

No landscaping, retaining walls, or buildings may obstruct the access to fire hydrants. Minimum clearances must be maintained around fire hydrants to facilitate their use. Customers are responsible to maintain a seven-foot (7') clearance on either side (where 2½" connectors are located), four-foot (4') clearance (including landscaping, retaining walls) on back, ten-foot (10') clearance in front (where steamer connection is located), and twenty-five-foot (25') clearance above all fire hydrants. The breakaway collar must be six inches (6") above the finished grade.

5. Fire Hydrant Meter.

Fire hydrant meters are allowed to be used by special permit. Only fire hydrant meters with backflow prevention are provided by the City to a customer for a special use. The City will specify what fire hydrant will be used and all water will be billed at City's bulk water rate unless a rate variance is approved by the City manager. Only City personnel are allowed to install and remove fire hydrant meters unless a written variance is issued. The customer will be subject to a penalty if he attempts to install or remove a fire hydrant meter. The customer is responsible for any damage, including vandalism or freezing, to fire hydrants or fire hydrant meters. The customer is responsible to provide adequate protection when freezing may occur. Fire hydrant water shall not be used for drinking purposes at any time without permission of the City. If the water is to be used for lawn irrigation or any use considered posing a hazard, the customer shall provide a backflow device.

1.17 SANITARY SEWER SYSTEM

The following general regulations shall apply to the City sanitary sewer system:

- A. Purpose. The City sanitary sewer system is intended to effectuate the treatment and disposal of water contaminated by biodegradable wastes and is not intended for receiving flood waters, surface drainages, industrial process waters or discharge or water from above ground or underground sources unless so contaminated.
- B. Ownership of Sewer Facilities. For sewer, the entire service line from the building to the main line is the property of the customer who shall remain responsible for its maintenance. This principle of ownership shall not be changed by the fact that the City may construct, finance, pay for, repair, maintain, or otherwise affect the customer's service line.
- C. Prohibited Sewer Connections.
 - 1. Drains. No connection of roof drains, exterior foundation drains, areaway drains, garage floor drains, or other sources of surface runoff or groundwater to a private sewer service line, building sewer or storm drain, which in turn is connected directly or indirectly to the City sewer system is permitted.
 - 2. Discharge Restrictions – General. Except as hereinafter provided, no person shall discharge, or cause to be discharged, to any interceptor, any waste prohibited by these Public Works Manual, or any harmful waters or wastes, whether liquid, solid, or gas, capable of causing obstruction to the flow in sewer lines, damage or hazard to structures, equipment or personnel of the sewage works; inhibiting the biological activity in the waste water treatment facilities; otherwise interfering with the proper operation of the sewage works; constituting a hazard through exposure to the City sewer effluent; or causing the City to be in violation of federal, state or local laws.
 - 3. Discharge Restrictions – Prohibited Wastes. No person or entity shall discharge or cause to be discharged into the City Sewer System the following wastes:
 - a. Water from storm drains, floor drains in garages, roof runoff, drainage collection systems, foundation drains, sumps, surface runoff, sub-surface drainage, or cooling processes.
 - b. Any oil, grease, or other similar petroleum product which is not water soluble. Such prohibited wastes shall include diluted wastes of such nature, including but not limited to, water or wastes containing grease, oil, hydrocarbons, fatty acids, soaps, fats, or waxes which exceed 50 mg/1 as determined by solvent (Freon) extraction.
 - c. Explosive materials, including but not limited to, gasoline, kerosene, naphtha, benzene, toluene, xylene, ethers, alcohols, ketones, aldehydes, peroxides, chlorates, perchlorates, bromates, carbides, hydrides and sulfides. Such limitation shall additionally include any waste capable of raising the Lower Explosive Limit (L.E.L.) of the ambient atmosphere in any sewer to five percent (5%) for any two (2) successive readings or to ten percent (10%) for any single reading on an explosion hazard meter.
 - d. Any solid or viscous substance in quantities or sizes capable of causing obstruction to the flow in the sewer lines or other interference with the proper operation or the City Sewer System, such as, but not limited to, ashes, cinders, sand, mud, straw, shavings, metal, glass, rags, feathers, tar, plastic, wood, unground garbage, whole blood, cattle manure, hair and fleshings, entrails, grit, brick, cement, onyx, carbide, and shredded or whole paper

- products other than tissue, toilet paper, and other products intended for toilet disposal.
- e. Any waste having a temperature higher than one hundred fifty (150°) degrees Fahrenheit (66°Celsius).
 - f. Any waste having a Ph value lower than 5.5 or greater than 9.0.
 - g. Any toxic substance, or substance requiring pretreatment, as those terms are defined in 40 Code of Federal Regulations §403, as amended from time to time, unless otherwise covered under this Section.
 - h. Any radioactive wastes or isotopes.
 - i. Any noxious or malodorous substance capable of creating a public nuisance.
 - j. Any wastes having a color concentration in excess of thirty (30) color units, based on the Platinum Cobalt Scale.
 - k. Any wastes having a flash point lower than one hundred eighty-seven degrees Fahrenheit (187°F) (86°C) as determined by the Tagliabue (Tag.) closed-cup method.
 - l. Any waste having a five (5) day Biochemical Oxygen Demand which may contain more than 1,000 parts per million by weight as averaged during any twelve (12) hour period.
 - m. Any wastes containing phenolic compounds over 5 mg/l expressed as phenol.
 - n. Any cyanides or compounds capable of liberating hydrogen cyanide in excess of 1 mg/l expressed as hydrogen cyanide from any individual outlet.
 - o. Any wastes containing sulfides over 3 mg/l expressed as hydrogen sulfide.
 - p. Any wastes containing toxic or poisonous substances having a twenty-four (24) hour proportionate composite sample concentration, at point of discharge, in excess of the following:
 - 1) Total Chromium as Cr 7.5 mg/l
 - 2) Copper as Cu 4.5 mg/l
 - 3) Nickel as Ni 15.0 mg/l
 - 4) Cadmium as Cd 1.2 mg/l
 - 5) Zinc as Zn 12.0 mg/l
 - 6) Iron as Fe 15.0 mg/l
 - 7) Lead as Pb 15.0 mg/l
 - 8) Arsenic as As 0.25 mg/l
 - 9) Manganese as Mn 0.25 mg/l
 - 10) Selenium as Se 0.05 mg/l
 - 11) Silver as Ag 0.25 mg/l
 - 12) Mercury as Hg 0.10 mg/l
 - q. Any waste that would cause a violation of the City's Discharge Permit. Any person or entity found to be discharging wastes prohibited by this section shall be fined ten thousand dollars (\$10,000.00) for each day such prohibited discharge continues and for each subsection violated, along with all other remedies available at law or equity, including damages, attorneys' fees and costs.
4. Sewer Tap Permit Provisions. The City Application for Connection Permit allows discharge into the City Sewer System, through a specified sewer tap, of sewage not otherwise restricted or prohibited by this Public Works Manual. Spot discharges of recreational vehicle wastes, portable toilet wastes, or any other wastes; and discharges of swimming pool water, must be specifically authorized by the Application for Connection Permit or other written permit.
5. Discharge Restrictions – Special Review. On written application from a customer, the Council may, at its discretion, review a request to discharge into the City Sewer System any waste otherwise prohibited under this section. Said written application

- shall include an analysis of the types, amounts, concentrations, and times of discharge of each prohibited waste, and an analysis of the impact of such discharge on the City Sewer System, including the City's sewer effluent. After consultation with the City Engineer, the City may allow discharge of the prohibited waste, provided such discharge does not violate, or cause the City to violate, federal, state, county or local laws.
6. If approved, the City may prescribe the times, places, concentrations, total amounts, fees and charges, and any other conditions under which such prohibited waste may be discharged. When necessary in the opinion of the City, the Customer shall provide, at his or her expense, such pretreatment facilities as may be necessary to treat such prohibited waste prior to discharge to the interceptor. Plans, specifications, and any other pertinent information relating to proposed pretreatment facilities shall be submitted for the approval of the City and of the State Board of Health, and no construction of such facilities shall be commenced until such approval is obtained in writing. Where pretreatment facilities are provided for any prohibited waste, they shall be maintained in continuously efficient operation by the Customer, at his or her own expense. When required by the City, the Customer served by a service line carrying prohibited wastes shall install and maintain, at his or her expense, a suitable control access hole in the service line to facilitate observation, sampling and measurement of the wastes. The access hole shall be installed by the customer and maintained at the customer's expense. In the event that no special access hole has been required, the control access hole shall be considered to be the nearest downstream access hole in the interceptor to the point at which the service line is connected. No foreign matter which could cause stoppage may be discharged from vehicle wash racks, filling stations, restaurants, or other building sewers as specified by the City shall be connected to any sewer service line unless the discharge first passes through an acceptable grease, sand and oil interceptor. Grease interceptors or sand/oil/gas interceptors of a design set forth in this Public Works Manual, shall be provided when, in the opinion of the City, or its designated representative, they are necessary for the proper handling of prohibited waste or liquid waste containing grease in an excessive amount, or any flammable wastes, sand, and other harmful ingredients. However, such interceptors shall not be required for dwelling units, unless such waste is generated by said units. Floor drains for automobile repair, automobile mechanics, tire repair, automobile painting, and automobile lubrication facilities shall be prohibited. The uses set forth in Section 1.17.3.6 shall require mandatory interceptors. Where installed, the interceptors shall be maintained by the Customer, at his or her expense, in continuously efficient operation at all times. The customer is required to provide testing and pumping records of all pumping activity of grease interceptors to the City whenever the pumping activity occurs.
 7. Mandatory Interceptors. The following uses shall be subject to special review by the City Engineer and required to install state-of-the-art interceptors.
 8. Food service establishment: Designs for all drainage systems for commercial establishments serving or preparing food shall be subject to review and written approval by the City Engineer. All food service establishment drainage systems shall include a state-of-the-art grease interceptor and shall be constructed in accordance with the technical specifications as set forth in this Public Works Manual.
 9. Car wash: Designs for all commercial car wash drainage systems shall be subject to review and written approval by the City Engineer. All commercial car wash drainage systems shall include a state-of-the-art sand/oil/gas interceptor and shall be subject to best management practices as required and approved by the City Engineer.

10. Manufacturing and Industrial Uses. Manufacturers and industries are prohibited from using the City sewer system unless they obtain a special permit from the City, the granting of which is discretionary, said permit defining the conditions, limitations, and restrictions, and the fees and charges determined by the City to be for the best interest of the City and its inhabitants. Each user which discharges any toxic pollutants which cause an increase in the cost of managing the effluent of the sludge of the City's treatment works shall pay for such increased costs.
11. Discharge from Swimming Pools. All swimming pools, hot tubs, whirlpool tubs, bath tubs and the like, having a capacity of 1,000 gallons or greater must be registered with the City by size and location. A permanent sign must be placed in the filter room or location at the drain control with instructions for draining the pool as follows: BEFORE DRAINING THIS POOL, CONTACT THE CITY WASTEWATER DEPARTMENT. The City Manager shall arrange a time for draining the pool into the City's sewer system between the hours of 11:00 p.m. and 6:00 a.m. Draining of pools at other times or without approval of the City Manager is prohibited.
12. Swimming Pool Acid Cleaning. If acid cleaning is used, the customer is subject to the increased cost of operation and a non-conforming discharge assessment to be determined by the City.

D. Use of Sewer Required

No sewage disposal system shall be constructed within the City unless it is connected with a City sewer main. Pursuant to *C.R.S. 32-1-1006(a)(1)*, the City can compel a property owner located within the City and within 400 feet of a sanitary sewer line to connect to the City's sanitary sewer system. If the City's sewer line is greater than 400 feet from the unit to be served, the City may grant specific authorization for an exemption, until such time as City sewer service is available within 400 feet of the unit to be served, and only if the following conditions are met:

1. Extension to the City's sewer system is impractical or unfeasible; and
2. A private disposal system is constructed meeting all State Health Department Standards and has been approved by the City Manager.

END OF SECTION

DIVISION 4



Division 4 Minimum Design Standards

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STREET STANDARDS

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SECTION 4.0 – MINIMUM DESIGN STANDARDS

STREETS

4.01 GENERAL

All curb, gutter, sidewalk and street design, rights-of-way and street widths shall conform to the minimum requirements of the City of Craig Standard Specifications and Drawings for Design and Construction and the City Subdivision Regulations. Definition of streets shall be as defined therein. Care shall be taken to insure continuity of grades, widths, etc., of proposed, existing and future installations. Private non-commercial streets and parking lots shall be built to these standards, including curbs, gutters and sidewalks, unless otherwise approved by the City Engineer.

4.02 GEOMETRICS AND GRADES

Street widths shall conform to City of Craig Standard Drawings. Streets having a percentage of grade along the centerline stationing equal to or greater than one (1) percent shall be designed with two (2) percent crown. Where percentages of grade along centerline stationing are less than one (1) percent, crown shall be increased to three (3) percent. Back of walk elevations shall be set equal on all streets. Where intersection is encountered in the design, the cross section of the street approaching another shall be transitioned (for seventy-five (75') feet) from a crown slope to a cross-slope condition, matching the intersecting streets flowline grade. In no case shall a flowline slope at an intersection.

The following shall be the maximum and minimum grades and minimum length of vertical curves for all street design. The City Engineer may permit deviations from these requirements when, in his judgment, terrain conditions are such that minimum or maximum grades as set forth are not feasible. Absolute minimum grade that may be considered by the City will be 0.5% and shall be carried in continuous intervals not to exceed 100 ft. as indicated by centerline stationing. Percentage of grade along the centerline through intersections shall not exceed five (5) percent. Centerline street profiles shall be extended for future construction, beyond the limits of the project being designed, for a distance of 1000 feet or to connect to an existing improved street, whichever is the lesser.

<u>Design Geometrics</u>	<u>Type of Street</u>	<u>Minor &</u>	<u>Unit</u>	<u>Local</u>	<u>Collector</u>	<u>Arterial</u>
Nominal Design Speed			MPH	20	20	35
Maximum Grade			%	10	8	6
Minimum Grade	(1)		%	1	1	1
Vertical Curve @ Crest	(1) (2) K		25	50	100	
Vertical Curve @ Sag	(1) (2) K		35	50	80	
Centerline Radius	(1)		Ft.	100	175	350
Sight Distance – Stopping	(1) (3) Ft.		200	250	375	
Sight Distance – Intersection	(1) (4) Ft.		300	350	450	
Tangent Section between Reverse Curves	(1)		Ft.	50	150	150

1. All values are minimums.
2. Length of vertical curve $L=KA$, A= Algebraic difference in grade.

3. Measured from height of eye 3.75 ft. to a height of six (6) inches on pavement.
4. Measured from a point on the minor road at least 15 ft. from the edge of the major road pavement and measured from a height of eye of 3.75 ft. to a height of object of 4.5 ft. on the major road.

4.03 STREET DESIGN

Construction of streets shall conform with the following design standards and regulations:

- A. The street pattern shall conform to any transportation plan or comprehensive plan adopted by the City Council and shall afford safe and convenient access to all lots within the subdivision.
- B. Streets shall be designed to join with planned or existing streets.
 1. Intersections of streets shall be at right angles unless otherwise approved by the Planning and Zoning Commission and the City Engineer.
 2. No more than two streets shall intersect at one point.
 3. Two local streets meeting a third street from opposite sides shall meet at the same point, or their centerlines shall be offset at least one hundred feet (100').
 4. Arterial or collector streets meeting a third street from opposite sides shall meet at the same point, or their centerlines shall be offset at least one hundred feet (100').
 5. The City Engineer may approve exceptions to the provisions of this subsection in extraordinary circumstances where safety is not compromised.
- C. Streets shall have the names of existing streets which are aligned in the City, or as specified by the City of Craig Public Works Manual.
- D. Streets which are an extension of existing or platted streets shall bear the same classification as that assigned to the existing or platted street in any adopted transportation or comprehensive plan, and shall conform to any special standards pertaining to such classifications.
- E. Local residential streets shall be laid out to discourage through traffic, and where a proposed subdivision borders on or includes a street designated arterial intersections of proposed streets with such arterial shall be held to a minimum. Lots bordering arterial roadways may be either reverse facing on an interior street within the subdivision, or served by a frontage road.
- F. Streets shall be designed to bear a logical relationship to the existing topography.
- G. Dead end streets shall not be permitted. A street may end in a permanent cul-de-sac providing that the street is not longer than six hundred sixty feet (660') and that the radius of the turning areas be at least forty-five feet (45') to the curb, and fifty feet (50') to the edge of the right-of-way. Adequate space shall be provided for plowed snow storage by providing a T-shaped turnaround with a minimum turning radius of fifty feet (50') for a residential development and seventy-five (75') for commercial or industrial developments where tractor-trailer trucks will be using the street.
- H. All subdivision streets shall comply with the "Recommended right-of-way Cross-Sections" which may be adopted and amended from time to time by resolution of the City Council.

Streets, alleys, rights-of-way, sidewalks and easements shall comply with all federal and state specifications, and in addition, shall meet the following minimum width standards:

1. Arterial streets shall have a minimum right-of-way of one hundred feet (100'). The minimum paved portion to the street measured from flow line to flow line shall be sixty-four feet (64');
2. Collector streets shall have a minimum right-of-way of seventy-five (75'), with a minimum paved portion and measured from flow line to flow line, of forty-seven feet (47');
3. Local residential streets shall have a minimum right-of-way of fifty feet (50'), with a minimum paved portion of thirty-six feet (36'), measured from flow line to flow line;
4. Alleys (where permitted), twenty feet (20').
5. Crosswalk easements, ten feet (10').
6. Drainage easements, ten feet (10'), or larger if so required by the City Engineer.
7. Half-streets shall not be permitted, except when required to complete a half street already in existence;
8. Where a street classified as arterial intersects with any other arterial street, no on-street parking shall be allowed on the arterial street within thirty feet (30') of the intersection. If the arterial street consists over its general length of only two traffic lanes, then a third lane shall be provided and stripes painted to the specifications of the City Engineer to enable vehicles to make left turns at such intersections without impeding other traffic;
9. All utilities shall be installed before streets or alleys are surfaced;
10. Subdivision as-builts shall show dedicated right-of-way;
11. All sewer and water utilities to clearly show:

4.04 ALLEYS AND EASEMENTS

Paved alleys may be provided and shall be required unless other provisions are made and approved for service access. Easements for utility purposes shall be required along all sides and real lot lines. Drainage easements shall be designed to accommodate expected runoff and shall comply with the provisions of the City of Craig Public Works Manual.

4.05 STREET IMPROVEMENTS

All street improvements described in the City of Craig Public Works Manual are the financial responsibility of the subdivider, subject to the provisions of the City of Craig Public Works Manual, unless specifically exempted through written agreement with the City Council. All streets and alleys proposed for dedication to the public shall be laid out, graded and paved from curb to curb, and painted to the specifications to the City. Curb and gutter and sidewalks shall be installed on all streets unless special circumstances warrant the City Council to specifically waive installation in writing. In cases where a previously existing street which has not been brought up to City specifications is located within a subdivision, such street shall be paved with curb and gutter; sidewalk and other improvements shall be installed in order to meet City specifications. If any subdivision is located adjacent to any existing street right-of-way, the subdivider shall provide such street with improvements as required to bring such street up to City specifications. The subdivider shall provide and install street signs to all street intersections and also traffic control signs as requested by the City Council through their designated representatives, or shall reimburse the City for their initial installation. Permanent reference monuments and monument boxes shall be installed by the subdivider to City specifications, as shall bicycle paths where they are required by City regulations. Streetlights when required by City regulations shall be installed.

4.06 CURBS, GUTTERS, SIDEWALKS AND CROSSPANS

All curbs, gutters, sidewalks and crosspans shall conform to the City of Craig Standard Drawings. Standard combination curb, gutter and sidewalk sections shall be six and a half foot (6'6") wide in locations noted as follows:

- A. On individual streets where the obsolete section exists intermittently along 50% of the total frontage of both sides of the street, or where it is reasonable and practical to continue the obsolete section as determined by the City Engineer. (Intermittently shall be interpreted to mean at least three (3) different sections with at least one (1) section on each side of the street).
- B. Where obsolete sections exist to boundary of earlier subdivision; this section shall be continued in new subdivision to first radius point.
- C. Where existing obsolete section is being replaced.
- D. Sidewalks are required on both sides of all streets and shall be at least five feet (5') wide in residential areas and eight feet (8') wide in commercial areas. All streets shall have vertical curb and gutter and attached sidewalk. In residential areas, sub arterial streets shall have a vertical curb and detached sidewalk at least five feet (5') in width separated from the curb by a minimum of four and one-half feet (4 1/2'). Design of streets in commercial and industrial areas shall be approved by the Planning and Zoning Commission.
 - 1. Construction of sidewalks shall be to specifications set by the City Council through their designated representatives
 - 2. All sidewalks shall be ramped to meet ADA standards at all street intersections or other pedestrian crossing areas.

4.0.7 UTILITIES

All house service lines, main lines, etc., shall be installed according to City of Craig Standard Specifications prior to paving of any street.

4.0.8 DRAINAGE

All streets shall be designed to provide continuous surface drainage directed to storm drain inlets and drainage courses. Grades shall permit flow without ponding. Eight (8) feet concrete crosspans shall normally be installed across those streets at intersections carrying traffic, which must stop. Installation of pans between intersections or across streets carrying through traffic at intersections shall be avoided in all possible cases. A check shall be made to be sure of continuity of drainage design between the proposed construction and existing of future construction. In no case shall surface drainage be permitted to be disposed of overland except by approved storm drainage facilities

4.0.9 FLEXIBLE PAVEMENTS

Flexible pavement shall consist of deep strength asphaltic concrete or a combination of asphaltic concrete and granular base course. Pavement thickness shall be determined by use of underlying soil group index values. These values shall be determined by recognized soils testing laboratories under direction of professional engineers. Samples for group index

value determinations shall be taken between gutter lip lines of proposed streets at 300-foot intervals for all new streets. Where the length of the proposed new street is less than 300 feet, two (2) group index determinations shall be made. Test results shall be interpreted in such a manner as to insure adequate pavement thickness in all cases. Where testing indicates maximum average group index values less than 4.0, deep strength thickness shall be taken as six (6) inch minimum for collector and four inch (4") minimum for local streets. Minimum thickness of base and asphaltic pavement combinations shall be three (3) inch asphaltic concrete, twelve (12) inch pit run and six (6) inch road base for collector and local streets respectively. Where group index values exceed 4.0, pavement thickness shall be determined from standard drawing. Where appreciable changes in group index values occur for different streets throughout a subdivision, thickness may vary but thickness shall remain constant throughout each street.

END OF SECTION

SECTION 4.1
CONSTRUCTION MATERIALS AND METHODS
STREETS

4.1.1 GENERAL

Curb, gutter, crosspans, sidewalk, ramps, driveway access, street surfacing and/or rejuvenation of asphaltic surface in public right-of-way under the jurisdiction of the City, shall be installed in accordance with approved engineered plans, these Specifications and the General Conditions of the Public Works Manual of the City of Craig.

Requirements for site preparation, care of topsoil, excavation, embankment and treatment of cut areas are covered in Section 4.3 of these Standard Specifications.

The contractor shall obtain a street cut permit and notify the engineer in writing, twenty-four (24) hours before the planned construction is to commence or when work is to be resumed following a delay.

The City shall perform all required asphalt paving of City streets per ordinance 578.

4.1.2 MATERIALS

Materials that are to be manufactured, processed, furnished and installed in street subgrades and finished surfaces shall conform to the minimum standards hereinafter referred to.

Specifications for materials as set forth by the American Society for Testing Materials (ASTM), the American Association of State Highway Testing Officials (AASHTO) and the Colorado Department of Transportation (CDOT) are made a part of these specifications. Referenced standards are considered to be the latest edition and revisions thereof.

4.1.3 CONCRETE

Class "A" concrete, as set forth in Part 2 Section 9 of these Standard Specifications, shall be used in the construction of curbs, gutters, sidewalks and cross pans.

4.1.4 BORROW

Loose friable soil reasonably free of refuse, stumps, roots and rocks. The maximum dimension of any rocks placed in fills shall not exceed two-thirds of the depth of lift being placed or twelve (12) inches, whichever is the lesser.

4.1.5 AGGREGATES FOR SUBBASE, BASE COURSE AND SURFACE COURSES

Aggregate and soil aggregate meeting the gradation hereinafter specified which have a plastic index not to exceed six (6), when tested in accordance with AASHTO T89 and T90 respectively, shall conform to the quality requirements of AASHTO M-147 except as modified below.

A. SELECT SUBBASE

Sieve Designation	% by weight passing 2/3 (depth of lift) 100
Characteristics	Retained on #10-LA abrasion-(not applicable)
Characteristics	Passing #4 – L.L. 30 max.

B. BASE COURSE

<u>Sieve Designation</u>	<u>% by weight passing</u>	
	<u>Class 5</u>	<u>Class 6</u>
2 1/2"		
2"		
1 1/2"	100	
1"	95-100	
3/4"		100
#4	30-70	30-65
*8		25-55
#200	3-15	3-12
L.A. Abrasion	50 max	50 max
Liquid Limit	30 max	30 max
Plastic Index	6 max	6 max

Recycled concrete meeting the above requirements can be substituted.

A. HOT PLANT MIX ;PAVEMENT AGGREGATE

	<u>% by weight passing</u>	
<u>Grading S (2)</u>	<u>Grading SX (2)</u>	<u>Application</u>
<u>Sieve Designation</u>	<u>Surfacing</u>	<u>Overlay</u>
1"	100	
3/4"	90-100	
1/2"		90-100
3/8"		
#4	(1)	(1)
#8	23-49	28-58
#3		
#200	2-8	2-10

1. 50% of the aggregate by weight retained on the #4 sieve shall have at least two (2) fractured faces when tested in accordance with Colorado Department of Transportation Procedure 45.
2. Aggregates shall have a percentage of wear, when tested in accordance with AASHTO T-96, of not more than forty-five (45).

4.1.6 CHIP SEAL COAT COVER AGGREGATES

Aggregates for cover coat material shall be 100% crushed stone, crushed slag, crushed gravel, or natural gravel conforming to the following requirements:

- A. % of wear, Los Angeles Test (AASHTO T-96), not more than 35.
- B. 100% of the gravel by weight retained on the No. 4 sieve shall have at least two (2) fractured faces.
- C. When tested in accordance with AASHTO T-182, aggregate shall have a retained bituminous film above 95%.
- D. Meet the following gradations:

<u>Sieve Designation</u>	% by weight passing		<u>Application lbs / sq.yd.</u>
	<u>Type II</u>	<u>Type III</u>	
1/2"	100	100	
3/8"	60-100	60-100	
#4	0-15	0-30	
#200	0-01	0-1	20-25

4.1.11 BITUMINOUS MATERIALS

Asphaltic cements shall conform to the requirements of AASHTO M 320 and liquid asphalt materials shall conform to the requirements of AASHTO M-81, M-82 and ASTM D-2026 for the designated types and grades

Emulsified asphalt shall conform to AASHTO M-140 and M-208 for the designated types and grade.

Asphalt rejuvenating agents shall be composed of a petroleum resin-oil base uniformly emulsified with water and shall conform to the quality requirements of the Colorado Department of Transportation.

- A. Prime Coat shall be MC-70 bitumen applied at the rate of 0.25 – 0.25 gal/sq.yd. of surface area.
- B. Cement shall be PG58-28, or as stated in the contract. incorporated with hot plant mix pavement aggregate at the rate determined by a Mix design prepared by a Professional Engineer meeting the requirements of Section 401 of the Colorado Department of Transportation Current Standard Specifications.
- C. Tack Coat shall consist of one (1) part Grade CSS-1h emulsion conforming to AASHTO M-208 and one (1) part water, applied at the rate of not more than 0.1 gal/sq.yd. of surface area.
- D. Seal Coat shall be a cationic rubberized or polymerized asphalt emulsion.
- E. CRS-2P or HFRS-100S when applied at the rate of 0.30 – 0.35 gal/sq.yd. of surface area are considered as meeting this specification.

4.1.12 GEOGRID

4.1.13 GEOTEXTILE FABRIC

Geotextile fabric to be in accordance with Section 712.08 of the latest revisions to the Colorado Division of Transportation Standard Specifications for Road and Bridge Construction.

4.1.14 CONSTRUCTION PRACTICES

All work in public rights-of-way shall be constructed to the lines and grades called for on City approved plans. Stakes to control the work shall be set in the field by survey parties working under the supervision of a registered land surveyor. City survey crews will establish the control for City projects and controls established by developers are subject to checking by City crews.

Bituminous materials and aggregates conforming to the material section of these specifications, shall be blended to the proportions of the job mix formula, spread, finished and compacted in place, utilizing equipment and procedure methods as set forth in Sections 401.01 through 401.20 of the Colorado Department of Transportation Standard Specifications and these specifications.

4.1.15 SITE PREPARATION, EXCAVATION, AND EMBANKMENT

(See Section 4.3 of this public works manual).

4.1.16 CURB, GUTTERS, SIDEWALKS AND CROSSPANS

All curbs, gutters, crosspans, sidewalks, walk ramps and driveways shall be cast in place to conform to the dimensions and contain the reinforcing called for by the City of Craig Standard Detail Drawings. Preparation of subgrade shall be in accordance with the requirements of Section 4.3 of these Standard Specifications. Forming, concrete placing, finishing and cutting shall conform with the requirements set forth in Section 4.3.

Crosspans, curb return wings, driveways, walk ramps and sidewalks shall have a concrete thickness of not less than six (6) inches. Detached sidewalks that are not subjected to vehicular traffic shall have a minimum concrete thickness of four (4) inches. Crosspans and curb return wings shall be reinforced with #4 rebar at 2 foot centers in both directions as called for in the Standard Drawings.

Where curbs and gutters are adjacent to and constructed in conjunction with sidewalks, the concrete shall be placed simultaneously on a compacted subgrade. Monolithic concrete so placed, as in all slabs on grade, shall be divided into ten (10) foot sections by dummy joints formed with a jointing tool. Dummy joints shall extend into the concrete for a depth of not less than ¼ of the slab concrete depth and shall be approximately 1/8" in width.

Premolded expansion joint filler ¼" to ½" in thickness that extends for the full depth of the concrete shall be installed between all, concrete sidewalks, driveways, and any fixed structures or appurtenances such as manholes, utility poles, etc.

Back of curbs and edges of sidewalks shall be backfilled and shaped to drain after the forms have been removed. Areas between Property lines and back of sidewalk or curbs shall be shaped and uniformly graded.

4.1.18 AGGREGATE BASE COURSE

Base course shall be placed and compacted in four (4) inch to six (6) inch layers on a prepared subgrade surface in conformity with the lines, grades and typical cross sections shown on the plans.

Each layer shall be densified to ninety-five (95) percent of the Modified Proctor when tested in accordance with AASHTO T-180. Water shall be uniformly applied during compaction so as to achieve proper consolidation.

The prepared surface, ready to receive the surface course shall be uniformly graded to design elevation so when tested with a ten (10) foot straight edge the variation above or below the testing edge, between any two (2) contact points with the surface, shall not exceed $\frac{1}{2}$ " for Class 1 or $\frac{1}{4}$ " for Class 5 or Class 6 base course. Areas that do not conform with these tolerances shall be reworked.

4.1.19 ASPHALTIC CONCRETE JOB MIX FORMULA

The job mix formula developed in conformance with by the Colorado Department of Transportation Standard Specifications on the aggregates to be incorporated in the asphaltic concrete surface must be submitted to the City of Craig Public Works Director for approval prior to commencing the work.

Hot plant mix surfacing material using aggregates from sources that have not been tested, for the purpose of developing a job mix formula, within nine (9) months prior to the date of intended delivery will be rejected.

The job mix formula with allowable tolerances shall be within the master range specified in the material section of these specifications.

4.1.20 MANHOLE AND UTILITY BOX ADJUSTMENTS

Manholes, valve and survey range boxes shall be adjusted to $\pm 3/8$ " of finish grade after the surface course of asphalt is placed. The contractor shall remove all foreign matter found or introduced into them in the performance of his work, and it shall be his responsibility to insure proper compaction around same after they have been adjusted.

On streets that are being sealed, the contractor shall cover the manhole and valve covers with a roofing paper or other suitable material prior to sealing. The covering shall be left in place for a minimum of forty-eight (48) hours after which it shall be removed and disposed of. All covers shall be clean when work is complete.

On streets that are being overlaid with asphaltic concrete the contractor shall adjust the valve boxes and manhole lids by adding riser rings.

4.1.21 BITUMINOUS PRIME OR TACK COATING

Compacted subbase material, in place and shaped to subgrade elevation, shall be primed or tacked to the limits specified in the Special Conditions or at the rates stated in Guidelines for Design and use of Asphalt Pavements for Colorado Roadways.

Bituminous materials shall be applied to the width of the section to be coated by means of pressure distributions in a uniform and continuous spread. Care shall be taken that the application of bituminous material at any point, especially at the junction of spreads, is not in excess of the specified amount. Coatings shall not be applied when the surface is wet or when the temperature is below fifty (50) degrees Fahrenheit.

Coatings shall be applied in such a manner as to offer the least inconvenience to traffic and to permit one-way traffic without pickup or tracking of the bituminous material.

4.1.22 BLOTTING

If after the application of the prime coat or rejuvenating agent, the bituminous material fails to penetrate or if chip and seal applications bleed, approved blotter material shall be spread in the amounts required to absorb any excess bituminous material.

4.1.23 FLEXIBLE PAVEMENT

Hot plant mix asphaltic concrete shall be prepared and mixed to the proportions of the Colorado Department of Transportation job mix formula for the aggregate source, in accordance with Section 401.13 through 401.15 of the CDOT Standard Specifications.

Hot plant mix asphaltic concrete shall be placed only on properly prepared or constructed and accepted subgrades that are free of water, snow or ice. Contact surfaces of curbs, gutters, manholes and other structures shall be tack coated with a thin uniform coating of RC of SS-IH bituminous material prior to placing asphaltic concrete adjacent thereto.

Asphaltic concrete, to provide in place compacted thickness of four (4) inches or less, shall be placed and struck off by means of bituminous pavers. Use of spreader boxes to place the bituminous mixtures shall be limited to asphaltic sidewalks or trails, trench patching and the bulbs of cul-de-sacs. Black base bituminous mixtures, whose in place compacted thickness is to be greater than four (4) inches and less than seven and one half (7 ½) inches, may be uniformly spread using a patrol. In areas where irregularities or unavoidable obstacles make the use of mechanical spreading and finishing equipment impracticable, the mixture shall be spread, raked and luted by hand tools. For such areas the mixture shall be dumped, spread and screeded to give the required compacted thickness.

Along the lip lines of gutters and crossspans sufficient bituminous material shall be deposited so that, after compacting, the wearing surface will remain not less than 1/4" nor more than 1/2" above the concrete when compacted to a catch curb. For median or spill curb wearing surface will be from 1/8" to 1/4" below concrete.

Longitudinal joints in the wearing surface layer shall be hand luted and provide a uniform transition, after compacting, between passes with the paving machine. They shall also be positioned such that they will overlay any sublayer longitudinal joint by six (6) inches. Longitudinal joints in the wearing surface shall be generally located as follows:

- A. For two lane roadways – at the center line of the pavement and at the outside edge of the traveled lanes.

- B. For roadways of more than two lanes – at the lane lines and at the outside edge of the travel lanes.

The bituminous mixtures shall be placed within the air temperatures limitation designated herein below and only with the weather conditions otherwise permit the pavement to be properly placed and finished.

PLACEMENT TEMPERATURE LIMITATIONS

<u>MINIMUM COMPACTED LAYER THICKNESS</u>	<u>WEARING SURFACE MINIMUM PLACEMENT AIR & SURFACE TEMPERATURE</u>	<u>BLACK BASE MINIMUM PLACEMENT AIR & SURFACE TEMPERATURE</u>
1" or less	60 degrees Fahrenheit	50 degrees Fahrenheit
>1" to 3"	50 degrees Fahrenheit	40 degrees Fahrenheit
>3"		30 degrees Fahrenheit

Asphaltic concrete shall be handled and placed on the prepared subgrade in such a manner as to minimize segregation. All segregated areas behind the pavers shall be removed immediately upon discovery and replaced at contractor's expense, with specification material before the initial rolling. If more than fifty (50) square feet of segregated material is ordered removed and replaced in any 500 linear feet of paver width laydown, paving operations shall be discontinued until the source of the segregation has been found and corrected.

After the asphaltic concrete has been spread, struck off and surface irregularities adjusted, it shall be thoroughly and uniformly compacted by rolling. Rolling of the surface shall begin as soon after spreading as rolling will not cause undue displacement cracking or shoving of the mixture. Rolling shall start at the sides and proceed longitudinally parallel with the street center line, each trip overlapping one-half (1/2) of the roller width, gradually progressing to the crown of the street. Rolling shall be continued until all roller marks are eliminated and a minimum density of change to match CDOT specs for superpave mix designs of a laboratory specimen made in the proportions of the job mix formula has been obtained.

On lifts of asphaltic concrete three (3) inches or more in thickness breakdown rolling shall immediately follow the spreading sequence using rubber tired rollers, free of recapped tires, followed by steel wheel rolling. Field density determinations will be made in accordance with Colorado Procedure #44 and #81.

Variation between any two (2) contacts with the surface shall not exceed 3/16" in ten (10) feet. All lumps or depressions exceeding the specified tolerance shall be corrected by removing defective work and replacing it with new material as directed.

4.1.24 PARKING LOTS, TRAILS AND WALKWAYS

Subgrades for parking lots, bicycle trails and walkways shall have all vegetation removed, subgrade shaped, compacted and the soils then sterilized prior to installing base course and/or asphaltic concrete to prevent plant growth.

Asphaltic concrete Grading S or SX shall be placed and compacted to a minimum compacted thickness of four (4) inches for bicycle trails and walkways, and a density of match superpave mix requirements of a laboratory specimen made in proportion to the job

mix formula. Compaction shall be uniform and accomplished by means of City approved power rollers and/or hand tamping. Only in areas inaccessible to rollers will hand tamping be permitted. Asphalt thickness for parking lots shall be as called for in the plans.

4.1.25 STREET PATCHING

Areas in streets designated to be patched shall have the broken asphalt and subgrade materials removed to a depth of six (6) inches and disposed of. The patch subgrade shall then be stabilized with 1.5-inch rock as directed or compacted and fine graded. The perimeter of the patch area shall be trued to vertical uniform line and then tack coated with a thin uniform coating of RC or SS-IH bituminous material prior to placing and compacting asphaltic concrete adjacent thereto and therein.

4.1.27 GEOGRID – SUBGRADE STABILIZATION

Subgrades to be geogrid stabilized shall be cleared of all vegetation or topsoil and then proof rolled to determine local soft spots, observe deflections, rutting and/or pumping. Areas so identified shall be excavated and the void thus created shall be refilled with approved granular material and again proof rolled and shaped, as directed in the field by the City Representative.

Sections of specified geogrid shall then be rolled to cover the subgrade, cut and trimmed to clean manholes and valve boxes by one foot while providing a minimum roll overlap of one and one-half feet along the seams. On areas that cannot be covered and properly overlapped with two rolls of geogrid; installation shall commence along the perimeter edges and proceed towards the center of the area making sure the minimum overlap along seams is obtained. Seams between rolls shall be anchored or tied together with wire, polyethylene braid, or stakes driven through the apertures of overlap, on ten (10) foot centers.

Select granular fill materials shall then be end dumped adjacent to the exposed geogrid and then advanced to cover the geogrid in a minimum five (5) inch lift using a front end loader or dozer. At no time shall the equipment, advancing the fill cover, be in direct contact with the geogrid.

After the initial five (5") inch granular cover lift is placed, the entire lift shall be proof rolled. Rutted and settlements that develop shall be filled with additional select material. Proof rolling and adding of select materials shall continue until the entire geogrid is in tension, the area being stabilized is to the plan designated elevation of cover material, or as directed.

4.1.28 GEOTEXTILE FABRIC PAVEMENT SYSTEMS

Base course and soil subgrades shall be shaped and compacted to grade in preparation for placement of geotextile fabric. Previously asphalted surfaces shall have all holes and soft spots patched with Colorado Department of Transportation Grading C hot bituminous asphalt. Existing cracks narrower than 3/8 inch in width shall be filled with a liquid asphalt cement. Cracks larger than 3/8 inch shall be filled with an approved asphalt filler. After patching and filling the existing asphalt surface shall have all dirt, water and grease removed there from. When required, truing or leveling courses of asphalt shall be in place prior to installation of the fabric.

The approved surface to be overlaid shall then be given a tack coat of PG 58- 28 asphalt cement, applied at the rate of 0.20 to 0.25 gallons per square yard, and immediately covered thereafter with the geotextile fabric.

Laydown of the fabric shall be performed such that there are no wrinkles and the overlap between rolls is between two (2) and six (6) inches. Where wrinkles occur, the fabric shall be cut and laid flat. Corrected wrinkle areas and seams between rolls shall be retacked with asphalt cement to insure fabric saturation.

Fabric shall be installed to within zero (0) to six (6) inches of gutter lip lines or crossspans with a minimum of two inches (2") of asphalt. If pavement is not milled, fabric shall be installed to eighteen inches (18") within curb line. Around manholes, valve boxes, vaults, etc. the fabric shall be neat line trimmed and cut so as to clear the intrusion by one (1) foot.

Immediately after the fabric is in place, asphalt overlay paving shall commence. The minimum compacted thickness of asphalt overlay pavement, installed over a geotextile fabric, shall be 1 ½ inches. Use of fabric at locations where a potential for shoving exists, such as turning lanes and stopping intersections, is not recommended.

4.1.29 COLD MILLING, ASPHALT SURFACES

All valve boxes, manhole rings and covers within the area to be cold milled shall be lowered sufficiently to clear the milling operation, and then raised to within 3/8 inch of the resurfaced finished grade. Electric and phone vaults shall not be lowered, but shall be protected from damage during the performance of the work.

Cold milling shall be performed using mechanical equipment capable of uniformly routing materials while providing a uniform milled level or tapered surface, varying between 6 ½ to 8 feet wide and zero to 2 ½ inches in depth, per pass. Milled edges shall be vertical and true with the alignment of each pass of the equipment.

Electric and phone manholes and vaults are to be left with gradual asphalt tapered approaches in alignment with traffic flow, when resurfacing will not immediately follow the milling operation. Such approaches left to facilitate traffic adjacent to vaults, crossspans, utility manholes, structures, etc. shall be milled out or removed by other acceptable means, immediately preceding the resurfacing operation. Leaving of abrupt vertical edges that will impede traffic will not be allowed.

Where milling is required along and parallel with concrete gutters the router shall be set to provide a uniform tapered slope. The slope shall vary from two (2) inches below the gutter lip line to daylight with the existing asphalt surface, 6 ½ to 8 feet from and perpendicular to the gutter flow line.

Material recovered during the milling operation shall be disposed of by the contractor at his expense, unless otherwise directed.

Unless otherwise approved, milling and resurfacing shall be performed simultaneously such that both operations are completed during the same day.

4.1.30 OVERLAY SURFACE TREATMENT

Surfaces designated for asphaltic concrete overlay treatment shall have all soft areas removed and asphaltic concrete compacted in the void thus created. All cracks shall be sealed and low spots brought to grade with a leveling course of asphaltic concrete. The entire area shall be free of water and broom cleaned prior to commencing the leveling and/or overlay operation.

Cleaned areas to be leveled shall be tack coated, at the rate of 0.10 gallon per square yard with a 1:1 diluted CsS-1h emulsified asphalt. The tacked surface shall then be brought to grade by blade spreading or box laying and rolling therein, Colorado Department of Transportation Grading SX hot bituminous asphalt concrete.

Areas prepared for overlay shall be tack coated as specified above, for the leveling course. However, when a geotextile fabric is to be installed, the surface shall be tack coated with PG58-28 asphaltic concrete, applied at the rate recommended by the supplier.

Plant mix asphaltic concrete conforming to the Colorado Department of Transportation Grading SX shall be placed to an average compacted yield of 1 ½", or as directed over the tacked area. Plant mix asphaltic concrete shall be installed in accordance with the requirement set forth herein for flexible pavement. Except the compacted finished grade of asphaltic concrete at gutter lip line may not exceed the lip line elevation by more than one inch.

END OF SECTION

SECTION 4.2
CONSTRUCTION MATERIALS AND METHODS
CONCRETE

4.2.1 GENERAL

All concrete and reinforcing placed in structures that are considered as capital improvements to the City of Craig shall conform to approved engineered plans and these specifications.

Specifications of the American Society for Testing Materials (ASTM), detailed recommendations for acceptable practices set forth by the American Concrete Institute (ACI) and the Concrete Reinforcing Steel Institute (CRSI) are made a part of these specifications.

The contractor, through his fabricator, shall prepare and submit shop drawings showing all dimensions for fabrication and placing of the reinforcing steel, form work and accessories for review and approval before fabrication, when called for in the Special Conditions.

4.2.2 MATERIALS

Materials that are to be incorporated in the structure shall conform to the minimum standards hereinafter referred to, unless otherwise approved.

4.2.3 CEMENT

- B. Portland Cement, conforming to the requirements of ASTM C-150 Type I or II.
- C. Chemcomp, expansive shrinkage compensating cement, as manufactured by Texas Industries, Inc., or equal product licensed by and conforming to the requirements of the Chemical Prestressed Concrete Corp. (CPCC).

Admixtures

- D. Air Entraining Agent conforming to the requirements of ASTM C-260, Protex R03300-3, or approved equal.
- E. Water Reducing Agent conforming to the requirements of ASTM C-494, Master Builders Pozzoloth, or approved equal. No accelerators or admixtures containing chlorides will be permitted.
- F. Retarding Agent conforming to the requirements of ASTM C-494, Type B, Master Builders MB-HC, or approved equal. If Type D is used, adjust mixture of water reducing agent.

Lignin type retarders will not be permitted.

- G. Coloring Agent, when called for in the Special Conditions, shall conform to:
 - 1. Dry Shake Type, W.R. Grace & Co. Colorundum, or approved equal. Master Builders Colorcron will not be permitted.

2. Mix Dry type, W.R. Grace & Co. Staybrite, Master Builders Colormix, or approved equal.
- H. Fibrous Concrete Reinforcement: 1.5 lbs./cy o 100% virgin polypropylene fibrillated fibers, as manufactured by Fibermesh Co., Chattanooga, Tennessee, or approved equal, shall be plant batched into the mix when called for in the Special Conditions.
 1. Water – Potable, nonalkaline water devoid of salts and other injurious elements for concrete mixing shall be used.

4.2.4 AGGREGATES

- A. General: All fine and course aggregates shall conform to the following specifications:

Concrete Aggregate	ASTM C-33
Unit Weight of Aggregates	ASTM C-29
Organic Impurities Colormetric	ASTM C-40
Soundness of Aggregate by Sodium Sulfate	ASTM C-88
Sieve Analysis	ASTM C-29

- B. Gradation: Fine and course aggregates are regarded as separate ingredients and each shall be well graded between the limits as shown in the following chart:

Percentage Passing Designated Sieves and Nominal Size Designation

<u>Sieve Size</u>	<u>#467</u> <u>1 1/2" to #4</u>	<u>COURSE</u> <u>#57</u> <u>1" to #4</u>	<u>#67</u> <u>3" to #4</u>	<u>FINE</u> <u>AASO-M6</u> <u>#4 to #100</u>
2"	100			
1 1/2"	95-100	100		
1"		95-100	100	
3/4"	35-70		90-100	
1/2"		25-60		
3/8"	10-30		20-55	100
#4	0-5	0-10	0-10	95-100
#16		0-5	0-5	45-80
#50				10-30
#100				2-10

4.2.5 REINFORCING STEEL

- A. Bar Steel shall be round bars conforming to ASTM A-615, Grade 60, except #5 or smaller bars may be Grade 40 or 60 as shown on drawings, and deformed in accordance with the requirements of ASTM A-305.
- B. Dowels for Slabs on Grade at joints where indicated shall be hot rolled merchant bars conforming to ASTM A-151, C-1020.
- C. Miscellaneous Reinforcement not covered above must conform with the requirements of ACI-315 and ACI-318.

4.2.6 JOINT MATERIALS

- A. Non-extruding and resilient non-bituminous type conforming to ASTM D1752 or resin-impregnated fiberboard having the Physical requirements of ASTM D-1752, in widths shown or 3/8" where not shown, shall be used where joint sealers are indicated. Materials shall be Darasel-U fiberboard filler as manufactured by W.R. Grace & Co. or equal. Filler material containing asphalt or tar will not be allowed.
- B. Non-extruding and resilient bituminous type conforming to ASTM D-1751 shall be used for concrete paving and structural construction where joint sealers are not called for.
- C. Portland cement concrete pavement joints shall be sealed in accordance with the Colorado Department of Transportation (CDOT) specifications.

4.2.7 CURING COMPOUNDS

Curing Compounds where allowed shall conform to ASTM C-309.

4.2.8 PROPORTIONING INGREDIENTS

Concrete ingredients shall be proportioned so as to provide concrete which is workable and homogeneous, yet when hardened it will provide the required strength, durability, resistance to deterioration, abrasion, water tightness, appearance and other specified properties.

4.2.9 CLASS "A" CONCRETE

Concrete shall have a maximum allowable water cement ratio of 0.50 by weight. The fine aggregate shall be between 345 and 38% by volume of the total aggregates and the end product shall have a minimum 28-day compressive strength of 4,000 psi when tested in accordance with ASTM C-31.

4.2.11 CLASS "C" CHEMCOMP CONCRETE

Concrete shall have a minimum of 6.0 sacks of expansive shrinkage compensating cement per cubic yard and a water reducing admixture, incorporated in strict conformance with the printed instruction of the cement manufacturers of the concrete, so as to produce a slump not to exceed six (6) inches and an end product having a minimum twenty-eight (28) day compressive strength of 4,300 psi, when tested in accordance with ASTM C-31.

4.2.13 CLASS "F" FLOW FILL CONCRETE

Concrete mix design for flow fill concrete, a substitute for Colorado Department of Transportation CL I & CL II Structural and Utility Trench Backfill shall be as follows:

<u>Mix Proportion</u>	<u>ASTM</u>	<u>Per CY of Concrete</u>	
Portland Cement	C-150	42	lbs.
Sand	C-33	1,845	lbs.
Aggregate #57	C-33	1,700	lbs.
AA	C-260	5	oz.
Water	C-94	325	lbs.
Compressive Strength: 28 day = 60 psi MAX			

4.2.14 CONSTRUCTION

Application for the various combination of aggregate size, in combination with allowable air content and slump range, for the different classes of concrete are as shown below.

Nominal Max. Size Coarse Ag.	Air Content Range	Vib. Slump Range	Min. Cement Content	Concrete	
In.	% by vol.	In.	Sks/CY	Class	Typical Application
1 ½"	4-7	1-4	6.0	A	Columns, Slabs on Grade, Reinforced Walls
	4-7	1-3	6.0	A	Grade Beams, Caissons, Reinforced & Plain Footings
	4-7	2-3	6.0	A	Roadway Pavement
	4-7	2-4	5.0	A	Pipe Encasement, thrust blocks
	4-8	1-3	0.45	F	Structural backfill Utility Trenches V-ditches
1'	5-7	1-4	6.0	A	Columns, Slabs on Grade, Reinforced Walls
	5-7	1-3	6.0	A	Reinforced & plain footings, Grade Beams, Caissons, Columns
	5-7	2-4	5.0	A	Pipe Encasement, Thrust blocks
	5-7	4-6	5.5	C	Reinforced Slabs on grade
¾"	5-8	2-3	6.6	A	Bridge Deck
	5-8	1-3	6.0	A	Structural Slabs on Grade; Reinforced Columns, Footings, Beams and Walls
	5-8	4-6	5.5	C	Reinforced Slabs on grade

4.2.15 MIX DESIGNS

- A. Designs employing the same ingredients proposed for use and used successfully on a previous project under similar conditions to those anticipated on this project may be used. Provided the contractor requests and obtains City approval on the following, all of which must be certified to by the supplier.
1. Concrete mix designs conforming to these specifications.
 2. ID sets of 7 and 28-day concrete strength tests made during the last 6 months on concrete conforming to the design in (1) above.
 3. Curve showing relationship of 7 and 28 day strengths in (2) above.
 4. Reports of compliance tests of fine and course aggregates made during the last six (6) months.

OR

- B. The contractor shall employ, at his expense an acceptable independent laboratory to design, proportion and select ingredients from the supplier's sources that will produce a concrete mix conforming to the requirements of these specifications, while providing proper placability, durability, strength and other required physical properties for the proposed application.

4.2.16 FORM WORK

Provide all forms, shores, cores, molds and similar items in sufficient quantity and quality to properly execute the work.

Lumber or plywood contact surfaces must be free from knots, warps, breaks, or other defects likely to cause irregular surfaces. Metal forms must be free from irregularities, dents and sags and suitable for concrete exposed to view in finished areas.

Do not reuse forms if there is any evidence of surface wear or tear which would impair the quality of the finish. Thoroughly clean and relubricate forms for reuse.

4.2.17 TOLERANCES

Construct forms so as to insure that concrete surfaces will conform to tolerances of Section 203.1 ACI 347.

4.2.18 REPARATION OF FORM SURFACES

Make forms sufficiently tight to prevent leakage of grout or cement paste. Seal wood surfaces against absorption of moisture from the concrete with an acceptable oil, sealer, or factory applied nonabsorptive liner.

Coat forms to prevent bond with concrete prior to placing of the reinforcing steel. Do not allow coating material to stand in puddles in forms nor to come in contact with concrete against which fresh concrete will be placed.

4.2.19 REMOVAL OF FORMS

- B. Form work that supports weight of concrete must remain in place until concrete has reached its specified 28-day strength, unless otherwise specified or permitted.

- C. Form work not supporting weight of concrete may be removed as soon as the concrete has hardened sufficiently to resist damage from removal operations.
- D. Whenever the form work is removed during the curing period, the exposed concrete shall be immediately cured by one of the methods herein specified.

4.2.20 FABRICATION AND PLACEMENT OF EMBEDDED REINFORCEMENT

4.2.21 FABRICATION TOLERANCE

- A. Sheared length and bends, $\pm 1"$.
- B. Depth of truss bars, stirrups, ties and spirals, $\pm 1/2"$.

4.2.22 PLACEMENT TOLERANCE

- A. Concrete cover to formed surface, minimum spacing between bars, top bars in slabs or beams and members to 8 inches deep, $\pm 1/4"$.
- B. Members between 8" to 24" deep, $\pm 1/2"$.
- C. Members more than 24" deep, $\pm 1"$.
- D. Crosswise of members spaced evenly within 2".
- E. Lengthwise of members, $\pm 2"$.

Movement of bars more than one diameter or in excess of above tolerances, to facilitate installation of embedded items, must be approved by the project engineer.

4.2.23 REINFORCEMENT PLACEMENT

Support and wire together all reinforcing bars to prevent displacement from external loading prior to and during concrete placement. On ground where necessary supporting concrete blocks may be used, otherwise use concrete, metal, plastic or other satisfactory bar chairs and spacers. Templates will be required for all column dowels.

At time of concrete placement all steel is to be free from loose, flaky rust, mud, oil or other coatings that may destroy or reduce bond.

Unless otherwise noted on the drawings, the steel shall be protected by concrete, after placement as follows:

- A. $3/4"$ for interior slabs.
- B. 1" for interior walls and formed exterior slabs.
- C. 1 1/2" for beams, columns and concrete exposed to the weather or in contact with the ground.
- D. 3" for concrete deposited against the ground.

Smooth dowels to join existing concrete to new concrete shall be epoxied into drilled holes and extend into the old concrete a distance of 24 diameters.

4.2.24 JOINTS

Provide joints only where shown unless otherwise specifically permitted by written authorization from the project engineer.

4.2.25 CONSTRUCTION JOINTS

Continue all reinforcing steel and welded wire fabric across joints, unless otherwise indicated. Provide keys and inclined dowels as shown or as directed. Provide longitudinal keys at least 1 ½" deep in all joints in walls and between walls and slabs.

Thoroughly clean surfaces and remove all laitance on the surface of joints before next placement.

When required or directed, obtain bond between hardened concrete and new concrete by:

- A. Use of an epoxy bond in accordance with the applicable provision of ACI Journal, Proceedings V59 #9, September 1962, p. 1121-1142.
- B. Use of an acceptable chemical retarder.
- C. By roughening surface of old concrete in an acceptable manner such as sandblasting.
- D. Provide a continuous water stop as specified.

4.2.26 EXPANSION JOINTS

Install filler in expansion joints ¾" thick by ½" less than slab thickness. For floors place a ¾" x ½" tapered wood strip over the joint filler, flush with the top of the slab and finish the edges with an edging tool. After the concrete has hardened remove the wood strip and seal the joint flush with the surface.

4.2.27 CONTROL JOINTS

Joints shall be formed by use of acceptable sheet metal forms, or by insertion of hard-pressed fiberboard strips into the plastic concrete, or by sawing with carborundum or diamond-tipped blade after concrete has set. Joints shall be ¼" wide and approximately ¼ of the slab thickness in depth, unless otherwise indicated or directed.

When concrete is dry, clean out sawed or fiberboard joints and fill to wearing surface with joint sealer.

4.2.28 EMBEDDED ITEMS

Items to be embedded include, but are not limited to, water stops, anchor bolts, inserts, sleeves, curb angles, dovetail anchor slots, frames, etc. and shall be placed prior to concrete placement.

4.2.29 PLACING EMBEDDED ITEMS

Position accurately and support against expansion joint material, water stop and embedded items. Fill temporarily with readily removable material to prevent the entry of concrete into the voids in sleeves, inserts and anchor bolts.

4.2.30 WATER STOPS

Provide water stops in construction and expansion joints in the maximum practical length possible. Forming necessary splices and intersections shall conform to manufacturer's recommendations and directions.

4.2.31 CONCRETE MIXING

Concrete shall be mixed and transported to the job site in accordance with the requirements of ASTM C-94.

Delivery tickets for each batch delivered shall show the date, mix by number or sack content with maximum size aggregate, admixtures and amounts used per cubic yard, air content, slump and time of loading.

4.2.32 AGITATING, MIX AND DISCHARGE

Concrete shall be continuously agitated from the time water is added and then mixed for 2 ½ minutes just prior to discharge. The mix shall be discharged from the truck within one (1) hour after cement is batched, unless longer time is specifically authorized.

4.2.33 WATER

Indiscriminate addition of water to increase slump is prohibited.

4.2.34 ADMIXTURES

- A. Liquid admixtures shall be charged into the mixer by means of an approved metering device.
- B. Powder admixtures shall be weighted or measured by volume in accordance with manufacturer's recommendation.
- C. When two or more admixtures are to be incorporated in the mix, they shall be added separately during batching sequence.

4.2.35 RETEMPERING

Mix concrete only in quantities for immediate use. Concrete will not be allowed.

Concrete arriving at the project with slump below that suitable for placing may have water added only if neither:

- A. The maximum permissible water-cement ratio has not been exceeded.

- B. Maximum slump has not been exceeded.

Any addition of water above that permitted by limitation on water-cement ratio must be accompanied by a quantity of cement sufficient to maintain proper cement ratio and a mixing time of 1 ½ minutes. No such additions will be permitted unless specifically authorized in writing by a City representative.

4.2.36 WEATHER

Perform work in conformance with detailed recommendations in ACI 306 for cold and ACI 305 for hot weather concrete placement.

4.2.37 BATCH TEMPERANCE

As mixed temperature of concrete shall be maintained above 55 degrees F and below 80 degrees F, even though the mean temperature falls below 40 degrees F.

4.2.38 PROTECTION

Provide adequate protection against rain, sleet, snow, cold and other weather conditions.

Protect exposed surfaces from rain water and from 40 degrees F and below temperatures with suitable covering, and equipment to maintain a minimum temperature of 50 degrees F for a period of 72 hours after the concrete has been placed.

4.2.39 PLACING

4.2.40 PREPARATION OF SURFACES

Preparation for placing shall include, but is not limited to, form construction, setting of reinforcing steel and embedded items, securing and alignment of forms, cleaning thoroughly all surfaces that will be in contact with concrete and keeping them free of debris, ice, rust, scale, grease or other coatings during placement of the concrete.

4.2.41 EQUIPMENT AND LABOR

Assemble and provide sufficient labor and equipment for proper mixing, transporting, placement and protection of concrete until accepted by the City.

4.2.42 CONVEYING

Truck mixers, agitators, and non-agitating units, including their manner of operation, must conform to the applicable requirements of ASTM C-94. Aluminum tubing or pipe for conveying concrete will not be allowed.

Concrete shall be conveyed to place of final deposit by methods which will prevent segregation or loss of ingredients and insure the required quality of the concrete is obtained. A hopper or tremie will be required at the end of metal chutes having a slope greater than 1:2 or less than 1:3 vertical to horizontal; or chutes in excess of 20 feet in length.

Use of horizontal belt conveyors discharging into a hopper and pumping or pneumatic conveying equipment such that the loss in slump does not exceed 1 ½" shall be subject to approval.

4.2.43 DEPOSITING

Deposit concrete continuously, or in layers of such thickness that no concrete is deposited on concrete which is hardened sufficiently to cause formation of seams or planes of weakness within the section. Deposit concrete as nearly as practicable in its final position to avoid segregation due to rehandling or flowing.

Depositing of concrete in general shall conform with the applicable detailed recommendation of ACI 304.

4.2.44 CONSOLIDATION

Perform consolidation in conformance with applicable detailed recommendation of ACI 309.

Consolidate all concrete by internal and external vibrators, spading, rodding or forking so that concrete is thoroughly worked around reinforcement, embedded items and into form corners, eliminating all air or stone pockets which may cause honeycombing, pitting or planes of weakness. Thoroughly consolidate concrete in slabs and floors with vibrating bridge screeds, roller pipe screeds or other acceptable means. Only mechanical vibrators having a minimum frequency 7000 RPM and operated by competent workmen shall be employed.

Over vibration and transporting concrete within the form by vibration will not be allowed.

4.2.45 UNDERWATER CONCRETING

Placing of concrete under water will not be allowed unless specifically approved method and authorization in writing has been obtained.

Where concrete is authorized to be placed under water, the cement content shall be increased 25% at contractor's expense, to compensate for losses due to water.

4.2.47 TIE HOLES

Patch all tie holes, after being cleaned and thoroughly dampened, by filling solid with patching mortar immediately after form removal.

4.2.48 DEFECTIVE AREAS

Remove and repair all honeycombed and other defective concrete down to sound concrete.

Dampen area to be patched and area six (6) inches wide surrounding it. Brush into surface a bonding grout (1 part cement to 1 part sand passing a #30 sieve) mixed to a consistency of thick cream. Immediately after breaking in grout, patch the defective area with a mortar (1 part cement to 2 ½ parts sand by damp loose volume) using no more water than necessary for handling and placing.

4.2.50 SELECTION OF FINISHES

Unless otherwise shown or called for in the Special Conditions, the following finishes shall be provided.

<u>Type Finish</u>	<u>Type of Surface Intended</u>
Scratch	To receive bonded applied cementitious application
Floated	To receive water proofing membranes or terrazzo
Trowled	Walking surfaces or for reception of floor covering
Broom or Belt	Sidewalks, garage floors and ramps
Non-slip	Exterior platforms, steps, athletic courts, landings and ramps
Board Form	Concrete surfaces not exposed
Smooth Rubbed	Interior vertical and other exterior surfaces
Exposed Aggregate	Scrubbed, sandblast and tooled finishes as specified in the Special Conditions

4.2.52 TOLERANCES OF FINISH

<u>Finish Class</u>	<u>Application</u>	<u>Minimum Slope</u>
"A"	Roads Slopes to Drains Floors	1/8" in 10 ft. using a 10 ft. straight edge
"B"	Ramps Sidewalks	1/4" in 10 ft. using a 10 ft. straight edge
"C"	Athletic Courts	1/4" in 15 ft. using a 15 ft. straight edge

4.2.52 FLOATED FINISH SLABS

After concrete has been placed, struck off, consolidated, leveled and allowed to set to the point where water sheen has disappeared or where mix has stiffened sufficiently to permit proper working, being consolidation of the surface with power driven machines. Hand float with wood or cork-faced floats in locations inaccessible to power driven machines. Recheck trueness of surface at this state with applicable straight edge applied at not less than two different angles. Cut down all high spots and fill all low spots during this procedure to a Class "B" tolerance, then refloat the slab immediately to a uniform, smooth, granular texture.

4.2.53 TROWELED FINISH SLAB

Perform first power troweling immediately after power floating to produce a smooth surface which is relatively free of defects but which may still contain some trowel marks. Perform additional troweling and consolidation of the surface by hand until a ringing sound is produced as the trowel is moved over the surfaces.

To resist slip the finish surface may show trowel marks which are uniform in texture and appearance, otherwise it shall be free of all trowel marks. In either case, the surface shall be to a Class "B" tolerance.

4.2.54 BROOM OR BELT FINISH

Sidewalk slabs and other slabs so specified shall have a coarse traverse sawed texture obtained by drawing a broom or burlap belt across the surface immediately after floating.

4.2.55 CURING

Freshly deposited concrete shall be protected from premature drying and excessively hot or cold temperatures and maintained with minimal moisture loss at a relatively constant temperature for the time required for hydration of cement and proper hardening of the concrete.

4.2.56 INITIAL CURING

Immediately following finishing the contractor shall provide methods to keep the concrete continuously moist at least overnight unless otherwise specified by:

- A. Ponding or continuous sprinkling
- B. Absorptive mat or fabric kept continuously wet
- C. Sand or other covering kept continuously wet
- D. Steam vapor mist bath at a temperature not to exceed 150 degrees F.
- E. Curing compounds conforming to ASTM C-309 applied according to manufacturer's recommendations, providing the surface to be cured is not to be bonded to other cementitious materials.

4.2.57 DURATION OF CURING

Continue curing until the cumulative number of days, or fraction thereof, not necessarily consecutive, during which the air temperature in contact with the concrete is above 50 degrees F, has totaled seven (7) days.

4.2.58 Cold Weather Curing

Curing shall conform to all applicable detail recommendations in ACI-306. Temperature of concrete shall be maintained between 50 degrees - 70 degrees F for the required curing period when the mean daily atmospheric temperature is less than 40 degrees F. Sufficient equipment and materials required to comply with this specification shall be at the site prior to placing concrete.

4.2.59 HOT WEATHER CURING

Curing shall conform to all applicable detail recommendations, in ACI-305. As quickly as concrete hardening and finishing will allow, the contractor shall install such protective measures, such as, but not limited to, windbreaks, shading, fog spraying, sprinkling, ponding or wet covering as may be required.

4.2.60 PROTECTION FROM DAMAGE

Especially during the curing period and until the work is accepted, the contractor shall protect the concrete from damage by vehicular or mechanical equipment, foreign materials and by rain or by running water.

4.2.61 TESTING

Technical services performing routine preliminary testing of materials of proposed mix designs and resulting concrete for compliance with the specifications will be provided by the City, at no expense to the contractor.

4.2.62 TESTS FOR CHANGES AND NON-COMPLIANCE

Testing required because of changes in materials or proportions of the mix requested by the contractor, as well as any extra testing of concrete, field cured cylinder, or materials occasioned by failure to meet specification requirements, shall be at the contractor's expense.

4.2.63 TESTING PROVIDED BY THE CITY

- A. Test contractor's proposed material for compliance.
- B. Review and check test contractor's proposed mix design.
- C. Prepare and cure complete set of concrete cylinders, test and report results of 7 and 28 day compressive strength, in accordance with ASTM C-39, for each placement up to 50 cubic yards.
- D. Determine slump range of concrete as delivered in accordance with ASTM C-143.
- E. Determine air content of standard weight concrete with either ASTM method.
- F. Check batching and mixing operations.

4.2.64 CONTRACTOR RESPONSIBILITIES

- A. Preliminary Material Samples and Mix Design
Deliver to City preliminary representative samples of all the materials, mix designs and other materials contractor proposed to use on the project which require testing, with request for acceptance.
- B. Casual Labor
Furnish such labor as is necessary to handle samples at the project or at the material source.
- C. Storage Facilities
Provide and maintain adequate facilities on the site for safe storage and proper curing of concrete test cylinder for the first 24 hours, as required by ASTM C-31.

4.2.65 CERTIFICATES OF COMPLIANCE

- A. Submit the following in duplicate for each shipment, with applicable ASTM Specifications:
- B. Cement – Mill Test Certificate of Conformance.
- C. Aggregate – Certified Test Report.
- D. Reinforcing Steel – Mill Test Certificate of Conformance.
- E. Air Entraining Admixture – Certificate of Conformance.
- F. Water – Reducing Admixture – Certificate of Conformance.

4.2.66 DEFECTIVE CONCRETE

If concrete is found defective from testing, placing, curing or for other causes, and if the contractor is so directed, he must remove the concrete at no cost to the City.

END OF SECTION

SECTION 4.3

CONSTRUCTION MATERIALS AND METHODS

DEMOLITION, SITE PREPARATION, EXCAVATION AND EMBANKMENT

4.3.1 GENERAL

The work to be performed shall include the demolition and removal from the site of all designated: buildings, slabs on grade, retaining walls, steps, asphalt, rubbish, stumps, trees, shrubs, fencing, buried tanks, pipe, etc.; on site wells shall be sealed; depressed areas are to be filled and graded to drain.

In public right-of-ways, wherein the City will assume the maintenance of materials installed, the work to be performed shall also include: top soil removal and replacement, unclassified excavation, placing and compacting embankment, shaping and compacting subgrades, etc.; for drainage ways, parks, concrete slabs on grade, etc.

4.3.2 LOCAL LAWS, ORDINANCES AND CODE

The contractor shall be licensed with and bonded to the City of Craig and shall comply with all current federal, state and local laws, codes and ordinances pertaining to demolition, wrecking, clearing and grubbing operations.

4.3.3 PROTECTION OF PUBLIC IMPROVEMENTS

The contractor will be held responsible to insure the protection of all existing public improvements such as fire hydrants, street lights, traffic lights, parking meters, traffic signs, catch basins, manholes, valves, survey monuments, overhead utility lines and poles, and any existing underground sprinkler or utility lines which may be damaged during the execution of the contract. It will be the contractor's responsibility to replace all public improvements so damaged at his own expense. Existing manhole rings and covers, valve boxes and sprinkler heads found defective shall be replaced, as directed by the City representative.

The contractor shall take proper precautions for the protection of and replacement or restoration of driveway culverts, street intersection culverts or aprons, storm drains or inlets, fences, irrigation ditches, crossings and diversion boxes, mail boxes, shrubbery, flowers, ornamental trees, driveway approaches and all other public or private installations that may be encountered during the performance of the work. He shall provide each property with access at all times during construction. Existing driveways shall be cut, filled and graded as required or as directed by the City representative to provide permanent access. Existing driveways shall be resurfaced with the then existing type of surfacing, whenever surfaces are destroyed.

Work shall include saw cutting or proper preparation of remaining materials, which are to be reconstructed. Materials left in place shall be protected from damage during construction. Contractor shall be responsible to maintain or repair materials left in place.

4.3.4 DISCONNECTION OF EXISTING UTILITIES

Before starting demolition of the structure, the contractor shall arrange for the disconnection of all utility service connections; such as water, sewer, cable T.V., telephone, gas and electrical power connected thereto. Disconnects and marking shall be made in accordance with the regulations of the utility that controls the supply of service involved.

Underground services are to be cut, capped and marked at point of disconnect to facilitate future location of the line. Caps of underground storm and sanitary sewer shall consist of a plug being placed in the line and the opening then sealed with concrete. Markings of the end of the line shall consist of a 4 x 4 wooden stake or metal fence post driven into the ground and then tagged to note the type of facility.

The county, district, or City Public Works Department will provide a representative to be on site to observe and approve the contractor's disconnect of the water and sewer services at the main line. It shall also be the responsibility of the contractor to backfill all holes to finish grade and install concrete or asphalt surfacing when the holes excavated are in streets or paved areas. The contractor will be given written approval and acceptance for disconnects that are proper. The contractor shall correct any unsatisfactory disconnects.

4.3.5 EQUIPMENT OPERATED ON STREETS

The contractor shall be permitted to operate only pneumatic-tired equipment over any paved surface and shall be responsible for any damage to street surface resulting from his operations.

4.3.6 PROTECTION OF SURVEY MONUMENTS

Prior to start of demolition or construction, any public survey monument or range box that may be disturbed during construction shall be referenced to a minimum of two points outside the limits of construction by a Colorado Professional Land Surveyor. Any public survey monument or range box disturbed as a result of construction shall be replaced by a Colorado Professional Land Surveyor in accordance to the current Colorado Revised Statutes.

Non-pneumatic-tired equipment shall be allowed if the paved area in question is flagged off from public use for the duration of construction and will not be re-opened to public use until sufficient repair/replacement of paving surface is complete. Repair/replacement of paving surface shall be determined to the City Engineer or City Representative for the project.

4.3.7 DEMOLITION, CLEARING AND GRUBBING

The contractor shall remove from the site, or within the limits of construction, all obstructions specified in the special conditions or noted on the plans.

4.3.8 FENCES

Where existing fence or corner markers are to be removed, site corners shall be marked by ½" rebar, 18" long, firmly implanted at ground level by the contractor.

4.3.9 TREES AND SHRUBS

Trees not impeding demolition of structures or performance of the work will not be removed except as designated. Trees and shrubbery designated for removal will include stumps and roots to an elevation of two (2) feet below existing or finished grade, whichever is lower. Downed trees, brush and rubble shall be removed from the site.

Trees scheduled to remain shall be carefully protected from damage during performance of the work. Any damage due to the contractor's operations shall be repaired by suitable tree surgery methods. Damaged trees shall be replaced, as approved by the City at the contractor's expense.

4.3.10 BURIED FUEL AND SEPTIC TANKS

Tanks that may exist on the site shall be completely removed and contaminated soils remediated. The void created shall be filled by the contractor to finished grade.

Underground motor fuel storage tanks shall be excavated and removed under the direction and in the presence of a representative from the City of Craig. The contractor shall notify the fire district twenty-four-(24) hours in advance of the time he proposes to start excavation in the vicinity of the tanks.

4.3.11 WELLS

On site wells and well casings shall be sealed to prevent contamination of ground water aquifers in accordance with Section 5: Abandonment Regulations, State Board of Examiners, Rules and Regulations and Water Well and Pump Installation Contractors Law, State of Colorado Division of Water Resources. All abandonment activities shall be approved by the utility that services the location, and the state engineer. There may be instances where the well will not be plugged, but merely capped with a steel, lockable cover plate.

4.3.12 BUILDINGS

The demolition of buildings shall include the removal from the site of all roofs, walls, chimneys, basement walls, supporting walls, footings, footing post, caissons, basement floors, including all pipes, conduits and similar appurtenances lying therein or beneath for a depth of two (2) feet below grade.

4.3.13 SLABS ON GRADE

All concrete and asphalt slabs on grade shall be removed from the site. This shall include, but is not limited to, floor slabs, driveway and garage slabs, sidewalks, curbs, cross pans, gutters, etc.

4.3.14 WALLS

Retaining walls and their footing shall be removed in their entirety, from the site.

4.3.15 SALVAGE

Unless otherwise specified in the Special Conditions; all materials, salvageable or otherwise, to be removed from the site is considered as being the property of the contractor performing the work.

4.3.16 FILLING AND GRADING

Depressions resulting from the removal of structures, basement walls, footings, buried tanks, etc. shall be filled and compacted with clean fill materials so as to eliminate hazards of cave-in, accumulation and ponding of water. Under no circumstances shall organic building material, broken concrete or asphalt be considered as approved fill material.

Immediately following demolition and removal of rubbish from the site, the contractor shall grade the entire contract area by filling, compacting, and leveling the site to existing adjacent grades. Grading and cleanup of the site must be complete and acceptable before any consideration will be given to making final payment for the work.

4.3.17 TOPSOIL

The contractor shall salvage within the project limits, or acquire when needed, loose friable loam reasonably free of admixtures of subsoil, refuse, stumps, rocks, roots, brush, weeds or other material which would be detrimental to the proper development of vegetative growth for use as topsoil.

Topsoil shall be placed and spread at locations and to the thickness shown on the plans, after the areas to be covered have been properly prepared and grading operations in the area have been completed and accepted. Soil so placed shall be keyed to the underlying subgrade by the use of harrows, rollers or other equipment suitable for the purpose, followed by applying water in a fine spray by nozzles or spray bars in such a manner and extent that wash or eroding will not occur.

4.3.18 DISPOSAL

Unusable material may be disposed of outside the limits of view from the project with written permission of the property owner on whose property the material is placed. Copies of all agreements with property owners are to be furnished to the City Engineer.

Where portions of structures are to be removed, the remaining portions shall be prepared to fit new construction. The work shall be done in accordance with the development drawings and in such manner that materials to be left in place shall be protected from damage; all damage to portions of structures to remain in place shall be repaired by the Developer at his expense. Reinforcing steel projecting from the remaining structure shall be cleaned and aligned to provide bond with new extension.

4.3.19 EXCAVATION

Excavation will be unclassified and shall consist of the excavation of all material of whatever character encountered within the limits of the project, including but not limited to surface boulders, muck, rock, concrete foundations, slabs, stripping, excavation for ditches or channels, borrow, etc.

Excavation operations shall be conducted so that material outside the limits of slopes will not be disturbed, and to provide adequate drainage at all times. Insofar as practicable, all suitable materials shall be used in the formation of embankments and backfilling. Materials that are considered unsuitable or surplus by the City representative shall be disposed of by the contractor at his expense.

All excavations shall be made to subgrade elevations and shall be true to grade. Material below subgrade elevation in cuts shall not be loosened by plowing or other methods during the progress of the work except with the approval of the project engineer. No excavation shall be made below subgrade elevation except to remove spongy material, vegetable matter or other undesirable materials. In the event the contractor over excavates an area, he shall replace the excavated materials with satisfactory material and thoroughly compact same at his own expense.

Whenever excavation below subgrade elevation to remove spongy material, vegetable matter, or other material is ordered by the engineer, the contractor shall remove the same to the satisfaction of the engineer and shall replace it with satisfactory material in layers not to exceed six (6) inches in thickness and thoroughly compact each layer before the next layer is placed. The volume of material ordered to be removed shall be paid for at the unit price for excavation. When such excavations are backfilled with suitable material from other excavations in the project, no separate payment will be made. In the event the engineer orders such excavations to be filled with material from borrow, the contractor will be paid at the unit price for "Select Subgrade Material" when called for in the proposal.

The contractors shall not deposit surplus or undesirable materials on private property without first securing the written consent of the property owner and filing a copy of said consent with the City representative. When approved, disposal of surplus material on City property shall be kept below the grade designated by the engineer.

4.3.20 EMBANKMENT

Areas to receive embankment and the top of cut areas shall first be stripped of all vegetation, organic material and materials unsuitable for use in embankments. Topsoil shall be stockpiled for reuse and unsuitable material disposed of.

Within the limits of the embankment and cut area the subgrade shall be scarified to a depth of six (6) inches and the moisture content increased or reduced as necessary to bring the moisture within 2% of optimum. This scarified layer shall then be rolled and compacted to the relative compaction specified for the type of soil. The remainder of the embankment volume shall then be constructed in six (6) inch lifts of suitable material, containing 2% of optimum moisture content and compacted to the relative compaction specified. Rollers shall be of a tamping type conforming to CDOT standards.

In connection with his normal grading operations, the contractor shall use his trucks, tractors, bulldozers and other pieces of equipment in the most effective manner by routing the equipment over the entire embankment or roadway width.

4.3.21 COMPACTION

Maximum dry densities of all soil types encountered or to be used will be determined in accordance with AASHTO T-99 or T-180 Methods C-D. The percent of relative compaction

required will be equal to or greater than minimum values as hereinafter shown for the various classes of soil and type of compactions.

<u>Soil Classification (AASHO M-145)</u>	<u>AASHO T-99 Minimum Relative Compaction</u>	<u>AASHO T-180 Minimum Relative Compaction</u>
A-1	100	95
A-3	100	95
A-2-4	100	95
A-2-5	100	95
All Others	95	90

Compacted subgrade ready to receive sub-base material shall conform to the lines, grades and cross-section called for on the plans. Subgrade is to be established by survey.

4.3.22 SUBGRADE FOR SLABS ON GRADE AND PAVING

Subgrade areas to be occupied by curbs, gutters and sidewalks base course or asphaltic concrete shall be excavated, backfilled and compacted to establish grade. This work shall be done with particular care in accordance with all requirements herein.

Proof rolling may be required to determine whether certain areas of subgrade meet compaction requirements. Proof roll designated areas with heavy rubber-tired roller having a minimum weight of 50 tons, or single axle water truck loaded to provide equivalent wheel loading. Areas found to be weak or fail the test shall be ripped, scarified, wetted if necessary, and re-compacted to requirements for density and moisture at contractor's expense.

Surface of ground between curb or sidewalk line and property line shall be sloped as staked or as directed by the project engineer and rounded into existing lawn or ground surface.

4.3.23 WETTING AND COMPACTING

Embankments, bases of cuts, natural foundations, base courses and surface courses shall be wetted and rolled to obtain the densities required by the specifications. The contractor shall use his equipment to consolidate each layer of embankment in the most effective manner. Each layer shall be compacted by routing the loaded hauling equipment over the entire width, and spreading equipment shall be operated so as to produce a dense, stable fill. Successive layers of material shall not be placed until the layer under construction has been thoroughly compacted. Where methods in use do not consolidate materials to required densities, rollers or mechanical tamping units of the type ordered by the project engineer shall be used.

Concurrently with the rolling or tamping operations, the materials shall be wetted by uniformly sprinkling each layer or course of material being placed, to 2% of optimum. Sprinkling shall be done in such a manner that areas of dry material alternated with areas of saturated material and pools of water will be avoided.

Where mechanical tampers are used as ordered by the engineer, they shall be operated at all times with an air pressure not less than eighty (80) psi at the tamper. Successive blows with the tamper shall overlap at least one-fourth the width of the tamper foot.

4.3.24 HOUSEKEEPING, RESTORATION AND CLEANUP

A. Surplus Excavation

All surplus excavated material shall be removed from the job site by and to locations provided by the contractor. Written permission shall be obtained by the contractor, before disposal of excess material on private property, and a copy of said emission shall be furnished to the project engineer. The City relinquishes all right and title to the surplus material unless otherwise specified in the Special Conditions.

Excess material shall not be wasted on any public ROW without written permission from the City engineer.

B. Concrete Curb, Gutter and Valley pans

The contractor shall replace in like kind all curb and gutter and valley pans that are damaged during construction. The replacement shall be of equal or better quality than found.

C. Repair of Tree Damage

Any trees along the alignment of the conduit damaged by the contractor shall be repaired and treated accordingly. All broken limbs shall be sawed off evenly and cut faces painted with an approved compound. All repairs and treatment shall be done in accordance with the forestry regulations of the authority having jurisdiction and at contractor's expense.

D. Surface Restoration

The contractor will secure all street cut and ROW permits required for the prosecution of the work. The contractor shall assume full responsibility for the consequences of such cutting or damaging and shall comply with all requirements contained therein.

The replacement of excavated base course, permanent paving and damaged curb and gutter shall be done in accordance with the Public Works Manual and requirements contained in the permits.

Damaged driveways shall be replaced in like kind by the contractor to an equal or better condition than existed prior to construction. All cuts necessary for the replacement of damaged concrete shall be made using a concrete saw. Drainage and ditch facilities shall be maintained in operating condition at all times during construction.

E. Unsurfaced Areas: The general grade and condition of all unsurfaced areas shall be restored to nearly as practicable to the grade and condition immediately prior to construction. Topsoil shall be removed, saved and replace in cultivated and agricultural areas; and any excess earth shall be removed from the ROW at no additional expense to the City. All grassed areas shall be reseeded or re-sodded, and the contractor shall be responsible for caring for the grass until its growth is established.

F. Surfaced Areas: Roadway surface cuts shall be made in a vertical plane and in a straight line. All roadway surfacing between the surface cuts on each side of the excavations shall be removed and replaced with base coarse material and/or hot mix bituminous or concrete

surfacing. In the event that the trench must be paved before hot mix bituminous material can be acquired, the contractor, at the discretion of the project engineer, shall install and maintain temporary cold mix bituminous paving. When hot mix bituminous material becomes available, the contractor shall remove the temporary cold mix material, add the compact base course material, if necessary, and install the permanent hot mix bituminous surfacing.

- G. Cleanup: Upon completion of the work, the contractor shall remove from the job site all rubbish, unused materials, concrete forms and other like material. Also, at all times during construction, the contractor shall maintain the site, partially finished structures, material stockpiles and other like areas in a reasonable state of order and cleanliness.
- H. In the event of the contractor's failure to perform the above work, the Work may be performed by the City at the expense of the contractor.

END OF SECTION

SECTION 4.4

CONSTRUCTION MATERIALS AND METHODS

SPRINKLER IRRIGATION SYSTEMS

4.4.1 GENERAL

All sprinkler irrigation systems installed as Capital Improvements within the City of Craig shall conform to approved design plans and these specifications.

The Contractor shall insure and guarantee complete coverage of the areas shown on the drawings to be irrigated. The Contractor shall verify actual job site conditions and available water pressure as needed for the coverage guarantee. It shall be the Contractor's responsibility to report to the City Engineer any deviations between the drawings, specifications and the site. Any inconsistencies shall be noted by the City Engineer and a written copy of the corrections shall be given to the Contractor.

When the Contractor is satisfied that the system is operating properly, that it is balanced and adjusted and that all work and cleanup is completed, he shall notify the City Engineer for final inspection with date and time given, at least seventy-two hours in advance.

4.4.2 DRAWINGS

The specifications and drawings are intended to specify an efficient and complete sprinkler irrigation system. Use of the sprinkler irrigation system will follow the manufacturer's recommendations and meet the City's approval without further cost to the City.

All plot dimensions are approximate. Before beginning any phase of work, the Contractor shall check all dimensions on the drawings, verify the accuracy of each dimension and notify the City of any discrepancies between the drawings and the site.

All work noted on the drawings or details shall be furnished and installed by the Contractor whether or not the work is mentioned in the specifications.

Omissions from the specifications or drawings or any mis-description of detail work which is absolutely necessary to carry out the intentions of the drawings or specifications shall not relieve the Contractor from performing such omitted detail work. The detail work shall be executed by the Contractor as if fully set forth and described in the specifications and drawings.

The Contractor will supply the City with four sets of drawings and specifications. The drawings and specifications will indicate the work related to this contract. The Contractor shall record all changes in the work which constitutes departures from the original contract drawings, on one set called the Record Drawings. These Record Drawings (or As-Built Drawings) will become the property of the City at the time of acceptance. Contractor shall supply to the City Engineer two 24" x 36" hard copy drawings of the as-built and an electronic copy in both PDF and ACAD of the final as-built drawings

The Contractor shall dimension from two permanent reference points (such as sidewalks, road intersections, manholes, abutment walls, etc.) the location of the following items:

1. Connections to existing water lines.
2. Public Service electric supply connections.
3. Sprinkler control valves.

The Contractor shall deliver, on or before the date of final inspection, the corrected and completed Record Drawings to the City or City Engineer. Delivery of the Record Drawings will not relieve the Contractor's responsibility to provide location information during the two year warranty period.

4.4.3 RULES AND REGULATIONS

- A. Work and materials shall be in accordance with the latest edition of the National Electric Code, the Uniform Plumbing Code as published by the Western Plumbing Officials Association, and applicable laws and regulations of the governing authorities.
- B. When the contract documents call for materials or construction of a better quality or larger size than required by the above-mentioned rules and regulations, provide the quality and size required by the contract documents.
- C. If quantities are provided either in these specifications or on the drawings, these quantities are provided for information only. It is the Contractor's responsibility to determine the actual quantities of all material, equipment and supplies required by the project and to complete an independent estimate of quantities and wastage.

4.4.5 DEMOLITION

- A. Remove existing sprinklers, valves, automatic controllers and other existing irrigation components indicated on the drawings. Remove items in a manner that minimizes damage to the components. Deliver only salvageable items to City's Representative. All other items shall be disposed of by the Contractor.
- B. Existing pipelines shall be abandoned in place. If an existing pipeline is encountered during the installation of a new pipeline, a section of the existing pipeline shall be cut and removed. Remove two (2) feet of the existing pipeline on either side of the new pipeline.
- C. Removal and disposal of existing asbestos-concrete (transite) pipelines shall be in accordance with the General Conditions, Special Conditions and the environmental Protection Agency rules and regulations.

4.4.6 TESTING

- A. Notify the City's Representative three days in advance of testing.
- B. Pipelines jointed with rubber gaskets or threaded connections may be subjected to a pressure test at any time after partial completion of backfill. Pipelines jointed with solvent-welded PVC joints shall be allowed to cure at least 24 hours before testing.
- C. Subsections of mainline pipe may be tested independently, subject to the review of the City's Representative.

- D. Furnish clean, clear water, pumps, labor, fittings and equipment necessary to conduct tests or retests.
- E. Hydrostatic Pressure Test:
 - 1. Subject mainline pipe to a hydrostatic pressure equal to 120 psi for two hours. Test with mainline components installed.
 - 2. Backfill to prevent pipe from moving under pressure. Expose couplings and fittings.
 - 3. Leakage will be detected by inspection. Replace defective pipe, fitting, joint, valve or appurtenance. Repeat the test until the pipe passes test.
 - 4. Cement or caulking to seal leaks is prohibited.
- F. Hydrostatic Pressure Test (Gasketed Pipe):
 - 1. Close tightly all isolation gate valves and sprinkler lateral isolation gate valves on mainline for tests. Backfill trenches with enough material to prevent pipe from moving under pressure.
 - 2. Test each section of pipe between isolation gates valves on the mainline pipe separately.
 - 3. Purge all air from the pipeline before test. Attach pressure gauge to pipeline in test section. Attaching pressure gauge to quick coupling valve between mainline isolation gate valves in the test section is acceptable.
 - 4. Subject mainline pipe to the anticipated operating pressure of 165 psi for two hours. Observe pressure loss on pressure gauge. If pressure loss is greater than 2 psi, identify reason for pressure loss. Replace defective pipe, fitting, joint, valve or appurtenance. Repeat the test until the pressure loss is equal to or less than 2 psi.
 - 5. Cement or caulking to seal leaks is prohibited.
- A. Operational Test:

Activate each remote control valve in sequence from controller. The City's Representative will visually observe operation, water application patterns and leakage.

 - 1. Replace defective remote control valve, solenoid, wiring or appurtenance to correct operational deficiencies.
 - 2. Replace, adjust or move water emission devices to correct operational or coverage deficiencies.
 - 3. Replace defective pipe, fitting, joint, valve, sprinkler or appurtenance to correct leakage problems. Cementing or caulking to seal leaks is prohibited.
 - 4. Repeat test(s) until each lateral passes all tests. Repeat tests, replace components and correct deficiencies at no additional cost to the City.
- B. Control System Acceptance Test:
 - 1. Upon completion of construction, a System Acceptance Test must be passed.
 - 2. Following construction completion and a Review by the Engineer, an evaluation period will begin. After 30 days of continuous service without major system problems, the system will be accepted and the guarantee/warranty period will begin. If at any time during the 30-day evaluation period, a major system problem occurs, the source of the problem will be determined and corrected and the 30-day evaluation period will start again. Equipment will not be accepted until such time as the System Acceptance Test is passed.
 - 3. If successful completion of the System Acceptance Test is not attained within 90 days following commencement of the evaluation period, the City's Representative has the option to request replacement of equipment, terminate the order, or portions

- thereof, or continue with the System Acceptance Test. These options will remain in effect until such time as a successful completion of the System Acceptance Test.
4. Final payment will be made after successful completion of the System Acceptance Test.

C. Control System Grounding:

1. Test for proper grounding control system per manufacturer's recommendations. Test results must meet or exceed manufacturer's guidelines for acceptance.
2. Replace defective wire, grounding rod or appurtenances. Repeat the test until the manufacturer's guidelines are met.

4.4.7 CONSTRUCTION REVIEW:

- A. The purpose of on-site reviews by the City's Representative is to periodically observe the work in progress, the Contractor's interpretation of the construction documents and to address questions with regard to the installation.
- B. Scheduled reviews such as those for irrigation system layout or testing must be scheduled with the City's Representative as required by these specifications.
- C. Impromptu reviews may occur at any time during the project.
- D. A review will occur at the completion of the irrigation system installation and Project Record (As-Built) Drawing submittal.

4.4.8 WARRANTY AND REPLACEMENT:

The purpose of this warranty is to insure that the City receives irrigation materials of prime quality, installed and maintained in a thorough and careful manner.

- A. For a period of two years from commencement of the formal maintenance period, guarantee/warranty irrigation materials, equipment, and workmanship against defects. Fill and repair depressions. Restore landscape or structural features damaged by the settlement of irrigation trenches or excavations. Repair damage to the premises caused by a defective item. Make repairs within seven days of notification from the City's Representative.
- B. Contract documents govern replacements identically as the new work. Make replacements at no additional cost to the contract price.
- C. Warranty applies to originally installed materials and equipment and replacements made during the warranty period.

4.4.9 MATERIALS

4.4.10 QUALITY

Use materials which are new and without flaws or defects of any type and which are the best of their class and kind.

4.4.11 SUBSTITUTIONS:

- A. Acceptable sprinkler equipment manufacturers are Rain Bird, Hunter, Weather-Matic and others indicated on irrigation plans, details and special conditions. Alternative equipment must be approved in writing by the Engineer prior to bidding. The Contractor is responsible for making any changes to the design to accommodate alternative equipment.
- B. Pipe sizes referenced in the construction documents are minimum sizes, and may be increased at the option of the Contractor.

4.4.12 SLEEVING:

- A. Install separate sleeve beneath hardscape areas to route each run of irrigation pipe or wiring bundle.
- B. Sleeving material beneath drives, streets and pedestrian pavements shall be PVC Class 200 pipe with solvent welded joints.
- C. Sleeving diameter shall be as indicated on the drawings and installation details or equal to a minimum of twice that of the pipe or wiring bundle.

4.4.13 PIPE AND FITTINGS:

- A. Mainline Pipe and Fittings:
 - 1. Use rigid, unplasticized polyvinyl chloride (PVC) 1120, 1220 National Sanitation Foundation (NSF) approved pipe, extruded from material meeting the requirements of Cell Classification 12454-A or 12454-13, ASTM Standard D1784, with an integral belled end.
 - 2. Use Class 200, SDR-21, rated at 200 psi, conforming to the dimensions and tolerances established by ASTM Standard D2241. Use PVC pipe rated at higher pressures than Class 200 in the case of small nominal diameters which are not manufactured in Class 200.
 - 3. Use rubber-gasketed pipe equipped with factory installed reinforced gaskets for mainline pipe with a nominal diameter greater than or equal to 3 inches. Gasketed pipe joints must conform to the "Laboratory Qualifying Tests" section of ASTM D3139. Gasket material must conform to ASTM F477. Use rubber gasketed deep bell ductile iron fittings conforming to ASTM A-536 and ASTM F-477. Use lubricant approved by the pipe manufacturer.
 - 4. Use solvent weld pipe for mainline pipe with a nominal diameter less than 3 inches or where a pipe connection occurs in a sleeve. Use Schedule 40, Type 1, PVC solvent weld fittings conforming to ASTM Standards D2466 and D1 784. Use primer approved by the pipe manufacturer. Solvent cement to conform to ASTM Standard D2564.
 - 5. No plowing/pulling of mainline accepted.
 - 6. One inch meter is required on all irrigation systems.
 - 7. All systems will require a backflow preventer as detailed in section 3 of the PWM.
- B. Lateral Pipe and Fittings:
 - 1. Use rigid, unplasticized polyvinyl chloride (PVC) 1120, 1120 National Sanitation Foundation (NSF) approved pipe, extruded from material meeting the requirements

- of Cell Classification 12454-A or 12454-13, ASTM Standard D1784, with an integral belled end suitable for solvent welding.
2. Use Class 160, SDR-26, rated at 160 psi, conforming to the dimensions and tolerances established by ASTM Standard D2241. Use solvent weld pipe for lateral pipe.
 - a. Use Schedule 40, Type 1, PVC solvent weld fittings conforming to ASTM Standards D2466 and D1 784 for PVC pipe. Use primer approved by the pipe manufacturer. Solvent cement to conform to ASTM Standard D2564, of a type approved by the pipe manufacturer.
 3. For drip irrigation laterals downstream of riser connections, use $\frac{3}{4}$ inch UV radiation resistant Netafim Techline polyethylene pipe with self-flushing, pressure-compensating bubblers with the following: 1) shrubs – 1 bubbler; 2) 2" trees – 2 bubblers; 3) trees over 2" – 3 bubblers.
 4. No plowing or pulling of lateral lines accepted.

C. Specialized Pipe and Fittings:

1. Low Density Polyethylene Hose:
 - a. Use pipe specifically intended for use as a flexible swing joint.
Inside diameter: 0.490+0.010 inch
Wall thickness: 0.100+0.010 inch
Color: Black
 - b. Use spiral barb fittings compatible with the nominal size of the hose.
2. Assemblies calling for threaded pipe connections shall utilize PVC Schedule 80 nipples and PVC Schedule 40 or 80 threaded fittings.
3. Joint sealant: Use only Teflon-type tape or Teflon based paste pipe joint sealant on plastic threads. Use nonhardening, nontoxic pipe joint sealant formulated for use on water-carrying pipes on metal threaded connections.

D. Thrust Blocks:

1. All thrust blocks shall comply with City's water standards as detailed in section 3 of PWM.
2. Use thrust blocks for fittings on pipe greater than or equal to 3-inch diameter or any diameter rubber gasketed pipe.
3. Use 4,000 psi concrete.
4. Use 2 mil plastic.
5. use No. 4 Rebar wrapped or painted with asphalt tar based mastic coating

E. Joint Restraint Harness:

1. Use a joint restraint harness wherever joints are not positively restrained by flanged fittings, threaded fittings, and/or thrust blocks.
2. Use a joint restraint harness with transition fittings between metal and PVC pipe, where weak trench banks do not allow the use of thrust blocks, or where extra support is required to retain a fitting or joint.
3. Use bolts, nuts, retaining clamps, all-thread or other joint restraint harness materials which are zinc plated or galvanized.
4. Use on pipe greater than or equal to 3-inch diameter or any diameter rubber gasketed pipe.

4.4.14 MAINLINE COMPONENTS

- A. Main System Shutoff Valve as per local practice and in compliance with local code.
- B. Winterization Assembly: Remove backflow preventer and blow lines out with air at this location.
- C. Master Valve Assembly: as presented in the installation details.
- D. Isolation Gate Valve Assembly with square key: as presented in the installation details. Install a separate valve box over a 3 inch depth of $\frac{3}{4}$ inch gravel for each assembly with a 2 inch operator.
- E. Quick Coupling Valve Assembly: double swing joint arrangement as presented in the installation details.

4.4.15 SPRINKLER IRRIGATION COMPONENTS

- A. Remote Control Valve (RCV) Assembly for Sprinkler Laterals: Provide Rainbird GB Series brass valves as presented in the installation details. Use wire connectors and waterproofing sealant to join control wires to solenoid valves. Use standard Christy I.D. tags with hot-stamped black letters on a yellow background. Install a separate valve box over a 3 inch depth of $\frac{3}{4}$ inch gravel for each assembly.
- B. Sprinkler Assembly: Provide Rainbirdalcon models F4-FC-SS-HS and F4-PC-SS-HS as presented in the drawings and installation details. Use the sprinkler manufacturer's pressure compensating screens (Rainbird PCS) to achieve 30 psi operating conditions on each sprinkler and to control excessive operating pressures.

4.4.16 DRIP IRRIGATION COMPONENTS

- A. Remote Control Valve (RCV) Assembly for Drip Laterals: as presented in the installation details. Use wire connectors and waterproofing sealant to join control wires to solenoid valves. Use standard Christy I.D. tags with hot-stamped black letters on a yellow background. Install a separate valve box over a 3-inch depth of $\frac{3}{4}$ inch gravel for each assembly.
- B. Combination Pressure Regulator / Filter Assembly: as presented in the installation details. Install a separate valve box over a 3-inch depth of $\frac{3}{4}$ inch gravel for each assembly.
- C. Zone Control Valve Assembly: as presented in the installation details. Install a separate box over a 3-inch depth of $\frac{3}{4}$ inch gravel for each assembly.
- D. Air/Vacuum Relief Valve Assembly: as presented in the installation details. Install at finish grade at high point of each Techline grid layout.
- E. Line Flushing Valve Assembly: as presented in the installation details. Install a separate box over a 3-inch depth of $\frac{3}{4}$ inch gravel for each assembly.

4.4.17 CONTROL SYSTEM COMPONENTS

A. Irrigation Controller Unit::

1. As presented in the drawing specifications and installation details.
2. Lighting protection: Provide 8-foot copper-clad grounding rod at controller location. Use American Wire Gauge No. 6 bare copper wire between the controller and grounding rod assembly.
3. Wire Markers: Pre-numbered or labeled with indelible non-fading ink, made of permanent, non-fading material.
4. Switch/Outlet: Use 120 VAC, 15 amp combination switch / GFCI outlet.

B. Control Wire:

1. Use American Wire Gauge (AWG) No. 14-1 solid copper, Type UF or PE cable, UL approved for direct underground burial for individual control wires and spare wires from the controller unit to each remote control valve or stub-out location. Use American Wire Gauge (AWG) No. 12-1 solid copper, Type UF or PE cable, UL approved for direct underground burial for common ground wire from the controller unit to each remote control valve or stub-out location. Contractor will run electrical power to irrigation controller from the nearest approved power source.
2. Contractor will pour concrete pad that provides a minimum collar of concrete around the irrigation controller at least 6 inches wide and set irrigation controller in the center of the concrete pad.
3. Color: Wire color shall be continuous over its entire length. Install low voltage wires using the following color coding:

Controller "A" control Wires	Red
Controller "A" common wire	White/Red stripe
Controller "B" control wires	Orange
Controller "B" common wire	White/Orange stripe
Spare wires from master valve locations to future stub-out locations	Green
Spare control wires along wire routing from each controller	Yellow
Spare common wires along wire routing from each controller	Yellow / Blue stripe

Splices: Use wire connector with waterproof sealant. 3M DBY. Contractor will label valve wires:

Valve wires	Red
Common wires	White
Spare wires	Yellow
Master valve wire	Blue
Flow meter wire	Orange

4. Mark wire routing not located near PVC irrigation pipe with warning tape as described in these specifications. Contractor will hook valve wires to controller. Four spare wires are needed to run from barmaid master valve to Controller "B". These four wires need to be two different colors. Contractor must numerically label all valve wires.

5. Warning tape: Inert plastic film highly resistant to alkalis, acids or other destructive chemical components likely to be encountered in soils. Three inches wide, colored red, and imprinted with "CAUTION: BURIED ELECTRIC LINE BELOW."
- C. Existing Control Wire: It is assumed that existing low voltage control wire between existing controller and solenoid valves is in workable condition. Field verify quantity, location and proper operation prior to construction. Any concerns are to be brought to the attention of the Owner's Representative prior to installation of the replacement controller.
- D. Controller Enclosure:
 1. As presented conceptually in the installation details or noted in the special conditions.
 2. Constructed of stainless steel with free-flow ventilation. The key system is to be common to all enclosures made part of this project.
 3. Prepare shop drawings to show the exact placement of all components housed in the enclosure.
 4. Electrical conduit: Use PVC Schedule 40 conforming to the dimensions and tolerances established by ASTM Standard D-1 785.
 5. Lightning protection: Provide 8-foot copper-clad grounding rod at each controller location.
 6. Wire markers: Pre-numbered or labeled with indelible non-fading ink, made of permanent, non-fading material.
- E. Power Wire:
 1. Electric wire from the power source to controller shall be solid or stranded copper, Type UF single conductor cable or multi-conductor with ground cable, UL approved for direct underground burial. Power wires shall be black, white and green in color. Size as presented in the drawings. The Contractor is responsible for verifying that the power wire sizes shown on the drawings are compatible and adequate for the control system being used.
 2. Splices: UL approved connectors.
 3. Conduit: PVC Schedule 40.
 4. Warning tape: Inert plastic film highly resistant to alkalis, acids or other destructive chemical components likely to be encountered in soils. Three inches wide, colored red and imprinted with "CAUTION: BURIED ELECTRIC LINE BELOW."

4.4.18 OTHER COMPONENTS AND MATERIALS:

- A. Tools and Spare Parts: Provide operating keys, servicing tools, test equipment, spare parts and other items indicated in the General Notes of the drawings.
- B. Sod and Fertilizer: Provide sod and fertilizer as required by the City of Craig and as described in these specifications.
- C. Other Materials: Provide other materials or equipment shown on the drawings or installation details which are part of the irrigation system, even though such items may not have been referenced in these specifications.

4.4.19 EXECUTION

4.4.20 INSPECTIONS AND REVIEWS:

- A. Site Inspections:
 - 1. Verify construction site conditions and note irregularities affecting work of this section. Report irregularities to the Owner's Representative prior to beginning work.
 - 2. Beginning work of this section implies acceptance of existing conditions.
- B. Utility Locates ("Call Before You Dig")
 - 1. Coordinate with Parks Representatives and all appropriate local authorities to arrange for the location and marking of all underground utilities.
 - 2. Repair any underground utilities damaged during construction. Make repairs at no additional cost to the contract price.
- C. Irrigation System Layout Review: Irrigation system layout review will occur after the staking of sprinkler head locations and Techline grid alignments have been completed. Notify the Owner's Representative one week in advance of review. Modifications will be identified by the City's Representative at this review.

4.4.21 LAYOUT OF WORK:

- A. Stake out the irrigation system. Items staked include: sprinklers, Techline grid alignment, sleeving, mainline and lateral line pipes, control valves, line flushing valves, air/vacuum relief valves, controllers, and isolation valves.
- B. Install all mainline pipe and mainline components inside of project property lines.

4.4.22 EXCAVATION, TRENCHING, BACKFILLING AND SOD REPLACEMENT:

- A. Excavate to permit the pipes to be laid at the intended elevations and to permit work space for installing connections and fittings.
- B. Minimum cover (distance from top of pipe or control wire to finish grade):
 - 1. 36" over mainline pipe and over electrical conduit.
 - 2. 36" over control wire.
 - 3. 15" over lateral pipe to sprinklers and over supply header lateral pipe to drip system riser connections.
 - 4. Netafin Techline dripperline grids shall be installed directly on the soil surface and secured to grade with approved stakes.
- C. Backfill only after lines have been reviewed and tested.
- D. Excavated material is generally satisfactory for backfill. Backfill shall be free from rubbish, vegetation matter, frozen materials and stones larger than 2-inches in maximum dimensions. Remove material not suitable for backfill. Backfill placed next to pipe shall be free of sharp objects which may damage the pipe.
- E. Backfill unsleeved pipe and sleeves in either of the following manners:

1. Backfill and puddle the lower half of the trench. Allow to dry 24 hours. Backfill the remainder of the trench in 6-inch layers. Compact to density of surrounding soil.
 2. Backfill the trench by depositing the backfill material equally on both sides of the pipe in 6-inch layers. Compact to density of surrounding soil.
- F. Enclose pipe and wiring beneath roadways, walks, curbs and other hardscape conditions in sleeves. Minimum compaction of backfill for sleeves shall be 95% Standard Proctor Density, ASTM D698-78. Use of water for compaction around sleeves, "puddling", will not be permitted.
- G. Dress backfilled areas to original grade. Dispose of excess backfill off site.
- H. Where utilities conflict with irrigation trenching and pipe work, contact the City's Representative for trench depth adjustments.
- I. Any and all turf grass areas disturbed during the construction process shall be repaired as follows:
1. At any location where it is necessary to cross over a sidewalk or any other concrete or asphalt areas, every effort shall be made to protect said concrete and/or asphalt from damage. In the event that any concrete or asphalt does become damaged, it is the responsibility of the Contractor to repair or replace the damage.
 2. All affected areas will have sod removed, with a sod cutter or other appropriate equipment to provide a uniform edge for sod replacement. All stripped sod shall be removed from the site and properly disposed of.
 3. Fill soil added to raise the soil level in any area shall be placed in no greater than six inch (6") lifts and then compacted to eliminate future settling.
 4. These areas will then be rough graded. Clear the prepared area of clods, stones, wood, rubbish and all debris that will not pass through the tines of a garden rake, final approval by the City of Craig.
 5. The area should then be rolled to reduce future settling.
 6. The prepared areas should then be fertilized at the rate of twenty pounds per 1,000 square feet of 5-20-5 fertilizer. Submit manufacturer's analysis.
 7. Notify the City of Craig 24 hours prior to sodding to obtain approval of grade and sod bed prior to sodding. To avoid ponding, no tolerance in sod area grading is permitted. If determined by the City of Craig to be necessary the area will be regarded and/or fill dirt added to provide a smooth, even, uniform transition from the undisturbed areas to the disturbed areas.
 8. Sod shall be Colorado grown, 100% certified blended Kentucky Bluegrass of 3 to 4 types, or a mixture approved by the City of Craig, complying with applicable Colorado and Federal regulations, having a healthy root system, regularly fertilized, watered, mowed, sprayed and free from objectionable weeds and/or grasses. Sod strips shall have from 5/8" minimum to 1" maximum thickness of soil adhering to the root system, cut into strips 18" maximum width by 24" minimum length. Sod which has dried out, or sod with adhering soil which breaks, tears or crumbles away will not be accepted. Sod cut for more than twenty-four (24) hours will not be accepted. Sod rolls shall be kept moist, protected from sun, heat and wind, and properly protected in transport. The sod source shall be made known to and approved by the City of Craig after contract signing.

- 9. Sodding dates must be approved by the City of Craig.
- J. No plowing or pulling of pipe will be allowed.

4.4.23 SLEEVING AND BORING:

- A. Install sleeving at a depth which permits the encased pipe or wiring to remain at the specified burial depth.
- B. Extend sleeve ends six inches beyond the edge of the paved surface. Cover pipe ends and mark with stakes.
- C. Bore for sleeves under obstructions which cannot be removed. Employ equipment and methods designed for horizontal boring. At locations where pavers are installed and set in sand base, remove the pavers and sand for surface trenching of sleeving and conduit crossings. Reset sand and pavers after backfilling sleeve or conduit to original condition as directed by City's Representative.

4.4.24 ASSEMBLING PIPE AND FITTINGS:

- A. General:
 - 1. Keep pipe free from dirt and pipe scale. Cut pipe ends square and debur. Clean pipe ends.
 - 2. Keep ends of assembled pipe capped. Remove caps only when necessary to continue assembly.
 - 3. Trenches may be curved to change direction or avoid obstructions within the limits of the curvature of the pipe. Minimum radius of curvature and offset per 20 foot length of pipe by pipe size are shown in the following table. All curvature results from the bending of pipe lengths. No deflection will be allowed at a pipe joint.

RADIUS	OFFSET PER 20' LENGTH
25'	7' – 8"
25'	7' – 8"
100'	1' – 11"
100'	1' – 11"
100'	1' – 11"

B. Mainline Pipe and Fittings:

1. Use only strap-type friction wrenches for threaded plastic pipe.
2. PVC Solvent Weld Pipe:
 - a. Use primer and solvent cement. Join pipe in a manner recommended by the manufacturer and in accordance with accepted industry practices.
 - b. Cure for 30 minutes before handling and 24 hours before allowing water in pipe.
 - c. Snake pipe from side to side within the trench.
3. Fittings: The use of cross type fittings is not permitted.

C. Lateral Pipe and Fittings:

1. Use only strap-type friction wrenches for threaded plastic pipe.
2. PVC Solvent Weld Pipe:
 - a. Use primer and solvent cement. Join pipe in the manner recommended by the manufacturer and in accordance with accepted industry practices.
 - b. Cure for 30 minutes before handling and 24 hours before allowing water in the pipe.
 - c. Snake pipe from side to side within the trench.
3. Techline Dripline Pipe:
 - a. Join pipe in the manner recommended by manufacturer and in accordance with accepted industry practices.
 - b. Hold in place with tubing stakes or landscape fabric staples spaced every four feet. Pipe is not to be compressed or crimped by the stake or staple or other construction activity.
4. Fittings: The use of cross type fittings is not permitted.

D. Specialized Pipe and Fittings:

1. Low Density Polyethylene Hose: Install per manufacturer's recommendations.
2. No galvanized pipe will be allowed.
3. PVC Threaded Connections:
 - a. Use only factory-formed threads. Field-cut threads are not permitted.
 - b. Use only Teflon-type tape or Teflon based paste.
 - c. When connection is plastic-to-metal, the plastic component shall have male threads and the metal component shall have female threads.
5. Make metal-to-metal, threaded connections with Teflon-type tape or pipe joint compound applied to the male threads only.

E. Thrust Blocks:

1. Use cast-in-place concrete bearing against undisturbed soil.
2. Size, orientation and placement shall be as shown on the installation details.

3. Wrap fitting with plastic to protect bolts, joint and fitting from concrete.
 4. Install rebar with mastic coating as shown on the installation details.
- F. Joint Restraint Harness: Install harness in the manner recommended by the manufacturer and in accordance with accepted industry practices.

4.4.25 INSTALLATION OF MAINLINE COMPONENTS:

- A. Main System Shut Off Valve: Install where indicated on the drawings.
- B. Winterization Assembly: Install where indicated on the drawings.
- C. Master Valve Assembly: Install where indicated on the drawings.
- D. Isolation Gate Valve Assembly:
1. Install where indicated on the drawings.
 2. Locate at least 12-inches from and align with adjacent walls or edges of paved areas.
- E. Quick Coupling Valve Assembly: Install where indicated on the drawings.

4.4.26 INSTALLATION OF SPRINKLER IRRIGATION COMPONENTS:

- A. Remote Control Valve (RCV) Assembly for Sprinkler Laterals:
1. Flush mainline before installation of RCV assembly.
 2. Install where indicated on the drawings. Wire connectors and waterproof sealant shall be used to connect control wires to remote control valve wires. Install connectors and sealant per the manufacturer's recommendations.
 3. Install a ball valve in front of each valve. Install only one RCV to a valve box. Locate valve box at least 12-inches from and align with nearby walls or edges of paved areas. Group RCV assemblies together where practical. Arrange grouped valve boxes in rectangular patterns. Allow at least 12-inches between valve boxes.
 4. Adjust RCV to regulate the downstream operating pressure.
 5. Attach ID tag with controller station number to control wiring.
 6. Brand all valve box lids with an approved number in a sequence that corresponds to the controller layout.
- B. Sprinkler Assembly:
1. Flush lateral pipe before installing sprinkler assembly.
 2. Install per the installation details at locations shown on the drawings.
 3. Locate rotary sprinklers 6-inches from adjacent walls, fences or edges of paved areas.
 4. Locate spray sprinklers 3-inches from adjacent walls, fences or edges of paved areas.
 5. Install sprinklers perpendicular to the finish grade.
 6. Supply appropriate nozzle or adjust arc of coverage of each sprinkler for best performance.
 7. Adjust the radius of throw of each sprinkler for best performance.

4.4.27 INSTALLATION OF DRIP IRRIGATION COMPONENTS:

- A. Remote Control Valve (RCV) Assembly for Drip Laterals:
 - 1. Flush mainline pipe before installing RCV assembly.
 - 2. Locate as shown on the drawings. Wire connectors and waterproof sealant shall be used to connect control wires to remote control valve wires. Connectors and sealant shall be installed as per the manufacturer's recommendations.
 - 3. Install only one RCV to valve box. Locate at least 12-inches from and align with nearby walls or edges of paved areas. Group RCV assemblies together where practical.
 - 4. Arrange grouped valve boxes in rectangular patterns.
- B. Zone Control Valve Assembly: Install at locations shown on the drawings.
- C. Techline Emitter Grid Layout:
 - 1. Locate as shown on the drawings and installation details.
 - 2. Flush lateral supply header pipe before installing Techline grid.
 - 3. Use tools and techniques recommended by the manufacturer.
- D. Air/Vacuum Relief Valve Assembly: Install at the high point of each Techline grid layout as shown on the installation details.
- E. Line Flushing Valve Assembly: Install at the end of each Techline grid layout as shown on the installation details.

4.4.28 INSTALLATION OF CONTROL SYSTEM COMPONENTS:

- A. Irrigation Controller Unit:
 - 1. The location of the controller unit as depicted on the drawings is approximate; the City's Representative will determine the exact site location upon commencement of contract.
 - 2. Lightning protection: Provide grounding components such as ground rod assembly, grounding wire, etc., in accordance with manufacturer's recommendations. Drive 8-foot copper-clad grounding rod into the soil. If rock prevents driving, bury at least four feet deep. Use one ground rod assembly for each controller. Connect controller to grounding rod with AWG No. 6 solid conductor copper wire. Secure wire to grounding rod with approved Calweld Brand Connectors or approved equal.
 - 3. Install primary surge protection arrestors on incoming power lines.
 - 4. Identifying wire and valve box lids numbering will be in sequential order of our Motorola system furnished by the City and given to the Contractor prior to installation. Contractor will pour pad for Motorola controller and strong box for backflow device. Template will be supplied by the City.
 - 5. Attach wire markers to the ends of control wires inside the controller unit housing. Label wires with the identification number (see drawings) of the remote control valve to which the control wire is connected.
 - 6. Install combination switch / GFCI outlet inside the controller enclosure.
 - 7. Connect control wires to the corresponding controller terminal.
- B. Control Wire:

1. Bundle control wires where two or more are in the same trench. Bundle with pipe wrapping tape spaced at 10-foot intervals. Do not tape wire together where contained within sleeving or conduit.
2. Provide a 24-inch excess length of wire in an 8-inch diameter loop at each 90 degree change of direction, at both ends of sleeves and at 100-foot intervals along continuous runs of wiring. Do not tie wiring loop. Coil 30-inch length of wire within each remote control valve box.
3. Install common ground wire and one control wire for each remote control valve. Multiple valves on a single control wire are not permitted.
4. If a control wire must be spliced, make splice with wire connectors and waterproof sealant, installed per the manufacturer's recommendations. Locate splice in a valve box which contains an irrigation valve assembly, or in a separate 10-inch round valve box. Use same procedure for connection to valves as for in-line splices.
5. Unless noted on plans, install wire parallel with and below PVC mainline pipe.
6. Protect wire not installed with PVC mainline pipe with a continuous run of warning tape placed in the backfill six inches about the wiring.

C. Power Wire:

1. Route power wire as directed on plans. Install with a minimum number of field splices. If a power wire must be spliced, make splice with recommended connector, installed per manufacturer's recommendations. Locate all splices in a junction box in accordance with local codes. Contractor will set Motorola controller on concrete pad and supply 11 electrical power to controller from the nearest approved power source.
2. All power wire shall be laid in trenches. The use of a vibratory plow is not permitted.
3. Green wire shall be used as the common ground wire from power source to all satellites.
4. Carefully backfill around power wire to avoid damage to wire insulation or wire connectors.
5. Encase power wire in electrical conduit with a continuous run of warning tape placed in the backfill, 6-inches above the wiring.

4.4.29 INSTALLATION OF OTHER COMPONENTS:

- A. Tools and Spare Parts: Prior to the review at completion of construction, supply to the Owner operating keys, servicing tools, spare parts and any other items indicated in the General Notes on the drawings.
- B. Other Materials: Install other materials or equipment shown on the drawings or installation details which are part of the irrigation system, even though such items may not have been referenced in these specifications.

4.4.30 PROJECT RECORD (AS-BUILT) DRAWINGS:

- A. The Contractor is responsible for documenting changes to the design. Maintain on-site and separate from documents used for construction, one complete set of contract documents as Project Documents (Record Drawings). Keep documents current. Do not permanently cover work until as-built information is recorded.

- B. Record pipe and wiring network alterations. Record work which is installed differently than shown on the construction drawings. Record accurate reference dimensions, measured from at least two permanent reference points, of each irrigation system valve, each controller or control unit, each sleeve end, each stub-out for future pipe or wiring connections and other irrigation components enclosed within a valve box.
- C. Prior to acceptance, Record drawings shall be provided to the City Engineer in electronic format including PDF, ACAD and GIS.

4.4.31 WINTERIZATION AND SPRING START-UP:

Winterize the irrigation system in the fall and start-up the irrigation system in the spring of the first year following final approval of construction. Repair any damage caused by improper winterization at no additional cost to the City. Coordinate the winterization and start-up with the landscape maintenance personnel.

4.4.32 MAINTENANCE:

- A. Upon completion of construction and review by the City's Representative, maintain irrigation system for a duration of 30 calendar days. Make periodic examinations and adjustments to irrigation system components so as to achieve the most desirable application of water.
- B. Following completion of the Contractor's maintenance period, the City will be responsible for maintaining the system in working order during the remainder of the guarantee warranty period, for performing necessary minor maintenance, for trimming around sprinklers, for protecting against vandalism, and for preventing damage after the landscape maintenance operation.

4.4.33 CLEANUP:

Upon completion of work, remove from the site all machinery, tools, excess materials, and rubbish.

END OF SECTION

SECTION 4.5
CONSTRUCTION MATERIALS AND METHODS
PLANT LANDSCAPING

4.5.1 GENERAL

Fertilizing, seeding, mulching, sodding, planting or transplanting of trees, shrubs, or other plants required to provide landscaped areas for the City shall be supplied and installed using current approved horticultural practices, these specifications and the contract documents.

4.5.2 MATERIALS

Materials to be incorporated into the landscaped areas shall conform to the minimum standards hereinafter referred to in the following (or approved equals).

4.5.3 SHRUBS, TREES AND OTHER PLANTS

Plants shall be healthy representatives of the specified species or variety with well-developed branch and root systems that are free of all objectionable features, diseases and insect pests. The minimum sizes and/or heights of all plants will be specified in the bid documents. Plant materials shall be measured as indicated in the plans by container size, height, and/or caliper. Caliper is the measured diameter of the tree at a six-inch height above the root ball. In trees above three inches in diameter the caliper measurement is made at a height of twelve inches above the root ball of the tree.

The contractor's successful procurement arrangements for all plant material shall be evidenced by his/her act of submitting a Bid Proposal.

- A. Planting Pit Backfill – Backfill for each planting pit will be an improved soil consisting of three parts on-site topsoil and one-part sphagnum peat, thoroughly blended and free of inorganic foreign substances.
- B. Tree Wrap – The contractor will wrap each tree in crepe nursery wrap, spirally applied with one (1) inch overlap and double wrapped at top and bottom, as manufactured by Kraft of 3M. Waterproof tape will be used to hold the wrap in place.
- C. Plant Anchorage – Trees will be anchored by the use of double strands of twelve-gauge galvanized steel wire anchored to the plant through new or non-fractured garden hose. This wire will be attached to metal tee-posts. The number of stakes or posts and the specific methods of anchorage will be indicated in the plans or specifications.
- D. Soil Conditioners For Trees And Shrubs – The desired soil conditioner and fertilizer will vary per project. Consult plans and project specifications for specific application of mulches and soil mixes desired.
 - 1. Agriform planting tablets (twenty-one grams/tablet) containing a 20-10-5 NPK ratio, as manufactured by the Sierra Chemical Company.

2. Liquid commercial fertilizer containing a 20-30-10 NPK ratio and chelated iron applied in accordance with the Colorado Nurseryman's Association's recommendation on trees three (3) inches and larger in caliper.
3. Sphagnum peat certified to have a ph less than five and containing ninety-five percent organic matter when supplied to six to seven and one half cubic feet compressed bales.
4. Mountain peat shall have a ph less than six and one-half and contain a minimum of 50 percent organic matter, subject to specific testing and approval by the project manager prior to delivery.
5. Miracle Compost as manufactured by Majestic Mushroom Company, Golden, Colorado.

4.5.4 PLANTING PIT MULCH AND COVER.

- A. Tree pits shall be covered with an approved four (4) inch thick chipper chip, or designated mulch material, in seeded areas and sodded areas. Edging, if included, will be shown on the drawings.
- B. Shrub beds shall be covered with a four (4) inch compressed thickness of two to three inch long chipper chip or designated mulch material placed directly on the dirt around the plants. Edging, if included, will be shown on the drawings.
- C. Weed Barrier, a layer of approved filter fabric (Myrify, Typar, Trevira) will be used in shrub beds or tree pits if designated on the drawings.

4.5.5 GRASS MATERIALS.

All bluegrass seed shall be eighty percent "Baron" bluegrass and 20 percent "Pennfine" rye grass unless otherwise indicated in the plans, drawings or specifications. Other blends will not be allowed unless specifically called for in the special conditions.

- A. Seed – Seed shall be furnished in containers that are labeled in conformance with applicable state and federal regulations and showing at least the name and address of supplier, seed name, lot number, net weight, percent of seed content, guaranteed percent of purity and percent of germination. All seed furnished shall be free from noxious weed seeds. Containers whose contents become wet, moldy or otherwise damaged will not be acceptable. All seed labels will be received by the project manager prior to acceptance of the seeding. Final or finish grade will be accepted by the project manager prior to seeding.
- B. Sod – Sod produced from the type of seed previously described shall be live nursery-grown grass actively growing or capable of renewing growth after dormancy. Sod shall be free of all undesirable perennial or annual grasses, plants, stones or any other material detrimental to growth or future maintenance. Grass shall be mowed to a height of two inches in the field. The sod will be machine cut in rectangular sections having a minimum soil thickness of five-eighths of an inch and sized to allow lifting and rolling without breaking. No netting or other material can be used to lift new sod.
- C. Soil Conditioner for Grass or Sod. A commercial fertilizer certified as to containing an NPK ratio of 20-10-5 unless otherwise specified in the Special Conditions.

- D. Mulch for Seeded Grasses – Dyed wood cellulose fiber that is free of any substance which will inhibit germination or grass growth, will evenly disperse and suspend when agitated in water, will absorb water while allowing infiltration and when air dry will contain less than ten percent moisture especially at the time of delivery.

Cellulose fiber shall be supplied in packages, having a gross weight of 100 pounds or less and marked to show the air dry weight content.

- E. Topsoil – Loose, friable loam that is free from admixtures of subsoil, refuse, stumps, rocks, roots, brush, weeds or other material which would be detrimental to the proper development of vegetative growth.

4.5.6 TREE, SHRUB AND PLANT LANDSCAPING

Final or finish grade must be approved by the project manager prior to planting.

4.5.7 TRANSPLANTING OF PLANTS

Handling plants shall be done according to recognized standard practices at all times. Plants shall be properly dug, pruned, inspected and tagged. The root system will be kept moist and the plant protected from all adverse conditions until planting is complete.

Plants may be furnished in non-biodegradable containers, which must be removed prior to planting or with the root system balled and burlapped. Balling and burlapping must conform to the “American Standard for Nursery Stock” specifications. The plant ball shall be natural, not man-made, and used for handling the plant at all times. Plants having a trunk loosened from the root ball or a broken ball will be rejected.

All plants will be inspected and approved by the project manager on site before they are planted. The project manager or a designated representative will select and reject plants at the nursery, if possible. Leaders on central trunks will be healthy. All plants that are found to be stressed damaged, drying out, insect infested, diseased or otherwise failing to meet the specifications or which appear incapable of normal growth will be rejected. All trees and shrubs will be tagged for genus and species. Plants not tagged will be rejected.

Deciduous tree trunks shall be wrapped from the top of the ball to the first branch, after pruning, then tape with waterproof tape securely at top and bottom.

Locally grown trees not to exceed a six caliper inch trunk diameter will be machine transplanted. However, the lapsed time between digging and placing in the tree pit shall not exceed twelve hours.

4.5.8 PRUNING

All pruning will conform to currently approved horticultural practices. Pruning evergreens shall be limited to the removal of damaged or dead foliage. Other plants shall have all damaged or dead roots or branches pruned to slightly above the nearest healthy side bud, at an angle not to exceed 45 degrees from the remaining portion. Leaders shall not be pruned. Other pruning, as required by the project manager, may be required.

Within ten days prior to transplanting, locally grown deciduous trees and shrubs shall be pruned to reduce their foliage spread by one-third unless otherwise directed.

4.5.9 EXCAVATING FOR PLANTING PITS

Planting pits shall be flat bottomed, circular in outline and excavated with vertical sides. No glazed smooth holes will be accepted. The contractor will, at the request of the project manager, roughen the surfaces of the plant pits. Pits shall have a diameter eighteen (18) inches greater than the earth ball diameter for trees and twelve (12) inches greater than the earth ball diameter of bare root or container shrubs. A minimum layer of select backfill will be placed below the bottom of the earth ball or root system. The backfill will be at least nine (9) inches deep under trees and six (6) inches deep under shrubs. Areas to be planted with ground cover shall be suitable furrowed using select backfill to a depth of six (6) inches. Pits shall be free of underground obstructions such as pipes, wires, rock formation, debris or contaminants.

The contractor shall protect and maintain in service all existing underground utilities, sprinkler system equipment, piping and amenities or structures, whether or not shown on the drawings during the performance of the work. He/she shall adequately barricade any pit or hole which is to remain open in excess of four hours.

4.5.10 PLANTING TREES AND SHRUBS

Planting of trees, shrubs and other plants shall be done at a time of year that is favorable to plant growth and in accordance with good horticultural practice.

Excavation for planting shall not commence until the project manager has staked all plant pits or shrub beds. Under no circumstances shall plant material be installed which interferes with the operation or coverage of the sprinkler system equipment or which will be damaged by the irrigation spray.

Following excavation of the planting pit, the contractor shall place the specified depth of improved planting mix into the hole before setting any tree or shrub. Upright plants shall be set plumb. Prostrate plants shall be set at the same depth to the ground surface as originally grown. The ball of each tree shall be set so that the top of the ball is parallel to the slope of the plant bed.

In irrigated areas all deciduous trees will be planted two (2) inches above finished grade, evergreen trees will be placed with the top of the ball three (3) inches above finished grade. In non-irrigated areas, the top of the ball shall be surrounded by a saucer, the diameter of the plant pit, that will hold water; and the top of the ball will be set one (1) inch above ground level. All wire baskets or any synthetic material must be totally removed from the root ball of all plants. Remove all cord and peel burlap back from the top one third of the root ball. The wire and cord removed from each tree will be set to the side of the newly planted tree for inspection by the project manager.

During the setting of the plant, the contractor shall partially backfill the pit to within six (6) inches of finish grade by carefully placing and compacting as specified planting pit backfill around the ball of the plant. The plant shall then be fertilized by meeting Agriform tablets, equally spaced, eight (8) inches below finish grade. Four tablets shall be placed in the pits for each tree with a caliper three (3) inches and larger; three (3) tablets shall be placed in

the pits for each tree with a one and one-half (1/2) to two and one-half (2 ½) inch caliper. Shrubs shall have two (2) tablets each placed 180 degrees apart in the pit.

Following fertilization, the placement and gentle compaction of planting pit backfill around the ball shall continue until the hole is completely backfilled. Water shall then be placed in the pit by means of a water lance so that the hole is irrigated from the bottom upward.

When water has disappeared, the pit shall be filled with more Planting pit backfill until stabilized to the desired finish grade.

Trees shall then be anchored by means of stakes and wire. Stakes shall be metal tee-posts placed in u undisturbed soil outside the pits; and guy wires shall be anchored to above the first and second limb crotch of the tree. The guy wire will be threaded through rubber hose so that no wire contacts the tree. The wire shall then be tightened sufficiently by twisting the wire to anchor the tree in a true vertical plumb, allowing the plant one inch play in each direction. Two guy wires 180 degrees apart in an east-west orientation will be used for each tree two (2) inches in caliper or smaller.

4.5.11 MULCHING PLANT PITS

All single trees, clusters of trees and/or shrubs, including row patterns, shall be mulched with chipper chip shredded wood or designated mulch material. Mulch shall cover the tree pit around each tree and shrub. Shrub and ground cover beds shall be mulched unless otherwise stated or shown on the drawings.

4.5.12 GRASS LANDSCAPING

Prior to seeding or sodding and in accordance with the requirements of the applicable section of the City Standard Specifications, the area to be landscaped shall be cleaned, grubbed and graded to within one-half inch of finish grade.

All irregularities in the ground surface, except the saucers for trees and shrubs in rough grass seeding areas, shall be removed. Special measures shall be taken to eliminate all low spots and pockets that would trap water and to clear the area of one to one and one-half inch and larger rocks or other debris.

4.5.13 SEASON FOR PLANTING GRASS SEED

Seeding seasons in any calendar year shall be limited to those periods of time favoring a healthy growth of grass by accepted horticultural practices. Unless otherwise approved by the project manager, seeding shall be accomplished within the following time periods:

<u>Grass Area</u>	<u>Early Season</u>	<u>Late Season</u>
Sprinkler Irrigated	March 1 to April 15	September 1 to October 1
Non-Irrigated	March 1 to April 15	-----

Seeding shall not be performed during windy weather or when the ground is frozen or otherwise untellable. Seeding portions of the designated areas may be permitted before construction is complete in order to take advantage of the

4.5.14 BED PREPARATION FOR SEEDING OR SOD PLACEMENT

Commercial fertilizer (18-46-0 NPK) at the rate of 300 pounds per acre shall be applied and then be spread and tilled into the top two inches of the soil. The ground surface shall be graded and worked by hand, if necessary to within one-half inch of finish grade to prepare for seeding or sod placement. Areas to be seeded or sodded which are contiguous with curbs, sidewalks or other architectural structures shall be sloped and graded to a level growing season, with prior approval of the project manager. one inch lower than the structural surface grade, on the uphill side of the paved surface. On the downhill side of the structured surface, the finish grade, after seeding or sodding, will be flush with the top of the paved surface.

All areas that have set for any period of time after fertilizing, which become firm or leaked over for whatever reason, shall be retiled to a depth of one inch prior to seeding.

4.5.15 SEED PLANTING RATE

Seed shall be sown to provide the coverage of "Pure Live Seed" (PLS) mixture, as determined in accordance with the following formula:

$$\text{Lbs. (PLS)} = \text{lbs. seed} \times \% \text{ Purity} \times \% \text{ Germination}$$

4.5.16 PLANTING SEED

The contractor will seed over fertilized ground using approved mechanical power-drawn drills followed by packer wheels.

Fertilizer type and method of application may vary with each project. Consult the project plans and specifications for any modifications in the fertilization or bed preparation process.

The power-drawn drill shall be set to maintain a seed planting depth of one-fourth (1/4) inch. Seed sown by broadcast type seeders or by hand shall be "raked in" or otherwise covered with soil to a depth of one-quarter (1/4) inch. The hand-broadcasting method of seeding shall be limited to those areas not accessible by machine methods.

4.5.17 MULCHING SEEDED AREAS

Mulching seeded areas shall be accomplished by the hydraulic method using wood cellulose fiber mulch. Hydraulic mulching in slurry form shall be applied to all seeded areas. Proportionate quantities of water and other approved materials shall first be placed in the slurry tank and mix. Cellulose fiber mulch shall be added and mixing continued until the slurry is homogeneous. The slurry mixture shall then be uniformly spray applied at the rate of 1,400 pounds/acre over the designated area, using the color of the mulch as a metering agent. Hydraulic mulching shall not be performed in the presence of free surface water. Seed shall not be included in the hydraulic mulch. Mulch shall be Weyerhaeuser Silva-Fiore or approved equal.

Areas not properly mulched or damaged due to contractor's negligence, shall be repaired and remulched in an acceptable manner at the contractor's expense. Mulch removed by wind or water erosion prior to acceptance shall be reseeded and remulched by the contractor at his expense.

4.5.18 PLACING SOD

Sod placement may start after the sod bed or finished grade has been fertilized and prepared as previously specified. Special care shall be taken to prepare the surface to the specified elevations and to neatly rake the finished grade near fences, curbs, sidewalks, buildings, etc. Sod shall be transplanted within twenty-four hours after lifting, unless weather conditions prohibit normal operations. Sod shall be laid smoothly, edge to edge, perpendicular to slope, with staggered joints and pressed firmly into contact with the sod bed by tamping. All holes in the sod, frayed edges and missing strip corners shall be trimmed to straight lines and patches to completely fill all voids in the surface. Sod laid in slopes of 3:1 or greater will be secured with six (6) inch long wood stakes, as needed, until growth is established.

Once in place, the sodded area shall be lightly watered and rolled to insure full contact with the soil. After rolling, water shall continue until the added moisture penetrates the subsoil to a depth of not less than two inches.

Sod that becomes withered, moldy or yellow from heating, or has been allowed to dry out or freeze, will be rejected.

4.5.19 CARE AND MAINTENANCE

All trees, shrubs, other plant materials and seeded or sodded areas shall be cared for, watered, maintained and if necessary, barricaded and protected from damage from whatever cause until their acceptance. By the time of final inspection for acceptance, plant grower tags shall be removed. The landscaping shall be finally accepted for warranty and guaranteed by the contractor, after the following conditions have been met.

4.5.20 TREES, SHRUBS AND OTHER PLANTS

All plants shall be cared for, watered and maintained by the contractor until final project acceptance. The contractor shall not request an acceptance inspection until all plants that are dead or damaged due to his operation or vandalism or any other reason are replaced with like size and species.

4.5.21 SEEDED GRASS AREAS

Seeded areas shall be mowed to a two inch height at least once by the contractor. The contractor will otherwise maintain seed until there is an acceptable uniform plant growth. Areas that are not producing a uniform plant growth within five weeks following seeding shall be reseeded.

Unacceptable uniform plant growth shall be defined as scattered bare spots, greater than one square foot, exceeding three percent of the seeded area. However, for seeded areas under irrigation it shall also include producing a uniform plant growth to a height of two inches. Irrigated areas that are seeded late in the fall planting season which are not producing an acceptable uniform plant growth, as previously defined, shall be reseeded during the following spring planting season. If such a condition exists and the contractor has diligently pursued the performance of his work, the City, at its option, may extend the contract completion date and reduce the contract retainage. Retainage may be reduced to

less than five percent of the total contract amount but shall be at least double the estimated or contracted cost of obtaining the required growth in the indicated areas, plus those areas which are susceptible to damage by winter kill, washout or other causes.

4.5.22 SODDED AREAS

Sodded grass areas shall be watered as needed and mowed at least once, and otherwise maintained for a period of thirty days after transplanting the sod.

Any areas that fail to sustain a healthy growth of grass during this period or appear susceptible to negative drainage shall be reworked and resodded before acceptance by the contractor.

4.5.23 GUARANTEE AND WARRANTY OF PLANTS

The contractor will replace all plants which die during the two year warranty. Exception will be made for plants which die during this period due to vandalism or neglect. Replacement will be limited to one time only. Replacement materials will be identical in size and species to the original plants specified. Replacement materials will be high quality. The project manager reserves the right to reject any replacement materials not meeting City or Craig standards.

Contractor agrees to replace dead plants within two weeks after notification by the project manager. The project manager will maintain an accurate copy of the planting plan indicating which specimens were removed and/or replaced.

SECTION 4.6

STREET CLASSIFICATION GUIDE

PART 1 FUNCTIONAL CLASSIFICATION

- A. The width, street configuration, alignment, and design speed of a street is related to its functional classification. For the purpose of these guidelines, the following functional classifications shall apply.
1. Alley: A roadway, usually unnamed, which primarily provides secondary vehicle access to the rear entrance of abutting property
 2. Arterial: A street that provides a network connecting vehicles and transit to areas beyond Craig. They accommodate heavy vehicular movement, including residential, commercial, and transit trips. They also accommodate low to moderate pedestrian movement, moderate bicycle movement, and moderate to heavy transit movements. When surrounding uses are in close proximity to the street, the arterial will include curb and gutter. With larger setbacks and access controls, shoulders and drainage swales are appropriate. An arterial may have access and traffic control devices.
 3. Bikeway: A street that incorporates designated bicycle lanes within the roadway to allow for commuter bicycle circulation.
 4. Collector Street: A street that primarily provides movement between local streets and streets of higher classification and, secondarily, provides access to abutting property. It accommodates low-to-moderate vehicular movement, low to heavy pedestrian movement, moderate to heavy bicycle movement, and low to moderate transit movement. It has on-street parking, street trees, traffic safety street lighting, and sidewalks. It may also include landscaping, and pedestrian-scale lighting.
 5. Local Residential Street: A street that provides direct access to abutting residential property. It carries low vehicular movement, low to heavy pedestrian movement, and low to moderate bicycle movement. On street parking, street trees, and sidewalks should be provided. Traffic safety street lighting may be appropriate at intersection and pedestrian crossings.
 6. Industrial Street: An industrial street provides direct access to abutting properties where the dominate land use is light industrial or industrial based mixed uses. Traffic includes a higher than normal amount of truck movement. Street widths are wider to accommodate a range of vehicle sizes.
 7. Private Streets: A street that provides only direct access to abutting property and carries low vehicular movement. It may also provide for low to heavy pedestrian movement, and low to moderate bicycle movement. It has the same overall standards, design and construction as a public street, with the exception that the responsibility for maintenance is private.
 8. Rural Collector Road: A road in an agricultural or open space setting that primarily provides movement between rural local and collector roads and roads or streets of higher classification. It secondarily provides access to abutting property. It carries low to moderate vehicular movement, low pedestrian movement, and low to moderate bicycle movement. It may include traffic safety street lighting and underground utilities.
 9. Transitway: A street that provides for moderate to heavy transit movement and moderate to heavy pedestrian movement, along with traffic for other land uses including commercial retail and mixed uses. Passenger amenities, including way

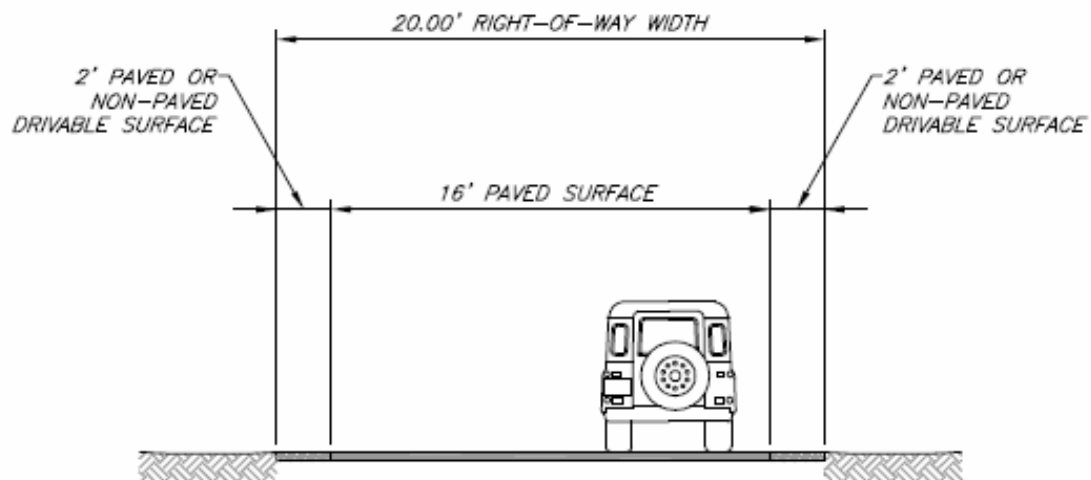
finding signs and shelters, should be provided. It has wide sidewalks, street trees, traffic safety measures, and street lighting.

PART 2 STREET IMPROVEMENT POLICIES AND STANDARDS

1. The design standards provided in this Public Works Manual are intended to:
 - a. accommodate traffic volumes at reasonable speed and
 - b. minimize the short and long term expense associated with street maintenance and construction.
2. All new streets in Craig, whether public or private, shall comply with the street design standards in the Public Works Manual.
3. When an existing street that does not comply with the design standards in the Public Works Manual will be substantially improved or rebuilt, efforts should be made to bring the street into compliance with the applicable standards in this Manual.
4. When various dimensions are referenced in this manual that can be applied to a new or existing street, the City shall determine the specific dimension that shall be used based on the volume of traffic anticipated, the type of vehicles that will likely use the street, and the intensity of the adjacent land use.
5. All streets shall include a 20 foot minimum drivable surface to accommodate fire apparatus and emergency vehicles.
6. Notwithstanding the standards in this manual, the total unobstructed road section width adjacent to buildings exceeding 30 feet in height shall be a minimum of 26 feet to accommodate aerial fire apparatus.
7. Each intersection design radius shall allow for a minimum of a 33 foot inside turn radius and a 45 foot outside radius to accommodate fire apparatus. Other radii may be required if the intersections are on a bus or truck route within the community.
8. Transitions from the Montezuma County minimum lane width to Craig streets shall require a design solution that successfully transition to the reduced City standards provided in this manual. The City shall determine the most appropriate means to make the transition.
9. Diagonal on street parking shall increase the parking dimension from 8 feet to 19 feet.

DESIGN STANDARDS:

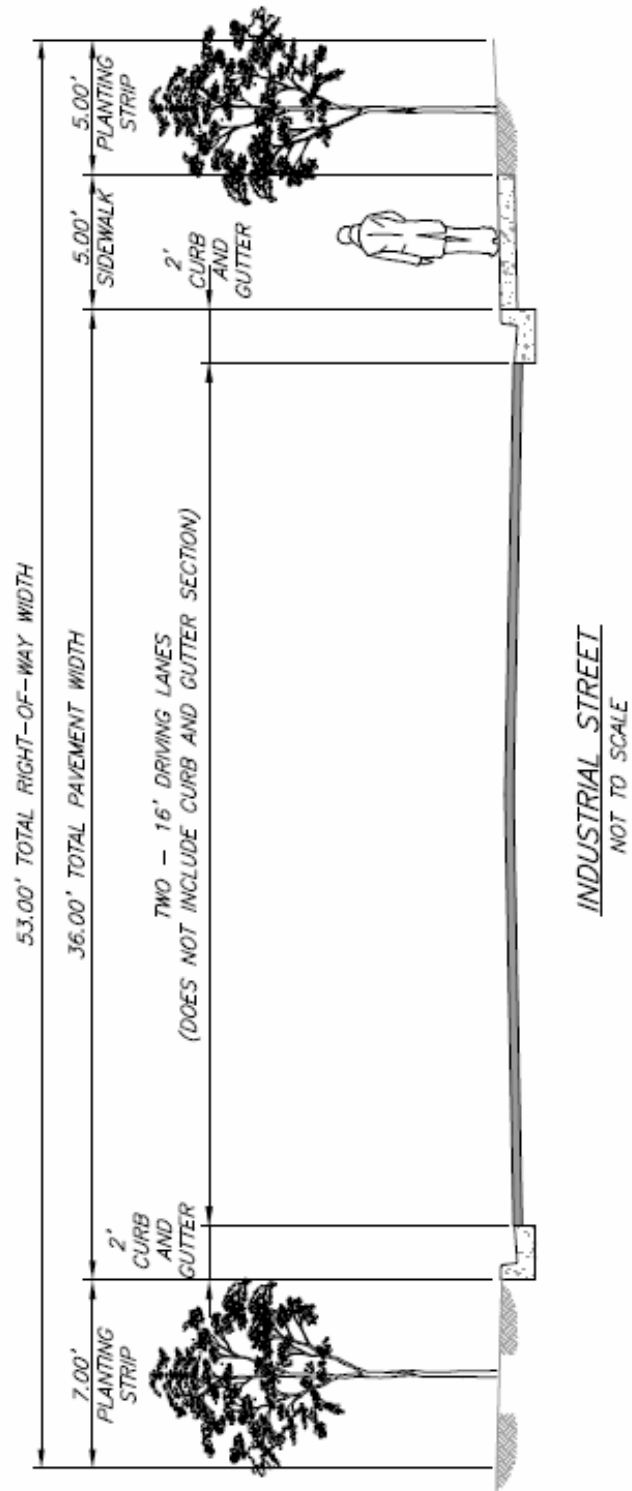
1. AN ALLEY CONNECTS TWO "DIFFERENT" LOCAL STREETS.
2. PARKING IS NOT ALLOWED WITHIN THE ALLEY RIGHT-OF-WAY.
3. WHEN AN ALLEY IS PRESENT, ACCESS TO ADJACENT PROPERTIES SHALL ONLY BE THROUGH THE ALLEY.
4. TREES ARE ENCOURAGED BETWEEN DRIVEWAY APRONS ADJACENT TO ALLEY RIGHT-OF-WAY.
5. INTERSECTION RADIUS DESIGN SHALL ALLOW ROLLOVER CURB FOR LARGE TRUCKS AND EMERGENCY VEHICLES — 33 FOOT INSIDE RADIUS AND 45 FOOT OUTSIDE RADIUS FOR FIRE TRUCKS.

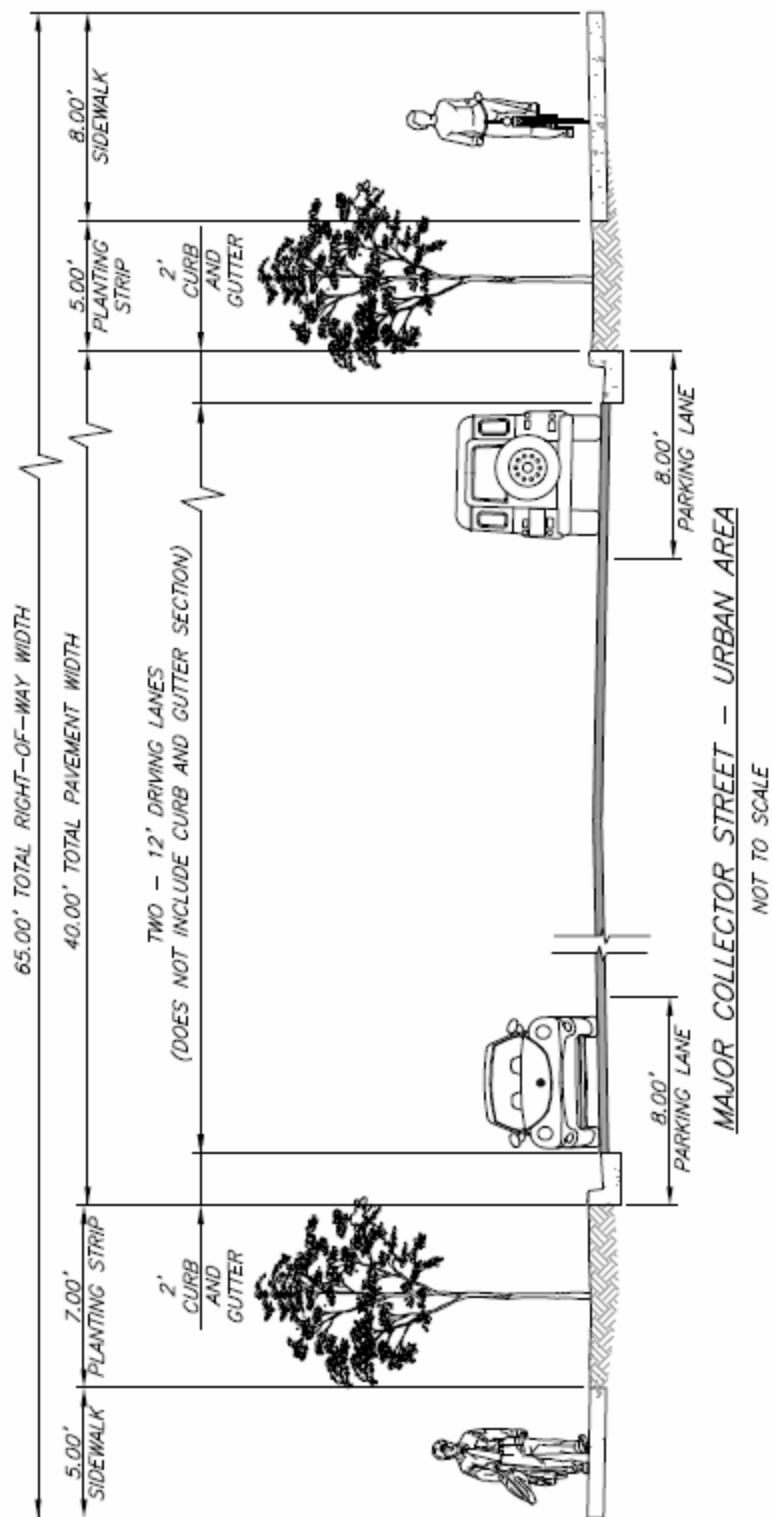


ALLEY — URBAN AREA
NOT TO SCALE

DESIGN STANDARDS:

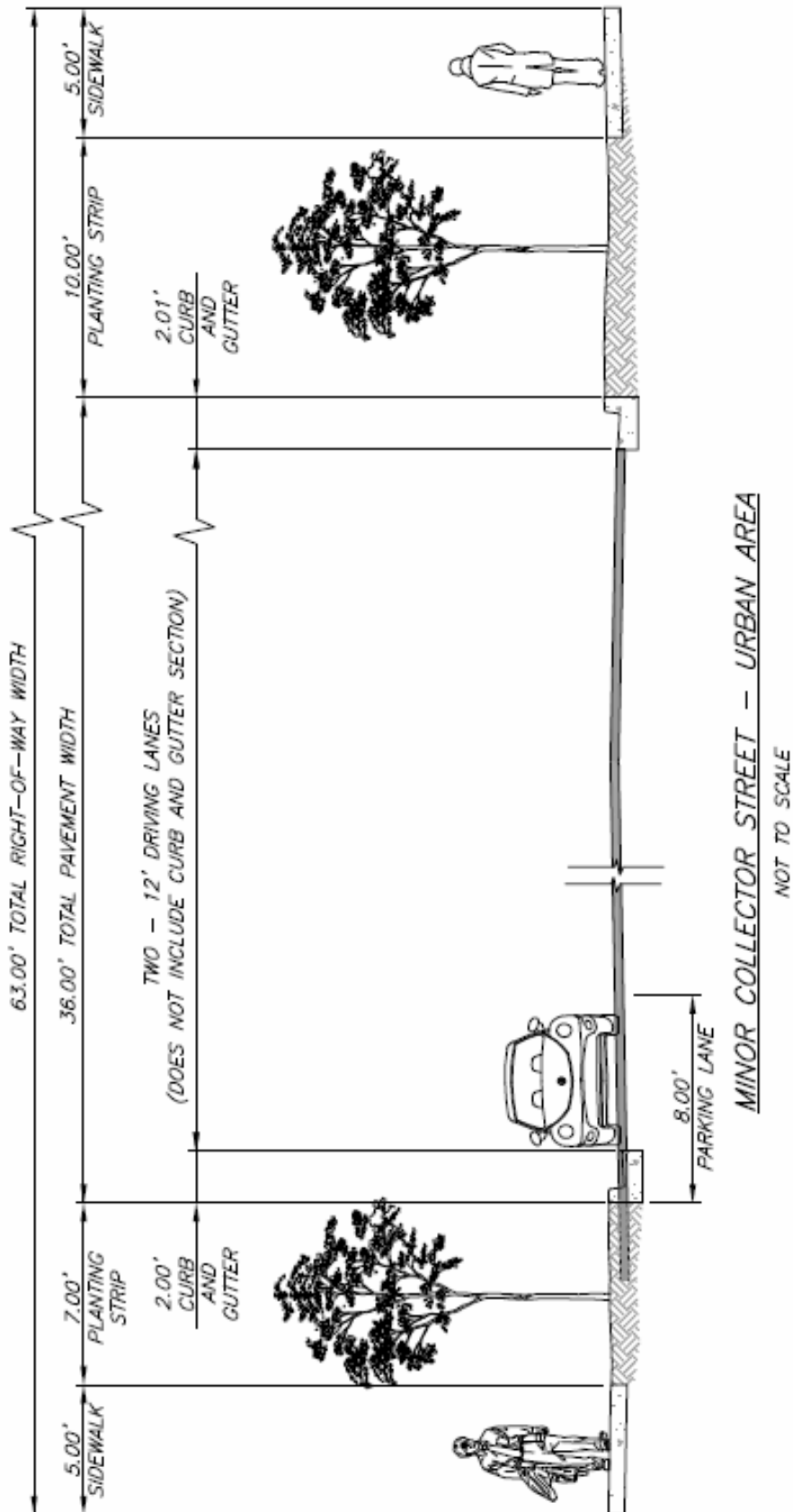
1. PARKING ON STREET NOT ALLOWED.
2. PLANTING STRIPS TO ACCOMMODATE SNOW STORAGE TO EXTENT POSSIBLE.
3. INTERSECTION RADIUS DESIGN SHALL ALLOW ROLLOVER CURB FOR LARGE TRUCKS AND EMERGENCY VEHICLES — 33 FOOT INSIDE RADIUS AND 45 FOOT OUTSIDE RADIUS FOR FIRE TRUCKS.





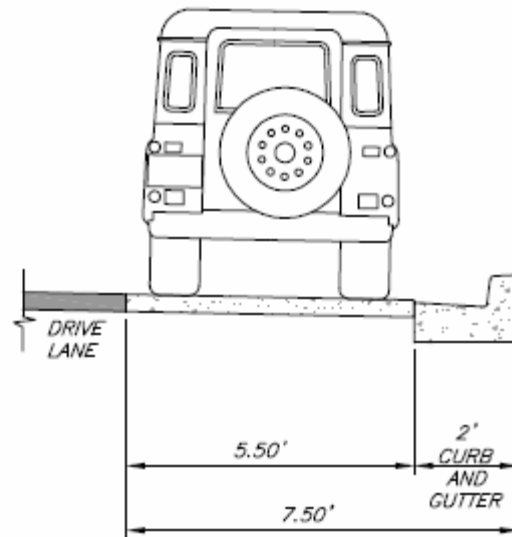
DESIGN STANDARDS:

1. MAJOR COLLECTORS REQUIRED FOR HIGHER VOLUME ROUTES AND AREAS WITH MORE INTENSE ADJACENT COMMERCIAL AND MIXED LAND USES.
2. PARKING ALLOWED ON BOTH SIDES OF THE STREET.
3. SIDEWALKS ON ONE SIDE OF THE STREET SHOULD BE WIDER TO ALLOW BIKES TO TRAVEL OUT OF THE LANE OF TRAFFIC, WHICH MAY BE REDUCED TO FIVE FEET IF A BIKEWAY IS PROVIDED AND THE RIGHT-OF-WAY IS ADJUSTED ACCORDINGLY.
4. SNOW STORAGE WILL BE TO CENTER OF THE DRIVE LANES.
5. WINTER PARKING RESTRICTIONS MAY BE REQUIRED.
6. INTERSECTION RADIUS DESIGN SHALL ALLOW ROLLOVER CURB FOR LARGE TRUCKS AND EMERGENCY VEHICLES - 33 FOOT INSIDE RADIUS AND 45 FOOT OUTSIDE RADIUS FOR FIRE TRUCKS.



DESIGN STANDARDS:

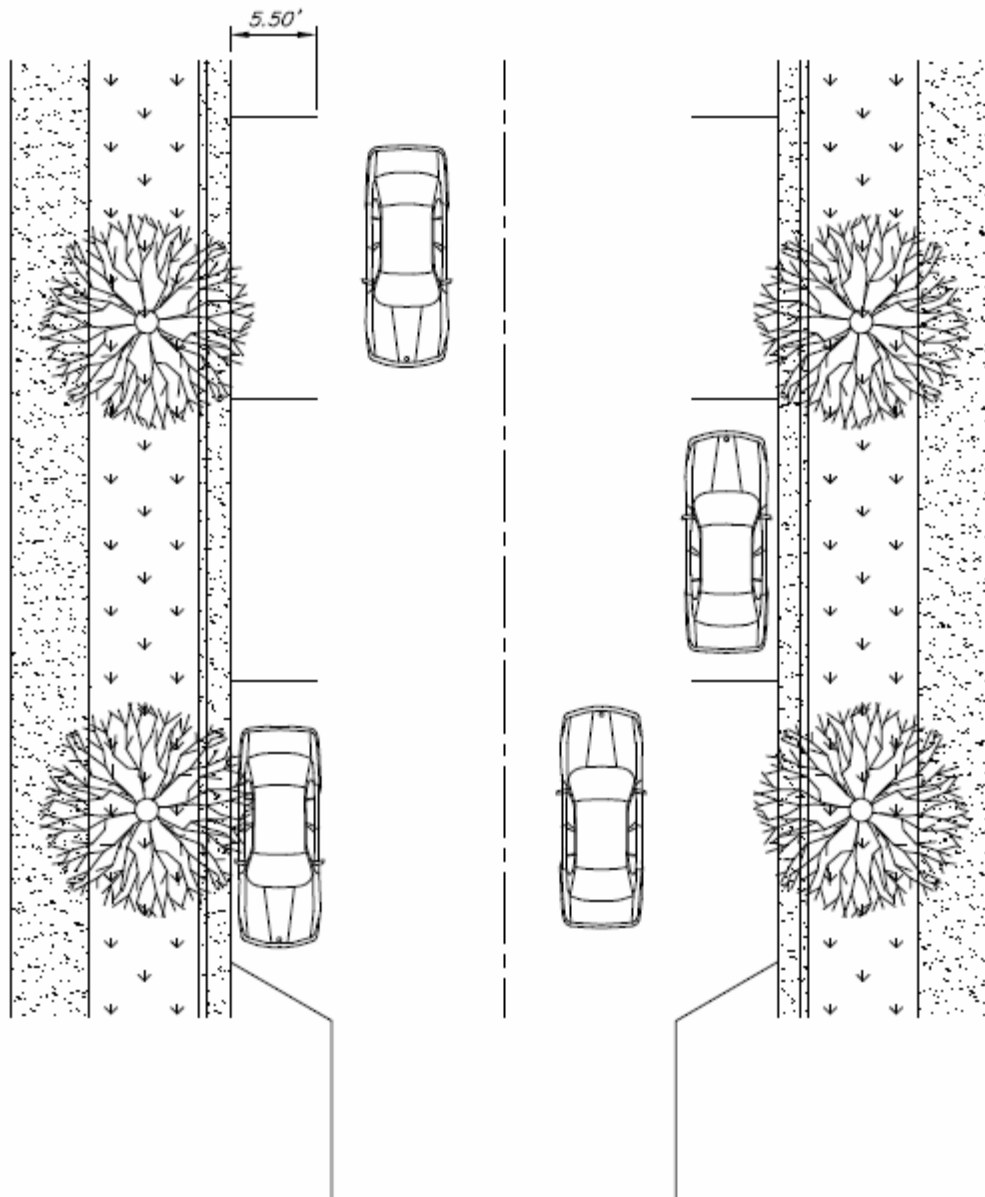
1. MINOR COLLECTORS RESTRICTED TO LOWER VEHICLE VOLUME ROUTES AND AREAS OF LESS INTENSE



ON-STREET PARALLEL PARKING DESIGN
NOT TO SCALE

DESIGN STANDARDS:

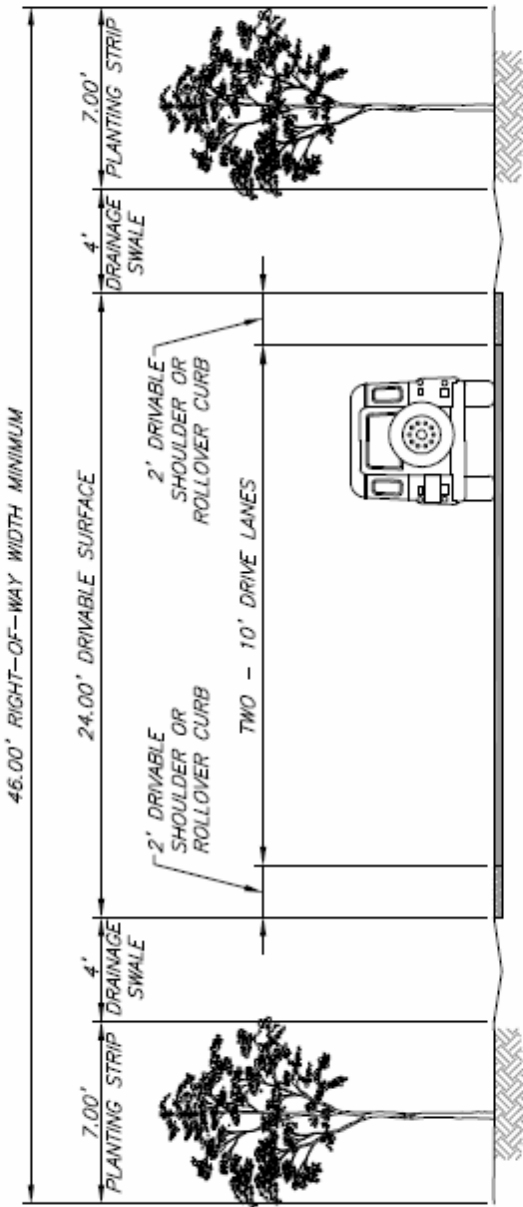
1. *STREET, SIDEWALK, AND PLANTING STRIP DIMENSIONS SHALL COMPLY WITH STANDARDS FOR SPECIFIC STREET TYPE.*



ON-STREET PARALLEL PARKING DESIGN
NOT TO SCALE

ADDITIONAL STANDARDS:

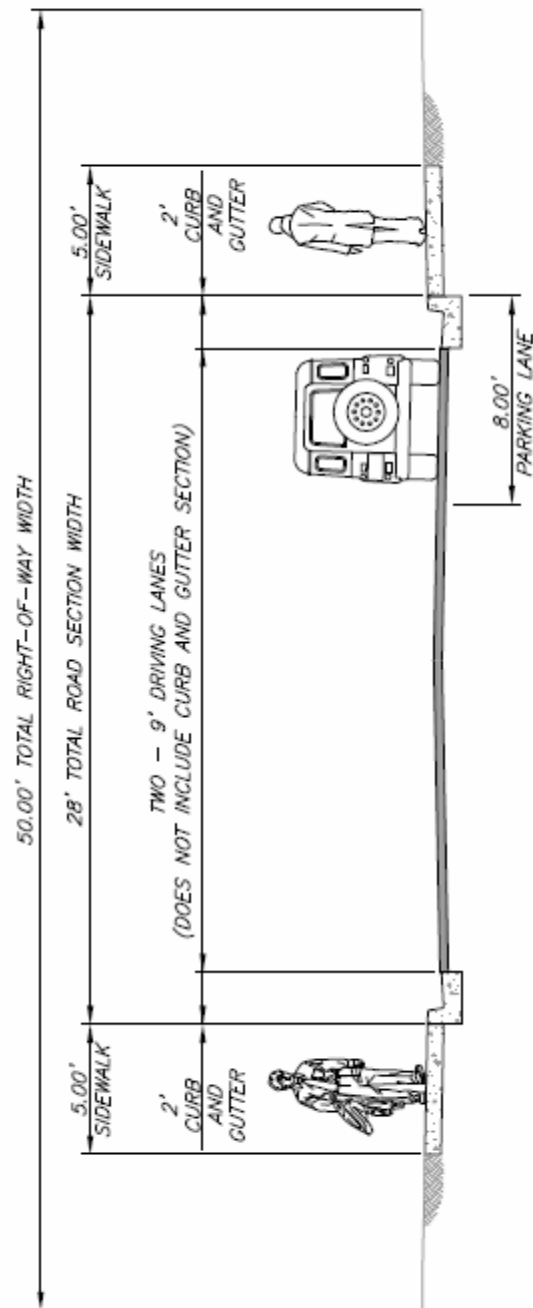
- 1. A DETACHED 5 TO 8 FOOT PATH MAY BE REQUIRED ON ONE SIDE OF THE STREET, INCREASING RIGHT-OF-WAY WIDTH ACCORDINGLY.
- 2. NO ON-STREET PARKING ALLOWED.
- 3. INTERSECTION RADIUS DESIGN SHALL ALLOW ROLLOVER CURB FOR LARGE TRUCKS AND EMERGENCY VEHICLES – 33 FOOT INSIDE RADIUS AND 45 FOOT OUTSIDE RADIUS FOR FIRE TRUCKS.



COLLECTOR STREET – RURAL RESIDENTIAL
NOT TO SCALE

DESIGN STANDARDS:

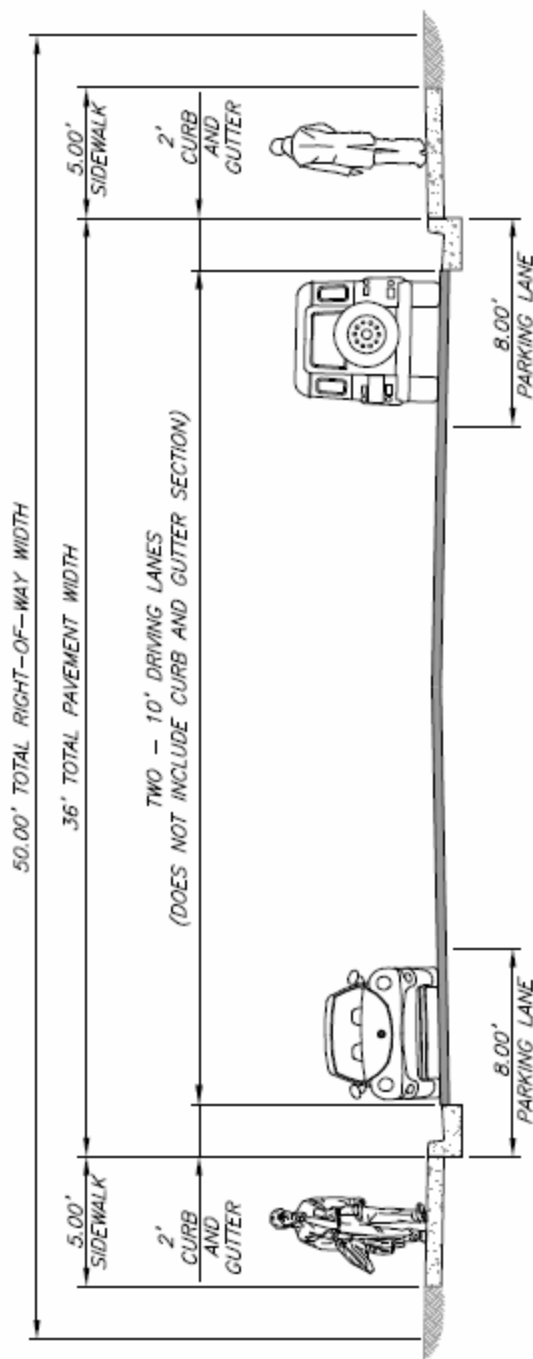
1. PARKING ON ONE SIDE OF STREET ONLY.
2. PLANT STRIP OPPOSITE PARKING LANE SHALL BE WIDER TO ACCOMMODATE SNOW STORAGE.
3. PERIODIC WINTER PARKING RESTRICTION MAY BE NECESSARY TO CLEAR SNOW FROM PARKING LANE.
4. INTERSECTION RADIUS DESIGN SHALL ALLOW ROLLOVER CURB FOR LARGE TRUCKS AND EMERGENCY VEHICLES – 33 FOOT INSIDE RADIUS AND 45 FOOT OUTSIDE RADIUS FOR FIRE TRUCKS.



LOCAL STREET – URBAN RESIDENTIAL (OPTION 2)
NOT TO SCALE

ADDITIONAL STANDARDS:

1. PARKING ON BOTH SIDES OF STREET.
2. SNOW STORAGE WILL BE TO CENTER OF THE DRIVE LANES.
3. EACH DRIVE LANE SHALL BE 12 FEET. AT THE TOWN'S DISCRETION, DRIVING LANES MAY BE REDUCED TO 10 FEET ONLY WHEN WINTER PARKING RESTRICTIONS PROHIBIT SEASONAL PARKING (DECEMBER 1 TO APRIL 1) ON ONE SIDE OF STREET TO ALLOW SNOW STORAGE IN A PARKING LANE.
4. INTERSECTION RADIUS DESIGN SHALL ALLOW ROLLOVER CURB FOR LARGE TRUCKS AND EMERGENCY VEHICLES - 33 FOOT INSIDE RADIUS AND 45 FOOT OUTSIDE RADIUS FOR FIRE TRUCKS.



LOCAL STREET - URBAN RESIDENTIAL (OPTION 3)
NOT TO SCALE

DIVISION 5



TECHNICAL SPECIFICATIONS



Division 5 Technical Specifications

INDEX

TECHNICAL SPECIFICATIONS

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SECTION 01300**SUBMITTALS****PART I - GENERAL****1.01 REQUIREMENTS INCLUDED**

The CONTRACTOR shall submit to the ENGINEER for approval all submittals required by the General Conditions and these Specification sections. Submittal shall be submitted on form 1300-A.

1.02 INSURANCE CERTIFICATES

Refer to General Conditions for submittal requirements. Submit updated certificates as necessary to verify current coverage.

1.03 SCHEDULE OF VALUES

Refer to General Conditions for requirements. On bid items to be paid as lump sum that may extend beyond a single pay estimate, a schedule of values shall be submitted to OWNER a minimum of 10 days prior to work on that item. Adequate detail shall be given to allow a value to be placed on work completed during any given pay estimate. Where payment is to be based on unit bid prices, correlate schedule of values with Divisions and Sections of Specifications unless otherwise approved by the ENGINEER. If separate payment is to be requested for materials suitably stored but not installed, segregate delivered costs from installation costs, including overhead and profit.

1.04 CONSTRUCTION SCHEDULE

(See Section 01310 for Construction Schedule Submittal details).

1.05 SHOP DRAWINGS

(See Section 01340 for Shop Drawing Submittal details).

1.06 PROJECT RECORD DOCUMENTS

(See Section 01700, Contract Closeout, for project record document details).

END OF SECTION

SECTION 01310**CONSTRUCTION SCHEDULES****PART 1 GENERAL****1.01 SUMMARY**

- A. Within ten (10) days after effective date of agreement or by the pre-construction conference, the Contractor shall submit a critical path project schedule covering the duration of the project, beginning with the Notice to Proceed and indicating Substantial Completion and "Contract Completion". The purpose of the Project Schedule shall be to:
 - 1. Assure adequate planning, scheduling and reporting during the execution of the Work by the Contractor.
 - 2. Assure coordination of the Work of the Contractor and various Subcontractors at all tiers.
 - 3. Establish a critical path for the completion of the Work to assist the Contractor, Owner, and Engineer in monitoring the progress of the Work and evaluating proposed changes to the Contract Duration and the Project Schedules resulting from changes in the Work and/or potential weather delays.
 - 4. Assist in the coordination of construction activities so as to complete the Work within the Contract Time.
- B. The Project Schedule shall be based upon the Critical Path Method (CPM) for planning, scheduling and progress reporting of the Work.
- C. The Project Schedule shall include a graphic network prepared by the Contractor. The Contractor shall transmit all schedule submissions to the Owner or his representative as both a printed or plotted pure logic diagram and a bar chart with an accompanying computer disk of the schedule. The computer disk shall be in a file format published by Primavera Project Planner (Windows versions), Primavera Sure Trak, or Microsoft Projects.
- D. The Contractor shall provide a Network, which shall be a reasonable representation of how the Work is planned to be performed and shall be used to monitor the progress of the work of the Contract. All costs associated with the development and maintenance of the schedule shall be borne by the Contractor Description.

1.01 SCHEDULING

- A. The Contractor shall submit a preliminary Project Schedule as stated above. The Owner or his representative shall review the preliminary Project Schedule and return comments to the Contractor within ten (10) working days after receipt. The Contractor then shall have five (5) working days to review the schedule and return it to the Owner or his representative for review. The five (5) working day review and review cycles shall continue until an acceptable schedule is received by the Owner. The owner's review of the project schedule is for compliance with this article and other contractor requirements. Acceptance by the owner of the contractor's project schedules does not relieve the contractor of any of his responsibility whatsoever for the accuracy or feasibility of the project schedule, or of the contractor's ability to meet the contract completion date, nor does such acceptance expressly or impliedly warrant, acknowledge or admit the reasonableness of the activities, logic, duration or, when

included, cost loading of the contractor's project schedule. An approved schedule shall be required prior to submission of the first progress payment in accordance with the Contract Documents. The following guidelines must be met:

1. The Project Schedule shall contain a sufficient number of activities to allow effective monitoring of the progress of the work.
2. Each activity shall contain only the work of a single trade or subcontractor.
3. Each activity shall be less than fifteen (15) working days in duration. Procurement and material delivery, surveying and shop drawing approvals may exceed fifteen (15) working days in duration. Activities exceeding fifteen (15) working days in duration shall be separated into two or more individual activities of less than sixteen (16) working days by area, type of work, etc. to allow for effective monitoring of the Work.
4. Each activity shall include a description of the work, original duration, contractor or subcontractor performing the work, the equipment and manpower required to do the work, all specific area, phasing or milestone classifications and the activity's relationship to other activities (contained in the Methods Statement).
5. The Project Schedule shall begin with the Notice to Proceed and end with Contract completion activities. A critical path (zero float path) through Contract completion must be generated.
6. Normally anticipated weather conditions shall be included in the Project Schedule.
7. Anticipated utility relocation activities must be shown in the schedule as they affect the contractor's activities.
8. Failure by the Contractor to include any element of work required for performance of the Contract shall not excuse the Contractor from completing all work within the Contract Time.
9. Work times shall be included showing number of days per week, shifts per day and hours per shift.
10. The Project Schedule shall contain activities for the anticipated submittal cycle of equipment or materials that could affect timely completion of the project.
11. The schedule shall include activities for anticipated procurement and delivery of material or equipment with lead times greater than three (3) weeks.
12. The progress schedule shall include all activities for all work on the project, including subcontracted work, delivery dates for critical material, submittal and review periods, milestone requirements and no work periods. Where the project has specific phases, each phase shall be described separately for each salient feature.

1.03 METHODS STATEMENT

- A Methods Statement shall be included for all work items that fall on the critical path of the construction schedule. This Methods Statement shall be a detailed narrative describing each feature and all work necessary to complete the feature. The Methods Statement shall be submitted with the Construction Schedule. The following format is required.
1. Feature: name of the feature.
 2. Responsibility: Contractor, subcontractor, supplier, utility, etc. responsible of the feature.
 3. Procedures: procedures to be used to complete the work. The procedure to be used shall include general information regarding methods such as forming, excavation, placing, heating, curing, backfill and embankment, trenching, protecting the work, etc. When separate or different procedures are to be employed by the Contractor due to seasonal or project phasing requirements, such differing procedures shall be described in the procedure statement.
 4. Production Rates: the planned quantity of work per day for each feature

5. Labor Force: the labor force planned to do the work.
6. Equipment: the number, types, and capacities of equipment planned to do the work.
7. Work Times: the planned time for the work to include:
 - a. Number of work days per week.
 - b. Number of shifts per day.
 - c. Number of hours per shift.

- B. At the Owner's request, the Contractor shall update the Methods Statement, or any part thereof, and submit it with the next monthly schedule update.

1.04 PROJECT SCHEDULE UPDATES

- A. The Project Schedule updating shall be done on a monthly basis. The revision shall indicate actual progress to date, changes resulting from change orders, and planned changes necessary to complete the Work in accordance with the Contract Documents.
- B. Should the Project Schedule update indicate that the project is more than ten (10) days behind schedule it shall be revised to indicate the means which the Contractor shall use to regain the Contract Completion Date.
- C. Updating the Project Schedule to reflect actual progress made up to the date of a schedule update shall not be considered revisions to the Project Schedule.
- D. Failure by the Contractor to update the schedule shall result in a material breach of contract and will also result in the withholding of progress payments until an acceptable update is submitted by the Contractor and accepted by the Owner.

1.05 TIME IMPACT ANALYSIS FOR CHANGE ORDERS, DELAYS & CONTRACTOR REQUESTS

- A. When Change Orders are initiated or delays are experienced a Time Impact Analysis shall be completed to determine the effect on the Contract Completion Date. The durations of effected activities shall be altered as mutually agreed upon and the schedule recalculated. The Contract Completion Date will not be extended unless the schedule recalculation indicates a completion date beyond the current Contract Completion Date. A delay must impact the critical path of the Project Schedule as a condition to extending the Contract Completion Date.
- B. Delays caused by weather shall be reviewed at the monthly update meetings. Seasonal weather conditions shall be considered and included in the planning and scheduling of all work influenced by high or low ambient temperatures, wind, and/or precipitation to ensure completion of all work within the Contract Time. Seasonable weather conditions shall be determined by an assessment of average historical climatic conditions.
- C. Float is not for the exclusive use or benefit of either the Owner or the Contractor. Extension of the Contract Time will be granted only to the extent the equitable time adjustments to the activity or activities affected by the Change Order or delay exceeds the total (positive or zero) float of a critical activity (or path) and extends the Contract Time as set forth in the Contract.

1.06 SUBMITTALS

- A. The number of opaque reproductions required by the CONTRACTOR plus four (4) copies which will be retained or distributed by the OWNER/ENGINEER.
Do not submit fewer than five (5) copies.
- B. Distribution
 - 1. After review, ENGINEER will distribute copies of schedules to:
 - a. Two (2) copies to OWNER.
 - b. One (1) copy to Resident Project Representative.
 - c. One (1) copy to be retained in ENGINEER's file.
 - d. One (1) copy to CONTRACTOR to be kept on file at CONTRACTOR's field office.
 - e. Remainder to CONTRACTOR for his distribution following modifications if required.
- C. Schedule recipients will report promptly to ENGINEER and CONTRACTOR, in writing, any problems anticipated by the projections shown on the schedules.

END OF SECTION

SECTION 01340**SHOP DRAWINGS****PART 1 GENERAL****1.01 REQUIREMENTS INCLUDED**

- A. The CONTRACTOR shall submit to the ENGINEER for approval all shop drawings required by the specification sections.

1.02 SHOP DRAWINGS

- A. Shop drawings shall be prepared by a qualified detailer for CONTRACTOR, subcontractor, supplier, or manufacturer, and shall illustrate some portion of the work, showing fabrication, layout, setting, or erection details.
- B. Identify details by reference to sheet and detail numbers shown on Contract Drawings. Use same symbols used on Contract Drawings to identify shop drawing details wherever practicable.

1.03 PRODUCT DATA

- A. Submit manufacturer's standard schematic drawings:
 - 1. Modify drawings to delete information that is not applicable to the project.
 - 2. Supplement standard information to provide additional information applicable to project.
- B. Submit manufacturer's catalog sheets, brochures, diagrams, schedules, performance charts, illustrations, and other standard descriptive data.
 - 1. Clearly mark each copy to identify pertinent materials, products or models.
 - 2. Show dimensions and clearances required, performance characteristics and capabilities, wiring diagrams and controls, and any other pertinent data applicable to the project.
- C. Submit manufacturer's certificate of compliance certifying to compliance with specification requirements, applicable reference standards and test data requirements. Include reference to the specification section and paragraph with which the product or materials is intended to comply.

1.04 CONTRACTOR RESPONSIBILITIES

- A. CONTRACTOR shall submit quantities specified in Section 01000 General Requirements.
- B. Submittals shall be made by CONTRACTOR to the ENGINEER with a transmittal form or letter and not by subcontractors, suppliers or manufacturers. CONTRACTOR shall review, stamp with his approval, and submit in orderly sequence all submittals required by the specifications. By approving and submitting items, CONTRACTOR represents that he has verified all field measurements, field construction criteria, materials, catalog numbers, and similar data, and has coordinated each shop drawing with requirements of the project.

- C. The CONTRACTOR shall not begin work that requires submittals until the ENGINEER reviews and approves submittals. The ENGINEER will return an approved copy of the submittal to the CONTRACTOR.
- D. CONTRACTOR'S responsibility for errors and omissions in submittals, or for deviations in submittals from requirements of the Contract Documents, shall not be relieved by review of submittals unless ENGINEER gives written acceptance of specific deviations. The CONTRACTOR shall notify ENGINEER in writing at time of submission of deviations in submittals from requirements of the Contract Documents.

END OF SECTION

SECTION 01570**DETOURING/TRAFFIC CONTROL****PART 1 GENERAL****1.01 SCOPE**

This work shall consist of furnishing, installing, moving, maintaining and removing temporary traffic signs, advance warning signs, barricades, channelizing devices, delineators, and flagmen as required by the latest revision of the "Manual on Uniform Traffic Control Devices for Streets and Highways" and the latest revisions of the Colorado Supplement thereto, in accordance with the Drawings and these Specifications.

1.02 RELATED WORK SPECIFIED ELSEWHERE

All Sections.

1.03 REFERENCE STANDARDS

- B. Colorado Department of Transportation, Standard Specifications for Road and Bridge Construction 1999; Subsection 107.10 and Section 630.
- C. Colorado Department of Transportation, Standard Plans Oct 2000; S Standards.
- D. Federal Highway Administration; Manual on Uniform Traffic Control Devices.

1.04 SUBMITTALS

- A. Traffic Control Plan. Traffic control, both vehicular and pedestrian, through the construction areas is the responsibility of the Contractor. The Contractor shall prepare a Traffic Control Plan (TCP) to be submitted with the return of the signed agreement. The TCP shall include a schedule of traffic control devices to be used on the project, general layout of devices, situations that may require use of flaggers and/or pilot cars, and methods of notifying public of impending traffic changes. The TCP must be prepared by a certified traffic control supervisor and approved by the City prior to commencement of work.
- B. Methods of Handling Traffic (MHT). The Contractor shall control traffic in accordance with the Traffic Control Plan (TCP), as shown in the contract. To implement the TCP, the Contractor shall develop and submit a method for handling traffic (MHT) for each different phase of construction which shows the Contractor's proposed construction phasing and proposed traffic control devices consistent with the TCP. If at any time the Contractor desires to change the MHT, it shall be considered a different phase requiring a new MHT.

Each proposed MHT shall be approved in writing by the City before the corresponding phase of construction will be allowed to begin. The initial MHT shall be submitted a minimum of 10 days prior to the start of work on the project. All successive MHT's shall be submitted to allow reasonable time for review.

The proposed MHT shall include detailed information as contained in the Manual of Uniform Traffic Control Devices.

Approval of the proposed method of handling traffic shall constitute authorization to furnish the devices on the schedule. If, at any time, it is determined that unnecessary units are on the schedule or that additional units are required, the City will request the Contractor to revise the MHT and the devices shall be added or removed as approved.

The Contractor shall continually review their methods of handling traffic. If revisions are needed for the safe movement of traffic through or around the work areas, the Contractor shall immediately notify the City. The Contractor may implement temporary revisions to the MHT if, in absence of the City, failure to make the revision could compromise the safety of the public.

Changes in the plan or the methods of handling traffic shall be approved by the City. Approval of the traffic control plan and the proposed methods of handling traffic in no way shall relieve the Contractor of liability specifically provided for in the Contract.

PART 2 MATERIALS

2.01 GENERAL

All materials shall conform to the applicable portions of the Reference Standards.

2.02 BARRICADES

Shall conform to the MUTCD Minimum 8' wide on movable skids.

PART 3 METHODS AND PROCEDURES

3.01 DETOURS

None as anticipated.

3.02 ROAD RESTRICTIONS

As stated on Drawings.

3.03 FLAGMEN

Provide as needed, as directed by City or as stated on Drawings to control traffic encroaching in construction zone.

3.04 BARRICADES, CHANNELIZING DEVICES, FLASHING WARNING LIGHTS

Provide for all work areas, open trenches, lane closures, equipment and material storage, etc., and as called for on the Drawings and located within limits of construction. Protection to be in place 24 hours per day and device inspection shall be seven days per week.

3.05 TRAFFIC CONTROL MANAGEMENT

Provided by a certified traffic control supervisor on a 24-hours-per-day basis. An after hours

contact shall be provided for every calendar day from the first placement of traffic control devices until all devices are removed. Any changes to this contact shall be submitted to the City.

END OF SECTION

SECTION 02255**DUST SUPPRESSION****PART 1 GENERAL****1.01 SCOPE**

Work under this Section shall include furnishing all materials, labor, equipment and miscellaneous items necessary to provide dust control over the entire project site.

1.02 RELATED WORK SPECIFIED ELSEWHERE.

All *Division 2* Sections

1.03 SUBMITTALS.

- E. Chemical Products Descriptive literature defining chemical constituents.

PART 2 MATERIALS**2.01 MAGNESIUM CHLORIDE.**

<u>Constituents</u>	<u>Percentage by Weight</u>
Magnesium Chloride	Approximately 28%-36%
Sulphate	2.5%
Potassium, sodium, calcium	Less than 1%
Nitrate	-0-

PART 3 METHODS AND PROCEDURES**3.01 DUST CONTROL**

Dust control to be considered an integral part of the Work. Control shall be provided from the start of construction until the Work is complete. Fugitive dust as a result of construction shall be controlled at all times.

3.02 WATERING

For road construction, the Contractor shall have a water truck on site at all times for dust control. Wetting shall be done at the direction of the City as required until the final wearing surface is completed.

For utility construction, dust control may be accomplished by water truck or spray system from an on-site water system if approved. Contractor shall be prepared to provide dust control until the final acceptance of project.

The Contractor shall provide a water meter for metering any water taken from the municipal water system whether from fire hydrants or private taps.

3.03 CHEMICAL CONTROL

Where required by the City, dust control shall be provided by the use of magnesium chloride chemical spray to the road surface.

After the surface has been prepared, the road shall be pre-wet to a very damp condition. The product shall be applied using a watering truck with spray applicator, providing an even distribution across the surface. Application rate shall be 1/3 - 1/2 gallon per square yard. The surface shall be re-sprayed until complete coverage is attained.

END OF SECTION

SECTION 02271**RIPRAP****PART 1 GENERAL****1.01 DESCRIPTION**

- A. Work shall consist of furnishing and placing of riprap according to the location shown on the Drawings.
- B. Work shall conform to the relevant provisions of Section 506 "Riprap" of the Standard Specifications for Road and Bridge Construction, State Department of Highways, Division of Highways, State of Colorado, 1981 Edition, except as modified.

PART 2 PRODUCTS**2.01 RIPRAP**

- A. Riprap shall consist of hard, dense rough fractured rock as nearly cubical as possible. Thin slab, flaking rock and sandstone shall not be used. The rock shall have a minimum specific gravity of 2.25. Removed concrete may not be substituted for rock. Round river rock shall not be used as riprap unless approved by Engineer.
- B. The average diameter of rock shall be as shown on Drawings.

PART 3 CONSTRUCTION METHODS**3.01 SLOPE PREPARATION**

Areas on which the riprap is to be placed will be trimmed and dressed to conform to cross sections shown on the Drawings within an allowable tolerance of plus or minus two inches (2") from the theoretical slope lines and grades. Where such areas are below the allowable minus tolerance limit, they shall be brought to grade by filling with material similar to the adjacent material and well compacted with no additional compensation to be allowed to the Contractor for any extra materials thus required.

3.02 FILTER CLOTH

Provide Mirafi 140-N filter fabric under riprap, or equal. Fabric to be installed per Standard Erosion Control Details with anchor trenches, overlaps and staples.

3.03 BEDDING BLANKET.

To be six inches (6") thick placed on top of prepared slope and under riprap where called for on Drawings.

<u>Sieve Measure</u>	<u>% By Weight Passing Square Mesh Sieves</u>
3"	100
3/4"	20 - 90
#4	0 - 20
#200	0 - 3

3.04 RIPRAP PLACEMENT

Stone for riprap will be placed on the prepared slope in such a manner as to produce a reasonably well-graded mass of rock with the minimum practicable percentage of voids, and will be constructed within tolerances specified herein and to the slopes, lines and grades shown on the Drawings or as otherwise approved by Engineer in the field.

A tolerance of plus or minus three inches (3") from the slope lines and grades shown on the Drawings shall be allowed in the finished surface of the riprap. Placement of stones at the outlet of drainage structures shall allow positive flow in the direction intended with no stone placed to constrict or reduce flows (also see Section 506.03).

Riprap will be placed to its full course of thickness in one operation. The placing shall progress upwards on the slopes. The riprap will be carefully placed on the prepared slope in such a manner that adjacent stones are in close contact and, in general, have their greatest dimensions across or perpendicular to the slope. Through stones will be well distributed throughout the mass.

As used herein, a "through stone" is defined as a stone whose dimension as normal to the surface being riprapped is not less than the full depth of riprap. The finished riprap will be free from objectionable pockets of small stone clusters of larger stones. Placing riprap in layers will not be permitted.

END OF SECTION

SECTION 02520**DRAINAGE PIPE****PART 1 GENERAL****1.01 SCOPE**

- A. Work under this section includes furnishing, installing, cleaning and testing drainage pipe (including culverts) underdrains, trench drains, bands, collars, inlet section, outlet sections and all other items appurtenant to drainage pipe.

1.02 RELATED WORK SPECIFIED ELSEWHERE.

Section 02200 - Excavation and Embankment
Section 02201 - Excavation and Backfill For Structures
Section 02222 - Embedment and Base Course Aggregate

1.03 REFERENCE STANDARDS.

Colorado State Department of Transportation Standards
Specifications for Road and Bridge Construction Section 707 and M-Standards

1.04 SUBMITTALS

Product data including catalogue cut sheets and descriptive literature.

1.05 PROTECTION OF WORK

All pipe and appurtenances shall be carefully handled, stored and protected in such a manner as to prevent damage to materials and protective coatings and linings. At no time shall such materials be dropped or dumped into trench.

Precaution shall be taken to prevent foreign matter from entering the pipe and appurtenances prior to and during installation. Place no debris, tools, clothing or other materials in the pipe during installation.

PART 2 MATERIALS

This item covers the types of material that will be required for the construction and installation of drainage pipe. All materials used shall be new and the best quality available. All material used shall be in accordance with applicable standards of the American National Standards Institute (ANSI), the American Standards Association (ASA), the American Society of Testing and Materials (ASTM) and the American Association of State Highway Transportation Officials (AASHTO).

2.01 CORRUGATED GALVANIZED STEEL PIPE AND PIPE ARCHES.

- A. Pipe and Bands
1. Conform to Section 707.02 and applicable section of AASHTO M-36.

2. Size, length and shape as shown on Drawings.
3. Corrugations to be 2-2/3" x 1/2" or 3" x 1" unless shown otherwise.
4. Gauge to be minimum 16 gauge (.064").
5. Bands to be "Hugger" type with forged steel bars secured to connecting bar with tension straps.
6. Gasket use rubber O-ring, two for each joint.
7. Pipe seams shall be continuous weld type.

B. End Sections

1. Conform to M-603-CA.

2.02 CORRUGATED ALUMINUM PIPE.

A. Pipe and Bands.

1. Conform to Section 707.06 and AASHTO M-196.
2. Size, length and shape as shown on Drawings.
3. Corrugations to be 2-2/3" x 1/2" unless shown otherwise.
4. Thickness to be minimum 0.060".
5. Bands to be "Hugger" type with forged steel bars secured to connecting bar with tension straps.
6. Gasket use rubber O-ring, two for each joint.
7. Pipe seams shall be continuous weld type.

B. End Sections.

1. Conform to M-603-CA.

2.03 CORRUGATED POLYETHYLENE PIPE.

A. Pipe, bands and fittings.

1. Conform to the following applicable specifications:
ASTM F405, standard specification for corrugated polyethylene tubing and fittings.
ASTM F667, standard specifications for large diameter corrugated polyethylene tubing and fittings.
AASHTO M252, standard specification for polyethylene corrugated drainage tubing.
2. Size, length and shape as shown on Drawings.
3. Provide perforated tubing in locations shown on Drawings and in accordance with these Specifications.
4. Couplings shall be screw-on type or as approved.
5. Perforation Dimensional Requirements:

Nominal I.D. Inch	Number of Perforations Per Foot	Maximum Width (inch)	Maximum Length (inch)	Inlet Area Minimum Sq.in./ft.
4	106	0.125	1.25	1.0
6	106	0.125	1.50	1.0
8	18	0.125	1.50	1.0
10	12	0.125	1.75	1.0
12	36	0.125	1.75	1.0

2.04 SMOOTH INTERIOR CORRUGATED POLYETHYLENE PIPE.

- A. Pipe. This specification applies to high-density polyethylene corrugated pipe with an integrally formed smooth waterway. (Hancor Hi-Q or ADS N-12).

Nominal Sizes: 4" to 10" diameter
 12" to 60" diameter (AASHTO M259, Type S)

Pipe to have a full circular cross-section, with an outer corrugated pipe wall and an essentially smooth inner wall (waterway). Corrugations for sizes listed may be either annular or spiral. Corrugation type must compliment the bands and fittings supplied with the pipe.

Pipe manufactured for this specification shall comply with the requirements for test methods, dimensions, and markings found in AASHTO Designations M252 and M294.

Pipe and fittings shall be made from virgin PE compounds which conform with the requirements of cell class 324420C as defined and described in ASTM D3350.

Minimum parallel plate stiffness values when tested in accordance with ASTM D2412 shall be as follows:

<u>Diameter</u>	<u>Pipe Stiffness</u>	<u>Diameter</u>	<u>Pipe Stiffness</u>
4"	50 psi	18"	40 psi
6"	50 psi	24"	34 psi
8"	50 psi	30"	28 psi
10"	50 psi	36"	22psi
12"	50 psi	42"	19 psi
15"	42 psi	48"	17psi

- B. Fittings.

The fittings shall not reduce or impair the overall integrity or function of the pipe. Fittings may be either molded or fabricated. Common corrugated fittings include inline joint fittings, such as couplers and reducers, and branch or complimentary assembly fittings such as tees, wyes, and end caps. These fittings may be installed by various methods, such as snap-on, screw-on, bell and spigot, and wrap around. Couplings shall provide sufficient longitudinal strength to preserve pipe alignment and prevent separation at the joints. Only fittings supplied or recommended by the pipe manufacturer shall be used. Where designated on the plans, a neoprene or rubber gasket shall be supplied.

- C. Installation.

Installation of the pipe specified above shall be in accordance with ASTM Recommended Practice D2321 as covered elsewhere in these specifications.

2.05 PERFORATED ASTM 2729 LEACH FIELD PIPE.

- A. Pipe couplings and fittings.
 - 1. Conform to requirements of ASTM 2729.
 - 2. Size, length and shape as shown on the Drawings.

2.06 FILTER WRAPPED POLYETHYLENE PIPE.

- A. Pipe and bands.
 - 1. Conform to Section 2.03 above.
- B. Filter material.
 - 1. Conform to properties equal to or better than those found with Mirafi 140N drainage fabric.
 - 2. Size, length and location as shown on Drawings.

PART 3 METHODS AND PROCEDURES

3.01 CLEANING AND INSPECTION

Clean all pipe and appurtenances thoroughly of all foreign material and inspect for cracks, flaws or other defects prior to installation. Mark all defective, damaged or unsound materials with bright marking crayon or paint and remove from job site.

3.02 PIPE INSTALLATION

Pipe shall be laid in straight sections except as noted on the plans. Jointing of the pipe shall be made in accordance with the directions of the manufacturer of the pipe and the manufacturer of the coupling and shall have rubber gaskets or joint sealing compound as approved. All pipe to be installed with minimum cover of 12 inches.

3.03 PIPE EMBEDMENT

Pipe shall be embedded according to applicable details on the Drawings.

3.04 METAL APRON ENDWALLS

Metal apron endwalls (end sections) shall be constructed at the ends of all drainage pipe as shown on the plans. All entrance endwalls shall have toe plates. Excavation for endwalls shall be such that the endwall rests on undisturbed soil in its final position. Excavation for toe plates shall be such that the inside of the toe plate rests on undisturbed soil in its final position. Backfill shall be done as in Part 3.03 of this section.

PART 4 QUALITY CONTROL - FIELD

4.01 INSPECTION AND TESTING

Inspection and testing to be performed at direction of the Engineer. Contractor to cooperate fully with all testing procedures.

Any pipe section which has been damaged in any way which, in the opinion of the Engineer, may affect the structural integrity of the pipe or reduce the expected corrosion resistance of the pipe, shall be removed and replaced. At the option of the Engineer, re-coating of minor

dents and deformities with an approved fluid applied galvanized material may be allowed.

END OF SECTION

SECTION 02612**HOT BITUMINOUS PAVING****PART 1 GENERAL****1.01 Scope**

Work to be performed under this section shall include all labor, equipment, materials and miscellaneous items necessary to furnish and install one or more courses of bituminous mixture constructed on a prepared surface in accordance with the Specifications or as shown on the Drawings. The finished product shall be in close conformity with the lines, grades, thickness, and typical cross sections shown on the Drawings or as established in the field.

1.02 RELATED WORK SPECIFIED ELSEWHERE

Section 02222 - Embedment and Base Course Aggregate

1.03 REFERENCE STANDARDS

All work is to be performed in accordance with Section 4.

1.04 SUBMITTALS.

- A. Mix Design. Provide complete mix design by independent testing laboratory, including certifications of all material compliance.
- B. Prime Coat. Certification of material.
- C. Tack Coat. Certification of material.

1.05 COORDINATION

It shall be the responsibility of the Contractor under this section to coordinate this work with all other trades involved in the project. No paving work shall be started until the work of others has progressed to a point that a definable area can be paved; patching, blending, butting, etc. of work under this section will not be allowed except as required as part of the normal paving operation.

PART 2 MATERIALS**2.01 COMPOSITION OF MIXTURE. REFERENCE SECTION 4.0**

- A. Use Grading SX (Reference Section 703.04); aggregate gradation per Table 703-3.
- B. Asphalt Cement to be PG 58-22.
- C. The design mix for Hot Bituminous Pavement shall conform to the following:

Marshall Design -- 50 blow	
Marshall Stability	1200 (min.)
Flow, 0.01"	8-16
Air Void in Mix	3-5
VMA, % min.	See Table 403-2
Grade of Asphalt Cement	PG 58-22
Accelerated Moisture Susceptibility Tensile Strength (Lottman)	See Table 401-2
Voids filled with Asphalt	65-78

TABLE 403-2

Nominal Maximum Size*		Design Air Voids**		
Inches	(mm)	3.0%	4.0%	5.0%
3/4	19.0	12.0	13.0	14.0
1/2	12.5	13.0	14.0	15.0
3/8	9.5	14.0	15.0	16.0

* The nominal size is defined as one sieve larger than the first sieve to retain more than 10%.

** Minimum VMA must pass at 4% design air voids.

The Contractor shall prepare a quality control plan outlining the steps to be taken to minimize segregation of HBP. This plan shall be submitted to the Engineer prior to beginning the paving operations. When the Engineer determines that segregation is unacceptable, the paving shall stop and the cause of segregation corrected before paving operations will be allowed to resume.

- D. Contractor to provide to the Engineer, a job mix composition meeting this section. Submittal shall include testing results sufficient to show compliance. Testing shall be under the certification of an independent testing laboratory acceptable to the Engineer. The mix design shall have been completed within the preceding 12 months.
 - E. Contractor may use an anti-stripping additive from the current CDOT approved list of additives.
- 2.02 PRIME COAT. REFERENCE SECTION 702.02.
- A. Prime coat shall be MC-70 (ASTM D2026)
- 2.03 TACK COAT. REFERENCE SECTION 702.03.
- A. Tack Coat to be SS-1h (ASTM D977) or CSS-1h (AASHTO M208).

2.04 PAVEMENT MARKING. REFERENCE SECTION 708.05

- A. No glass beads required.

PART 3 METHODS AND PROCEDURES

Reference Section 403.03 (further reference 401.07 through 401.20) and Section 407.04 through 407.08.

- A. Maximum compacted pavement depth per pass to be 3".
- B. Prime not required unless indicated on Drawings. Prepared base course or subgrade surfaces receiving pavement courses shall be primed at Contractor's expense if the surface has deteriorated, due to traffic, weather or time lapse between surface preparation and placement of bituminous materials, such that in the opinion of the Engineer, use of prime coat is required.
- C. Tack coat required between lifts, on all abutting old pavement surfaces and for overlays on existing pavements unless waived by Engineer. Application rate shall be 0.05 to 0.10 gallons per square yard diluted.

Dilution shall be one part tack emulsion to one part water.

All cut asphalt surfaces that are to butt new pavement sections shall be tacked with a liberal application of tack coat prior to paving.

3.01 COMPACTION

The plant mix bituminous pavement shall be compacted by rolling. The number, weight and type of rollers furnished shall be that which is sufficient to obtain the required density while the mixture is in a workable condition. Compaction shall begin immediately after the mixture is placed and be continuous until the required density is obtained. When the mixture surface temperature falls below 185 degrees F, no further compaction effort will be permitted unless approved.

All roller marks shall be removed with the finish rolling. Use of vibratory rollers with the vibrator on will not be permitted during surface course final rolling and will not be permitted on any rolling on bridge decks covered with waterproofing membrane.

Pavement shall be compacted to a density of 92 percent to 96 percent of the maximum theoretical density, determined according to AASHTO T209. Field density determinations will be made in accordance with Colorado Procedure 44 or 81.

Along forms, curbs, headers, walls and all other places not accessible to the rollers, the mixture shall be thoroughly compacted with mechanical tampers.

Any mixture that becomes loose and broken, mixed with dirt, or is in any way defective, shall be immediately removed and replaced with fresh hot mixture, and compacted to conform with the surrounding area.

3.02 SURFACE TOLERANCES Section 401.20.

The variations between any two contacts with the surface shall not exceed 3/16 inch in 10 feet. Irregularities exceeding the specified tolerance shall be corrected at the Contractor's expense. No skin patching will be allowed.

3.03 PAVEMENT MARKING REFERENCE Section 627.06.

Centerline marking shall be double yellow line, 4" wide each stripe. Parking stall marking shall be single white line, 4" wide stripe. Crosswalk marking shall be white panels, 12" wide by 8' long with 12" clear spacing the width of the roadway. Cross-hatching to be white, 8" wide, spaced at maximum 4' intervals. Symbols, letters and arrows to conform to 'Standard Alphabets for Highway Signs and Pavement Marking', adopted by the Federal Highway Administration.

PART 4 FIELD QUALITY CONTROL

4.01 INSPECTION AND TESTING

Inspection and testing to be performed at the direction of the Engineer. Contractor to cooperate fully with all persons engaged in testing.

4.02 DENSITY TESTING AND CONTROL

- A. See Section 3.01, Compaction, above.
- B. Field Testing. Testing for density during compaction operations to be done using nuclear density methods.
- C. Frequency of Testing. Minimum of one (1) test every 10,000 square feet or as directed by Engineer. Testing to be paid for by Owner.
- D. Retesting. In the event of failure to meet compaction criteria, Contractor shall re-compact and/or replace defective work at direction of Engineer. All retesting to be paid for by Contractor and to be performed by testing firm approved by the Engineer.

END OF SECTION

SECTION 02626**CONCRETE CURB AND GUTTER, SIDEWALK, CURBWALK AND DRIVEWAY****PART 1 GENERAL****1.01 SCOPE.**

This Work shall include furnishing all materials, labor, equipment and miscellaneous items necessary for the construction of concrete curb, gutter, sidewalk, sidewalk ramps, driveway or any combination thereof, all in accordance with these Specifications and in close conformity with the lines, grades, and typical sections as shown on the Construction Drawings or established in the field. Sidewalks and sidewalk ramps shall meet Federal ADA Accessibility Guidelines.

1.02 RELATED WORK

Specified Elsewhere.

Section 02222 - Embedment and Base Course Aggregate

1.03 REFERENCE STANDARDS.

Federal Standards for Accessible Design – Rules and Regulations Americans with Disabilities Act - Accessibility Guidelines

PART 2 MATERIALS

The materials shall conform to the requirements specified in the following:

Section 02222 - Embedment and Base Course Aggregate

2.01 JOINT FILLER.

Pre-molded, preformed conforming to AASHTO M213 to the full depth of the section.

2.02 STRUCTURAL CONCRETE

28-day compressive strength of 4,000 psi. See Section 03300 for complete Specification.

2.03 FIBERMESH

Fibermesh only to be used with approval from City Engineer. Fibermesh additive at the rate of 1½ pounds/cubic yard shall be used with all concrete. Use shall be in accordance with manufacturer's recommendations.

PART 3 METHODS AND PROCEDURES**3.01 EXCAVATION**

Excavation shall be made to the required depth and width to permit the installation and

bracing of the forms. The foundations shall be shaped and compacted to a firm even surface conforming to the section shown on the Construction Drawings. Material determined to be unsuitable or non-compact by the Engineer will be removed and replaced.

3.02 FORMS

Forms shall be wood or metal and shall extend for the full depth of the concrete. All forms shall be straight, free from warp and of sufficient strength to resist the pressure of the concrete without springing. Bracing and staking of forms shall be such that the forms remain in alignment both horizontally and vertically until removal. Satisfactory slip forms may be used when approved. Use of curbing machine will be permitted providing line and grade tolerances can be met. Steel plates that can be shaped to the desired radius shall be used on all short radii. Open joints shall be formed with a steel separator plate conforming to the section being installed.

Oil and clean all forms prior to placement of concrete.

3.03 MIXING AND PLACING

The foundations shall be thoroughly moistened immediately prior to the placing of the concrete. Compaction of the concrete shall have thorough consolidation achieved by tamping, spading, vibrating or other acceptable methods. Forms shall be left in place until the concrete has set sufficiently to prevent deformation due to removal. Upon removal of the forms, the curb face shall be immediately finished to a uniform surface. In the case of matching existing concrete finishes, an approved method shall be used.

3.04 FINISHING

The surface shall be floated with a wood or magnesium float and given a broom finish. No plastering of the surface will be permitted. All outside edges of slabs and joints shall be rounded to a ¼ inch radius. Broom marks to be perpendicular to traffic or pedestrian flow for installation of sidewalk or concrete flatwork. Broom marks to be parallel to traffic flow for installation of curb and gutter.

3.05 JOINTS.

Expansion joints shall be made using ½" pre-molded expansion joint. Construction joints, using ½" pre-molded joint filler, shall be placed at the end of a day's run or during a day's work if there is more than a 30 minute delay in concrete delivery.

Construction joints shall be formed around all appurtenances such as manholes, utility poles, adjacent structures, etc., extending into or abutting the Work. Pre-molded expansion joint filler ¼" thick shall be installed in these joints. Expansion joint filler shall be installed between concrete sidewalks and any fixed structure.

Dummy joints (contraction joints) shall be made by a forming tool to a depth of ¼ of the section with a width of ⅛" to ¼". Open joints shall be made with a separator plate, ⅛" to ¼" in width. Dummy joints in lieu of open joints will be permitted with use of curbing machine.

Joint spacing shall be located as follows:

- A. Expansion joints: Every 100' on center; at end of corner radius; at driveway sections; as shown on Construction Drawings.
- B. Construction joints: As required during construction; at appurtenances and structures through or abutting Work.
- C. Dummy or open joints: Every 10' on center for curb and gutter and curbwalk; equal to width of sidewalk for sidewalk; as shown on Construction Drawings.

3.06 CURING

Immediately upon completion of the finishing, concrete shall be moistened and kept moist for a minimum of 72 hours. In lieu of wetting, use of a membrane curing compound, at the direction of the Engineer, will be permitted.

3.07 BACKFILLING.

After the concrete has set sufficiently, the areas behind the curb shall be backfilled to the required elevations and shall be thoroughly compacted in accordance with Section 02200 - Earthwork.

PART 4 FIELD QUALITY CONTROL

4.01 TOLERANCES

All vertical surfaces shall not vary more than $\frac{1}{4}$ " in 10' in the horizontal direction. Surface deviation shall not exceed $\frac{1}{4}$ " when measured with a 16' straight edge.

4.02 CONCRETE STRENGTH.

The Geo-technical Engineer may take field samples for purposes of testing concrete strength. All substandard strength concrete shall be removed and replaced at Contractor's expense.

END OF SECTION

SECTION 02720

METAL GUARDRAIL

PART 1 GENERAL

1.01 SCOPE

Work under this section shall consist of furnishing all materials, labor, equipment and miscellaneous items necessary to furnish and install metal guardrail as shown on the Drawings.

1.02 REFERENCE STANDARDS

All Work and materials shall be in compliance with applicable standards of the Colorado Department of Transportation.

PART 2 MATERIALS

2.01 GENERAL

All materials shall conform to M-606-2, Guardrail for Local Roads and Type 3 Bridge Rail, CDOT Design and Construction of Bridges and Roads.

2.02 "W" BEAM RAIL

The types of guardrail are designated as follows:
Type 3 Guardrail "W" Beam

The rail elements shall be corrugated sheet steel beams conforming to the requirements of AASHTO M 180 of the designated class and type. The beams and metal offset devices shall be galvanized.

2.03 GUARDRAIL POSTS

Railing posts shall be of wood.

- A. Wood posts shall be fabricated from an approved or specified timber species and shall be of the quality, diameter or section, and length as specified or as shown on the Drawings. When treated posts are specified, they shall be fabricated or framed before treatment. Timber preservatives shall conform to the requirements of AASHTO M 133. Preservative treatment shall conform to the requirements for "Preservative Treatments for Timber" of the AASHTO Standard Specifications for Highway Bridges.

2.04 GUARDRAIL HARDWARE

Splices and end connections shall be of the type and design specified or shown on the Drawings, and shall be of such strength as to develop the full design strength of the rail elements.

End anchor rods and accessories shall be as specified or as shown on the Drawings and shall

be of such size and strength as to develop the full design strength of the rail elements.

Bolts, nuts and washers shall be galvanized in accordance with AASHTO M 232, Class 6, or AASHTO M 298, Class 50, Type 1. All other fittings shall be galvanized in accordance with AASHTO M 111. Bolts, Nuts and washers for corrosion resistant guardrail shall be of corrosion resistant material and conform to or exceed the requirements of ASTM A 307.

2.05 STRUCTURAL STEEL

Steel shall be of the self-rusting type or "Corten".

2.06. PAINTING SYSTEM

Not Applicable

PART 3 METHODS AND PROCEDURES

3.01 POST AND RAIL ELEMENTS.

- A. Posts shall be set firm and aligned with a tolerance of $\pm 1/4"$ from plumb, grades and lines as staked. All fittings and metal plates shall be placed securely in position to conform to designated dimensions and requirements.

Posts shall be set as required in Drawings by one of the following methods:

1. Driven in place.
2. Set in dug holes.
3. Set in concrete base.
4. Posts on bridges shall be as shown on Drawings.

Driving of posts shall be accomplished with approved methods and equipment that will leave the posts in their final position free from any distortion, burring or any other damage.

Excavated post holes shall have a firm bottom and be backfilled with acceptable material placed in layers and thoroughly compacted.

When required, posts shall be spliced with breakaway plates as shown on the Drawings.

Dissimilar metal-to-metal or aluminum-to-concrete posts or rail installations shall have contact surfaces separated by an approved protective coating.

Wood posts cut in the field shall have the cut surfaces protected with two coats of hot creosote or a 5% pentachlorophenol-in-oil solution. When the cut surface is above ground, the treating solution to be used shall be the same type as was used in the original treatment.

- B. Rail elements shall be erected in a manner resulting in a smooth, continuous installation. All bolts in the finished rail shall be drawn tight. Bolts shall be of sufficient length to extend beyond the nuts. Rail shall be shop bent for installations on horizontal curves having a radius of 150 feet or less.

3.02 PAINTING. Not applicable.

PART 4 FIELD QUALITY CONTROL

4.01 INSPECTION AND TESTING

Inspection and testing to be performed at the direction of the Engineer. Contractor to cooperate fully with all persons engaged in testing.

PART 5 MEASUREMENTS AND BASIS OF PAYMENT

See Bid Schedule

END OF SECTION

SECTION 02751**UNDERGROUND SPRINKLER SYSTEM****PART 1 GENERAL****1.01 SCOPE**

Work to be performed under this section shall include all labor, materials, and equipment required to complete underground sprinkler system.

1.02 RELATED WORK SPECIFIED ELSEWHERE

Section 02830 - Trees, Plants and Ground Cover

Section 02821 - Revegetation - Seeding, Sodding & Hydroseeding

1.03 QUALITY ASSURANCE

Installer shall have satisfactorily installed acceptable underground sprinkler systems on at least three other comparable projects.

1.04 SUBMITTALS**A. Shop Drawings****B. Design:**

Any deviations in layout (equipment usage or trenching) from the proposed sprinkler design must be approved by the Engineer prior to construction. Submit three (3) copies of any design deviation for approval by Engineer before commencing any Work. Design shall be based on head, valve, and piping locations provided as shown. Sleeving to accommodate sprinkler pipe shall be installed prior to paving operation as set forth herein and as indicated on the Drawings. Zones and stationing shall conform to those indicated on the Drawings. Contractor shall determine water pressure at supply line for system pressure availability. Minimum water coverage for planted area shall be 85%.

C. Operation and Maintenance Date:

Submit written operating instruction including winterization procedures. Submit a controller programming schedule indicating length of time each zone is to be operated. Coordinate controller/watering operations with Owner's maintenance personnel.

D. Maintenance Materials: In addition to installed systems, provide Owner with:

1. Two sprinkler heads of each size and type.
2. Two valve keys for operating manual valves (two drain valve keys two gate valve keys).
3. Two keys for each type of valve cover.
4. Two wrenches for removing and installing each type of head.

1.05 DELIVERY, STORAGE AND HANDLING

Prevent damage to system components during loading, transporting and unloading. Deliver all components in original containers and store in a clean, dry location.

1.06 Warranty.

Warrant irrigation system for a period of two (2) years after completion and acceptance of all work against material defects and craftsmanship. The warranty shall be for 100% of the installed price. This warranty does not cover any defects resulting from neglect by Owner, abuse or damage by others, or unusual phenomena or incidents which are beyond the irrigation system installer's control.

1.07 RECORD DRAWINGS

Contract set of drawings for all phases of the work shall be maintained at the site, with all changes or deviations from the original drawings marked thereon in contrasting color. This shall be a separate set of drawings, not used for construction purposes, which will be kept up to date as the job progresses and be made available to the Engineer for inspection at all times. the sprinkler contractor shall revise his drawings to indicate all changes made during installation. Upon completion of the work, three sets of revised prints shall be delivered to the Owner.

PART 2 MATERIALS

2.01 PIPE AND PIPE FITTINGS.

- A. Pressure Pipe: PVC Class 200 for all pressure pipe.
- B. Conduit Pipe (downstream from circuit valves): Conform to Commercial Standard 80 NSF Polyethylene Pipe.
- C. Pipe Fittings: For PVC plastic pipe, ASTM D2466 socket fittings with ASTM A 2564 solvent cement.
- D. Sleeving: Class 160 PVC with primed and solvent (gray blue) welded joints.

2.02 VALVES AND VALVE BOXES.

- A. Valves: Electric automatic valves.
- B. Strainers: Y strainers on each valve.
- C. Backflow Preventer: Provide anti-siphon device to meet local code.
- D. Valve Box: Plastic
- E. Valve Cover and Frame: Plastic with provision for locking.

2.03 SPRINKLER HEADS

Manufacturer's standard unit designed to provide uniform coverage over entire area of spray shown on drawings at available water pressure, as follows:

- A. Pop-up Spray (PUSp): Fixed pattern with screw-type flow adjustment.
- B. Flush Surface (FLSrf): Fixed pattern with screw-type flow adjustment.

- C. Shrubbery (Shrub): Fixed pattern with screw-type flow adjustment.

2.04 DRAINAGE BACKFILL

Cleaned gravel or crushed stone, graded from 3" maximum to 3/4" minimum.

- A. General: Furnish a low voltage system manufactured expressly for control of automatic circuit valves of landscape irrigation systems. Provide unit capacity to suit number of circuits as indicated. Wall-mount station controller.
- B. Transformer: To convert building service voltage to control voltage of 24 volts.
- C. Circuit Control: Each circuit variable from approximately 5 to 60 minutes. Include switch for manual or automatic operation of each circuit.
- D. Timing Device: Adjustable, 24 hour and 7 to 14 day, clocks to operate any time of day and skip any day in a 7 day or 14 day period. Allow for manual or semi-automatic operation without disturbing present automatic operation.
- E. Wire: Size must meet local codes and be in accordance with manufacturer's recommendations.

PART 3 METHODS AND PROCEDURES

3.01 INSPECTION

Installer must examine the areas and conditions under which landscape irrigation system is to be installed and notify the General Contractor in writing of conditions detrimental to the proper and timely completion of the work. Do not proceed with the work until unsatisfactory conditions have been corrected in a manner acceptable to the installer.

3.02 TRENCHING AND BACKFILL.

- A. Excavation: All pipelines shall be installed in open cut trenches (machine trenched where accessible, otherwise manually excavated). The width of the trench in the pipe will be placed shall be sufficient to allow thorough tamping of suitable backfill material under and over the pipe. Boring will be permitted only where the pipe must pass under an existing obstruction which cannot be removed. In backfilling the bore, the final density of the backfill must match that of the surrounding soil. All other under pavement pipe laying shall be installed in sleeving material prior to placement of flatwork or other obstructions. Any trench deeper than 6' shall be adequately shored and/or braced for safety considerations. Trenches shall be dug to depths outlined under pipe and wire depth and shall be compacted by tamping to a minimum density of 95% Standard Proctor. No after-settling shall occur when finish grade has been re-established. (Verify established finished grades in planter areas before proceeding with the pipe installation).

The Contractor shall be responsible for investigating the type of soil and conditions in which these lines are to be installed and shall allow for same in his proposal. No extra will be allowed due to difficulty in trenching.

- B. Backfilling: Puddling or jetting compaction will not be allowed. Hand or machine tamp trenches are required for compaction.

Excavated trenching material will generally be considered satisfactory for backfill purposes. All backfill material shall be free from rubbish, vegetative matter, frozen materials, or stones larger than 2" in maximum dimension. Any material not suitable for backfill shall be hauled away.

Backfill shall not be done in freezing weather except with written approval from the Engineer.

- C. Pipe and Wiring Depth:
 - 1. Mainline Pressure Piping: 36" from top of pipe.
 - 2. Lateral Lines: 15" from top of pipe.
 - 3. Control Wiring: 36" from finish grade along mainline pipe.

3.03 INSTALLATION.

- A. General: Unless otherwise indicated, comply with requirements of the Uniform Plumbing Code.
- B. Backflow Preventer: Provide unions on upstream or downstream sides. Only two types of devices will be acceptable; the reduced pressure device or the pressure vacuum breaker device. The pressure vacuum breaker device will only be allowed if it can be mounted a minimum of twelve inches (12") above the highest discharge point on the system. If this cannot be done, a reduced pressure device will be used. A minimum of twelve inches (12") clearance above the floor or grade will be maintained to ensure an air gap between the device and any water discharged. Care shall be taken to ensure proper drainage from backflow device. In no case shall the device be allowed to be submerged.
- C. Circuit Valves: Install in valve box, arranged for easy adjustment and removal. Provide union on downstream side.

Adjust automatic control valves to provide flow rate of rated operating pressure required for each sprinkler circuit.

- D. Piping: Lay pipe on solid subbase, uniformly sloped without humps or depressions.

For circuit piping, slope to drain valve at least ½" in 10' of run.

Install PVC pipe in dry weather when temperature is above 40°F in strict accordance with manufacturer's instructions. Allow joints to cure at least 24 hours at temperatures above 40 degrees F before testing, unless otherwise recommended by manufacturer.

- E. Drain Pockets: Excavate to size indicated. Backfill with acceptable drain material to 12" below grade. Cover drain material with a sheet of 30 lb. asphalt saturated felt and backfill remainder with excavated material.
- F. Sprinkler Heads: Flush circuit lines with full head of water and install heads after hydrostatic test is completed.

Install lawn heads at manufacturer's recommended heights.

Install shrubbery heads at heights indicated. Locate part-circle heads to maintain a minimum distance of 4" from walls and 2" from other boundaries, unless otherwise indicated.

- G. Sleeves Under Pavement: Install 3" PVC for sleeving under all paved areas in which the irrigation system crosses.

PART 4 QUALITY CONTROL

- A. General: Notify Owner in writing when testing will be conducted. Conduct test in the presence of Owner.
- B. Hydrostatic Test: Test water piping and valves, before backfilling trenches, to a hydrostatic pressure of not less than 100 psi for 3 hours, unless otherwise indicated. Piping may be tested in sections to expedite the work. Remove and repair piping, connections, valves which do not pass the hydrostatic testing.
- C. Operational Testing: Perform operational testing after hydrostatic testing.

Demonstrate to the Owner that the system meets coverage requirements and that automatic controls function properly.

Coverage requirements are based on operations of one circuit at a time.

END OF SECTION

SECTION 02821**REVEGETATION - SEEDING, SODDING, HYDROSEEDING****PART 1 GENERAL****1.01 Scope**

- A. Furnish labor, materials, equipment and services to complete the following work which shall include but not necessarily be limited to:
1. Soil Preparation and Scarification
 2. Topsoil Placement
 3. Seeding, hydroseeding or sodding
 4. Fertilizing
 5. Mulching
 6. Installing erosion blanket
 7. Maintaining areas

1.02 RELATED WORK SPECIFIED ELSEWHERE

Section 02200 - Excavation and Embankment

Section 02201 - Excavation and Backfill for Structures

1.03 SUBMITTALS:

- B. Seed mixture certifications stating botanical & common name, percentage by weight, and percentage of purity, germination, and weed seed of each grass species.
- C. Certification for mulch as "weed free".
- D. Certificates of compliance for fertilizer and tacifier.

PART 2 MATERIALS**2.01 SEED MIX**

Seed shall be at least 95% pure and shall have a minimum germination percentage of 85%. Seed shall be furnished separately or in mixtures in standard containers with the same seed name, lot number, net weight, percentages of purity and of germination and hard seed, and percentage of maximum weed seed content clearly marked for each kind of seed. The Contractor shall furnish the Engineer duplicate signed copies of a statement by the vendor certifying that each lot of seed has been tested by a recognized laboratory for seed testing within 6 months of date of delivery. This statement shall include: Name and address of laboratory, date of test, lot number of each kind of seed, and the results of tests as to name, percentage of weed content for each kind of seed furnished, and in case of a mixture, the proportions of each kind of seed.

A. Recommended Dryland Seed Mix % of Total/
(below 9000 feet) 1000 Sq. Ft.

Western Wheat Grass/Slender	
Wheat Grass (50% split or	
as available)	50%
Green Needle Grass	6¼%
Candy or Upland Bluegrass	3¼%
Hard Fescue	9½%
Creeping Red Fescue	9½%
Kentucky Bluegrass "Troy"	9%
Lupine (Wildflower substitutes	12½%
are acceptable)	
Globe Mallow	
Scarlet Gilia	
Flax	
Aspen Daisy	

B. Recommended Seed Mixture
(9,000-10,500 feet)

Lincoln Smooth Brome	25%
Orchard Grass (Pot Omac)	20%
Nord Crest Wheat	20%
Slender Wheat Grass	20%
Russian Wild Rye	15%

C. Recommended Seed Mixture
(10,500 feet and above)

Kentucky Blue Grass	25%
Timothy	25%
Chewing Fescue	10%
Pennlawn Red Fescue	10%
Meadow Foxtail	10%
Manchar Smooth Brome	10%
Alsike Clover	10%

Note: As an addition to the basic above, add oats, barley or winter wheat as a seasonal cover crop.

2.02 FERTILIZER

Fertilize all seeded areas with a commercial type 15-40-5 mixture of similar ratio. Fertilizer shall be standard commercial fertilizers supplied separately or in mixtures containing the percentages of total nitrogen, available phosphoric acid, and water-soluble potash. They shall be applied at the rate specified in these Specifications and shall meet the specified requirements of the applicable Federal and State laws. They shall be furnished in standard containers with name, weight and guaranteed analysis of contents clearly marked thereon. No cyanamide compounds or hydrated lime shall be permitted in mixed fertilizers.

2.03 TOPSOIL

Material stripped from site consisting of loose friable loam reasonably free of admixtures of subsoil, refuse, stumps, rocks, brush, weeds or other material detrimental to proper development of vegetative growth. Topsoil shall be a minimum depth of four inches (4").

2.04 STRAW MULCH

Mulch all seeded and hydroseeded areas with straw mulch. Material for straw mulching shall consist of straw or oats, barley, wheat or rye and shall be certified as weed free. A copy of the certification shall be submitted to the Engineer prior to placement of any materials. Clean field hay may be substituted for straw when approved by the Engineer. Straw or hay in such an advanced stage of decomposition as to smother or retard the normal growth of grass will not be accepted.

2.05 TACIFIER

Straw mulch shall be secured by TerraTack or approved equal.

2.06 EROSION BLANKET

Erosion Blanket shall be as specified on Drawings. The blanket shall be smolder resistant, not toxic to vegetation or germination of seed and shall not be toxic or injurious to humans.

PART 3 EXECUTION

3.01 TIME OF YEAR TO SEED AND HYDROSEED.

Spring Seeding

Spring thaw to July 1st

Fall Seeding

Oct. 15th until consistent ground freeze

- A. "Spring thaw" shall be defined as the earliest date in a new calendar year in which seed can be buried ½-inch into the surface soil (topsoil) through normal drill seeding methods.
- B. "Consistent ground freeze" shall be defined as that time during the fall months in which the surface soil (topsoil) due to freeze conditions, prevents burying the seed ½-inch through normal drill seeding operations. At no time shall seed be sown, drilled or otherwise planted when the surface soil or topsoil is in a frozen or crusted state.
- C. Seeding at any time other than within the above seasons shall be allowed only when the Contractor submits a written request for permission to do so and permission is granted. In the request, the Contractor must agree to apply the specified seed at a rate of not less than 25 percent greater per unit area than the rates specified for use within the seeding season. The additional materials shall be furnished and placed at the Contractor's expense. The Contractor must also agree to reseed, re-mulch and repair any areas seeded out-of-season which fail to wind, erosion, lack of germination and/or disturbance by the Contractor.
- D. Where out-of-season seeding is ordered, the cost of additional material, if required, will be paid for, and in this event, the Contractor will not be held responsible for damage or failure beyond his control due to out-of-season seeding.

3.02 TOPSOIL EXCAVATION

Remove all sod, topsoil, organic earth, stockpile topsoil as designated on Drawings or as directed by Engineer.

3.03 TOPSOIL PLACEMENT

- A. General: When job site has been shaped and ready for placement of topsoil, cover all cut-fill areas and construction scars with topsoil to depth of 6". Contour all surfaces to approximate grade and blend with existing adjacent terrain in accordance with detail drawings.
- B. Slope Rounding: Round top and bottom of slopes and feather into undisturbed natural terrain. Avoid abrupt grade changes, making smooth transitions from slopes to more level areas.
- C. Slope Molding: Avoid long continuous slope faces by molding face of slope to accent existing adjacent terrain. Steepened slope faces near ridges and bluffs, laid back to link to natural draws, creating an undulating face.
- D. Surface Roughing: Gouge slope surfaces of 2:1 or steeper with horizontal ridges and trenches to depth of 6" minimum, creating roughened surface to lessen erosion, improve moisture percolation and soil layer binding. Trenches or ridges shall not be longer than 30' to prevent water accumulation and flowing water to cause rivulets.

3.04 PREPARATION FOR PLANTING OF LAWNS

- A. Grade lawn areas to smooth, even surface with loose, uniformly fine texture. Roll and rake and remove ridges and fill depressions as required to meet finish grades. Limit fine grading to areas which can be planted immediately after grading.
- B. Moisten prepared lawn areas before planting if soil is dry. Water thoroughly and allow surface moisture to dry before planting lawns. Do not create a muddy soil condition.
- C. Restore lawn areas to specified condition if eroded or otherwise disturbed after fine grading and prior to planting.
- D. Preparation of Unchanged Grades. Where lawns are to be planted in areas that have not been altered or disturbed by excavating, grading, or stripping operations, prepare soil for lawn planting as follows: Till to a depth of not less than six inches, apply soil amendments and initial fertilizers as specified; remove high areas and fill depressions; till soils to a homogeneous mixture of fine texture free of lumps, cods, stones, roots and other extraneous matter.

3.05 FERTILIZING. APPLY FERTILIZER AT THE RATE OF 100 LBS. PER ACRE.

3.06 SEEDING AND SODDING

- A. Hydroseeding
 - 1. Seed and fertilizer shall be applied by spraying them on slopes of 3:1 or greater gradient in the form of an aqueous mixture and by using the methods and equipment described herein.
 - 2. Spraying Equipment. The spraying equipment shall have a container or water tank equipped with a liquid level gauge calibrated to read in increments not larger than 50

gallons over the entire range of the tank capacity, mounted so as to be visible to the nozzle operator. The container or tank shall also be equipped with a mechanical power-driven agitator capable of keeping all the solids in the mixture in complete suspension at all times until used.

The unit shall also be equipped with a pressure pump capable of delivering 100 gallons per minute at a pressure of 100 pounds per square inch. The pump shall be mounted in a line which will recirculate the mixture through the tank whenever it is not being sprayed from the nozzle. All pump passages and pipelines shall be capable of providing clearance for 5/8" solids. The power unit for the pump and agitator shall have controls mounted so as to be accessible to the nozzle operator. There shall be an indicating pressure gauge connected and mounted immediately at the back of the nozzle.

The nozzle pipe shall be mounted on an elevated supported stand in such a manner that it can be rotated through 360° horizontally and inclined vertically from at least 20° below to at least 60° above the horizontal.

There shall be a quick-acting, three-way control valve connecting the recirculating line to the nozzle pipe and mounted so that the nozzle operator can control and regulate the amount of flow of mixture delivered to the nozzle. At least three different types of nozzles shall be supplied so that mixtures may be properly sprayed over a distance varying from 20 feet to 100 feet. One shall be a close-range jet nozzle. For case of removal and cleaning, all nozzles shall be connected to the nozzle pipe by means of quick-release couplings.

In order to reach areas inaccessible to the regular equipment, an extension hose at least 50 feet in length shall be provided to which the nozzles may be connected

3. Mixtures. Seed and fertilizer shall be mixed together in the relative proportions specified, but not more than a total of 220 pounds of these combined solids shall be added to and mixed with each 100 gallons of water.

All water used shall be obtained from fresh water sources and shall be free from injurious chemicals and other toxic substances harmful to plant life. Brackish water shall not be used at any time. The Contractor shall identify to the Engineer all sources of water at least 2 weeks prior to use. The Engineer may take samples of the water at the source or from the tank at any time and have a laboratory test the samples for chemical and saline content. The Contractor shall not use any water from any source which is determined to be unsuitable by the Engineer following such tests.

All mixtures shall be constantly agitated from the time they are mixed until they are finally applied to the seedbed. All such mixtures shall be used within 2 hours from the time they were mixed or they shall be wasted and disposed of at locations acceptable to the Engineer.

Mixtures of seed and fertilizer shall only be sprayed upon previously prepared seedbeds. The mixture shall be applied by means of a high-pressure spray, which shall always be directed upward into the air so that the mixtures will fall to the ground like rain in a uniform spray. Nozzles or sprays shall never be directed toward the ground in such a manner as might produce erosion or runoff.

Particular care shall be exercised to ensure that the application is made uniformly and at the prescribed rate and to guard against misses and overlapped areas. Proper predetermined quantities of the mixture in accordance with Specifications shall be used to cover specified sections of known area. Checks on the rate and uniformity of application may be made by observing the degree of wetting of the ground or by distributing test sheets of paper or pans over the area at intervals and observing the quantity of material deposited thereon.

Seeding shall be at 1.5 lbs. per 1000 sq. ft. or 65 lbs. per acre.

B. Dryland Seeding

1. Do not use wet seed or seed which is moldy or otherwise is damaged in transit or storage.
2. Sow seed using a spreader, seeding machine or drill seeder. Do not seed when wind velocity exceeds 5 miles per hour. Distribute seed evenly over entire area by sowing equal quantity in 2 directions at right angles to each other.
3. Sow not less than 1.5 lbs. per 1000 sq. ft.
4. Rake seed lightly into top 1/8" of soil, roll lightly, and water with a fine spray.

C. Sodding New Lawns

1. Lay sod within 24 hours from time of stripping. Do not plant dormant sod or if ground is frozen.
2. Lay sod to form a solid mass of with tightly fitted joints. Butt ends and sides of sod strips; do not overlap. Stagger strips to offset joints in adjacent courses. Work from boards to avoid damage to subgrade or sod. Tamp or roll lightly to ensure contact with subgrade. Work sifted soil into minor cracks between pieces of sod; remove excess to avoid smothering or adjacent grass.
3. Secure sod on slopes with wood pegs to prevent slippage. Water sod thoroughly with a fine spray immediately after planting.
4. Maintain sodded lawns by watering, fertilizing, weeding, mowing, trimming and other operations such as rolling, regrading and replanting as required to establish a smooth, acceptable lawn, free of eroded or bare areas until project is accepted by the Owner.

3.07 MULCHING. STRAW MULCHING

All seeded areas shall be mulched, as a separate process, with straw at a rate of 1½ tons/acre. Straw shall be applied in a uniform manner using standard straw blowing equipment. Areas not accessible, by reach, to straw blowing equipment shall be mulched by hand.

Areas not properly mulched or damaged shall be repaired and re-mulched in an acceptable manner, at Contractor's expense. Mulch removed by circumstances beyond the Contractor's control shall be repaired as ordered.

3.08 TACIFIER

Straw mulch not covered by erosion blanket shall be secured by TerraTack tacifier or approved equal. TerraTack shall be applied at a rate of 180 lbs/acre.

3.09 EROSION BLANKET

Areas requiring erosion blanket are designated on the Drawings and are generally on slopes of 1½:1 or greater. The blanket must be placed no later than 24 hours after seeding. The material shall be applied smoothly but loosely on the soil surface without stretching. The upslope end of each piece of blanket shall be buried in a narrow trench six inches deep. After the blanket is buried, the trench should be tamped firmly closed.

In cases where one roll of blanket ends and a second roll starts, the upslope piece should be brought over the buried end of the second roll so that there is a twelve (12) inch overlap to form a junction slot.

Overlaps of blanket which run down the slope, outside edges and center, shall be stapled on two foot intervals. Each width of jute mesh shall have a row of staples down the center as well as along the edge. Check slots and junction slots will be stapled across at six-inch intervals.

END OF SECTION

SECTION 02822**TEMPORARY EROSION CONTROL****PART 1 DESCRIPTION**

- A. This work consists of furnishing and applying a soil binding slurry over disturbed slopes as a temporary soil erosion inhibitor. Disturbed slopes that will not be re-worked and finished slopes that are not scheduled revegetation for a period 21 days or more shall be treated as construction progresses. As construction progresses into the Fall season, all disturbed slopes that will not be re-worked before spring and finished slopes that are not scheduled for revegetation until spring shall be treated before the onset of winter and far enough in advance, in order for the treatment to be applied in accordance of the climatic requirements of this specification. Contractor shall furnish the equipment and labor necessary for performing the work.
- B. Soil binding agent shall be applied to all disturbed open slopes using standard mechanized hydraulic equipment used for broadcasting water based slurry products.
- C. The soil-binding agent shall be added to the proportionate quantity of water and thoroughly mixed per manufacturer's recommendations.
- D. This specification shall apply to all disturbed areas outside CDOT right-of-way.

PART 2 MATERIALS

- A. Soil binder shall be Soil Master WR or approved equal. Soil binder shall be non-toxic, non-flammable and conform to the following properties:

Copolymer of methacrylates/acrylates/acrylics/tripolycate	60%
Extgoxylated surfactants	2%
Silicates	2%
Inert ingredients	36%
pH	4 - 5.1
Color	Milky white
Lbs. per U.S. gallon	9 - 10 lbs.

- B. Wood cellulose fiber mulch shall be Mat-Fiber, or approved equal. Wood cellulose fiber mulch shall conform to the following requirements:

Moisture content (total weight basis)	12.0% +/- 3%
Organic matter (oven-dried weight basis, min.)	99.3%
Inorganic content (oven-dried weight basis, max.)	0.7%
pH at 3% consistency in water slurry (avg.)	4.9
Water holding capacity (min.)	1.2 gal./lb.
Color	Green

- C. Water used for establishing the proper dilution ratio shall be clean, free of sediment and other debris and pollutants.

PART 3 CONSTRUCTION REQUIREMENTS

- A. Liquefied soil binder (Soil Master WR) shall be thoroughly mixed with water and wood cellulose fiber mulch (Mat-Fiber) into a homogeneous mix and applied to the disturbed ground at the following rate per acre:

<u>Soil Binder/Acre</u>	<u>Cellulose Fiber/Acre</u>	<u>Water/Acre</u>
165 gallons	200 pounds	2,000 gallons

- B. The soil-binding product and cellulose fiber mulch shall be slowly poured into the slurry tank with agitators activated until homogeneous slurry is formed. The soil binding slurry shall be applied when the ground temperature is fifty degrees (50°F). or greater at time of application and sustained while the slurry solidifies and stabilizes for a forty-eight hour period.
- C. The soil binding slurry shall be sprayed uniformly over the disturbed areas. Application shall be in the form of a mist and avoid over saturation that result in the slurry running off the slope. Contractor may need to spray areas more than once to achieve the proper coverage and avoid over-saturation. The slurry shall be applied to a moistened ground, but not in the presence of freestanding surface water. Any areas not sealed with the soil binder properly or areas damaged due to the negligence of the Contractor shall be repair and retreated.
- D. The Engineer may order test sections be established for adjusting the equipment and assure proper application and conformance to the specification.

END OF SECTION

SECTION 02830**TREES, PLANTS AND GROUND COVER****PART 1 GENERAL****1.01 SCOPE OF WORK**

Work to be performed under this Section shall include all furnishing of plants and related materials, labor and equipment required to complete the installation of the exterior landscape work indicated on the Drawings.

1.02 RELATED WORK SPECIFIED ELSEWHERE

Section 02200 - Excavation and Embankment

Section 02201 - Excavation and Backfill for Structures

Section 02751 - Raw Water Irrigation Distribution and Underground Sprinkler System

1.03 QUALITY ASSURANCE.**A. Reference Standards.**

Plants shall be first class representatives of the specified species or variety, in healthy conditions with normal well developed branch root systems, free of all objectionable features, and shall conform to the requirements of the USDA Standard For Nursery Stock, 1969 Edition, AAN Standardized Specifications, The American Joint Committee on Horticulture (AJCH) [plant names should meet the standards of AJCH], The American National Standard Institute (ANSI) [nursery stock should meet ANSI Standard Specifications], and The Colorado State Nursery Act of 1965. Where standards may conflict, use the standard which requires the highest quality of performance.

B. Inspection and Approval.

Engineer reserves the right to reject, at any time or place prior to acceptance of, any and all materials and plants which, in his opinion, fails to meet specifications. Inspection of plants are primarily for quality, size and variety, but other requirements are not waived even though visual inspection results in approval. Plants may be inspected where growing, but inspection at the place of growth shall not preclude the right of rejection at the site. Rejected plants and other materials shall be promptly removed from the site and replaced with suitable specimens. All trees and shrubs shall be from a point or origin similar in altitude and climate as the construction site.

C. Acceptable Contractor

Landscape work shall be subcontracted to a single firm specializing in this type of work.

1.04 SOURCE QUALITY CONTROL.**A. Substitutes**

If specified landscape material is unobtainable, submit to Engineer proof of

unavailability and proposals for use of equivalent material. When authorized, adjustment of contract amount will be made.

B. Trees and Shrubs.

1. Provide trees and shrubs grown in a recognized nursery in accordance with good horticulture practice.
2. Provide healthy, vigorous stock free of disease, insects, eggs, larvae and defects such as knots, sun-scald, injuries, abrasions, or disfigurement.
3. Sizes. Provide trees and shrubs of sizes shown or specified. Trees and shrubs of larger size may be used if acceptable to Engineer, and if sizes or roots or balls are increased proportionately.

C. Inspection

Engineer reserves the right to inspect trees and shrubs at site before planting, for compliance with requirements for name, variety, size and quality.

1.05 SUBMITTALS.

- A. Certificates. All required state, federal or other inspection certificates shall accompany the invoice for plant materials, showing source of origin and shall be filed with the Engineer prior to acceptance of the material.
- B. Topsoil. Before delivery of topsoil, furnish Engineer with written statement giving locations of properties from which topsoil is to be obtained, names and addresses of owners, depth to be stripped and crops growing during past two years.
- C. Planting Schedule. Submit planting and seeding schedule to Engineer showing scheduled dates for each type of planting in each area of site.
- D. Maintenance Data. At completion of work, furnish three (3) copies of written maintenance instructions to Engineer for maintenance and care of installed individual plant types through their full grange season.
- E. Warranty. At completion of work, furnish written warranty to Engineer based upon requirements of Paragraph 1.08.

1.06 DELIVERY, STORAGE AND HANDLING

A. Delivery.

1. Deliver packaged landscape materials to site in original unopened containers bearing manufacturer's information (chemical analysis, name, trade name, trademark and conformance to state law.
2. Provide freshly dug trees and shrubs. Do not prune prior to delivery. Do not bend or bind-tie trees or shrubs in such a manner as to damage bark, break branches or destroy natural shape. Provide protective covering during delivery.
3. Deliver trees and shrubs after preparations for planting have been completed and plant immediately. If planting is delayed more than six hours after delivery, set trees and shrubs in shade, protect from weather and mechanical damage, and keep roots moist.
4. Do not remove container-grown stock from container until planting time.

5. Each plant shall be identified by means of a grower's label affixed to the plant. The grower's label shall give the data necessary to indicate conformance to specifications. Use durable waterproof labels with water resistant ink which will remain legible for at least 60 days. Notify Engineer prior to delivery of plant materials to the site so that a pre-planting inspection may be made or indicate delivery schedule in advance so plant material may be inspected upon arrival at job site, whichever is more appropriate.
6. Removal unacceptable plant material immediately from job site.

B. Storage.

1. Deliver balled and burlapped stock directly from nursery and heel-in immediately if not being planted within the same day.
2. The Contractor will not be responsible for malicious destruction of plantings after installation. He shall be responsible for replacement of vandalized materials not yet installed. Report all cases of vandalism promptly to the Architect.

C. Handling.

1. Do not drop plants. Do not lift plants by the trunk, stems or foliage. The ball of the plant shall be natural, and the plant shall be handled by the ball at all times. No balled or burlapped plant shall be accepted if the ball is broken or the trunk is loose in the ball.
2. All plants shall be protected at all times from drying out or other injury. Minor broken or damaged roots shall be pruned before planting. Major damage shall be cause for rejections as determined by the Engineer.

1.07 JOB CONDITIONS

A. Existing Conditions.

1. Contractor shall determine location of utilities and perform work in a manner which will avoid possible damage. Hand excavate as required. Maintain grade stakes set by others until removal is mutually agreed upon by parties concerned.
2. The Contractor shall be responsible for proper repair of the sprinkler system and other underground pipe or electrical wiring damaged by operations under this section. Repairs will be made by contractors designated by the Engineer with cost being charged to this Contractor.
3. If a new tree or shrub is necessary due to interference with utility boxes or pits and undergrounding piping or wiring, the Contractor shall notify the Engineer and receive approval of a new location. The Engineer must approve the precise location of all plants prior to pit excavation and installation.
4. When conditions detrimental to plant growth are encountered, such as rubble fill, adverse drainage conditions, or obstructions, notify Engineer before planting.

B. Protection

The Contractor shall inform the Owner in writing if special tree protection and traffic control must be installed to protect the planting from damage after the Owner assumes responsibility for maintenance. Planting Schedule

1. Sequencing/Scheduling. Proceed with the complete landscape work as rapidly as portions of site become available, working within seasonal limitations for each kind of landscape work required.

2. Plant and install materials during normal planting seasons for each type of landscape work required. Correlate planting with specified maintenance periods to provide maintenance from date of substantial completion.
3. Prepare a proposed planting schedule and submit to Engineer. Schedule dates for each type of landscape work during normal seasons for such work in area or site. Correlate with specified maintenance periods to provide maintenance from date of substantial completion. Once accepted, revise dates only as approved in writing, after documentation of reasons for delays.

1.08 WARRANTY

A. Plant Material Guarantee

All plants shall be guaranteed to remain alive and healthy for two (2) full winters. A final inspection will be done by the Engineer at that time. Replacements shall be guaranteed an additional twelve (12) months. Inspection of the planting work, to determine its completion for beginning the guarantee period will be made by the Engineer upon notice requesting such inspection by the Contractor. All planting must be alive and healthy in order to be considered complete.

B. Final Inspection and Replacements.

Inspection of the planting to determine its final acceptance will be made at the conclusion of the guarantee period by the Engineer representative. No plants will be accepted unless they are alive and healthy. The Contractor shall replace any plants which are dead, or in the opinion of the Engineer, are in an unhealthy or unsightly condition, and/or have lost their natural shape due to dead branches. The cost of such replacement(s) shall be borne by the Contractor and shall be included in his bid price for this section of the Work.

C. Guarantee for Seeded Areas.

Areas failing to show an adequate germination of grass shall be replanted according to the instructions in Section 3.00 of the Specifications.

PART 2 MATERIALS

2.01 TOPSOIL.

- A. Topsoil will be stockpiled for re-use in landscape work. If quantity of stockpiled topsoil is insufficient, provide additional topsoil as required to complete landscape work.
- B. Provide new topsoil for soil mix for backfill of trees and shrubs which is fertile, friable, natural loam, surface soil, reasonably free of subsoil, clay lumps, brush, weeds and other litter, and free of roots, stumps, stones larger than 23" in any dimension, and other extraneous or toxic matter harmful to plant growth.

Obtain topsoil from local sources or from areas having similar soil characteristics to that found at project site. Obtain topsoil only from naturally, well-drained sites where topsoil occurs in a depth of not less than four inches; do not obtain from bogs or marshes.

2.02 SOIL AMENDMENTS

- A. Commercial Fertilizer. Complete fertilizer of neutral character, with some elements derived from organic sources and containing the following plant nutrient ratio: 20-20-5. Fertilizer shall be delivered to the site in unopened containers bearing the manufacturer's guaranteed analysis.
- B. Foliar Fertilizer. All tree and shrubs shall be foliar fertilized with "Rapidgro" or similar fertilizer. Dilute and apply fertilizer according to manufacturer's specifications. Foliar fertilization must be complete within two weeks of planting.

2.03 SOIL MIXTURES

- A. Plant pits: Soil Mixture containing one part Colorado Mountain Peat to three parts topsoil. These materials must be thoroughly mixed so there is no visible segregation of materials.

2.04 PLANT MATERIALS

- A. Quality. Provide trees, shrubs and other plants complying with recommendations and requirements of ANSI Z60.1 "Standard For Nursery Stock" and as specified in Section 1.03.
- B. Plant List. A complete list of plants including names, quantities, sizes and other requirements is shown on the Drawings. The plan shall have precedence over the plant list.
- C. Deciduous Trees. Provide trees of height and caliper listed or shown and with branching configurations recommended by ANSI Z60.1 for type and species required. Provide single stem trees except where special forms are shown or listed.
- D. Deciduous Shrubs. Provide shrubs of the height shown or listed and with not less than minimum number of canes required by ANSI Z60.1 for type and height of shrub required.
- E. Ground Cover. Provide plants established and well rooted in removable containers or integral peat pots and with not less than minimum number and length of runners required by ANSI Z60.1 for the pot size required.
- F. Seed.
 - 1. Seed shall be at least 95% pure and shall have a minimum germination rate of 85%. All seed shall be furnished in bags or containers clearly labeled to show the name and address of the supplier, the seed name, lot number, net weight, the percent of week seed content and the guaranteed percentage of purity and germination. Seed and seed labels shall conform to all current state and federal regulations and will be subject to the testing provisions of the Association of Official Seed Analysis.
 - 2. All seed mixes shall be free from such noxious weeds as Canadian Thistle, Coarse Fescue, European Bindweed, Johnson Grass and Leafy Spurge. The landscape contractor shall furnish to the Engineer a signed statement certifying that the seed furnished is from a lot that has been tested by a recognized laboratory. Seed which has become wet, moldy or in any other way damaged in transit or storage, will not be accepted.
 - 3. Bluegrass Seed. Bluegrass seed shall be "Quicklawn" mix or approved equal by John Ericson, Ericson Enterprises, 481 Grand Valley Drive, Grand Junction, Colorado 81514, (303) 434-3339.

- G. Sod
Provide strongly-rooted sod, not less than two years old and free of weeds and undesirable native grasses. Provide only sod capable of growth and development when planted (viable, not dormant). Provide sod composed principally of the following: 90% Kentucky Bluegrass (*Poa pratensis*).

2.05 MISCELLANEOUS LANDSCAPE MATERIALS.

- A. Mulch. Mulch all planted areas with shredded bark or approved equal.
- B. Stakes and Guys. Provide six-foot steel drive-in "T" posts. No. 125 for all tree staking. Provide wire ties and guys of two-strand, twisted, pliable galvanized iron wire not lighter than 12 gauge with zinc-coated turnbuckles. Provide not less than 1-inch hose, cut to required lengths, to protect tree trunks from damage by wires.
- C. Fiber Mulch. Mulch shall be "Conweb Hydro-Mulch" 2000 (Conweb Corporation, Fibers Division, Box 43237, St. Paul, MN 55164) or suitable approved substitute.

PART 3 METHODS AND PROCEDURES

3.01 INSPECTION

Installer must examine subgrade, verify elevations, observe conditions under which work is to be performed, and notify contractor of unsatisfactory conditions have been corrected in a manner acceptable to installer.

3.02 PREPARATION

- A. Layout
Layout individual trees and shrub locations by size and areas for multiple plantings. Stake locations and outline areas and secure Architect's acceptance before start of planting work. Make minor adjustments as may be requested. Prior to the excavation of planting areas or plant pits or placing tree stakes, the Contractor shall ascertain the location of all utility lines, electric cable, sprinkling system conduits so that proper precautions maybe taken not to disturb or damage any subsurface improvements.
- B. Preparation For Planting Beds.
 - 1. Loosen subgrade of planting bed areas to a minimum depth of eight inches using a cultimulcher or similar equipment. Remove stone over 1 inche in any dimension, and stick, stones, rubbish and other extraneous matter.
 - 2. Spread planting soil mixture to a 4-inch depth required to meet lines, grades and elevations shown, after light rolling and natural settlement. Place approximately one-half of total amount of planting soil required. Work into top of loosened subgrade to create a transition layer, and then place remainder of the planting soil.
- C. Excavation for Trees and Shrubs.
 - 1. Excavate pits, beds and trenches with vertical sides and with bottom of excavation slightly raised at center to provide proper drainage. Loosen hard subsoil in bottom of excavation.

2. For balled and burlapped (B&B) trees and shrubs, make excavation at least half again as wide as the ball diameter and equal to the ball depth, plus following allowance for setting of ball on a layer of compacted backfill.
3. Allow for six-inch setting layer of planting soil mix.
4. For container grown stock, excavate as specified for balled and burlapped stock, adjusted to size of container width and depth.

D. Preparation for Planting Lawns.

1. Grade lawn areas to smooth, even surface with loose, uniformly fine texture. Roll and rake and remove ridges and fill depressions as required to meet finish grades., Limit fine grading to areas which can be planted immediately after grading.
2. Moisten prepared lawn areas before planting if soil is dry. Water thoroughly and allow surface moisture to dry before planting lawns. Do not create a muddy soil condition.
3. Restore lawn areas to specified condition if eroded or otherwise disturbed after fine grading and prior to planting.
4. Preparation of Unchanged Grades. Where lawns are to be planted in areas that have not been altered or disturbed by excavating, grading, or stripping operations, prepare soil for lawn planting as follows:

- E. Till to a depth of not less than six inches, apply soil amendments and initial fertilizers as specified; remove high areas and fill depressions; till soils to a homogeneous mixture of fine texture free of lumps, cods, stones, roots and other extraneous matter.

3.03 PLANTING

A. Planting Trees and Shrubs.

1. Set B&B stock on layer of compacted planting soil mixture, plumb and in center of pit or trench with top of ball at same elevation as adjacent finished landscape grades. Remove burlap from sides of balls; retain on bottoms. When set, place additional backfill around base and sides of ball, and work each layer to settle backfill and eliminate voids and air pockets.
2. When excavation is approximately 2/3 full, water thoroughly before placing remainder of backfill. Repeat watering until no more is absorbed. Water again after placing final layer of backfill.
3. Set container grown stock as specified for balled and burlapped stock, except cut cans on two sides with an approved can cutter; remove bottoms or wooden bases after partial backfilling so as not to damage root balls.
4. Dish top of backfill to create a plant saucer with a four-inch lip.
5. Mulch around all plants with a two-inch layer of shredded bark. The boundaries of the mulched areas shall be the rim of the planting saucer or in shrub beds, the edge of the planting bed.
6. Staking and Guying. Stake and guy trees immediately after planting, as indicated by planting detail on Drawings.
7. Prune, thin out and shape trees and shrubs in accordance with standard horticultural practice. Prune trees to retain required height and spread. Unless otherwise directed by the Architect, do not cut tree leaders, and remove only injured or dead branches from flowing trees, if any. Prune shrubs to retain natural character and accomplish their use in landscape design.

B. Sodding New Lawns

1. Lay sod within 24 hours from time of stripping. Do not plant dormant sod or if ground is frozen.
2. Lay sod to form a solid mass with tightly-fitted joints. Butt ends and sides of sod strips; do not overlap. Stagger strips to offset joints in adjacent courses. Work from boards to avoid damage to subgrade or sod. Tamp or roll lightly to ensure contact with subgrade. Work sifted soil into minor cracks between pieces of sod; remove excess to avoid smothering or adjacent grass.
3. Secure sod on slopes with wood pegs to prevent slippage. Water sod thoroughly with a fine spray immediately after planting.

C. Seeding.

1. Seeding rate: Bluegrass Seed Mix, 6000 lbs/1000 sq.ft.
2. Application. Seed shall be broadcast and uniformly raked to incorporate into the soil. Seeded areas shall be lightly mulched with clean straw.
3. Watering of Seeded Areas. Immediately after seeding and mulching of bluegrass areas, the Contractor shall water the seeded areas lightly and sufficiently to a depth of two inches, but with care so that erosion takes place and no gullies are formed. Damage and erosion from over-watering shall be repaired by or paid for by the Contractor.

D. Hydroseeding.

1. Seed. All seed shall be delivered to the site tagged and labeled in accordance with the Colorado Agricultural Code and shall be acceptable to the County Agricultural Commissioner. Seed shall be of a quality which as a minimum pure live seed content of 70% (% purity x \$ germination), and weed seed shall not exceed 0.5% of the aggregate of pure live seed and other materials or a as standard for specific seed. The germination rate shall be 85%.
2. Fertilizer. A commercial fertilizer shall be ammonium phosphate and contain a minimum of 60 lbs. Actual available nitrogen, 50 lbs. actual available phosphoric acid and 25 lbs. actual available potash, uniform in composition, dry solvable, pelleted or granular.
All fertilizer shall be delivered in unbroken and unopened containers, labeled in accordance with applicable State regulations and bearing the warranty of the producer for grade finished.
3. Mulch. (Wood Cellulose) shall be manufactured from Aspen, Alder or Hemlock (no waste paper, dairy waste fiber, ground straw, rice hulls, etc., can be used - only "virgin wood fiber", i.e. "Conweb or Silva Fiber".

The mulch shall be colored with a non-toxic water-soluble green dye to provide a proper visual gauge for metering of material over ground surfaces. It shall be manufactured in such a manner that after addition and agitation in slurry tanks with fertilizer, seed, water, and other approved additives, the fibers in the material will become uniformly suspended to form a homogeneous slurry;; and that when hydraulically sprayed on the ground, the material will form a blotter-like ground cover impregnated uniformly with seed; and which, after application, will allow the absorption of moisture and allow the rainfall to percolate to the underlying soil.

Cellulose shall be certified to indicate that laboratory and field-testing of the product has been accomplished and that it meets all of the foregoing requirements based on testing. Weight specifications of this material from suppliers and for all application shall refer only to air dry weight of the fiber material.

Absolute air dry weight is based on the normal; standards of the Technical Association of The Pulp and Paper Industry for wood cellulose and is considered equivalent to 10% moisture.

4. Water. Water shall be clean, potable and added to the slurry mixture in sufficient amount to spread uniformly and required quantity of hydro-mulch solids (approximately 3000 - 4000 gallons per acre).
5. Organic Seeding Additive. Use "Ecology Control M-Binder" as per manufacturer's recommendations (apply at rate of 120 lbs/acre).
6. Seeding Requirements.
 - a. Application of Seed: The Contractor shall obtain approval prior to application of the hydro-mulch seed.
 - b. Seedbed Preparation: The area to be seeded shall have a firm seedbed which has been previously roughened by scarifying with the use of harrowing, cat tracks or other methods. Work to a depth of two inches to three inches. No implement shall be used that will create an excessive amount of down-movement of soil or clods on sloping areas. Seedbed preparation shall be suspended when soil moisture conditions are not suitable for the preparation of a satisfactory seedbed. This will be determined by the Project Inspector.
 - c. Fertilizing: The fertilizer shall be mixed and applied hydraulically in the form of a slurry. It shall be applied uniformly over the seedbed (i.e., 20-20-9 at 300 lbs.).
 - d. Seeding: Seed shall be distributed uniformly over the seedbed. The seed shall be added to the slurry mixture just before it is to be applied hydraulically to the seedbed and it shall not remain in the seeder longer than one hour. Seed source: Mile High Seed Company, 520 South 9th Street, P.O. Box 1988, Grand Junction, CO 81502) unless otherwise approved.

Seed

Wester Wheat Grass (50% split or as Slender Wheat Grass available)	50%
Green Needle Grass	6-1/4%
Candy or Upland Bluegrass	3-1/8%
Hard Fescue	9-3/8%
Creeping Red Fescue	9-3/8%
Kentucky Bluegrass "Troy"	3-1/8%
Mt. Sage (10% purity with 70% germination)	6-1/4%
Lupine	
Globe Mallow	
Scarlet Gilia (wildflower mix may vary)	
Phlox	
Aspen Daisy	<u>6-1/4%</u>
1/5 lbs. PLS/1000	

Contractor shall commence seeding immediately upon completion of grading and seedbed preparation. Additional spot seeding may be needed if area is disturbed.

All seeding shall be completed by July 1 (spring seeding) or October 15 (fall seeding) or as otherwise approved.

Mulching: The wood fiber mulch shall be applied uniformly with a hydraulic seeder at the rate of 2000 lbs/acre.

Equipment: Hydroseeder - Hydraulic equipment used for the application of the fertilizer, seed and slurry of prepared wood pump shall be of the type as approved by the Owner. This equipment shall have a built-in agitation system and operating capacity sufficient to agitate, suspend and homogeneously mix a slurry containing up to 40 lbs. of fiber plus combined total of 70 lbs. fertilizer solids for each 100 gallons of water. The slurry distribution lines shall be large enough to prevent sloppage. This discharge line shall be equipped with a set of hydraulic spray nozzles which will provide a continuous non-fluctuating discharge and delivery of the slurry in the prescribed quantities uniformly without misses, waste or erosion. The slurry tank shall have a minimum capacity of 500 gallons and shall be mounted on a traveling unit which will place the slurry tank and spray nozzles within sufficient proximity to the areas to be seeded so as to provide uniform distribution. The Owner may authorize equipment with smaller uniform distribution.

The Owner may authorize equipment with smaller tank capacity provided that the equipment has the necessary agitation system and sufficient pump capacity to spray the slurry in a uniform coat.

3.04 MAINTENANCE

- A. Begin maintenance immediately after planting. Maintain trees, shrubs and other plants until final acceptance but in no case less than 90 days after substantial completion of planting except as provided below for seeded areas. Maintain trees, shrubs and other plants by pruning, cultivating and weeding as required for healthy growth. Restore planting saucers. Tighten and repair stake and guy supports and reset trees and shrubs to proper grades or vertical position as required. Restore or replace damaged wrappings. Spray as required to keep trees and shrubs free of insect and disease.
- B. At the completion of the maintenance period, the Contractor shall:
 - 1. All plants that die or are in a badly impaired condition shall be removed and replaced.
 - 2. Replacement stock shall be subject to all requirements specified for the original material.
 - 3. Replacement stock shall be planted in accordance with the standard specifications. Maintenance requirements shall be specified below.
 - 4. Acceptability of the plant material furnished and planted shall be determined after all replacement plant material is planted. The Contractor shall as necessary, employ all possible means to preserve the plants in a healthy and vigorous growing condition to ensure their successful establishment.

3.05 CLEAN-UP AND PROTECTION

During landscape work, keep pavement clean and work areas in an orderly condition.

3.06 INSPECTION AND ACCEPTANCE

- A. When landscape work is completed, including maintenance, Engineer will, upon request, make an inspection to determine acceptability. Landscape work may be inspected for acceptance in parts agreeable to Engineer, provided work offered for inspection is complete, including maintenance.
- B. Where inspected landscape work does not comply with requirements, replace rejected work and continue specified maintenance until re-inspected by Engineer and found to be acceptable. Remove all rejected plants and materials promptly from project site.

END OF SECTION

SECTION 03100**CONCRETE FORMWORK****PART 1 GENERAL****1.01 SCOPE**

The work in this section consists of the design, furnishing, erecting and removing of forms for cast-in-place concrete.

1.02 RELATED WORK SPECIFIED ELSEWHERE.

Section 03200 - Concrete Reinforcement

Section 03300 - Cast-in-Place Concrete

1.03 QUALITY ASSURANCE.

- A. Reference Standards - American Concrete Institute Standards (ACI).
301 Specifications for Structural Concrete for Buildings, Chapter 4, Formwork. ACI 347, Recommended Practice for Concrete Formwork (Chapters 1 through 5) as modified herein.
- B. Design Criteria - Design formwork for the loads, lateral pressure and allowable stresses outlined in Chapter 1 of ACI 347.
- C. Maximum Allowable Tolerances
 - 1. Variation from plumb:
 - a. Lines and surfaces of columns and walls in any ten feet of length, ¼-inch; in 40 feet or more, ½-inch.
 - b. Control joint grooves, and other conspicuous lines. In any 20 feet of length, ¼-inch; in 40 feet or more, ½-inch.
 - 2. Variation from level or specified grade in slabs. In any 10 feet of length; ¼-inch; in 40 feet or more, ½-inch.
 - 3. Variation of the linear building lines from established position in plan and related position of columns and walls, in any bay, ½-inch; in any 20 feet of length, ½-inch; in 40 feet or more, 1 inch.
 - 4. Refer to ACI 301, Table 4.3.1 for additional requirements.

PART 2 MATERIALS**2.01 GENERAL**

Where "Smooth Form Finish", or "Grout Cleaned Finish" is specified, use prefabricated plywood panel forms, job-built plywood forms, forms lined with plywood, or steel forms. For reservoir walls, use two-foot wide form material to form the circular portion of the reservoir. The forms may be steel or plywood

2.02 STEEL FORMS

Symons "Steel-Ply", Simplex "Industrial Steel Frame Forms", Universal "Uniform". Forms shall be clean, straight and true, without surface defects.

2.03 PLYWOOD FORMS

Product Standard PS-1, waterproof, resin-bonded exterior type. Forms shall be clean, straight

and true, without surface defects.

2.04 LUMBER

Straight, uniform width and thickness, clean and free from offsets, holes, dents and other surface defects.

2.05 CHAMFER STRIPS

Clear white pine, surface against concrete planed.

2.06 FORM TIES

Permanently embedded one-inch break-back cone ties with water seal washers. Ties shall have a neoprene seal integral to the tie. Provide sufficient strength and rigidity to maintain forms in proper location without use of auxiliary spreaders. Form ties shall be uniformly spaced and aligned in vertical and horizontal rows.

2.07 JOINTS.

Joints in circular reservoir shall be formed as shown on the Drawings.

2.08 POLYETHYLENE FILM

Product Standard PS-17; 6 mil. See Drawings for application at the top of the reservoir wall.

2.09 FORM BOND BREAKING AGENT

Shall be non-staining agent that will allow the removal of forms without damaging or discoloring concrete.

PART 3 EXECUTION

3.01 GENERAL

Erect forms substantially tight to prevent leakage of mortar and braced or tied to maintain the desired position, shape and alignment before, during and after concrete placement. At vertical wall joints where forms overlay existing concrete, a mortar-tight joint shall be required. Use a bead of silicone caulking or foam joint filler against concrete before placing form.

Provide temporary openings at the bottom of column and wall forms and at other locations where necessary to facilitate cleaning and inspection.

Temporary openings in wall or column forms used to limit the free fall of concrete to a maximum of four feet shall be located to facilitate placing and compaction of the concrete. Such openings in walls shall not exceed 10 feet laterally to avoid moving concrete laterally more than five feet.

If tremies of proper length are used for depositing concrete in walls or columns, temporary openings for concrete placement will not be required.

Whenever the top of a wall will be exposed to weathering, do not extend the forms on one side above the top wall; bring to true line and grade.

At other locations, bring forms to a true line and grade, or provide a wooden guide strip at the proper location on the forms so that the top surface can be finished with a screed or template for concrete which is to have a specified elevation, slope or contour.

Flat segmental forms not more than 24 inches wide may be used for forming curved surfaces 25 feet in diameter or larger.

Where concrete is placed against rock, remove all loose pieces of rock and clean the exposed surface with a high-pressure hose.

The circular ring wall footing for the reservoir shall have a smooth steel troweled finish within the limits described on the Drawings.

3.02 EMBEDDED ITEMS

Anchor bolts, casting, steel shapes, conduits, sleeves and other materials that are to be embedded in the concrete shall be accurately positioned in the forms and securely anchored. Do not embed conduits, sleeves or other materials in the reservoir wall unless specifically shown on the Drawings.

Conduits shall not be installed in tank walls or slabs.

Assure embedments are clean when installed.

At pipe penetrations where a steel weep ring is not called for, provide a watertight seal between the pipe and wall using "Ramneck" butyl sealant.

3.03 PREPARATION OF FORM SURFACES. REMOVE MORTAR, GROUT AND OTHER FOREIGN MATERIAL FROM FORM SURFACES.

Coat form surfaces with form release agent before either the reinforcing steel, post-tensioning materials or concrete are placed. Do not allow form coating to:

- a. Stand in puddles in the forms;
- b. come in contact with the reinforced steel; or
- c. come in contact with adjacent hardened concrete against which fresh concrete is to be placed.

3.04 EDGES AND CORNERS

Place chamfer strips in forms to bevel exposed edges and projected corners. Tool the top edges of walls and slabs not indicated on the Drawings to be beveled.

Form beveled edges for all vertical and horizontal corners of equipment bases unless indicated otherwise on the Drawings.

Chamfer strips shall be 3/4-inch, unless indicated otherwise on the Drawings.

3.05 REMOVAL

Carefully remove forms only after concrete is able to support all dead and live loads and curing requirements are met. Apply potable water safe curing compound to all formed surfaces immediately after form removal.

Determine the strength of concrete from site-cured cylinders, cured in the same manner as the formed concrete.

If job cured cylinder test reports are not available for formed concrete, the form supports shall remain in place for not less than the following periods of time. These periods represent

cumulative number of days or fractions thereof, not necessarily consecutive, during which temperature of the concrete is above 50 degrees Fahrenheit (50°F).

Walls and columns

48 hours

Reservoir top slab

Only after satisfactory post-tensioned.

Re-shoring shall not be permitted.

After removal, ends of metal form ties shall be recessed a minimum of one inch from surfaces. Form tie holes shall be patched with high-strength, non-shrink grout in a manner as to be permanent.

END OF SECTION

SECTION 03200**CONCRETE REINFORCEMENT****PART 1 GENERAL****1.01 Scope**

The work in this section covers furnishing and installing steel bars and welded wire fabric for concrete reinforcement.

1.02 Related Work Specified Elsewhere.

Section 03100 - Concrete Formwork

Section 03300 - Cast-in-Place Concrete

1.03 Quality Assurance.**A. Reference Standards. American Concrete Institute Standards (ACI).**

301 - Specifications for Structural Concrete for Buildings.

315 - Manual of Standard Practice for Detailing Reinforced Concrete Structures.

318 - Building Code Requirements of Reinforced Concrete.

350R - Concrete Sanitary Engineered Structures.

344 - Design and Construction of Circular Prestressed Concrete Structures.

B. As modified herein or on the Drawings.**C. Allowable Tolerances. Fabrication Tolerances.**

1. Sheared length: + 1 inch

2. Depth of truss: + 0, -1/2 inch for concrete thickness 24 inches or less and + 0, -1/2 inch for concrete thickness over 24 inches.

3. Overall dimensions of stirrups, ties and spirals: + 0, 1/2-inch for concrete thickness 24 inches or less and + 0, -1/2 inch for concrete thickness over 24 inches.

4. All other bends: + 1 inch.

D. Welding.

Only A706 reinforcement may be welded and only with the approval of the Engineer.

1.04 SUBMITTAL OF SHOP DRAWINGS**A. Shop Drawings.**

1. Show sizes, quantity and dimensions for fabrication and placing of reinforced bars and bar supports.

2. Indicate bar schedules, stirrup spacing, and diagram of bent bars.

3. Reinforcement shop drawings shall be submitted on reproducible. Provide two sets of prints and reproducible. **B.**

Certificates. Mill test certificates identifying chemical and physical analysis of each load of reinforced steel delivered.

1.05 PRODUCT DELIVERY, STORAGE AND HANDLING

Deliver to site in bundles marked with metal tags indicating bar size and length. Carefully handle and store on supports, which will keep the steel from coming in contact with the new

ground.

1.06 JOB CONDITIONS

Do not burn or weld in the vicinity of tendons.

PART 2 PRODUCTS

2.01 REINFORCEMENT BARS

- A. Bars. Steel reinforcement shall be new, deformed billet steel, meeting ASTM Standard A615 or A706; for rebars No. 4 and larger, Grade 60; for No. 3 rebars and designated reinforcement, Grade 40 or Grade 60.
 - 1. Bend Test: Meet 180 degree bend at 60 degrees F. minimum temperature without cracking when bent around pin diameter indicated.
 - a. Number 3, 4 and 5 bars around pin diameter equal to 4 times nominal bar diameter.
 - b. Number 6 through 11 bars around pin diameter equal to 5 times nominal bar diameter.
 - 2. Bend test for 14 and 18: Meet 90 degree bend at 60 degrees F. minimum temperature without cracking when bent around a pin diameter equal to 10 times nominal bar diameter.
- B. Tie Wire. Annealed steel, Fed. Spec. QQ-W-461, 16 gage minimum.
- C. Bar Supports.
 - 1. Conform to "Bar support Specifications", CRSI Manual of Standard Practice.
 - 2. Where concrete surface will be exposed to fluids, view or weather, the supports or accessories shall be completely comprised of non-metallic material such as plastic or shall be completely plastic or epoxy coated.
- D. Splice Devices
Provide *Thermite* (Cadweld) welding process only when called for on the Drawings. Where mechanical splice devices are called for on the Drawings, provide *Lenton* (or equal approved by Engineer) "Formsaver" threaded reinforcement splices to match the reinforcement size that the splice is intended to extend. Splices shall meet ACI 318, Chapter 12 strength criteria of developing 125 percent of the specified yield strength of the reinforcement bar it replaces. Install per manufacturer's recommendations.
- E. Fabrication. In accordance with CRSI manual of Standard Practice, except for the allowable tolerances specified herein in Section 1.03 (C) of this specification.

2.02 WELDED WIRE FABRIC

ASTM A185 or A497.

PART 3 EXECUTION

3.01 PREPARATION

Remove all mud, oil, loose rust or mill scale and other foreign materials that may reduce bond.

Rust or mill scale which is "tight" will be permissible without cleaning or brushing, provided weights, dimensions, cross sectional area, and tensile properties meet requirements ASTM A615.

3.02 INSTALLATION.

- A. Bar Placement. Conform to CRSI-WCRSI "Placing Reinforcing Steel".
- B. Bar Supports.
 - 1. Provide minimum number of supports as required by ACI 315.
 - 2. Do not use pebble, piece of broken stone, common or face brick, metal pipe or wood blocks to support reinforcement.
 - 3. On ground, where necessary, solid concrete bricks may be used to support wire chairs that, in turn, support the reinforcing steel in the slabs on grade. Small squares of 1/2" plywood may be used to support grade lab chair on the compacted subgrade.
- C. Placement Tolerances.
 - 1. Clear distance to formed surface: See Section D. Concrete Cover below i) and ii).
 - 2. Spacing between bars: -1/4 inch
 - 3. Top bars in lab and beams: See Section D. Concrete Cover below i) and ii).
 - 4. Crosswise of members: Spaced evenly within 2 inches.
 - 5. Lengthwise of members: +2 inches.
 - 6. Maximum bar movement to avoid interference with other reinforcing steel, conduit or embedded items: One bar diameter.
 - a. If bars are moved more than one bar diameter, or enough to exceed the above tolerances, the resulting arrangement of bars may be rejected by Engineer.
- D. Concrete Cover
 - 1. Except as otherwise indicated on the Drawing, provide the following minimum concrete cover for reinforcement:
 - 2. Concrete cast against and permanently exposed to earth: 3"
 - 3. Concrete poured in form, but exposed to earth, weather or chlorinated water:

Bars larger than No. 5:	2"
Bars #5 or smaller:	1-1/2"
Beams:	2 3/4"
Walls and slabs (not exposed a in 2 above):	3/4"
- E. Reinforcing Adjustment
 - 1. Do not heat, bend or cut bars without Engineer' approval.
- F. Splices
 - 1. Do not splice bars except at locations shown on the Drawings without Engineer' approval.
 - 2. Minimum lap distance shall be as shown on the Drawings. If not shown, splices shall be as specified in ACI 318.
 - 3. Tie splices securely to prevent displacement during placement of concrete.
 - 4. In horizontal wall reinforcement, alternate place vertically so that all splice are not in the same vertical plane.
- G. Welded Wire Fabric

1. Install in longest practicable length.
2. Lap adjoining pieces one full mesh plus 2 inches minimum.
3. Do not make lap midway between simple separated members or directly over support members of continuous structures.
4. Offset lap in adjacent widths to prevent continuous lap.
5. Extend fabric through contraction joints and construction joint unless otherwise indicated on the Drawings.

END OF SECTION

SECTION 03300**CAST-IN-PLACE CONCRETE****PART 1 GENERAL****1.01 SCOPE**

Work to be completed under this section shall include all labor, equipment, plant and materials necessary to furnish and install all poured-in-place concrete, together with all miscellaneous and appurtenant items, as shown on the Construction Drawings and as specified herein.

1.02 RELATED WORK SPECIFIED ELSEWHERE

Section 02201 - Excavation and Backfill for Structures

Section 02201 - Excavation and Backfill for Structures

1.03 REFERENC STANDARDS

Except as modified or supplemented herein, all Work shall conform to the following standards, latest edition. Refer to standards for detailed requirements.

ACI 318 - Building Code Requirement for Reinforced Concrete

ACI 301 - Specifications for Structural Concrete for Buildings

ACI 347 - Recommended Practice for Concrete Formwork

ACI 305 - Recommended Practice for Hot Weather Concreting

ACI 306 - Recommended Practice for Cold Weather Concreting

Publication SP-2, ACI Manual for Concrete Inspection

ASTM A 615 - Standard Specifications for Deformed and Plain Billet Steel Bars for Concrete Reinforcement.

ASTM A 185 - Specifications for Welded Steel Fabric for Concrete Reinforcement.

ASTM C 618 - Standard Specification for Fly Ash and Raw or Calcined Natural Pozzolan for use as a Mineral Admixture in Portland Cement Concrete.

1.04 SUBMITTALS

The following shall be submitted to and approved by the Engineer prior to beginning any concrete work.

- A. Lab Design Mix. Prior to the start of Work, Contractor to submit a statement of the proportions for the concrete mixture. Statement to include:

1. Location & identification of aggregate source.
2. Batch quantities for one (1) cubic yard of concrete, including:
 - a. Weight of fine aggregate in a saturated surface dry condition.
 - b. Weight of coarse aggregate in a saturated surface dry condition.
 - c. Weight or number of 94 pound bags of cement.
 - d. Weight or gallons of water.
 - e. Amount and description (including manufacturer, specific product name, and number) of all admixtures
3. Test results on trial batch concrete made from the proposed mix design, including:
 - a. Cement factor in bags per cubic yard based on yield tests.

- b. Water-cement ratio.
 - c. Percent of entrained air.
 - d. Consistency in inches of slump.
 - e. At least three 28-day compressive strength tests.
 - 4. Brand, type and place of manufacture of cement.
 - 5. Aggregate test results for grading, deleterious substances and physical properties using test procedures developed by ACI.
- B. Reinforcing Steel. Product data sheet and statement of manufacturer's compliance with applicable standards.
- C. Construction Joint Location. Location of all wall and slab construction joints.
- 1.05 RECORD OF THE WORK
Contractor to keep a record of time, date and location of each concrete pour and submit these records to the Engineer.
- 1.06 NOTICE OF INTENTION TO POUR
Contractor shall notify the Engineer at least 48 hours before an intended cast-in-place concrete pour. No structural cast-in-place concrete shall be poured until all reinforcing, forms and foundation soils have been inspected by the Engineer.
- 1.07 PROTECTION OF THE WORK
Contractor to be responsible for protection of all Work prior to acceptance. In place concrete shall not be subjected to loadings or stress prematurely.
- 1.08 STORAGE OF MATERIALS
Cement and aggregate shall be stored in such a manner as to prevent deterioration or intrusion of foreign matter. Any material which has deteriorated or which has been damaged shall not be used for concrete.
All reinforcing steel shall be stored in a dry location and protected from excessive accumulation of rust or scale.
- PART 2 MATERIALS
- 2.01 CEMENT
All cement shall be Portland Cement Type II conforming to "Specifications for Portland Cement" (ASTM C 150-62). The same brand cement for all exposed cast-in-place concrete shall be used.
- 2.02 STONE AGGREGATE
Fine and coarse aggregate shall conform to "Specifications for Concrete Aggregates" (ASTM C33-61T). Fine aggregates shall be clean, hard, natural and free from all foreign matter. Course aggregate shall be sound, crushed rock or gravel, free from adherent coating, organic water or injurious amounts of flat or friable pieces.
- 2.03 WATER
Water used in mixing shall be potable, cleaned and free from deleterious amounts of oil, acids, alkalis and organic material.

2.04 ADMIXTURES

Protex" as manufactured by Protex Industries, Inc. and conforming to Specifications of Air-Entraining Admixtures for Concrete (ASTM C260) is an approved air-entraining admixture. Other admixtures for retarding or accelerating concrete may be used in strict accordance with manufacturer's recommendations and ASTM Specifications upon approval of the Engineer.

2.05 FORM MATERIAL

For unexposed concrete surfaces, forms may be undressed lumber free from excessive knots. For exposed surfaces, use wood or metal forms as required to give finish as specified.

2.06 REINFORCING STEEL

Reinforcing steel shall be deformed bars conforming to "Standard Specifications for Deformed and Plain Billet Steel Bars for Concrete Reinforcement" (ASTM A615) and shall be Grade 60.

2.07 WELDED WIRE FABRIC

Welded wire fabric shall conform to "Specifications for Welded Steel Fabric for Concrete Reinforcement" (ASTM A185) and shall have a minimum wire yield strength of 60,000 psi.

PART 3 METHODS AND PROCEDURES**3.01 CONCRETE MIX.**

- A. Proportions. Concrete is to be proportioned according to laboratory designed mixes using the type of aggregate specified and producing the minimum of twenty-eight (28) day ultimate compressive strength as noted on the Construction Documents. All concrete shall be made with stone aggregate unless specifically noted, and no concrete shall have a 28 day compressive strength of less than 4,000 psi.
- B. Cement and Water Content. The minimum quantity of cement used per cubic yard of concrete shall be 580 pounds. Water content shall not exceed 0.48 pounds water/pounds cement.
- C. Air Entrainment. An air-entraining agent shall be added to all stone concrete so as to entrain 5%-8% by volume. Air-entraining agents shall be in strict accordance with the recommendations of the manufacturer and the testing laboratory for the design mix to assure strength requirements are being fully met or exceeded.
- D. Mixing of Materials. The concrete shall be mixed until there is a uniform distribution of the materials and shall be discharged completely before the mixer is recharged. For job-mixed concrete, the mixer shall be rotated at the speed recommended by the manufacturer.

For stone concrete, mixing shall continue for at least one minute after all materials are in the mixer. Ready mixed concrete shall be mixed and delivered in accordance with "Standard Specifications for Ready Mixed Concrete" (ASTM C94-69).

Sufficient time shall be allowed for proper mixing on the concrete to provide uniformity throughout the batch. Long delays in concrete placement shall be avoided and any concrete which has not been placed within one (1) hour after water has been added to the mix shall be rejected. Over wet mixes shall be rejected and shall not be corrected by the addition of either aggregate or cement to the mixer. Mix not less than ten minutes in transit mix trucks after addition of the mixing water.

- E. Consistency. Slumps shall be minimum, consistent with placing requirements. Slump test shall be made in accordance with "Slump Test for Consistency of Portland Cement Concrete" (ASTM C143-58). Unless written approval is obtained from the Engineer, the maximum slump shall be three (3") inches and the maximum size aggregate shall be one and one-half (1 ½) inches.

3.02 CONCRETE FORMS.

- A. Forms shall conform to the shape, lines, grades and dimensions of the concrete as detailed on the Construction Drawings. All forms for exposed finished surfaces shall be built with the material needed to produce the form, texture and design specified in Concrete Finishes of this section.
- B. Design of Forms. Forms shall be sufficiently tight to prevent leakage of mortar and shall be properly braced or tied together so as to maintain the desired position. The formwork shall be designed for the loads outlined in Part 3, Section 102 of "Recommended Practice for Concrete Form Work" (ACI 347-78). The forms shall be oiled for ease of removal of forms after setting of concrete.
- C. Form Ties and Incidentals. Form ties shall be bolts and rods (adjustable for tightening) arranged so that no metal is within 3'4" of surface after removal of forms. Ordinary wire ties will be allowed with the specific approval of the Engineer. No ties through exposed concrete will be allowed. Set forms for all required anchors, bolt inserts, slots, sleeves, supports, etc., furnished under portions of this Specification and installed under this section.
- D. Removal of Forms. Forms shall not be disturbed until concrete has hardened sufficiently to permit their removal with safety. The removal of the forms shall be carried out in such a manner as to insure the safety of the structure. Unless otherwise permitted by the Engineer, forms shall not be removed until 24 hours after pouring.

3.03 CONSTRUCTION AND EXPANSION JOINTS

Expansion and control joints shall be constructed in accordance with Construction Drawings. Unless otherwise indicated on the Construction Drawings, install one inch (1") thick asphalt impregnated fiberboard expansion joint filler (ASTM D1752) wherever concrete slabs abut buildings or footings or as shown on the plan details. All expansion joint filler shall extend the full depth of the slab.

3.04 CONCRETE PLACEMENT.

- A. transporting concrete shall be cleaned and all debris and ice shall be removed from places to be occupied by concrete. Forms shall be properly treated and all reinforcement cleaned of ice and other coatings. Water shall be removed from place of deposit before concrete is placed.
- B. Conveying. Concrete shall be conveyed from the mixer to the place of final deposit by methods which will prevent the separation or loss of the materials. Equipment for chuting, pumping, or pneumatically conveying concrete shall be of such size and design as to insure

a practically continuous flow of concrete at the delivery and without separation of the materials.

- C. Other Trades. Install by way of example, anchor bolts, reinforcing steel, pipe and conduit openings and sleeves, bearing plates, and knockouts as provided by other trades and as required by other trades. Provide minimum 7 days' notice to Engineer, Owner, or other trades prior to requiring materials or detailing information. Installation to meet location, dimension and alignment requirements of other trades.
- D. Depositing. Concrete shall be deposited as nearly as practicable in its final position to avoid segregation due to rehandling or flowing. The concreting shall be carried on at such a rate that the concrete is at all times plastic and flows readily into the space between the bars. No concrete that has been partially hardened or been contaminated by foreign matter shall be deposited on the Work, nor shall re-tempered concrete be used. When concreting is once started, it shall be carried on as a continuous operation until the placing of the panel or section is completed. Place concrete in approximately horizontal layers avoiding displacement of reinforcement above fresh concrete and formation of seams and planes of weakness in sections. When construction joints are necessary, they shall be located as specified in this section under Construction Joints. For bonding fresh concrete, roughen and clean exposed surface and brush with neat cement grout. Place new concrete before grout takes initial set.
- E. Compaction. Place concrete in layers not over 24" deep; compact each layer by mechanical internal vibrating equipment supplemented by hand spading, rodding, tamping, as directed. Vibrators shall not be used to transport concrete inside forms. Limit vibration duration to the time necessary to produce satisfactory consolidation without causing objectionable segregation. Do not insert vibrator into lower courses that have begun to set.
- F. Weather Conditions. Unless adequate protection is provided and the Engineer's approval is obtained, concrete shall not be placed during rain, sleet, or snow. When the mean temperature falls below 40°F for 3 successive days, concreting shall conform to "Recommended Practice for Cold Weather Conditions: (ACE 306 R-78). Concrete placed in hot weather shall meet the standards of "Recommended Practice for Hot Weather Concreting (ACI 305R-77). Concrete is not to be placed under water. A suitable means shall be provided for lowering the water level below surfaces upon which concrete is to be placed. This may require excavating approximately 12 inches below the bottom of the concrete surface and refilling with gravel and compacting. The groundwater shall not be allowed to rise to the bottom of the concrete until 24 hours after the concrete has been completed. Water shall not be allowed to fall upon or run across the concrete during this period.
- G. Protection and Curing. Concrete protection and curing shall be in conformance with ACI 308-71. Immediately after placing or finishing, concrete surfaces not covered by forms shall be protected from loss of surface moisture. All concrete shall be kept in a moist condition for at least five (5) days after placement. Curing compounds may be used upon approval of the Engineer.

3.05 SLABS ON GRADE

All slabs on grade shall be poured directly on the vapor barrier and prepared gravel subgrade where shown on the Construction Drawings. Construction joints shall be placed such that no

section of slab is greater than 25 feet on a side. Finishes, Expansion & Control Joints & Protection shall be as specified under other sections of this section.

Minimum six-inch (6") Class 6 aggregate base course shall be installed under the entire slab unless otherwise directed by the Engineer. The grading requirements as per Section 02222 for the aggregate course shall apply.

3.06 CONCRETE FINISHES

- A. Patching. Patching shall be done on all concrete surfaces immediately after stripping forms; all exposed surfaces shall have fins and other projections carefully removed, offsets leveled, and voids saturated with water and patched to a true and even surface with a wood float. Patch all holes left by the removal of the form ties or bolts. Patching material shall be a stiff mixture of sand and cement, the color of which matches the concrete being patched. Any major area of faulty or honeycombed concrete shall be completely removed and patched at the direction of the Engineer.
- B. Floor slabs. All concrete slabs shall be screened to levels or grades indicated and float finished monolithically completely free from humps or pits. Slabs shall not show surface deviation in excess of one-quarter inch (1/4") when tested with a 10 ft. straight-edge. Before the finish has set, the surface cement film shall be removed with a fine brush in order to have a fine-grained, smooth but sanded texture.
- C. Rubbed finish. All exposed concrete surfaces shall have a rubbed finish. After removal of forms, rubbing of all exterior surfaces shall be started as soon as its condition will permit. Immediately before starting this Work, the concrete shall be kept thoroughly saturated with water. Sufficient time shall have elapsed before the wetting down to allow the mortar used in the pointing to thoroughly set. Surfaces to be finished shall be rubbed with a medium course carborundum stone, using a small amount of mortar on its face. The mortar shall be composed of cement and fine sand mixed in the same proportions as the concrete being finished. Rubbing shall be continued until all form marks, projections and irregularities have been removed, all voids filled and a uniform surface has been obtained. The paste produced by this rubbing shall be left in place.

After all concrete above the surface being treated has been cast, the final finish shall be obtained by rubbing with a fine, carborundum stone and water. This rubbing shall be continued until the entire surface is of a smooth texture and uniform color.

After the final rubbing is completed and the surface has dried, it shall be rubbed with burlap to remove loose powder and objectionable marks.

- D. Chamfer. All exterior corners shall receive 3/4" chamfer.

3.07 REINFORCING.

- A. Placing Reinforcement. Reinforcing steel, at the time concrete is placed, shall be free from scale, rust or other coatings that will destroy or reduce bond. Reinforcement shall be accurately placed as shown on the Construction Drawings and shall be adequately secured in position by concrete or metal chairs and spacers.

Reinforcing shall be furnished in the full lengths indicated on the Construction Drawings unless otherwise authorized by the Engineer. Splicing of bars, except where shown on the Construction Drawings or specified, shall not be permitted without written approval by the Engineer. Reinforcement placed in any member shall be inspected before any concrete is placed and the Engineer shall be notified 24 hours in advance before any concrete placement.

The placing, fastening, splicing and supporting of reinforcing steel and welded wire fabric shall be in accordance with the Construction Drawings and the latest edition of the CRSI "Recommended Practice for Placing Reinforcing Bars" and in accordance with ACI 318-77. Bars shall be placed around all corners to splice steel in adjacent walls, footers and slabs (such detailing may not be shown on Construction Drawings).

- B. Concrete Protection & Reinforcement. Where not otherwise indicated on the Construction Drawings, the minimum thickness of concrete over the reinforcement shall be as follows:
1. Concrete deposited against earth: 3"
 2. Slabs and walls not exposed to weather or earth: 1"
 3. All other concrete placed in forms:
 - For bars larger than #5: 2"
 - For bars #5 or smaller: 1-1/2"
- C. Bearing Plates, anchor bolts, etc.
Place all bearing plates, anchor bolts, reinforcing rods and other structural items furnished by other trades. Contractor to provide 7-day notice to all such trades prior to affected pour.
Installation to be within tolerances required by other trades.

PART 4 FIELD QUALITY CONTROL

4.01 CONCRETE TESTS

6" x 12" cylinders shall be taken at the point of placing in the forms, shall be job cured and tested in accordance with ASTM Standards by the Engineer. For each strength of concrete used, one set of four (4) cylinders for each day's pour, but not less than one (1) set of cylinders for each 100 cubic yards poured shall be taken. Two (2) cylinders at seven (7) days and two (2) cylinders at twenty-eight (28) days shall be tested. In addition, when in the opinion of the Engineer there is a possibility of the surrounding air temperature falling below 40° F, additional specimens to be cured under job conditions may be required.

4.02 ENFORCEMENT OF STRENGTH REQUIREMENTS

Should the strengths shown by the test specimens fall below the specified values, the Engineer shall have the right to require changes in proportions to apply on the remainder of the Work.

If concrete fails to meet the strength requirements of this specification, the Engineer may order the Contractor to have a testing laboratory, acceptable to the Engineer, take and test core samples of questionable concrete. The Engineer may order all low-strength concrete removed and replaced if core strengths are below specified strengths. All costs connected with concrete coring and removal and replacement of low-strength concrete shall be borne by the Contractor.

Contractor shall repair all core holes at his expense.

4.03 SLUMP TESTS

Engineer to conduct slump tests on each day's pour and on individual trucks whenever concrete consistency varies. Test failure shall be grounds for rejection of individual or batch loads.

4.04 AIR CONTENT

Engineer to conduct air tests on each day's pour and on individual trucks as determined by the Engineer. Test failure shall be grounds for rejection of entire batch until satisfactory tests are obtained.

END OF SECTION

SECTION 04200**MASONRY****PART 1 GENERAL****1.01 Scope**

Work to be completed under this section shall include all labor, equipment, plant, and materials necessary to furnish and install all masonry units, together with all miscellaneous and appurtenant items required for installation and/or furnished by other trades, as shown on the Plans and as specified herein.

1.02 Related Work Specified Elsewhere.

Section 03300 - Cast-In-Place Concrete

1.03 Reference Standards.

ASTM C476 - Standard Specification for Mortar and Grout for Reinforced Masonry

ASTM C404 - Standard Specification for Aggregates for Masonry Grout

ASTM C144 - Standard Specification for Aggregates for Masonry Mortar

ASTM C55 - Standard Specification for Concrete Building Brick

International Masonry Industry, All-weather Council, "Recommended Practices and Guide Specification for Cold Weather Masonry Construction".

1.04 Submittals

Descriptive literature and catalogue cuts on masonry units, reinforcing steel and insulation.

1.05 Protection of Work

Contractor responsible for protection of all work prior to acceptance. Exposed insulation or cells shall be covered to prevent moisture or dirt intrusion.

1.06 Storage of Materials

Materials shall be stored in a dry place and in a manner to prevent damage or intrusion of foreign matter. During freezing weather, all masonry units shall be protected with tarpaulin or other suitable material. Concrete masonry units shall be stored under covers that will permit circulation of air and prevent excessive moisture absorption. Cement, lime and air-settling mortars shall be stored in watertight sheds with elevated floors. Reinforcement shall be protected from the elements; immediately before placing, reinforcement shall be free from loose rust, ice or other foreign coatings that will destroy or reduce the bond. Concrete masonry units shall be protected against wetting prior to use. Deliver packaged material in original manufacturer's containers. Materials showing evidence of water or other damage are subject to rejection.

PART 2 MATERIALS**2.01 Concrete Masonry Units (CMU's)**

Units shall conform to ASTM C90 specifications. All units shall be Type I. Units below grade or exposed to weather shall be Grade N. Other units may be Grade S. Crushing strength, f'm

= 1350 psi.

Units shall be in modular sizes with standard 8" width or 4" width as required. Corner units shall have square external corners. Jamb units at windows, bond beam units and other special units shall match the approved samples for the type of construction and locations designated. Units shall not contain iron spots or other substances that will strain plaster or paint.

2.02 Joint Reinforcement

Steel reinforcement for use in horizontal bed joints of concrete masonry units and other locations as hereinafter specified shall be prefabricated truss design type formed of zinc-coated cold drawn steel wire conforming to ASTM A82 and A116 of Class 3 coating. Side wire shall be formed of 9-gauge rod; cross rods shall be of 9 gauge, smooth or deformed wire, butt welded to side wires in the same plan at contact points. Special formed pieces shall be provided at corners and wall intersections. Reinforcing shall be of proper widths for the wall thicknesses shown. Reinforcing shall be Standard Type Fur-O-Wall, Rewal or approved equal. Unless otherwise noted on the plans, reinforcement in masonry walls shall be installed in the first and second bed joints above lintels, below sill at openings and below bond beams around the entire top of the perimeter walls of the building. Elsewhere, reinforcing shall be installed in bed joints at 16" vertical intervals. Side rods shall be lapped horizontally a minimum of 6". Joint reinforcement embedded in horizontal mortar joints shall have not less than 5/8" mortar coverage from the exposed face.

2.03 Reinforcing Steel

See Section 03300, Part 2.07.

2.04 Mortar and Grout

Shall conform to the property requirements of ASTM C476.
Proportion mix to meet strength and other requirements.

2.05 Portland Cement

See Section 03300, Part 2.01.

2.06 Loose Fill Insulation.

Zonolite, Permalite or approved equal water-repellent masonry fill insulation.

2.07 Masonry Cement. Cement shall conform to ASTM Specification C91. Cement shall be gray.

2.08 Lime

Hydrated lime shall be Type S conforming to ASTM Specification C207. Quicklime shall conform to ASTM Specification C5; it shall be slaked in accordance with the manufacturer's directions.

2.09 Lime Putty

Putty shall be a stiff mixture of lime and water. Keep putty moist until used. Putty made from quicklime shall be slaked and allowed to soak at least 24 hours before using. Putty made from Type S hydrated lime may be used immediately after mixing.

2.10 Sand

Sand shall conform to ASTM Specification C144 except that sand for mortar in ¼ inch wide joints shall pass a No. 16 sieve.

- 2.11 Mixing Water
Water shall be clean and potable.

- 2.12 Coarse Aggregate for Masonry Grout
Aggregate shall conform to ASTM Specification C404.

PART 3 METHODS AND PROCEDURES

- 3.01 Mixing Mortar
Mix all ementitious materials and sand in a mechanical batch mixer for a minimum of 5 minutes. Adjust the consistency of the mortar to the satisfaction of the mason, but add only as much water as is compatible with convenience in using the mortar. If the mortar begins to stiffen from evaporation or from absorption of a part of the mixing water, re-temper the mortar immediately by adding water and remix the mortar. All mortar shall be used within 2 1/2 hours of the initial mixing. It shall not be used after is has begun to set.

- 3.02 Other Trades
Other trades shall be consulted and provisions made such that the installation of their work is permitted in a manner to avoid butting and patching. Install, by way of example, anchor bolts, bearing plates, pipe and conduit openings and sleeves, HVAC openings and other knockouts required by other trades. Provide minimum 7-day notice to Owner, Engineer and other trades prior to requiring materials or detailing information. Build in work specified under other sections, as necessary and as the work progresses in accordance with requirements or other trades. Masonry contractor not responsible for installation of materials running within walls such as concealed conduit and piping.

- 3.03 Laying Masonry Units
All units shall be set plumb and true to line. All units shall be laid with level horizontal joints. Units shall be lain in "running bond" unless otherwise shown.

All interior masonry partitions unless otherwise shown shall terminate 1/2 inch from structural ceilings and a 1-inch thick by 8-inch wide expansion joint material installed thereon.

Where electric conduit, outlet and switch boxes occur, units shall be ground and cut before building in service. Work shall be coordinated with electrical subcontractor. Cutting of all units exposed in finished work shall be done with an approved type of power saw. Work must also be coordinated with plumbing subcontractor where plumbing occurs in masonry partitions.

Masonry units shall be reinforced horizontally with continuous joint reinforcement placed not to exceed 16" on center vertically in exterior walls and in non-load bearing partitions.

Bond each course at corners in a masonry bond and at intersections with metal ties, anchors or joint reinforcement spaced as above.

Partitions of all units that abut exterior walls, columns and other partitions shall be bonded in or be anchored thereto once every 16 inches in height. Where anchors are used they shall be 1/8 x 1-inch zinc coated steel anchors with ends turned up 2 inches and extending 4 inches into wall and not less than 8 inches onto partitions; or anchors may be of type to fit the slats in concrete.

Interior joints of all masonry construction shall be "flush". Exterior joints of all masonry

construction shall be "concave".

3.04 Special Requirements

Masonry shall not be laid when the temperature of the outside air is below 40°F., unless suitable means as approved by the Engineer are provided to heat materials, protect work from cold and frost and ensure that mortar will harden without freezing. (No anti-freeze ingredient shall be used in the mortar).

The facing material shall be protected against staining and tops of walls kept covered with non-staining waterproof coverings when work is not in progress. When work is resumed, top surface of work shall be cleaned of all loose mortar and in drying weather thoroughly wet except for concrete masonry units.

Where fresh masonry joins masonry that is partially set or totally set, clean the exposed surface of the set masonry and wet it lightly so as to obtain the best possible bond with the new work. Remove all loose brick and mortar. If it is necessary to "stop off" a horizontal run of masonry, this shall be permitted only with the Engineer's approval. (Toothing will not be permitted).

All reinforced hollow unit masonry shall be built to preserve the unobstructed vertical continuity of the cells to be filled. Walls and webs forming such cells to be filled shall be full bedded in mortar to prevent leakage of grout. All head (or end) joints shall be solidly filled with mortar for a distance of the longitudinal face shells. Bond shall be provided by lapping units in successive vertical courses or by equivalent mechanical anchorage.

Vertical cells to be filled shall have vertical alignment sufficient to maintain a clear, unobstructed continuous vertical cell measuring not less than 2 inches by 3 inches.

All cells containing reinforcement shall be filled solidly with grout. Grout shall be poured in lifts of 8 feet maximum height. All grout shall be consolidated at time of pouring by puddling or vibrating and then reconsolidated by again puddling later, before plasticity is lost.

When total grout pour exceeds 8 feet in height, the grout shall be placed in 4 foot lifts and special inspection during grout shall be required. Minimum cell dimension shall be 3 inches.

When the grouting is stopped for one hour or longer, horizontal construction joints shall be formed by stopping the pour of grout 1" inches below the top of the uppermost unit.

Steel in lintels shall be set in beds of mortar. Spaces around jambs and heads of metal door bucks and frames shall be filled solidly with mortar.

Bond beams or concrete caps along the top of the walls shall be provided with the necessary and required bearing plates, anchor bolts, expansion joint filler, etc. and welds and connections of the pre-cast concrete components to the walls shall be made by the contractor under this section.

3.05 Insulation

Loose fill insulation shall be poured directly from the bag. Block joints at columns or other vertical members shall be mortared in to prevent leakage. All block throughout the entire job is to be filled except interior partitions.

PART 4 FIELD QUALITY CONTROL**4.01 General**

All mortar smears and mortar chucks shall be cleaned from all exposed surfaces or surfaces to receive paint. Point all joints as directed by Engineer removing joint material sufficient to allow uniform joint after repair. Receive approval of finished wall.

END OF SECTION

DIVISION 6



Division 6 Construction Forms

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CONSTRUCTION FORMS

Construction Forms	Pages
Project Acceptance	9
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City of Craig Project Acceptance		Project:								FINAL ACCEPTANCE DATE	COMMENTS
Developer: _____		Contractor: _____		Materials Tester: _____							
				<div> <div>DEVELOPER</div> <div>CONTRACTOR</div> <div>INSPECTOR</div> <div>NOT</div> <div>REENGINEER</div> </div>							
SECT 2200 EXCAVATION AND EMBANKMENT				INITIAL UPON SATISFACTORY COMPLETION							
SUBMITTALS											
None Required											
MATERIALS TESTING <i>Documentation from Geotech</i>											
Moisture-Density Curve 1 test per different soil type											
In-Place Density 1 test per 2000 cy or fraction thereof											
VISUAL INSPECTION <i>Documented on Daily Report/Diary</i>											
Surface Restoration:											
-Existing surface improvements and site conditions disturbed during construction are restored to preconstruction condition or better.											
Finish Grading:											
-Tolerances met, grading in reasonable conformance with plans & specs.											
-Excess & unsuitable materials satisfactorily disposed.											
SECT 2201 EXCAVATION AND BACKFILL FOR STRUCTURES											
SUBMITTALS											
None Required											
MATERIALS TESTING <i>Documentation from Geotech</i>											
Gradation 1 test per 200 cy or fraction thereof											
Moisture-Density Curve 1 test per source (<i>minimum</i>)											
In-Place Density 1 per 200 cy, (<i>minimum</i>) 1 per structure											
VISUAL INSPECTION <i>Documented on Daily Report/Diary</i>											
Restoration of existing improvements											
-Existing structures or portion of structures to remain and existing surface improvements and site conditions are restored to preconstruction condition of better.											
-Adjacent property satisfactorily protected or restored to preconstruction condition or better.											
SECT 2221 TRENCHING, BACKFILLING, AND COMPACTION											
SUBMITTALS											
None Required											
MATERIALS TESTING <i>Documentation from Geotech</i>											
Gradation Submit report on bedding & select fill											
Moisture-Density Curve 1 test per different soil type											
In-Place Density 1 test per 250 lf per lift or fraction thereof											
VISUAL INSPECTION <i>Documented on Daily Report/Diary</i>											
All trenches backfilled, excess materials disposed of, & final grading complete.											

City of Craig Project Acceptance		Project:	DEVELOPER	CONTRACTOR	ENGINEER	NOTES	REVISIONS	FINAL ACCEPTANCE DATE	COMMENTS
SECT 2222 EMBEDMENT AND BASE COURSE AGGREGATE			INITIAL UPON SATISFACTORY COMPLETION						
SUBMITTALS									
None Required									
MATERIALS TESTING <i>Documentation from Geotech</i>									
Gradation 1 test per 2000 tons for each class									
Atterberg Limits 1 test per 1000 tons or fraction thereof									
Moisture-Density Curve 1 test per source									
In-Place Density 1 test per lift, or fraction thereof, as follows:									
Foundations-100 lf or less of trench									
Slabs on grade-2000 sf or less									
Pavements & walks-2000 sf or less									
Utility trenches-250 lf or less									
All other areas-5000 sf or less									
SURFACE TOLERANCE <i>Documented on Daily Report/Diary</i>									
1/4 inch per 10 foot straightedge									
VISUAL INSPECTION <i>Documented on Daily Report/Diary</i>									
Free of ruts & irregularities and true to grade; crown as shown on plans.									
Segregation (rock pockets) re-integrated or removed prior to paving.									
SECT 2520 CULVERT DRAINAGE PIPE <i>also sect. 2200,2201,2221,2222</i>									
SUBMITTALS									
Provide certificates of compliance from manufacturer for all materials used.									
MATERIALS TESTING <i>Documentation from Geotech</i>									
Gradation 1 test per 2000 tons for each class									
Atterberg Limits 1 test per 1000 tons or fraction thereof									
Moisture-Density Curve 1 test per source/type									
In-Place Density 1 test per lift per 250 lf or fraction thereof									
VISUAL INSPECTION <i>Documented on Daily Report/Diary</i>									
Inspect materials (pipe, collars, end sections) all defects corrected satisfactorily.									
Observe methods of construction. Were they satisfactory?									
-Inside of pipe clean.									
-Inlets are free of obstructions.									
-Outlets are free of obstructions and finish grade of ditch does not constrict or reduce the flow in any way (includes riprap where placed).									
-End sections or headwalls are secure and properly constructed.									
-Joints satisfactorily made; deflection, if any, meets specifications.									

City of Craig Project Acceptance		Project:	DEVELOPER	NOTARIAL	HOLOG	WON	RENEW	FINAL ACCEPTANCE DATE	COMMENTS
SECT 2271 RIPRAP			INITIAL UPON SATISFACTORY COMPLETION						
SUBMITTALS									
Provide certificates of compliance for geotextile when fabric is required.									
VISUAL INSPECTION <i>Documented on Daily Report/Diary</i>									
Stone is of correct size, shape, durability.									
Placement of stone is satisfactory.									
-Placement covers full area intended.									
-In drainage areas, finish grade will allow positive flow in direction intended.									
There are no constrictions/reductions in flows.									
-Stone is placed evenly with minimal voids or grouping of large rock.									
SECT 2555 WATER TRANSMISSION AND DISTRIBUTION LINES			also sect. 2200,2201,2221,2222						
SUBMITTALS									
Certificates of Compliance are provided for all materials (pipe, valves, bends, water services, etc.).									
MATERIALS TESTING <i>Documentation from Geotech</i>									
Gradation 1 test per 2000 tons for each class									
Atterberg Limits 1 test per 1000 tons or fraction thereof									
Moisture-Density Curve 1 test per source/type									
In-Place Density 1 test per lift per 250 lf or fraction thereof									
PERFORMANCE TESTING <i>Documented on appropriate test form</i>									
Successful hydrostatic tests Per Public Works Manual Subsection 4.01									
Successful disinfection									
-Chlorine application (initial & successive if needed).									
-Flushing, final flushing, & chlorine residual.									
-Bacteriological tests.									
VISUAL INSPECTION <i>Documented on Daily Report/Diary</i>									
Pipe & appurtenance materials-free from defects or defects were repaired.									
Construction methods satisfactory (bedding, pipe laying, cover, backfill, bury).									
All corporation stops are open.									
Tracer wire was installed and continuity tests successful.									
Final placement/grade of all items terminated above ground is satisfactory (includes curb stops, fire hydrants, valve boxes, etc.).									
Restoration of ex. improvements; all surface, structures, or adjacent property imp. are restored to equal or better than preconstruction conditions.									

City of Craig Project Acceptance		Project:	DEVELOPER	NOTAR	HOE	SON	REVIEWER	FINAL ACCEPTANCE DATE	COMMENTS
SECT 2560	SANITARY SEWER LINES	<i>also sect. 2200,2201,2221,2222</i>	INITIAL UPON SATISFACTORY COMPLETION						
SUBMITTALS									
Certificates of Compliance are provided for all materials (pipe, manholes, etc)									
MATERIALS TESTING <i>Documentation from Geotech</i>									
Gradation 1 test per 2000 tons for each class									
Atterberg Limits 1 test per 1000 tons or fraction thereof									
Moisture-Density Curve 1 test per source/type									
In-Place Density 1 test per lift per 250 lf or fraction thereof									
PERFORMANCE TESTING <i>Documented on appropriate test form</i>									
Successful low pressure air Public Works Manual Subsection 4.02									
Successful manhole test (vacuum or water leakage).									
Successful pipe lamp tests (deflection test (mandrel) or televise as required)									
VISUAL INSPECTION <i>Documented on Daily Report/Diary</i>									
Pipe & appurtenance materials-free from deflects or defects were repaired.									
Construction methods were satisfactory (bedding, pipe laying, cover, backfill).									
Pipe elevations to line & grade as shown on plans.									
Manhole const: Steps-all installed & aligned; dimension tolerances per									
PW Manual Details; Frame & lid adjusted to final grade.									
Services-all are installed, ends are marked, measurements provided from									
manhole to each service wye.									
Televise									
SECT 2612	HOT BITUMINOUS PAVING								
SUBMITTALS									
Approved mix design.									
Certificates of Compliance are provided for asphalt, prime coat, & tack coat.									
MATERIALS TESTING <i>Documentation from Geotech</i>									
AC Content 1 test per 500 tons or fraction thereof									
Gradation 1 test per 1000 tons or fraction thereof									
Fractured faces 1 test per source									
In-Place Density Min. 3 tests or 1 per every 2000sf per lift.									
Maximum specific gravity. 1 test per placement day									
Cores taken and test information submitted as required.									
VISUAL INSPECTION <i>Documented on Daily Report/Diary</i>									
Final grades are in reasonable conformance with plans & specs; HBP @									
gutters equal 1/4" to 1/2" above; Ridability/surface tolerances are met.									
Utility appurtenances (MH, WV) are adjusted to specification.									
Segregation is minimal or repaired; No excessive or wide cracks exist.									

City of Craig Project Acceptance	Project:	DEVELOPER	ROTARY	CONCRETE	FOOT	REINFORCE	FINAL ACCEPTANCE DATE	COMMENTS
SECT 2626	CONC. CURB & GUTTER, SIDEWALK, CURBWALK, & DRIVEWAY	INITIAL UPON SATISFACTORY COMPLETION						
SUBMITTALS								
Approved mix design.								
MATERIALS TESTING <i>Documentation from Geotech</i>								
Frequency <i>(for each strength of concrete used)</i>								
Air Content 1 test per placement day(<i>minimum</i>)								
Slump 1 test per cylinder set(<i>minimum</i>)								
Compressive Strength 1 set per day or 1 set per 100 cy								
VISUAL INSPECTION <i>Documented on Daily Report/Diary</i>								
Final grade in reasonable conformance to plans, specs, and adjacent features.								
Surface finish is satisfactory & in accordance with subsection 3.04.								
No excessive roughness, honeycombing, or rock pockets.								
Expansion & construction joints are at intervals per specifications.								
Excessive or open cracks, spalling, or pop offs do not exist or have been satisfactorily repaired/replaced.								
Sidewalk ramps are installed and meet the requirements/dimensions of appropriate drawings in the Public Works Manual.								
SECT 2720	METAL GUARDRAIL							
SUBMITTALS								
Provided certificates of compliance on all materials used.								
Provided welder certifications as appropriate.								
VISUAL INSPECTION <i>Documented on Daily Report/Diary</i>								
Rail was installed at locations shown of plans and provides intended protection.								
Rail installation does not create additional safety concerns								
Installation is in reasonable conformance with details given.								
SECT 2700	FINISHED GRADING AND RESTORATION							
VISUAL INSPECTION <i>Documented on Daily Report/Diary</i>								
General cleanup is satisfactory								
Existing improvements to remain including concrete flatwork & structures;								
walls; drainage and irrigation ditches; trees; shrubs; landscaping;								
pavement; signs; adjacent private property;etc. were satisfactorily								
protected or have been restored to equal or better than preconstruction								
condition.								

City of Craig Project Acceptance	Project:	DEVELOPER	ROTOR-200	HOE TOES	230H	2002-02E	FINAL ACCEPTANCE DATE	COMMENTS
SECT 2720 SEEDING, SODDING, AND TOPSOIL		INITIAL UPON SATISFACTORY COMPLETION						
SUBMITTALS								
-Certifications-seed mixture stating botanical & common name, percentage by weight, and percentage of purity, germination, and weed seed of each grass species.								
-Planting schedule and maintenance instructions.								
-Provided certification for mulch as "weed free".								
MATERIALS TESTING <i>Documentation from Geotech</i>								
-Topsoil - per source - one certified test results documenting pH, % organic, soluble salts, nutrient and micro-nutrient requirements.								
VISUAL INSPECTION <i>Documented on Daily Report/Diary</i>								
Work under this item has been satisfactorily completed.								
SECT 2821 REVEGETATION-SEEDING, SODDING, HYDROSEEDING								
SUBMITTALS								
-Certifications-seed mixture stating botanical & common name, percentage by weight, and percentage of purity, germination, and weed seed of each grass species.								
-Planting schedule and maintenance instructions.								
-Provided certification for mulch as "weed free".								
MATERIALS TESTING <i>Documentation from Testing Firm</i>								
-Topsoil - per source - one certified test results documenting pH, % organic, soluble salts, nutrient and micro-nutrient requirements.								
VISUAL INSPECTION <i>Documented on Daily Report/Diary</i>								
Work under this item has been satisfactorily completed.								
SECT 2830 TREES, PLANTS, AND GROUND COVER								
SUBMITTALS								
-Certificates-all required state, federal or other inspection reports showing source of origin.								
-Topsoil-information of source as per subsect. 1.05B.								
-Maintenance instruction per subsect. 1.05D.								
-Warranty-written warranty has been provided per subsect 1.08								
VISUAL INSPECTION <i>Documented on Daily Report/Diary</i>								
Items under this section are in good condition.								
Items under this section have been installed satisfactorily.								

City of Craig Project Acceptance	Project:	DEVELOPER	RECORDS	HOE	NOT	REVIEW	FINAL ACCEPTANCE DATE	COMMENTS
SECT 3100-3300 CAST-IN-PLACE CONCRETE		INITIAL UPON SATISFACTORY COMPLETION						
SUBMITTALS								
Approved mix design								
Reinforcing bar certifications								
MATERIALS TESTING <i>Documentation from Geotech</i>								
(for each strength of concrete used)								
Air Content 1 test per placement day(<i>minimum</i>)								
Slump 1 test per cylinder set(<i>minimum</i>)								
Compressive Strength 1 set per day or 1 set per 100 cy								
VISUAL INSPECTION <i>Documented on Daily Report/Diary</i>								
-Reinforcement-bar size and grade, spacing, lap splices, clearances, & cover are in reasonable conformance with the plans and specifications.								
-Concrete surfaces are completed satisfactorily and no excessive roughness, aggregate segregation, honeycombing, spalling, etc. exists.								
-Expansion and construction joints are constructed and located in reasonable conformance with plans and specs.								
SECT 3200 MASONRY								
SUBMITTALS								
Information has been provided on Concrete Masonry Units per subsect 1.05.								
VISUAL INSPECTION <i>Documented on Daily Report/Diary</i>								
-All materials were free of defects or satisfactorily repaired/replaced.								
-Construction methods-footings, horizontal & vertical control, mortar, etc. are satisfactory and within reasonable conformance with plans & specs.								
-Reinforcement-bar size & grade,spacing, laps, etc. are in reasonable conformance with plans and specs.								
-Finish product-alignment & grade, mortar, grout, appearance are satisfactory.								
SECT 4100 WIRE FENCING								
SUBMITTALS								
Certificates of compliance have been provided on all materials used.								
VISUAL INSPECTION <i>Documented on Daily Report/Diary</i>								
-Installation methods including alignment, posts plumb, wire taut, secure connecting hardware, and gates are satisfactory and in reasonable conformance with plans and specs.								

City of Craig Project Acceptance		Project:	DEVELOPER	CONTRACTOR	HOECHL	NOT	REVIEWER	FINAL ACCEPTANCE DATE	COMMENTS
SECT 2751 UNDERGROUND SPRINKLER SYSTEM			INITIAL UPON SATISFACTORY COMPLETION						
SUBMITTALS									
-Operation Instructions									
-Certificates of compliance for all materials.									
-Written warranty/guaranty.									
PERFORMANCE TESTING <i>Documented on appropriate test form</i>									
-Successful hydrostatic test reports									
-Successful operational tests									
VISUAL INSPECTION <i>Documented on Daily Report/Diary</i>									
-Per subsect. 4.00; including fully operational system, coverage, satisfactory finish grading, no damage to equipment, initial and final walk-through, clean-up.									
PROJECT ACCEPTANCE									
Developer: _____			Materials Tester: _____						
Contractor: _____			Engineer: _____						
RECORD DRAWINGS (AS-BUILT PLANS)									
SUBMITTALS			-Underground sprinkler system -Area improvements (curb, gutter, pavement, guardrail, fencing, lights, etc) -All other improvements not listed						
-Storm water system									
-Water transmission and distribution system									
-Sanitary sewer system includes service stub outs									
-Underground sprinkler system									

City of Craig Project Acceptance**Project:****PROJECT INITIAL**

INITIAL AND FINAL WALK-THROUGHS ARE COMPLETE

EXCESS MATERIALS HAVE BEEN SATISFACTORILY DISPOSED

CLEAN UP IS COMPLETE

ALL IMPROVEMENTS ARE WITHIN RIGHT-OF-WAY OR EASEMENT LIMITS

NO RIGHT-OF-WAY OR EASEMENT ENCROACHMENTS EXIST (other than shown)

ALL ITEMS ON PUNCHLISTS HAVE BEEN SATISFACTORILY ADDRESSED

ALL DOCUMENTATION HAS BEEN RECEIVED

ALL AS-BUILTS HAVE BEEN RECEIVED, REVIEWED, AND ARE COMPLETE

TO THE BEST OF OUR KNOWLEDGE, ALL REQUIREMENTS OF THIS PROJECT AS WRITTEN HEREIN OR CONTAINED IN ANY DOCUMENT GOVERNING THE ACCEPTANCE OF THIS PROJECT BY THE CITY OF CRAIG HAVE BEEN MET. IF DURING THE STATED WARRANTY PERIOD ANY DEFICIENCIES ARE DISCOVERED OR ANY ITEMS BECOME IN NEED OF REPAIR FOR REASONS AS STATED IN ANY WARRANTIES CONTAINED IN THE PROJECT DOCUMENTS, THE DEVELOPER SHALL HAVE THESE DEFICIENCIES OR REPAIRS CORRECTED WITHIN THE TIMES PRESCRIBED.

INITIAL ACCEPTANCE IS MADE ON THIS DAY

DEVELOPER: _____

CONTRACTOR: _____

GEOTECH: _____

ENGINEER: _____

CITY: _____

WARRANTY/GUARANTY PERIOD SHALL RUN TO**FINAL ACCEPTANCE IS MADE ON THIS DAY**

DEVELOPER: _____

CONTRACTOR: _____

GEOTECH: _____

ENGINEER: _____

CITY: _____

NOTE:

All test frequencies given are minimum required. If discrepancies exist, the higher frequency will govern. Minimum quantities also assume passing reports with few problems. The City and Engineer may require additional tests where quality or methods of construction are in question.

City of Craig Sewer Line Low Pressure Air Test

Project: _____

Contractor:

DATE:	_____	PIPE SIZE:	_____	PIPE TYPE:	_____	FROM:	_____	TO:	_____	LENGTH	_____
		STARTING PRESSURE:	_____	TEST START:	_____	TEST COMPLETE:	_____	ENDING PRESSURE:	_____	PRESSURE LOSS:	_____
ALLOWABLE LOSS:	0.5 PSI	PASS/FAIL:	_____	TEST BY:	_____	CONTRACTOR INITIAL:	_____	COMMENTS	_____		

DATE:	_____	PIPE SIZE:	_____	PIPE TYPE:	_____	FROM:	_____	TO:	_____	LENGTH	_____
		STARTING PRESSURE:	_____	TEST START:	_____	TEST COMPLETE:	_____	ENDING PRESSURE:	_____	PRESSURE LOSS:	_____
ALLOWABLE LOSS:	0.5 PSI	PASS/FAIL:	_____	TEST BY:	_____	CONTRACTOR INITIAL:	_____	COMMENTS	_____		

DATE:	_____	PIPE SIZE:	_____	PIPE TYPE:	_____	FROM:	_____	TO:	_____	LENGTH	_____
		STARTING PRESSURE:	_____	TEST START:	_____	TEST COMPLETE:	_____	ENDING PRESSURE:	_____	PRESSURE LOSS:	_____
ALLOWABLE LOSS:	0.5 PSI	PASS/FAIL:	_____	TEST BY:	_____	CONTRACTOR INITIAL:	_____	COMMENTS	_____		

DATE:	_____	PIPE SIZE:	_____	PIPE TYPE:	_____	FROM:	_____	TO:	_____	LENGTH	_____
		STARTING PRESSURE:	_____	TEST START:	_____	TEST COMPLETE:	_____	ENDING PRESSURE:	_____	PRESSURE LOSS:	_____
ALLOWABLE LOSS:	0.5 PSI	PASS/FAIL:	_____	TEST BY:	_____	CONTRACTOR INITIAL:	_____	COMMENTS	_____		

PROCEDURE:
Per section 2400, subsection 4.02 Leakage Test

Criteria:

Start test at 5 PSI
Allowable loss is 0.5 PSI

MINIMUM DURATION FOR AIR TEST PRESSURE DROP

Pipe Size (Inches)	Time (minutes)
4	2 1/2
6	4
8	5
10	6 1/2
12	7 1/2
15	9 1/2

Ordinance No. 578

AN ORDINANCE REGULATING THE MANNER OF MAKING CUTS AND OPENINGS IN STREETS AND ALLEYS WITHIN THE TOWN OF CRAIG, COLORADO; REQUIRING A PERMIT THEREFORE; PRESCRIBING THE METHOD AND COST FOR REPAIRING SUCH CUTS AND OPENINGS; AND PROVIDING A PENALTY FOR THE VIOLATION OF THE PROVISIONS OF THIS ORDINANCE; AND REPEALING ORDINANCES NO. 252 AND 416 OF THE CITY OF CRAIG, COLORADO.

BE IT ORDAINED BY THE BOARD OF TRUSTEES OF THE TOWN OF CRAIG, COLORADO:

SECTION 1. PERMIT REQUIRED. No cut, opening, hole or excavation shall be made or caused to be made between the dedicatory boundaries of any street, alley or thoroughfare within the corporate limits of the Town of Craig, Colorado, except by a contractor duly licensed by the Town of Craig, Colorado, under the provisions of the Ordinance No. 225 or its agent, or by a public utility. Any such cuts, openings, holes, curb cuts and excavation shall require permits which shall be issued by the City Clerk upon the approval of the City Engineer.

SECTION 2. PERMIT FEE. There shall be paid to the City Clerk, the sum of \$5.00 for the permit required by Section 1 herein.

SECTION 3. REQUIREMENTS. All such cuts, openings, holes, curb cuts and excavations shall be made in accordance with the City of Craig Standards and Specifications. The City Engineer shall be given 24 hours notice prior to the commencement of any work under the provisions of this Ordinance.

SECTION 4. BARRICADES, LIGHTS. All such cuts, openings, holes and excavation at all times when no actual work is in progress shall be properly barricaded and lighted to safeguard adequately the public damage from the same.

SECTION 5. REPAIRS. The repair of all cuts, openings, holes and excavations as described in this Ordinance shall be the responsibility of the licensed contractor or public utility who caused the same to be made. Backfilling shall be done by a licensed contractor or public utility as specified by the City of Craig Standards and Specifications. The installation of permanent pavement shall be done by the City of Craig and all cost related to such replacement thereof shall be paid by the contractor or public utility making the cut prior to the issuance of the permit in accordance with the schedule of costs for the same which shall be on file with the City Clerk, copies of which may be obtained at the time any permit is issued pursuant to the terms of this Ordinance.

Soil compaction and testing shall be in accordance with the City of Craig Standards and Specifications, at least one test shall be conducted upon the backfill and one test upon the aggregate base course directed by the City Engineer. The Engineer may waive such testing. The cost for testing shall be paid by the contractor or public utility.

SECTION 6. LIABILITY. Every contractor and every public utility making a cut, opening, hole or excavation as described in this Ordinance shall be responsible and liable for the proper maintenance and repair of such cut, opening, hole or excavation so made for the period of one year from the date of the filling or repair of the same. The City may require a performance bond or certified check from any such contractor or public utility to indemnify the City of any additional repairs which may have to be made because of such cut, opening, hole or excavation. Such bond or certified check will be made in at least the cost of the permit and repair fees and at most in the cost of the estimated cost of the project.

SECTION 7. PENALTY. Any person or corporation violating any of the provisions of this Ordinance shall, upon conviction, be fined in a sum of not less than One Hundred Dollars (\$100.00) nor more than Three Hundred Dollars (\$300.00). Each day's violation of any provision of this Ordinance shall constitute a separate offense.

SECTION 8. REPEAL. That Ordinances No. 252 and 416 of the City of Craig, Colorado, be in the same are hereby repealed.

SECTION 9. CONSTITUTIONAL. If any provision of this Ordinance or the application thereof to any person or circumstances is held invalid, such invalidity shall not affect the other provisions or applications of the Ordinance which can be given effect without the invalid provision or application, and to this end the provision of this Ordinance are declared to be severable.

SECTION 10. SAFETY. The Board of Trustees of the City of Craig hereby finds, declares and determines that this Ordinance is necessary for the immediate preservation of the public health and safety.

INTRODUCED, READ AND ORDERED PUBLISHED this February 10, 1981.

Signed by Jerry Thompson, Mayor

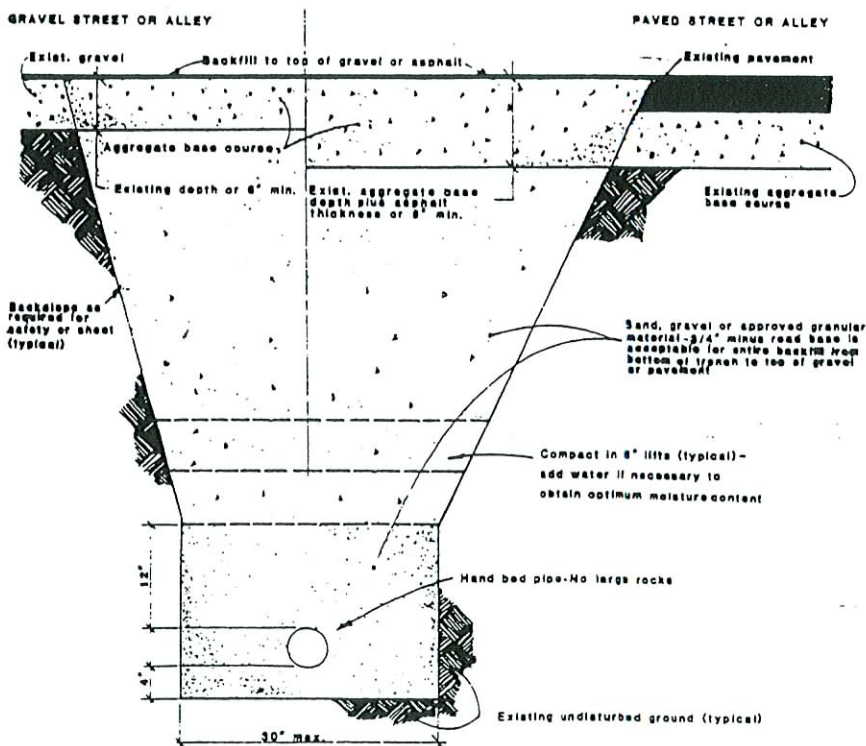
Attest by Donald B. Cooper, City Clerk

ADOPTED AND APPROVED ON SECOND READING this February 24, 1981.

Signed by Jerry Thompson, Mayor

Attest by Donald B. Cooper, City Clerk

CONTACT UTILITIES PRIOR TO EXCAVATION



Notes:

1. All work shall be in accordance with the City of Craig Standards and Specifications also known as the City of Craig Colorado Public Works Standard Specifications. This sheet summarizes some of the requirements of said standards. A copy of the complete standards is available to street cut applicants at no charge.
2. Maintain barricades and traffic control ~~as per MUTCD~~ as per MUTCD
3. Trench shall be backfilled immediately following pipe laying.
4. Contact City Engineer 24 hours prior to excavation.

Craig, Colorado - Local Utility Companies

Yampa Valley Electric Assoc.	824-6593
Greeley Gas	824-3221
US West	1-800-922-1987
TCI Cablevision	824-3296
Craig Water & Sewer Dept.	824-6340
Other Useful Numbers	
Craig Police Dept.	824-8111
Fire Dept./Ambulance	824-4915
Sheriff	824-4495
State Patrol	824-6501
Hospital	824-9411

City of Craig

Sanitary Sewer Manhole Leakage Test

Project: _____ Date: _____
Developer: _____ Location: _____
Contractor: _____

Vacuum Test Method

Manhole Designation: _____ **Results (circle one)** **Pass** **Fail**
Manhole Diameter: _____ ft. Allowable Loss: 1 inch HG

Time Started: _____ Test Vacuum Start: _____ in Hg
Time Complete: _____ Test Vacuum Finish: _____ in Hg
Test Duration: _____ Vacuum Loss: _____ in Hg

Vacuum Test Method

Manhole Designation: _____ **Results (circle one)** **Pass** **Fail**
Manhole Diameter: _____ ft. Allowable Loss: 1 inch HG

Time Started: _____ Test Vacuum Start: _____ in Hg
Time Complete: _____ Test Vacuum Finish: _____ in Hg
Test Duration: _____ Vacuum Loss: _____ in Hg

Vacuum Test Method

Manhole Designation: _____ **Results (circle one)** **Pass** **Fail**
Manhole Diameter: _____ ft. Allowable Loss: 1 inch HG

Time Started: _____ Test Vacuum Start: _____ in Hg
Time Complete: _____ Test Vacuum Finish: _____ in Hg
Test Duration: _____ Vacuum Loss: _____ in Hg

Vacuum Test Method

Manhole Designation: _____ **Results (circle one)** **Pass** **Fail**
Manhole Diameter: _____ ft. Allowable Loss: 1 inch HG

Time Started: _____ Test Vacuum Start: _____ in Hg
Time Complete: _____ Test Vacuum Finish: _____ in Hg
Test Duration: _____ Vacuum Loss: _____ in Hg

Vacuum Test Method

<u>Criteria:</u>	<u>Time (sec)</u>	<u>Criteria</u>
<u>4 Ft MH</u>		
0 - 10 Ft	60	Test starts at 10 inch HG
10 - 15 Ft	75	Allowable loss is 1 inch HG
15 - 20 Ft	90	

Comments: _____

Owner/Engineer: _____ **Contractor:** _____

City of Craig Water Line Testing

Project: _____

Contractor: _____

DATE: _____	PIPE SIZE: _____	PIPE LENGTH: _____	START TIME: _____	END TIME: _____	DURATION: _____
STARTING PRESSURE: _____	ENDING PRESSURE: _____	PRESSURE LOSS: _____	PASS/FAIL: _____	TEST BY: _____	CONTRACTOR INITIAL: _____
BAC T TEST: _____	CHLORINE TEST: _____	CONDUCTIVITY TEST: _____	WATER ADDED: _____		

DATE: _____	PIPE SIZE: _____	PIPE LENGTH: _____	START TIME: _____	END TIME: _____	DURATION: _____
STARTING PRESSURE: _____	ENDING PRESSURE: _____	PRESSURE LOSS: _____	PASS/FAIL: _____	TEST BY: _____	CONTRACTOR INITIAL: _____
BAC T TEST: _____	CHLORINE TEST: _____	CONDUCTIVITY TEST: _____	WATER ADDED: _____		

DATE: _____	PIPE SIZE: _____	PIPE LENGTH: _____	START TIME: _____	END TIME: _____	DURATION: _____
STARTING PRESSURE: _____	ENDING PRESSURE: _____	PRESSURE LOSS: _____	PASS/FAIL: _____	TEST BY: _____	CONTRACTOR INITIAL: _____
BAC T TEST: _____	CHLORINE TEST: _____	CONDUCTIVITY TEST: _____	WATER ADDED: _____		

DATE: _____	PIPE SIZE: _____	PIPE LENGTH: _____	START TIME: _____	END TIME: _____	DURATION: _____
STARTING PRESSURE: _____	ENDING PRESSURE: _____	PRESSURE LOSS: _____	PASS/FAIL: _____	TEST BY: _____	CONTRACTOR INITIAL: _____
BAC T TEST: _____	CHLORINE TEST: _____	CONDUCTIVITY TEST: _____	WATER ADDED: _____		

PROCEDURE:

TEST PRESSURE = 1.5 x WORKING PRESSURE (MIN. 150 PSI)

TEST DURATION = 2 HOURS

ALLOWABLE PRESSURE LOSS = 5 PSI

Allowable Leakage in Gallons per Hour per 1000 ft of DIP

Test Pressure PSI	Pipe Size (inches)						
	6	8	10	12	14	16	18
150	0.50	0.66	0.83	0.99	1.16	1.32	1.49
175	0.54	0.72	0.89	1.07	1.25	1.43	1.61
200	0.57	0.76	0.96	1.15	1.34	1.53	1.72
225	0.61	0.81	1.01	1.22	1.42	1.62	1.82
250	0.64	0.85	1.07	1.28	1.50	1.71	1.92
275	0.67	0.90	1.12	1.34	1.57	1.79	2.02
300	0.70	0.94	1.17	1.40	1.64	1.87	2.11

Hydrostatic Waterline Test for Underground Sprinkler System

Project: _____
Developer: _____
Contractor: _____

Date: _____
Location: _____

Date Line Filled: _____

Type of Pipe: _____

Pipe Being Tested

Diameter: _____	From: _____	To: _____	Length: _____	# of Joints: _____
Diameter: _____	From: _____	To: _____	Length: _____	# of Joints: _____
Diameter: _____	From: _____	To: _____	Length: _____	# of Joints: _____
Diameter: _____	From: _____	To: _____	Length: _____	# of Joints: _____
Diameter: _____	From: _____	To: _____	Length: _____	# of Joints: _____
Diameter: _____	From: _____	To: _____	Length: _____	# of Joints: _____
Diameter: _____	From: _____	To: _____	Length: _____	# of Joints: _____
Diameter: _____	From: _____	To: _____	Length: _____	# of Joints: _____
Diameter: _____	From: _____	To: _____	Length: _____	# of Joints: _____
Diameter: _____	From: _____	To: _____	Length: _____	# of Joints: _____

Designated Static Pressure: _____

Test Apparatus

Pump _____

Time Started: _____
Time Complete: _____

Guage _____

Test Pressure Start: _____ psig
Test Pressure Finish: _____ psig
Pressure Loss: _____ psig

Water Container _____

Maximum Allowable Pressure Loss: **2 PSI**

Duration of Test: **Two(2) Hours**

Observed loss (for test period): _____

Result (circle one): **Pass** **Fail**

Comments (including repairs needed): _____

Owner/Engineer: _____

Contractor: _____



300 W. 4th Street, Craig, CO 81625 (970) 824-4463

Public Works Department

STREET CUT PERMIT No. _____

_____ Licensed Contractor or Public Utility			_____ Date		
_____ Address			_____ Phone		
_____ City	_____ State	_____ Zip	_____ Authorized Representative		

_____ Street Cut Location			<input type="checkbox"/> Street		<input type="checkbox"/> Paved	
			<input type="checkbox"/> Alley		<input type="checkbox"/> Gravel	
_____ Subdivision			_____ Block		_____ Lot	
					_____ Other	
_____ Purpose of Cut			_____ Scheduled Construction Date			

Draw illustration in space provided below

CALL UTILITIES BEFORE EXCAVATION (See Page 2)

The Undersigned Applicant agrees to comply with Ordinance No. 578, a copy of which is reproduced on Page 2. Applicant agrees to pay all charges for permits and repairs to said street or alley as described herein within 30 days of billing.

Print Name	Signature	Date
------------	-----------	------

Contractor/Public Utility

City Clerk

Public Works Director/City Engineer

Approval: Permission is hereby granted for the purpose of making the street cut described above.

CHARGES			
Permit Fee	\$	5.00	
Asphalt	SF _____ x \$ _____	\$ _____	ESTIMATE
Total Amount Due	\$ _____	Receipt No. _____	
Date of Billing _____		Receipt No. _____	

Arrangements for asphalt patching by someone other than City crews must get a written waiver from City prior to placing pavement.

Ordinance No. 578

AN ORDINANCE REGULATING THE MANNER OF MAKING CUTS AND OPENINGS IN STREETS AND ALLEYS WITHIN THE TOWN OF CRAIG, COLORADO; REQUIRING A PERMIT THEREFORE; PRESCRIBING THE METHOD AND COST FOR REPAIRING SUCH CUTS AND OPENINGS; AND PROVIDING A PENALTY FOR THE VIOLATION OF THE PROVISIONS OF THIS ORDINANCE; AND REPEALING ORDINANCES NO. 252 AND 416 OF THE CITY OF CRAIG, COLORADO.

BE IT ORDAINED BY THE BOARD OF TRUSTEES OF THE TOWN OF CRAIG, COLORADO:

SECTION 1. PERMIT REQUIRED. No cut, opening, hole or excavation shall be made or caused to be made between the dedicatory boundaries of any street, alley or thoroughfare within the corporate limits of the Town of Craig, Colorado, except by a contractor duly licensed by the Town of Craig, Colorado, under the provisions of the Ordinance No. 225 or its agent, or by a public utility. Any such cuts, openings, holes, curb cuts and excavation shall require permits which shall be issued by the City Clerk upon the approval of the City Engineer.

SECTION 2. PERMIT FEE. There shall be paid to the City Clerk, the sum of \$5.00 for the permit required by Section 1 herein.

SECTION 3. REQUIREMENTS. All such cuts, openings, holes, curb cuts and excavations shall be made in accordance with the City of Craig Standards and Specifications. The City Engineer shall be given 24 hours notice prior to the commencement of any work under the provisions of this Ordinance.

SECTION 4. BARRICADES, LIGHTS. All such cuts, openings, holes and excavation at all times when no actual work is in progress shall be properly barricaded and lighted to safeguard adequately the public damage from the same.

SECTION 5. REPAIRS. The repair of all cuts, openings, holes and excavations as described in this Ordinance shall be the responsibility of the licensed contractor or public utility who caused the same to be made. Backfilling shall be done by a licensed contractor or public utility as specified by the City of Craig Standards and Specifications. The installation of permanent pavement shall be done by the City of Craig and all cost related to such replacement thereof shall be paid by the contractor or public utility making the cut prior to the issuance of the permit in accordance with the schedule of costs for the same which shall be on file with the City Clerk, copies of which may be obtained at the time any permit is issued pursuant to the terms of this Ordinance.

Soil compaction and testing shall be in accordance with the City of Craig Standards and Specifications, at least one test shall be conducted upon the backfill and one test upon the aggregate base course directed by the City Engineer. The Engineer may waive such testing. The cost for testing shall be paid by the contractor or public utility.

SECTION 6. LIABILITY. Every contractor and every public utility making a cut, opening, hole or excavation as described in this Ordinance shall be responsible and liable for the proper maintenance and repair of such cut, opening, hole or excavation so made for the period of one year from the date of the filling or repair of the same. The City may require a performance bond or certified check from any such contractor or public utility to indemnify the City of any additional repairs which may have to be made because of such cut, opening, hole or excavation. Such bond or certified check will be made in at least the cost of the permit and repair fees and at most in the cost of the estimated cost of the project.

SECTION 7. PENALTY. Any person or corporation violating any of the provisions of this Ordinance shall, upon conviction, be fined in a sum of not less than One Hundred Dollars (\$100.00) nor more than Three Hundred Dollars (\$300.00). Each day's violation of any provision of this Ordinance shall constitute a separate offense.

SECTION 8. REPEAL. That Ordinances No. 252 and 416 of the City of Craig, Colorado, be in the same are hereby repealed.

SECTION 9. CONSTITUTIONAL. If any provision of this Ordinance or the application thereof to any person or circumstances is held invalid, such invalidity shall not affect the other provisions or applications of the Ordinance which can be given effect without the invalid provision or application, and to this end the provision of this Ordinance are declared to be severable.

SECTION 10. SAFETY. The Board of Trustees of the City of Craig hereby finds, declares and determines that this Ordinance is necessary for the immediate preservation of the public health and safety.

INTRODUCED, READ AND ORDERED PUBLISHED this February 10, 1981.

Signed by Jerry Thompson, Mayor

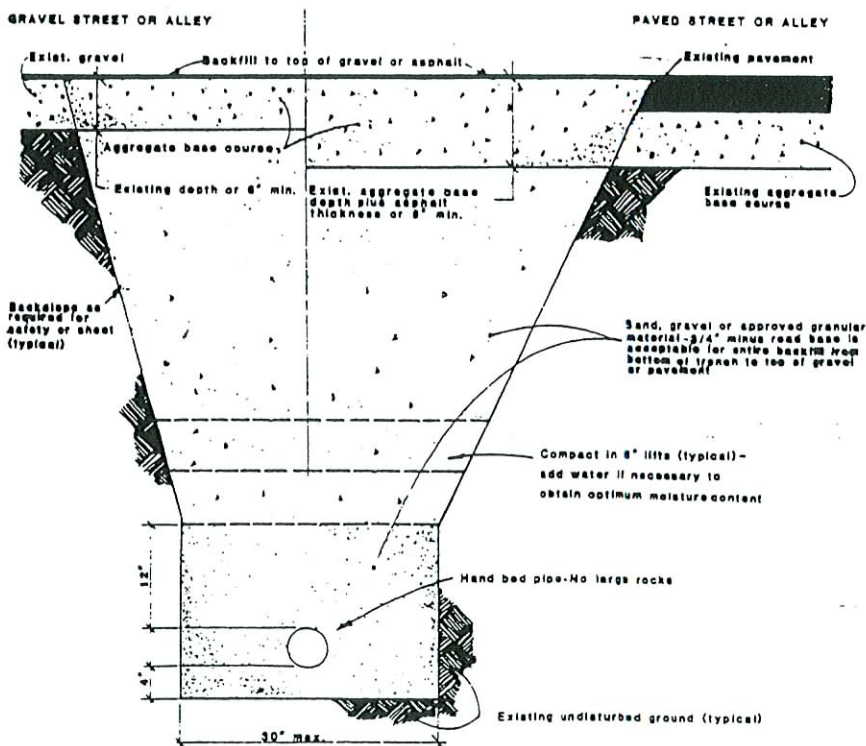
Attest by Donald B. Cooper, City Clerk

ADOPTED AND APPROVED ON SECOND READING this February 24, 1981.

Signed by Jerry Thompson, Mayor

Attest by Donald B. Cooper, City Clerk

CONTACT UTILITIES PRIOR TO EXCAVATION



Notes:

1. All work shall be in accordance with the City of Craig Standards and Specifications also known as the City of Craig Colorado Public Works Standard Specifications. This sheet summarizes some of the requirements of said standards. A copy of the complete standards is available to street cut applicants at no charge.
2. Maintain barricades and traffic control ~~as per MUTCD~~ as per MUTCD
3. Trench shall be backfilled immediately following pipe laying.
4. Contact City Engineer 24 hours prior to excavation.

Craig, Colorado - Local Utility Companies

Yampa Valley Electric Assoc.	824-6593
Greeley Gas	824-3221
US West	1-800-922-1987
TCI Cablevision	824-3296
Craig Water & Sewer Dept.	824-6340
Other Useful Numbers	
Craig Police Dept.	824-8111
Fire Dept./Ambulance	824-4915
Sheriff	824-4495
State Patrol	824-6501
Hospital	824-9411

CITY OF CRAIG
APPLICATION FOR WATER / SEWER TAP
(To be completed by licensed plumber only)

PAGE 1

Owner		Date
Mailing Address		Phone
This application is for permit to tap: <input type="checkbox"/> Water <input type="checkbox"/> Sewer		
Address of property to be served		
Addition	Block	Lot <input type="checkbox"/> Unplatted
<i>It unplatted, a legal description of the property and a map showing the property shall be attached to this application.</i>		
Property to be served is <input type="checkbox"/> Inside <input type="checkbox"/> Outside <input type="checkbox"/> City limits		
<i>An out-of-City water and sewer agreement is required to serve property outside the City limits.</i>		
Use of property: <input type="checkbox"/> Single family residence <input type="checkbox"/> Two family residence <input type="checkbox"/> Multi-family residence		
<input type="checkbox"/> Motel / Hotel	Number of Units / Apartments / Rooms	
<input type="checkbox"/> Commercial / Industrial	Description	
Number of meters required: Regular Remote		
Signature of licensed plumber		License No Phone

SPECIFICATIONS

1. Engineered construction drawing of proposed main extension(s) must be approved by the City Engineering Department prior to permit approval. A separate application for street cut shall be completed by contractor.

2. All materials and installation of taps shall be in accordance with all applicable specifications, regulations, codes and ordinances of the City of Craig, Right-of- recovery fees may be applicable and applicant agrees to pay such fees as determined by the City Clerk.

3. The size of water and sewer taps shall be based on the number of fixture units for the building(s), as per the Uniform Plumbing Code. Existing taps which are inadequate for the calculated fixture loads shall be re-tapped to the proper size.

CERTIFICATE OF OCCUPANCY SHALL NOT BE ISSUED FOR ANY BUILDING NOT IN COMPLIANCE WITH THIS SPECIFICATION.

4. Water service to the building will remain off until:
A. The Certificate of Occupancy is issued by the Building Department.
B. The owner starts service with the Utility Billing Department. (Owner may request temporary service during the construction process)

DO NOT TURN ON THE WATER FOR ANY REASON - ONLY THE WATER DEPARTMENT IS AUTHORIZED TO TURN WATER ON
(Non-compliance is a violation of the City of Craig Municipal Code Section 13.32.040. - Misdemeanor charge - \$300.00 per day fine.)

ACCEPTANCE OF SPECIFICATIONS

" I understand and agree to the above specifications and hereby request taps as described above. "

SIGNATURE OF OWNER	DATE
SIGNATURE OF PLUMBER	DATE
SIGNATURE OF PUBLIC WORKS DIRECTOR	DATE

Date application received _____ By _____

INFORMATION BELOW TO BE PROVIDED BY APPROPRIATE CITY DEPARTMENT

BUILDING DEPARTMENT	WATER	SEWER
Water pressure of main _____	PSI _____	
Fixture units calculated _____		
Distance to most remote fixture _____	FT _____	FT _____
Size tap required _____		
Size service line required (from curb stop to building) _____		
Size water meter required _____		
ENGINEERING DEPARTMENT		
Street cut required ? (Yes / No) _____		
WATER I SEWER DEPARTMENT		
Size & material of main to be tapped _____		
Extension of main required (Yes / No) _____		
CONDITIONS / COMMENTS: _____		

APPROVALS

Approved by Building Department: _____ Date _____

Approved by City Engineer: _____ Date _____

Approved by Water / Sewer Department: _____ Date _____

Approved by Planning Department: _____ Date _____

Approved by City Clerk: _____ Date _____

UTILITY BILLING DEPARTMENT

Water Tap Fee	\$ _____	Water Tap Permit Number	_____
Sewer Tap Fee	\$ _____	Sewer Tap Permit Number	_____
Raw Water Fee	\$ _____	COMMENTS	
Meter Charge	\$ _____		
Out-of-City Fee	\$ _____		
Right-of-Recovery Fee	\$ _____		
Other	\$ _____	Payment Receipt Number	_____
TOTAL FEES / CHARGES:	\$ _____	Payment Date	_____

SEWER TAP INSPECTION FORM



DATE: _____ WORK ORDER # : _____

DATE OF UTILITY NOTIFICATION: _____ WORK DEADLINE DATE: _____

APPLICANT / OWNER: _____

ADDRESS / PARCEL ID #: _____

DESCRIPTION OF PROPERTY: _____

COORDINATES OF SEWER CONNECTION

NORTHING: _____ EASTING: _____

LATITUDE: _____ LONGITUDE: _____

IS LOCATION CONSISTENT WITH INITIAL SITE VISIT?: YES / NO

DIAMETER OF SEWER MAIN: _____ MATERIAL OF SEWER MAIN: _____

DIAMETER OF SERVICE LINE: _____ MATERIAL OF SERVICE LINE: _____

DEPTH TO CONNECTION INVERT: _____ METHOD OF CONNECTION: WYE / TEE / SADDLE

TWO-WAY CLEANOUT INSTALLED WITHIN 5 FEET OF RESIDENCE?: YES / NO

WAS A BACKWATER CHECK VALVE INSTALLED?: YES / NO

WAS A PRESSURE TEST OF SEWER SERVICE PERFORMED?: YES / NO

BEDDING MATERIAL: _____ BACKFILL MATERIAL: _____

IS BEDDING MATERIAL ACCEPTABLE?: YES / NO WAS TRENCH OVER-EXCAVATED?: YES / NO

IS COMPACTION REQUIRED?: YES / NO IF YES, WHAT DENSITY?: _____

SKETCH OF CONNECTION IN RELATION TO PROPERTY:

WATER TAP INSPECTION FORM



DATE: _____ WORK ORDER # : _____

DATE OF UTILITY NOTIFICATION: _____ WORK DEADLINE DATE: _____

APPLICANT / OWNER: _____

ADDRESS / PARCEL ID #: _____

DESCRIPTION OF PROPERTY: _____

COORDINATES OF WATER CONNECTION

NORTHING: _____ EASTING: _____

LATITUDE: _____ LONGITUDE: _____

IS LOCATION CONSISTENT WITH INITIAL SITE VISIT?: YES / NO

DIAMETER OF WATER MAIN: _____ MATERIAL OF WATER MAIN: _____

DIAMETER OF SERVICE LINE: _____ MATERIAL OF SERVICE LINE: _____

WAS A PRV INSTALLED?: YES / NO WAS DOUBLE CHECK VALVE(S) USED?: YES / NO

WAS A PRESSURE TEST OF WATER SERVICE PERFORMED?: YES / NO

IS BEDDING MATERIAL ACCEPTABLE?: YES / NO WAS TRENCH OVER-EXCAVATED?: YES / NO

WATER METER SERIAL # : _____

WATER METER INITIAL READING : _____

SKETCH OF CONNECTION IN RELATION TO PROPERTY:

DIVISION 7

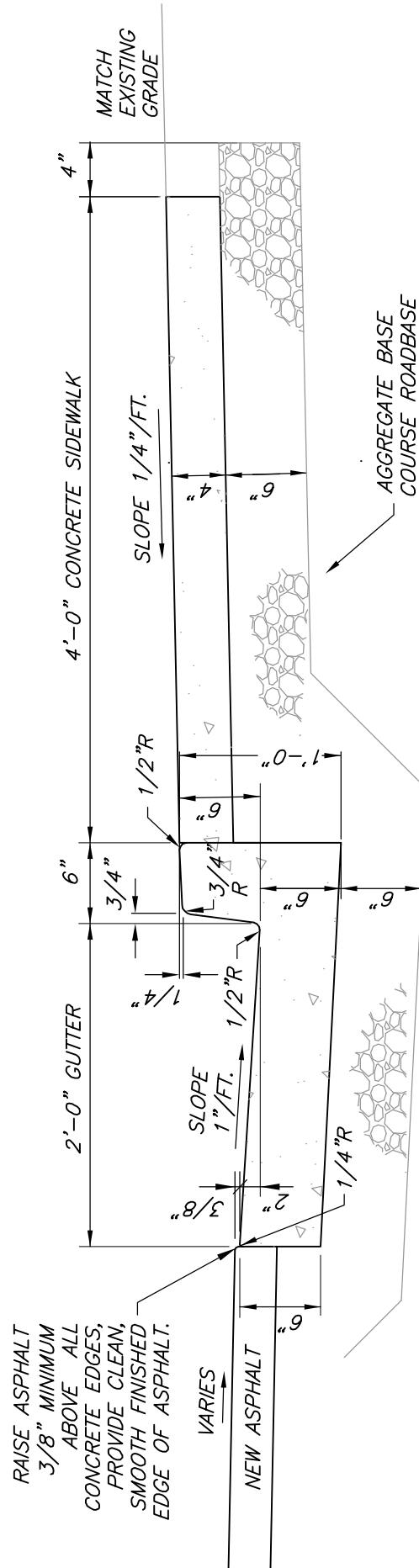


Division 7 Standard Details

INDEX

STANDARD DETAILS

Standard Details	Pages
Water Details	10
Wastewater Details	9
Concrete and Drainage Details	18



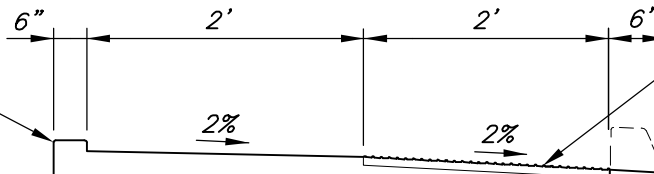
TYPICAL CURB, GUTTER, & SIDEWALK SECTION

SCALE: 1" = 1'-0"

CURB JOINT: CONTRACTION = 8'-0"
INTERVALS: EXPANSION = 100'-0"

DETAIL "C01"

6" WIDE
CONCRETE
PEDESTRIAN
CURB W/ 1/4"
RAD., HEIGHT TO
MATCH BW



CAST IRON
DETECTABLE
WARNING PLATES

CURB/GUTTER

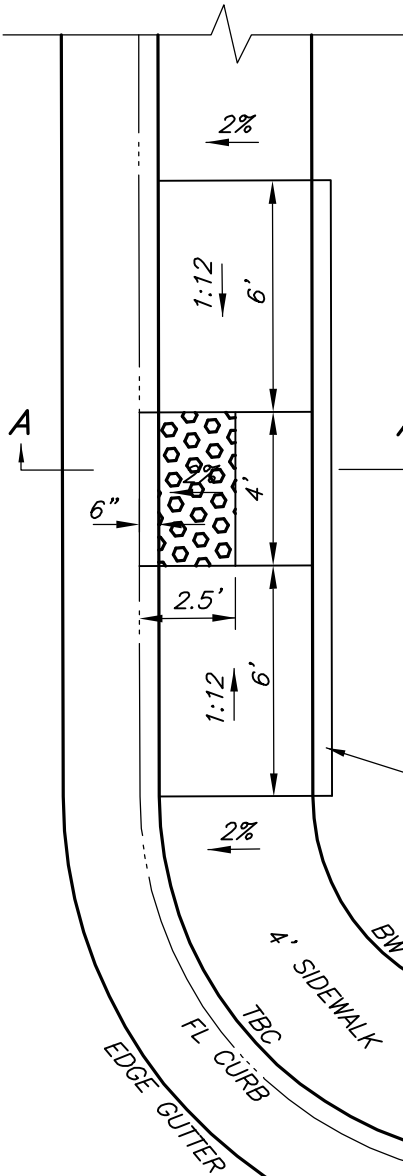
6" AGGREGATE
BASE ROADBASE
COURSE

SECTION A-A

NOT TO SCALE

NOTES:

1. DIMENSIONS MAY BE ALTERED TO AVOID OBSTRUCTIONS WITH ENGINEER'S APPROVAL.
2. SURFACE OF RAMP TO HAVE COARSE BROOM FINISH.
3. HANDICAP RAMPS SHALL BE 6" THICK CONCRETE ALL OTHER SIDEWALK CONCRETE FLATWORK SHALL BE 4" THICK, EXCEPT DRIVEWAYS. AGGREGATE BASE FOR 4" CONCRETE FLATWORK SHALL BE 6" COMPACTED ROADBASE.
4. FOR ADDITIONAL INFORMATION SEE CDOT DETAILS M-608-1.



6" WIDE CONCRETE
PEDESTRIAN CURB W/
1/4" RAD., HEIGHT TO
MATCH BW (TYP.)

CONCRETE WINGS
POURED
MONO-LITHICALLY
WITH RAMP SIDEWALK
& GUTTER (TYP.)

EDGE GUTTER
FL CURB
TBC
4' SIDEWALK
BW

CAST IRON DETECTABLE
WARNING PLATES (TYP.)

REFERENCE POINT,
CL OF RAMP AT FL
OF CG (TYP.)

CURB RAMP-TYPE 2A MODIFIED

NOT TO SCALE

DETAIL "C02"

File: I:\2013\2013-520_CITYOFCRAIG\001_MISCENGSVCS\12 - PUBLIC WORKS MANUAL\SEC. 7 - STANDARD DETAILS\DETAILS\DWG\PARALCURBRAMPTYPE2

-

6" WIDE CONCRETE
PEDESTRIAN CURB W/ 1/4"
RAD., HEIGHT TO MATCH BW

BW

4' SIDEWALK

2%

6'

1:12

4'

2%

6'

1:12

2.5'

CAST IRON
DETECTABLE
WARNING
PLATES

CONCRETE WINGS
POURED
MONO-LITHICALLY
WITH RAMP
SIDEWALK &
GUTTER

2%

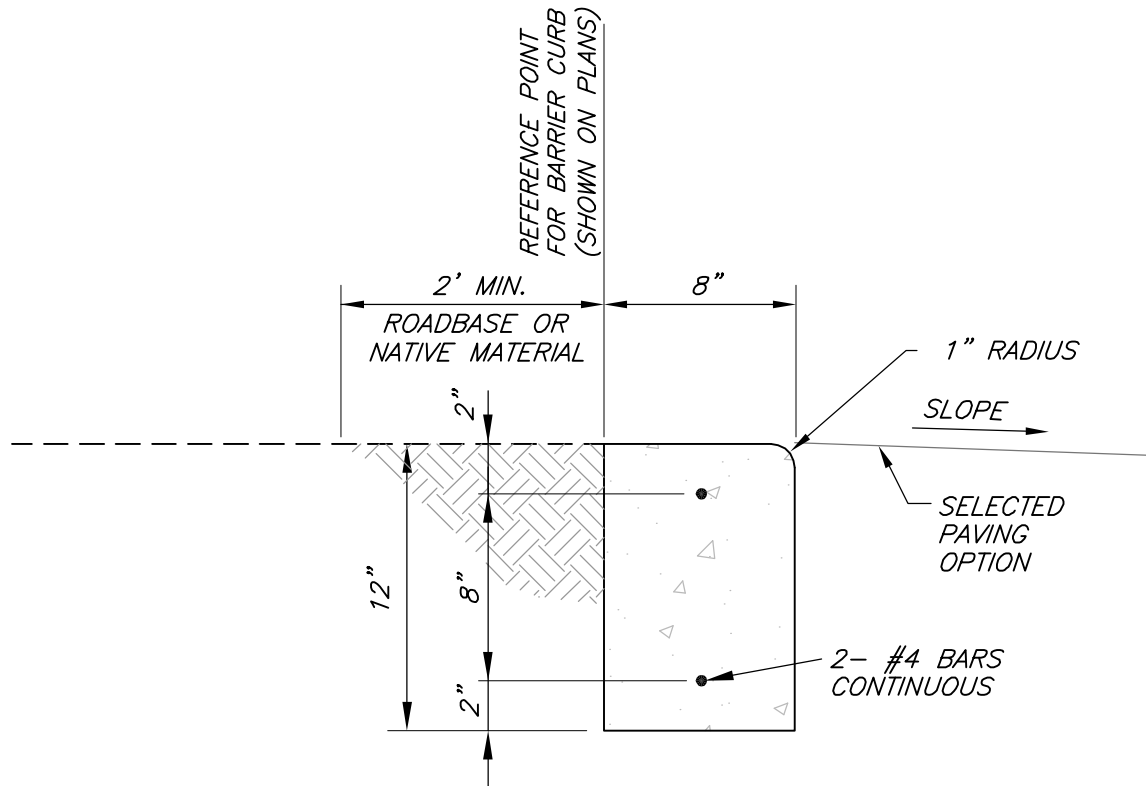
TBC

FL CURB

EDGE GUTTER

A

DETAIL "C03"

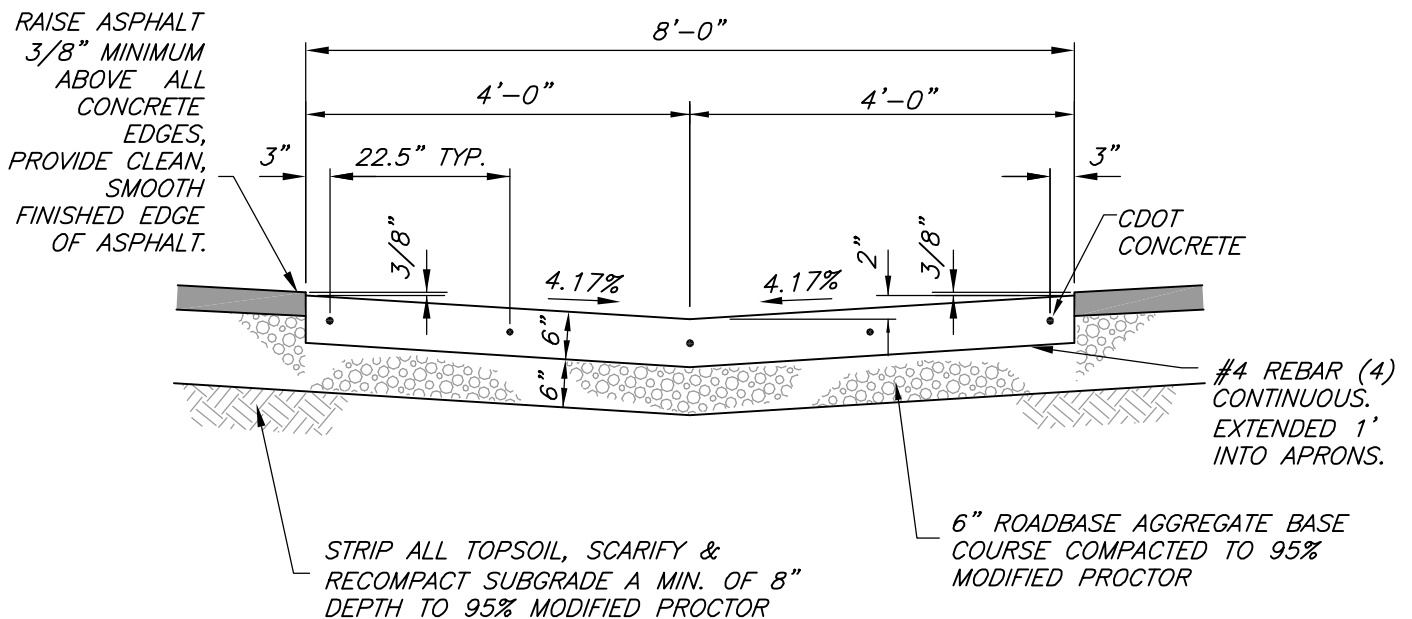


RIBBON CURB DETAIL

SCALE: 1 1/2" = 1'-0"

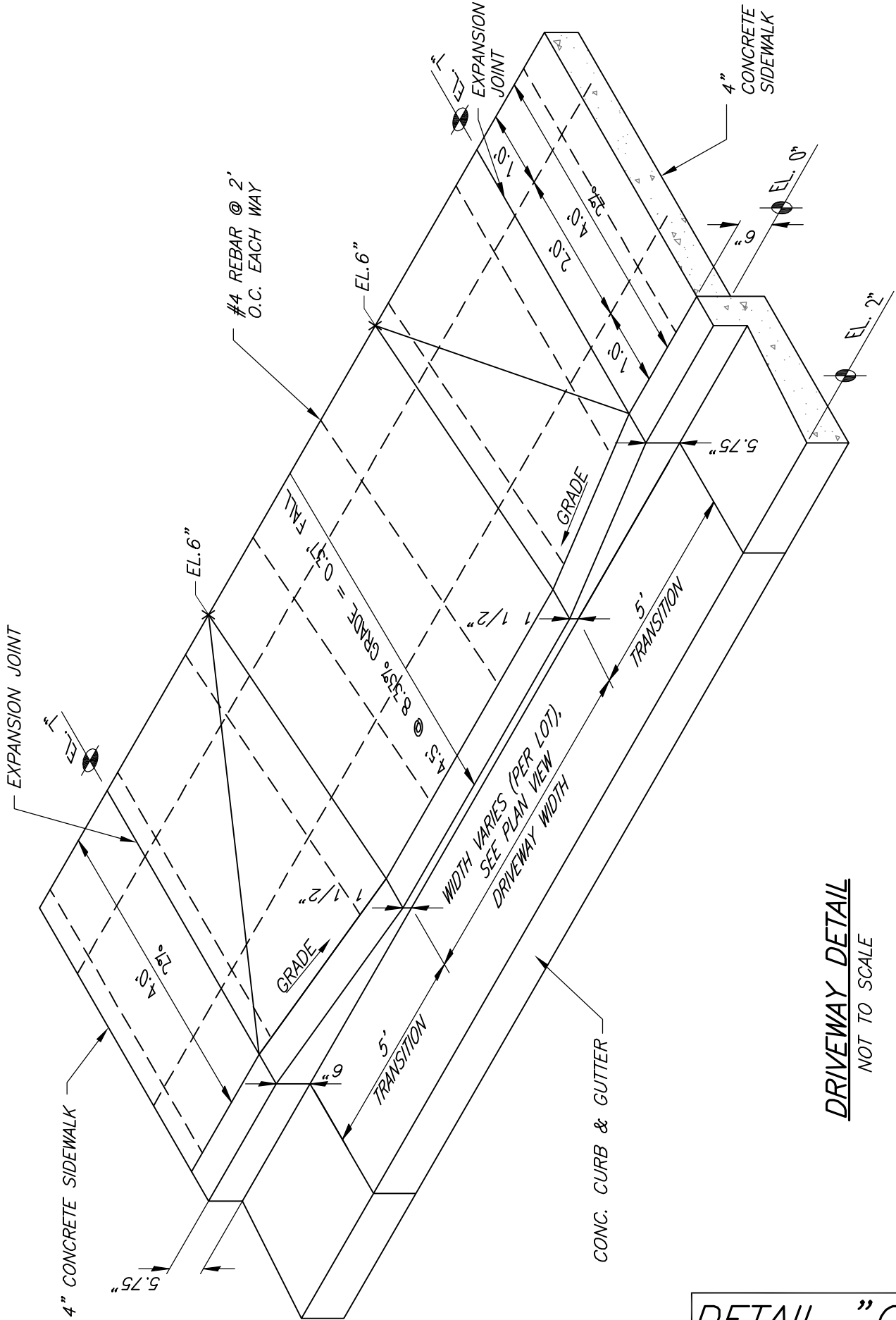
DETAIL "C04"

REFER TO GENERAL NOTES ON
CDOT STANDARDS M-609-1,
PAGE 1 OF 4, FOR ADDITIONAL
INFORMATION.



NOT TO SCALE

DETAIL "C05"

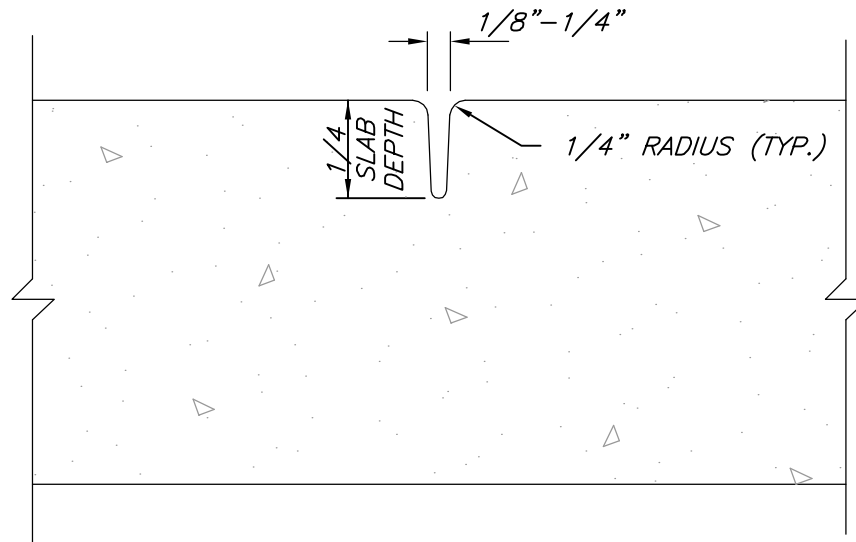


DRIVEWAY DETAIL
NOT TO SCALE

DETAIL "C06"

CONCRETE FOR FLATWORK AND CURB/GUTTER

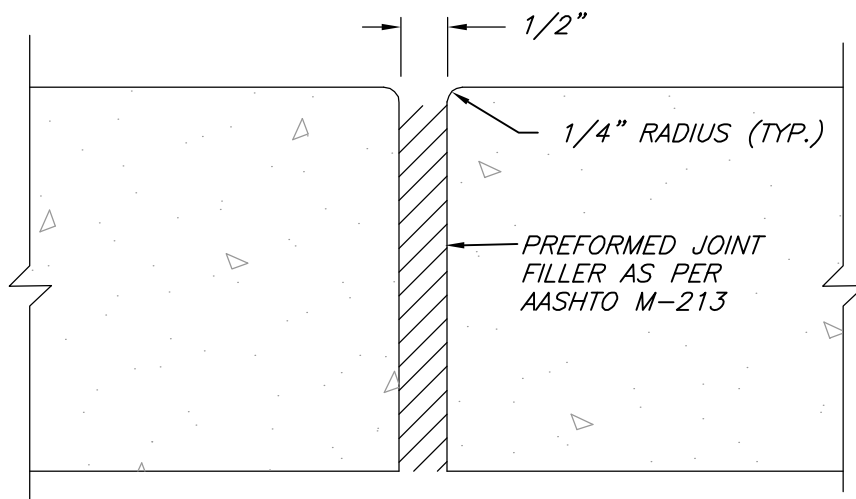
- 1) EXPANSION JOINTS: 100' ON CENTER AND AT DRIVEWAYS.
- 2) DUMMY JOINTS: 1"–1.25" DEEP BY 1/8"–1/4" WIDTH AT INTERVALS EQUAL TO SIDEWALK WIDTH.
- 3) USE 1/4" RADIUS ON ALL EDGES NOT SPECIFIED ELSEWHERE.
- 4) USE 6" DEPTH OF CONCRETE ON ALL DRIVEWAYS.
- 5) CURE FOR 72 HOURS USING CURING COMPOUND, PLASTIC COVERING OR MOISTURE.



STANDARD CONTRACTION/CONTROL JOINT

NOT TO SCALE

CURB JOINT: CONTRACTION = 8'-0"
INTERVALS: EXPANSION = 100'-0"



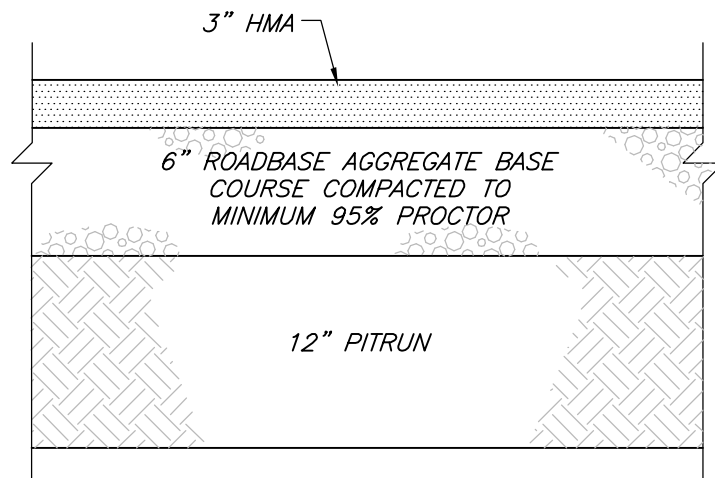
STANDARD EXPANSION JOINT

NOT TO SCALE

CURB JOINT: CONTRACTION = 8'-0"
INTERVALS: EXPANSION = 100'-0"

DETAIL "C07"

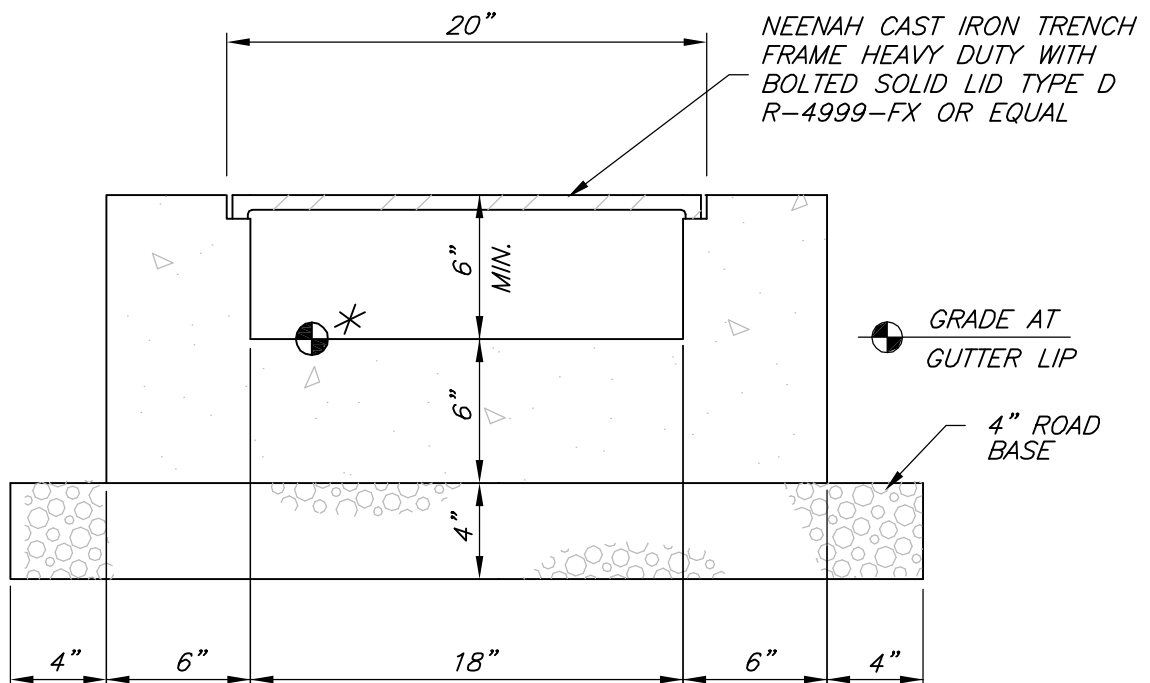
File: I:\2013\2013-520_CITYOF CRAIG\001_MISC\ENG\CS\12 - PUBLIC WORKS MANUAL\SEC. 7 - STANDARD DETAILS\DETAILS\DWG\PAVINGSECTION



TYPICAL PAVING SECTION
NOT TO SCALE

DETAIL "C08"

File: I:\2013\2013-520_CITY OF CRAIG\001_MISC\ENGVCS\12 - PUBLIC WORKS MANUAL\SEC. 7 - STANDARD DETAILS\DETAILS\DWG\CONCRETE TRENCH

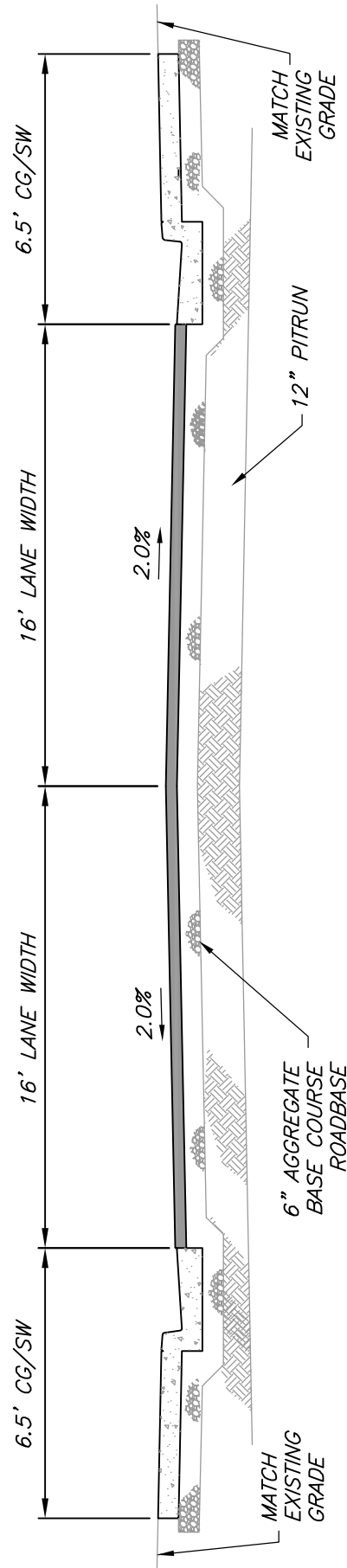


* FLOOR OF TRENCH TO SLOPE @ 1% TO DAYLIGHT.

CONCRETE TRENCH DETAIL

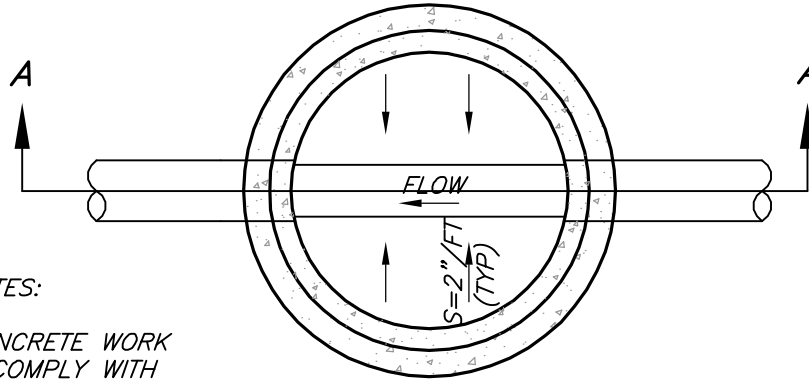
SCALE: 1 1/2" = 1'-0"

DETAIL "C09"



TYPICAL ROADWAY SECTION WITH ATTACHED SIDEWALK
NOT TO SCALE

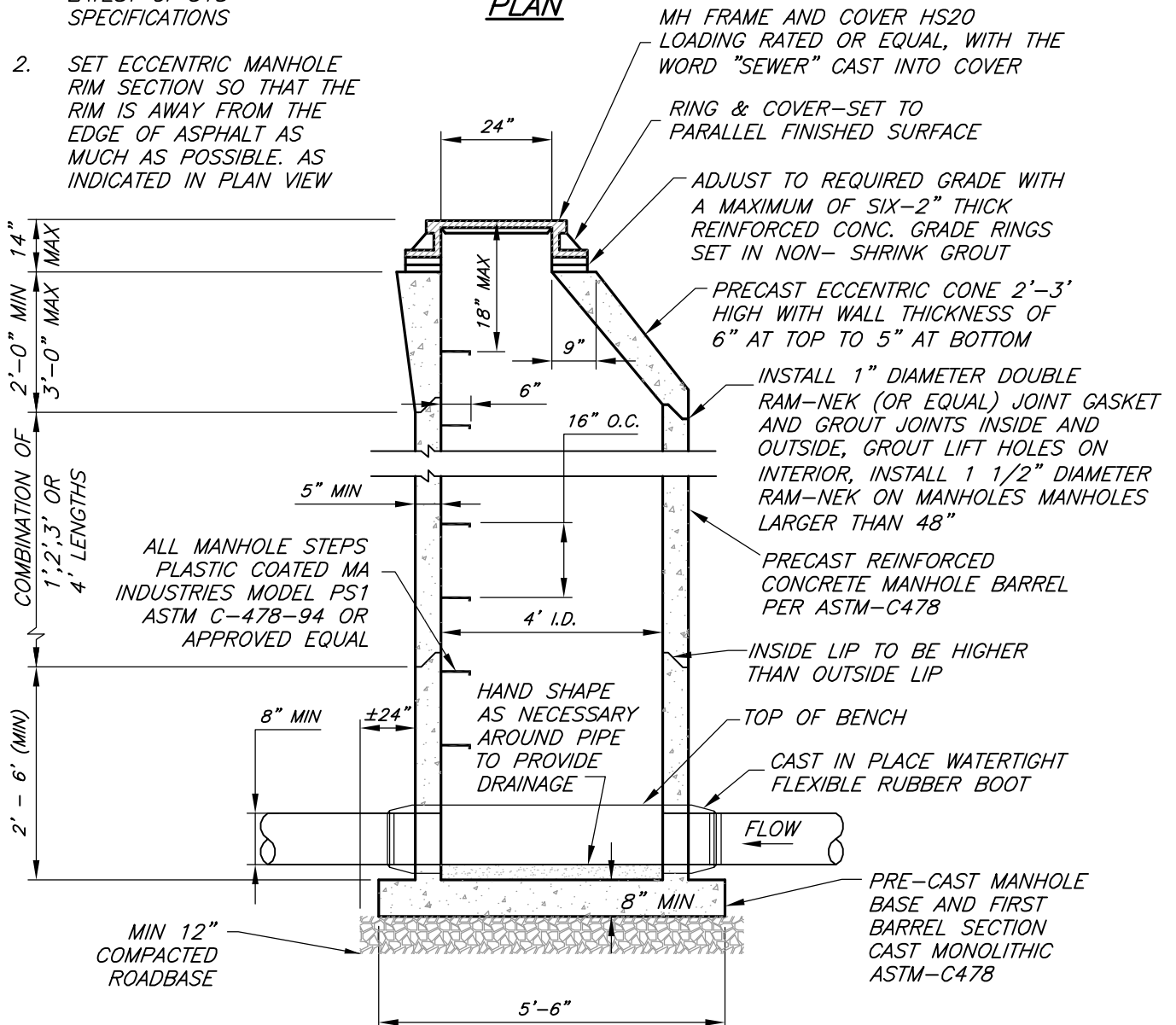
DETAIL "C10"



PLAN

GENERAL NOTES:

1. ALL CONCRETE WORK SHALL COMPLY WITH LATEST CI-318 SPECIFICATIONS
2. SET ECCENTRIC MANHOLE RIM SECTION SO THAT THE RIM IS AWAY FROM THE EDGE OF ASPHALT AS MUCH AS POSSIBLE. AS INDICATED IN PLAN VIEW

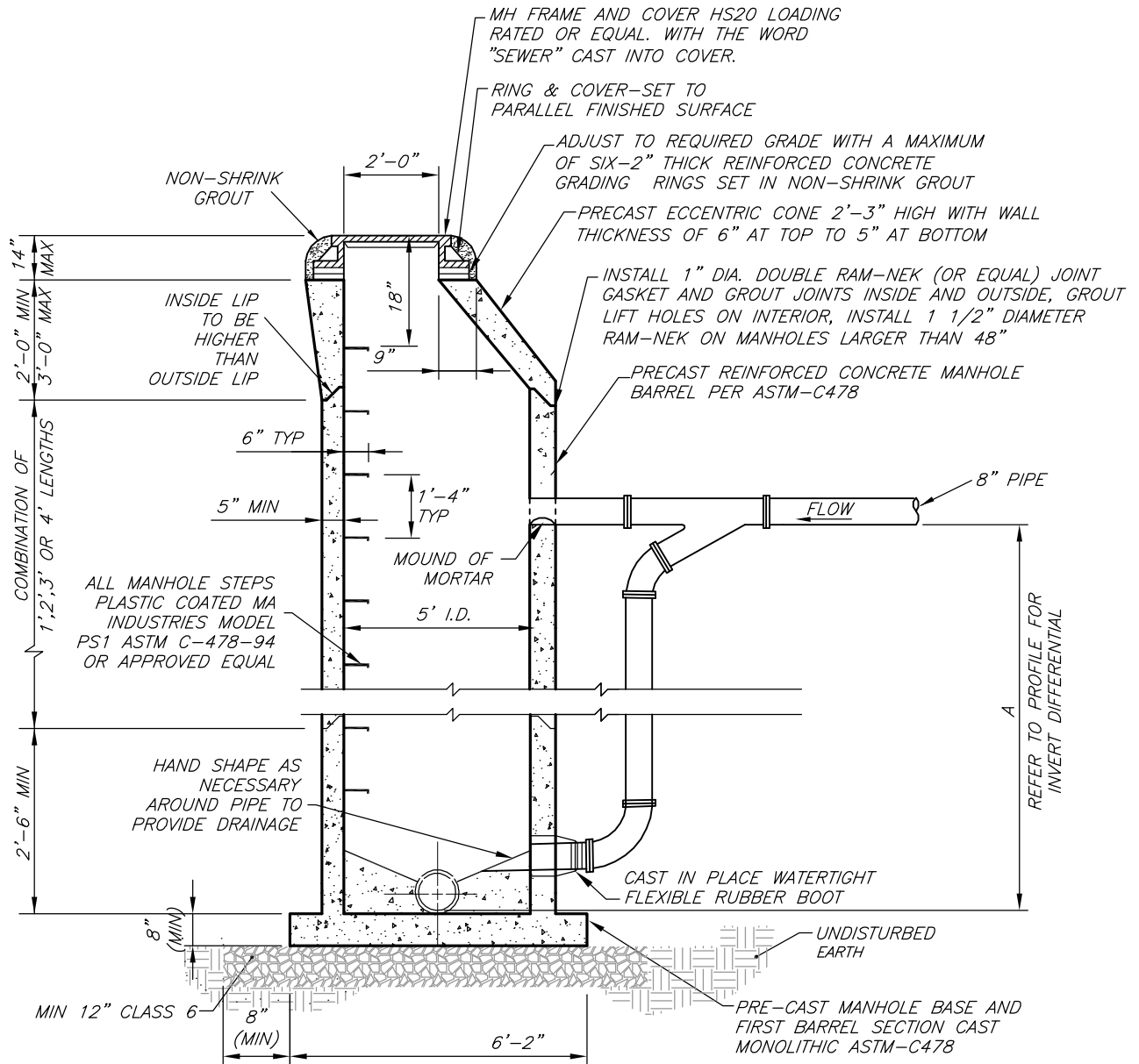


SECTION A-A

STANDARD MANHOLE
NOT TO SCALE

DETAIL "S01"

NOTE: DROP LINE TO BE ORIENTED
OPPOSITE MH RUNGS WITHIN MH.

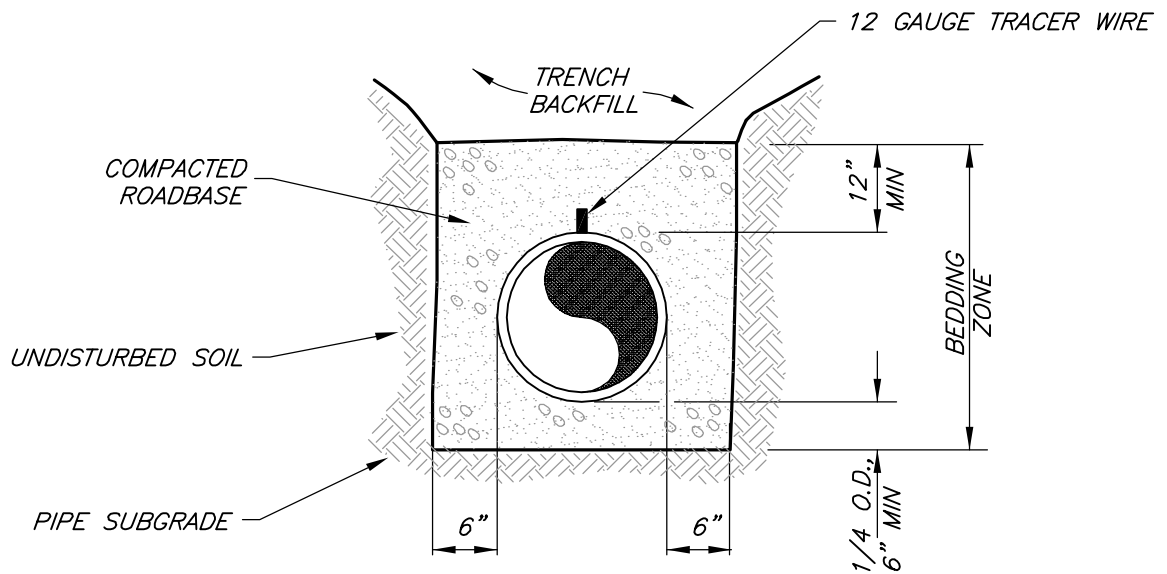
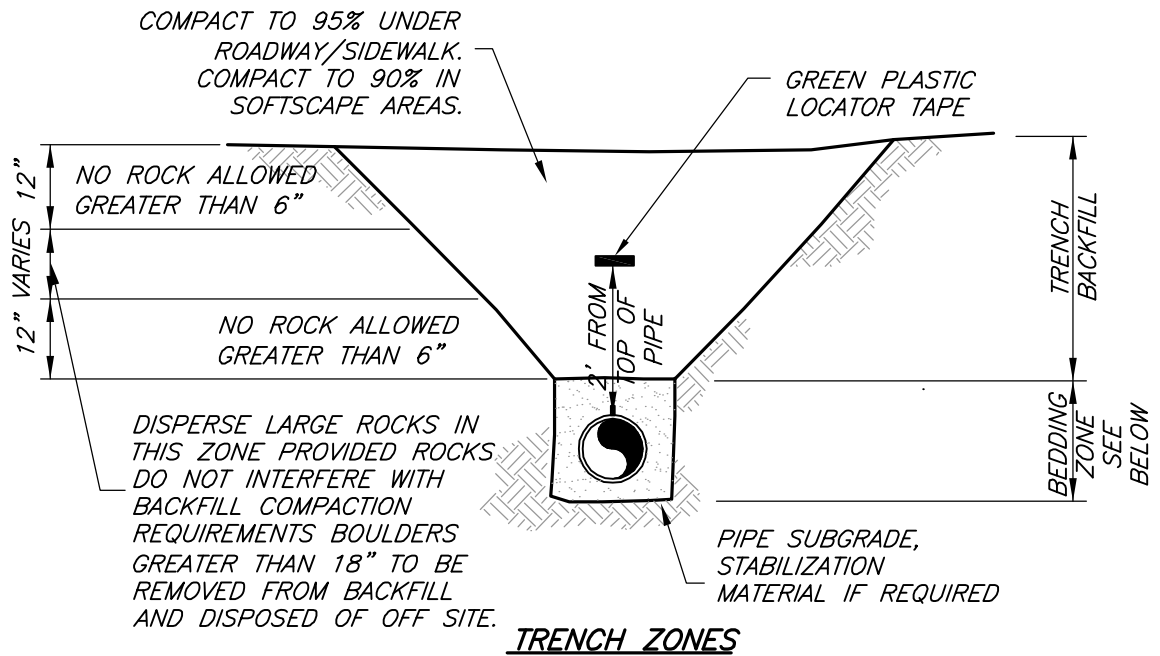


DROP MANHOLE

GENERAL NOTES:

1. ALL CONCRETE WORK SHALL COMPLY WITH LATEST CI-318 SPECIFICATIONS
2. A DROP MANHOLE IS REQUIRED WHEN THE "A" DIMENSION SHOWN ABOVE EXCEEDS 18"
3. SET ECCENTRIC MANHOLE RIM SECTION SO THAT THE RIM IS AWAY FROM THE EDGE OF ASPHALT AS MUCH AS POSSIBLE.

DETAIL "S02"



NOTE:

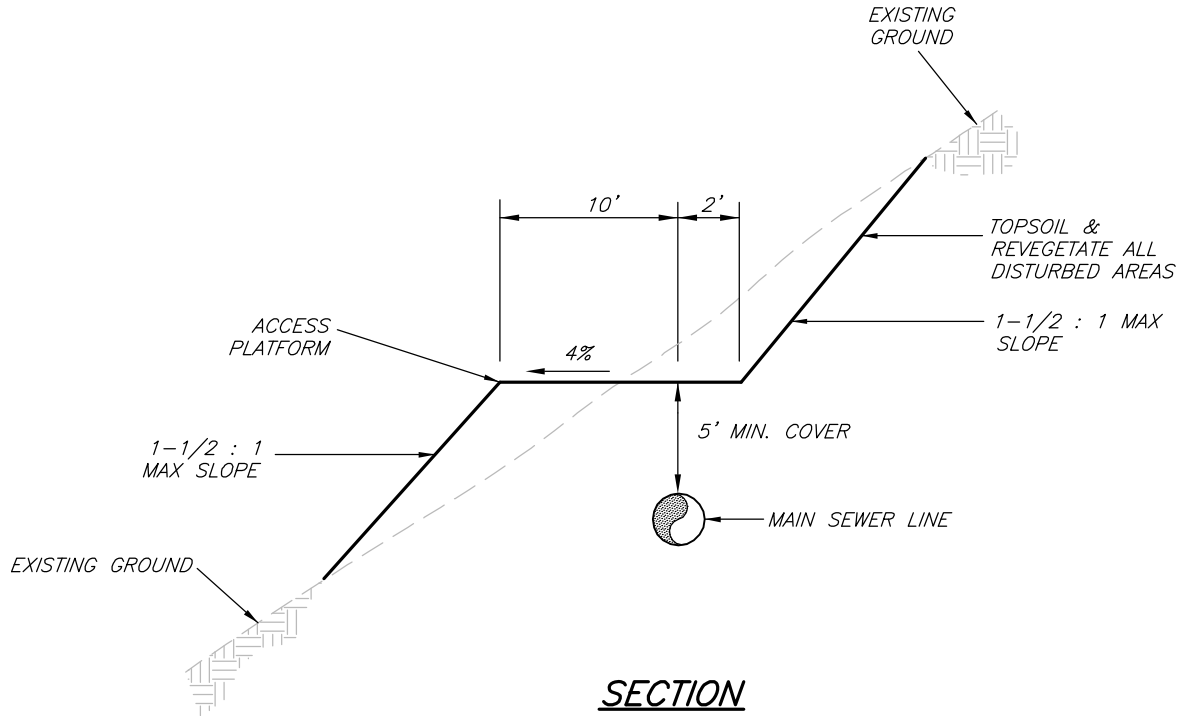
3/4 SCREENED ROCK IN WET AREAS IN PLACE OF ROADBASE ONLY APPROVED AS NEEDED

SEWER PIPE BEDDING
NOT TO SCALE

DETAIL "S03"

File: I:\2013\2013-520_CITYCRAIG\001_MISC\ENG\VC\1.2 - PUBLIC WORKS MANUAL\SEC. 7 - STANDARD DETAILS\DETAILS\DWG\SEWERMAINTACCESS-DI

CONSTRUCT HAMMERHEAD OR 90°SIDEARM TURN-AROUND
AT THE END OF ALL DEAD END SEWER LINES.



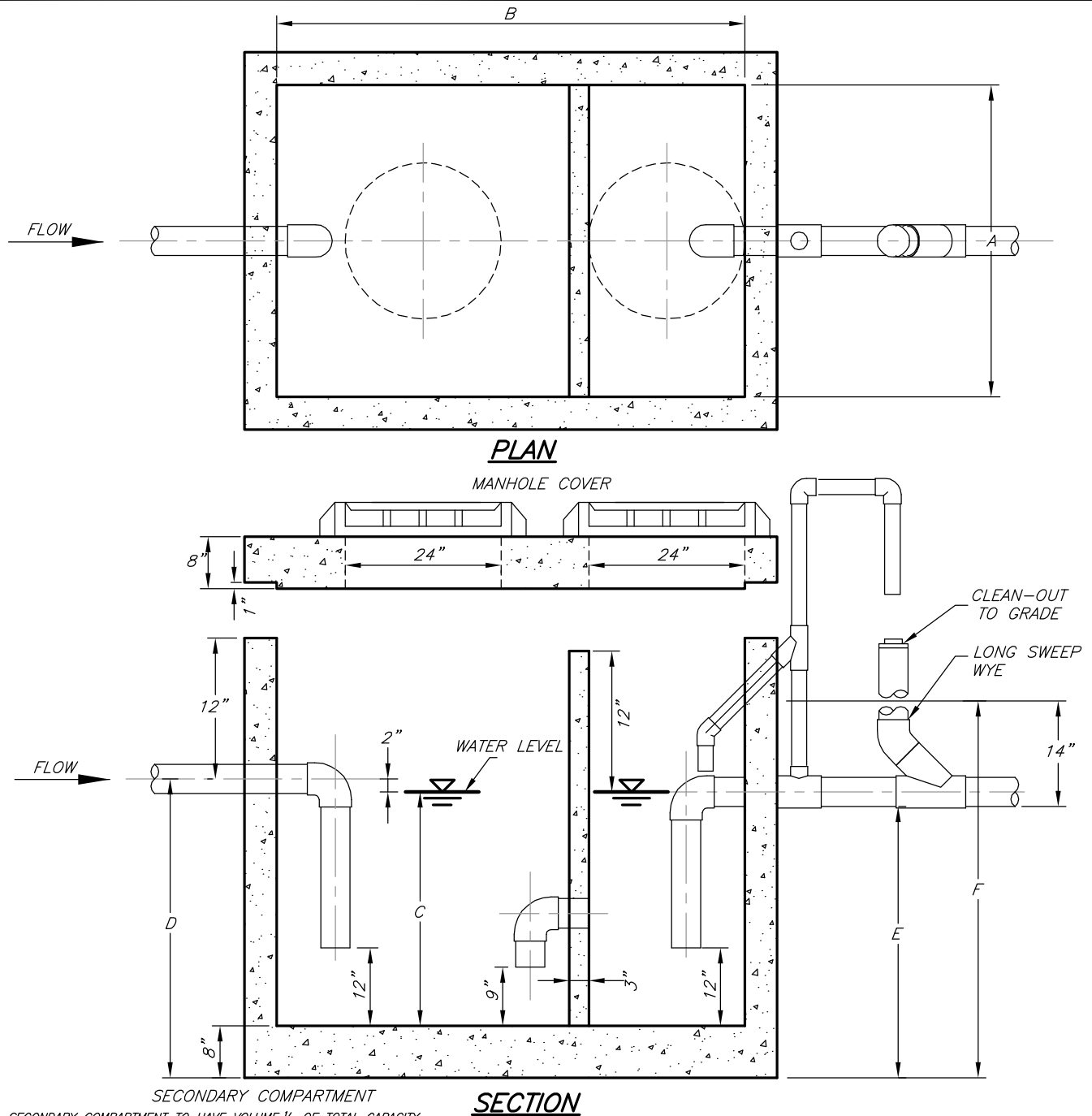
SEWER MAINTENANCE ACCESS

NOTES:

1. THE CONTRACTOR SHALL GRADE ALL OFFROAD SEWER LINE TRENCHES TO PROVIDE ACCESS PLATFORM.
2. ACCESS PLATFORMS SHALL BE GRADED TO MATCH ROAD GRADES TO PROVIDE VEHICULAR ACCESS AT ALL ROAD AND PLATFORM ACCESS INTERSECTIONS. MAXIMUM GRADE FOR BACKLOT ACCESS SHALL BE 7%.

DETAIL "S05"

File: I:\2013\2013-520_CITYCRAIG\001_MISCENGSVC\12 - PUBLIC WORKS MANUAL\SEC. 7 - STANDARD DETAILS\DETAILS\DMG\GREASEINT



- 1) SECONDARY COMPARTMENT TO HAVE VOLUME $\frac{1}{3}$ OF TOTAL CAPACITY
- 2) ALL PIPE AND FITTINGS TO BE SCHEDULE 40 PVC, 4" MINIMUM DIAMETER
- 3) ALL CONCRETE TO INCLUDE FIBERMESH REINFORCEMENT
- 4) COVERS TO BE REINFORCED LONGITUDINALLY WITH #6 REBAR ON 6" CENTERS, #4 REBAR ON 6" CENTERS WIDTHWISE AND #8 REBAR DIAGONALLY AROUND ACCESS HOLES
- 5) CLEAN OUT SHALL CONFORM TO STANDARD SEWER CLEAN-OUT DETAIL "24" OF THE CITY OF CRAIG RULES AND REGULATIONS
- 6) MANHOLE RING AND COVER SHALL CONFORM TO SECTION XI (SANITARY SEWERLINES) OF THE CITY OF CRAIG RULES AND REGULATIONS
- 7) A SHOP DRAWING DEPICTING ACTUAL DIMENSIONS, PENETRATION LOCATIONS AND REINFORCEMENT SIZE SHALL BE SUBMITTED TO THE DISTRICT FOR APPROVAL.
- 8) NO BOLT DOWN COVERS ARE ALLOWED WITHOUT THE PRIOR AUTHORIZATION OF THE DISTRICT
- 9) ALL CONCRETE WALL PENETRATIONS TO BE FILLED WITH NON SHRINK GROUT SUBSEQUENT TO PIPE INSTALLATION
- 10) THE TOTAL CAPACITY SHALL ACCOMMODATE A 30 MINUTE DETENTION TIME AT PEAK HOUR FLOW.
- 11) CAPACITY IS ALSO DETERMINED BY FREQUENCY OF CLEANING.
- 12) FLOW SHALL BE DETERMINED BY A PROFESSIONAL ENGINEER.

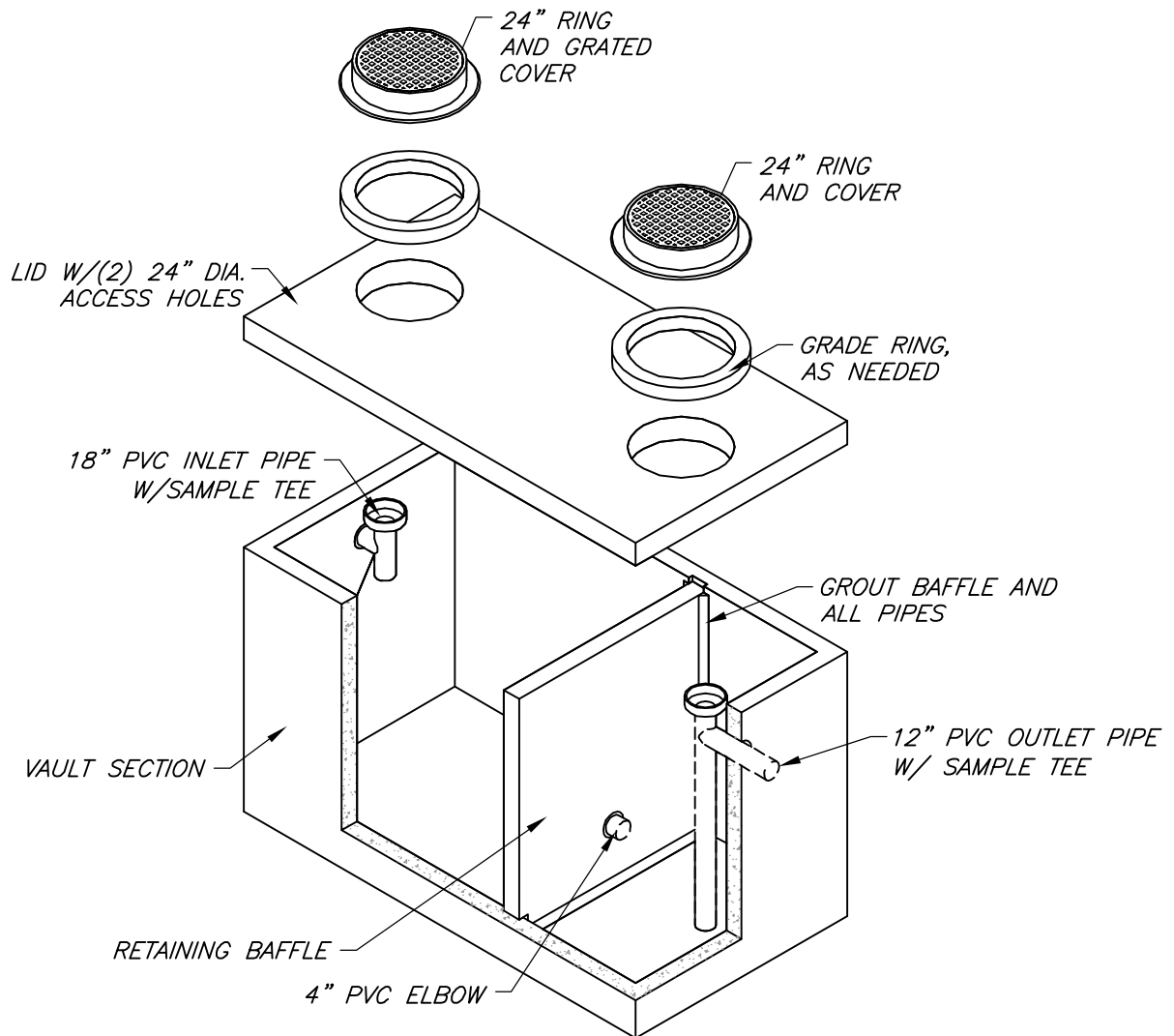
WATER CAPACITY APPROXIMATE GALLONS	GREASE CAPACITY APPROXIMATE CUBIC FEET	DIMENSIONS						
		TWO COMPARTMENT TANK, INCHES						
		A	B	C	D	E	F	G
320	17	48	72	22	32	30	44	24
500	32	48	72	36	46	44	58	24
780	47	48	96	40	40	48	62	20
1060	74	72	102	34	34	42	56	30
1250	87	80	112	35	45	48	57	36
2000	142	80	128	46	56	54	68	42

GREASE INTERCEPTOR

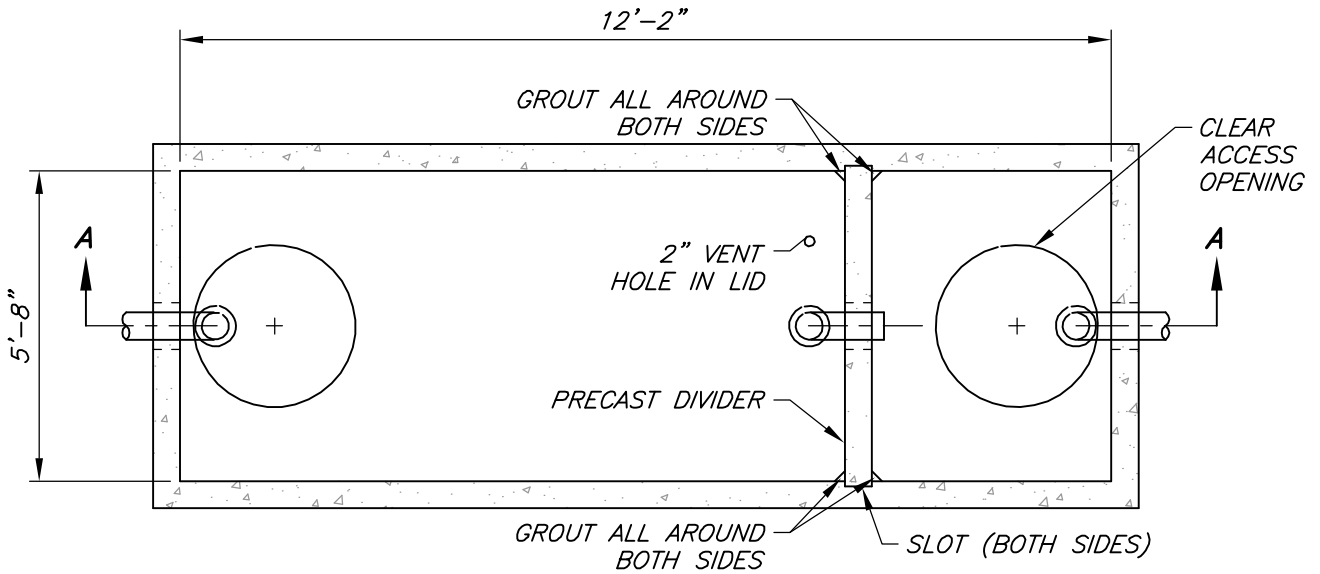
DETAIL "S06"

NOTES:

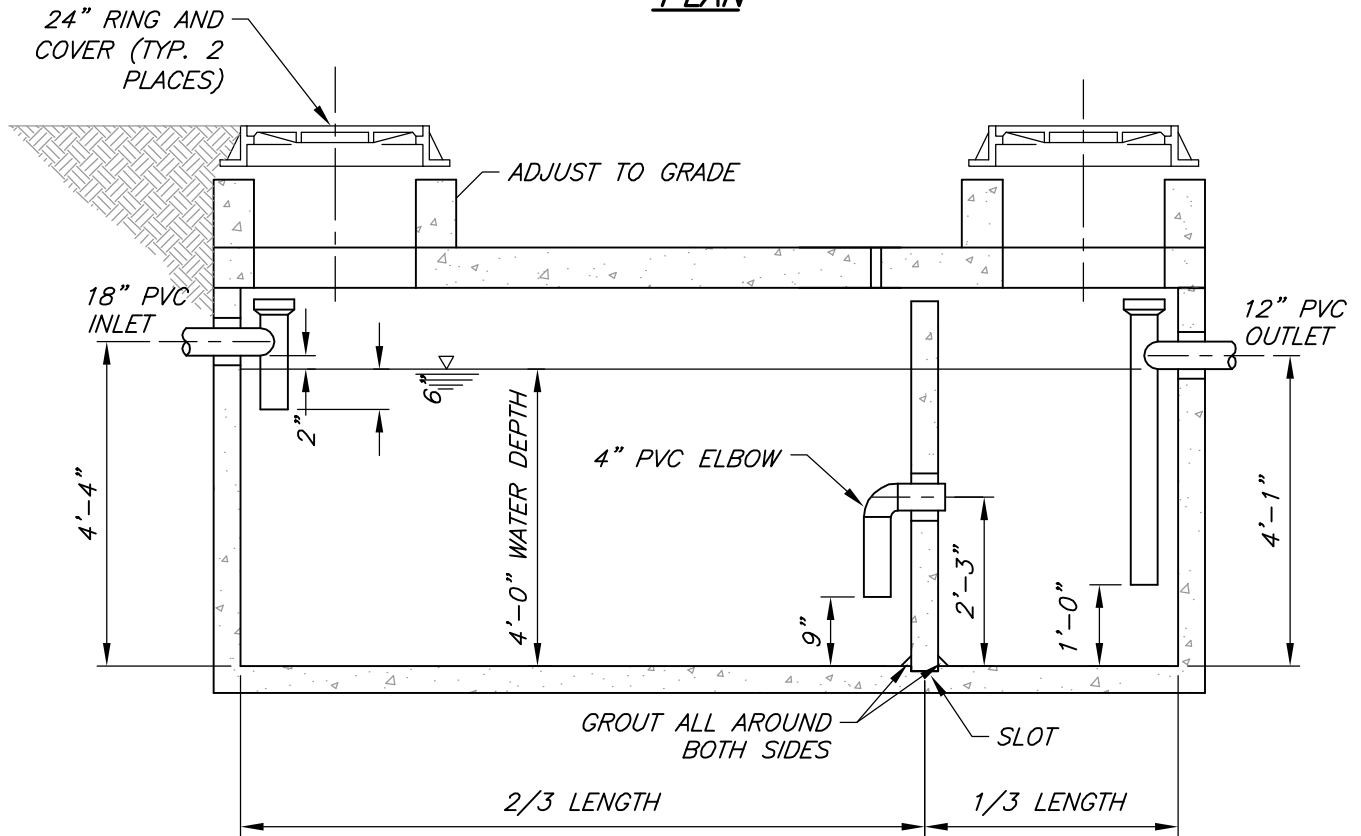
1. CONCRETE: 28 DAY COMPRESSIVE STRENGTH $f'_c = 4500 \text{ psi}$
2. DESIGNED FOR AASHTO HS-20 LOADING
3. DESIGNED ACCORDING TO ASTM C857-87 AND C858-83
4. FILL W/CLEAN WATER PRIOR TO START-UP OF SYSTEM
5. CONTRACTOR TO SUPPLY & INSTALL ALL PIPING & SAMPLING TEES
6. GRAY WATER ONLY, BLACK WATER SHALL BE CARRIED BY SEPARATE SIDE SEWER



DETAIL "S07"



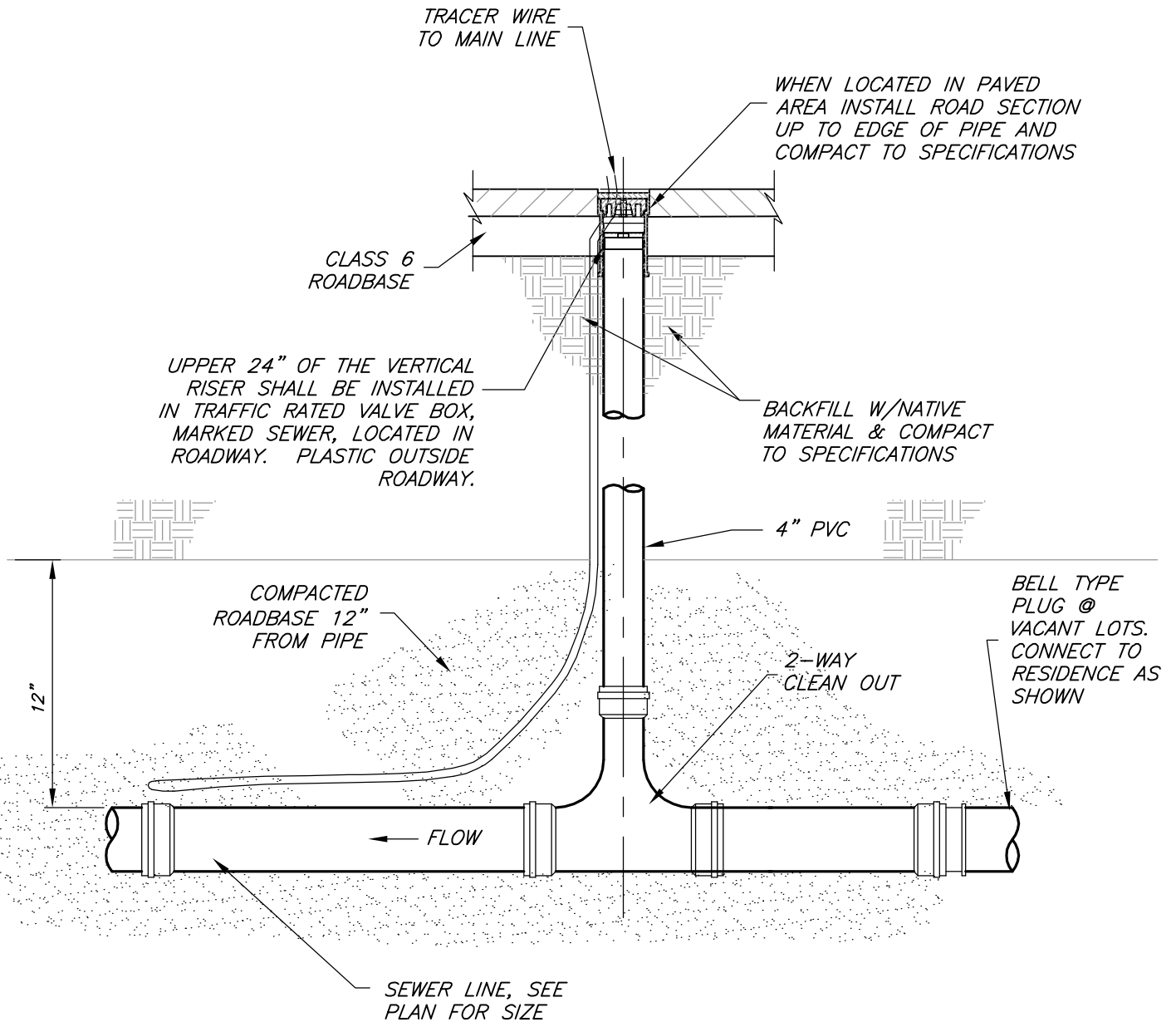
PLAN



SECTION A-A

1500 GAL. SAND/OIL INTERCEPTOR
NOT TO SCALE

DETAIL "S08"

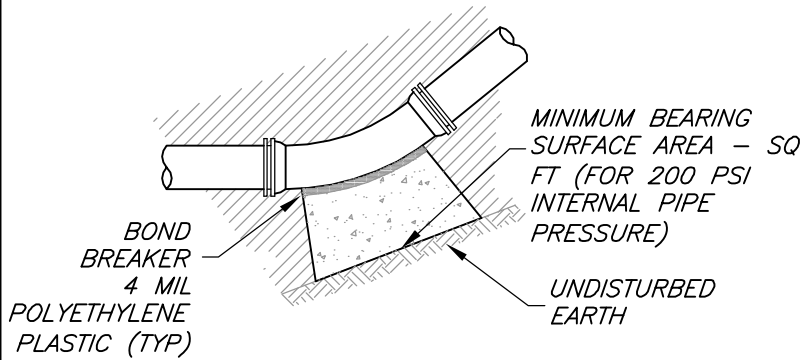


NOTES:

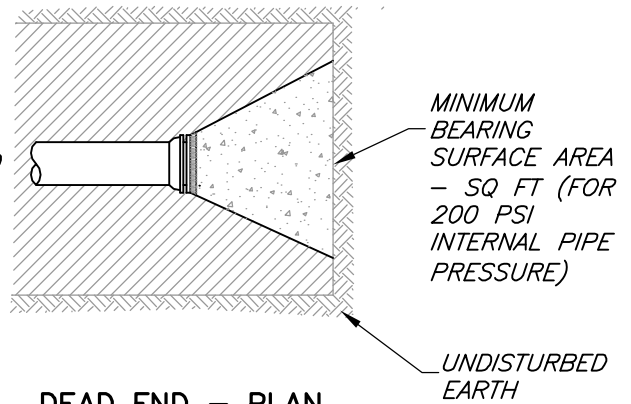
1. MUST BE TRAFFIC RATED IF INSTALLED IN TRAFFIC AREAS.
2. INSTALL 2-WAY SEWER CLEAN-OUT 5 FEET FROM RESIDENCE.
3. NO CLEAN-OUTS TO BE INSTALLED ON VACANT LOTS.

2-WAY SEWER CLEAN-OUT
NOT TO SCALE

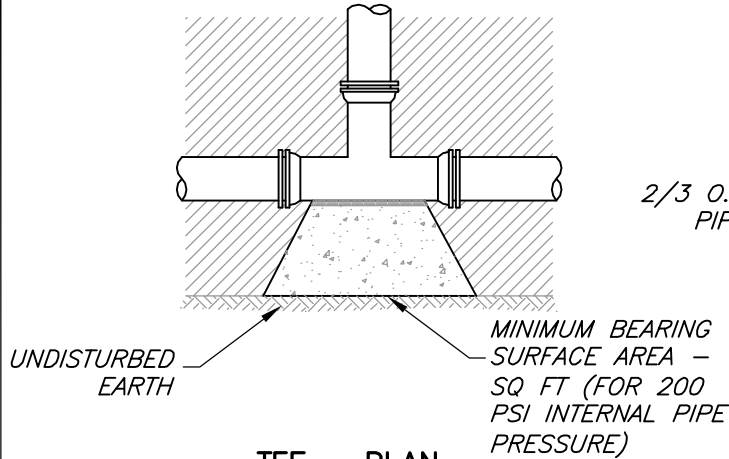
DETAIL "S09"



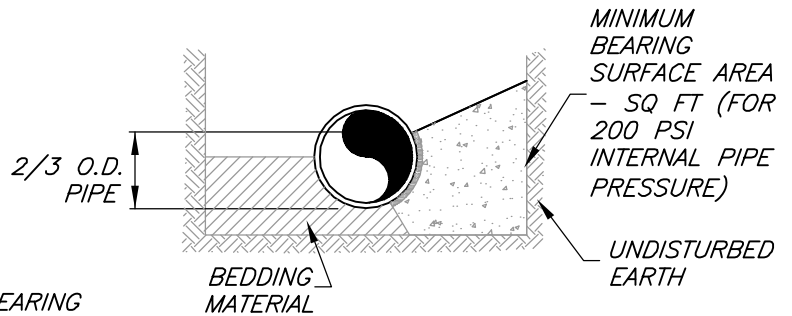
BENDS - PLAN



DEAD END - PLAN



TEE - PLAN



TYPICAL CROSS SECTION

MINIMUM BEARING SURFACE (SF) FOR 200 PSI AND LESS

SIZE OF PIPE	BENDS				TEE OR DEAD END
	11-1/4"	22-1/2"	45°	90°	
6"	1.3	2.5	5.0	9.0	6.4
8"	1.3	2.5	5.0	9.0	6.4
10"	1.9	3.8	7.4	13.7	9.7
12"	2.7	5.4	10.5	19.3	13.7
16"	4.7	9.3	9.1	33.6	23.8
20"	7.2	14.3	28.0	51.8	36.6

MINIMUM BEARING SURFACE (SF) FOR 250 PSI AND LESS

SIZE OF PIPE	BENDS				TEE OR DEAD END
	11-1/4"	22-1/2"	45°	90°	
6"	1.6	3.1	6.2	11.4	8.0
8"	1.6	3.1	6.2	11.4	8.0
10"	2.4	4.7	9.25	17.1	12.0
12"	3.4	6.7	13.1	24.2	17.1
16"	5.8	11.6	22.7	42.0	29.7
20"	9.0	17.9	35.0	64.8	45.8

NOTES:

- FOR 200 PSI INTERNAL PRESSURE, INCLUDING WATER HAMMER
- ALL FITTINGS (BENDS, CROSSES, PLUGS, VALVES AND TEES) TO HAVE A CONCRETE THRUST BLOCK AND MEGALUG INSTALLED IN ACCORDANCE WITH THE THRUST BLOCK TABLE SHOWN ON THE DETAIL SHEET. FOR CLARITY'S SAKE, ALL THRUST BLOCKS MAY NOT HAVE BEEN SHOWN ON THE PLAN VIEW DRAWINGS.
- MINIMUM AREA REQUIRED WILL BE THAT OF AN 8-INCH MAIN
- ALL THRUST BLOCKS SHALL BE FORMED. THE MINIMUM THICKNESS FORM MATERIAL SHALL BE 3/8" PLYWOOD
- BEARING AREA BASED ON SOIL BEARING PRESSURE OF 2000 LB/SF
- CONCRETE SHALL HAVE A 28 DAY COMPRESSION STRENGTH OF 4000 PSI

CONCRETE THRUST BLOCKS
NOT TO SCALE

DETAIL "WO1"

VOLUME OF THRUST BLOCK IN CUBIC
YARDS (VERTICAL DOWNWARD BENDS)

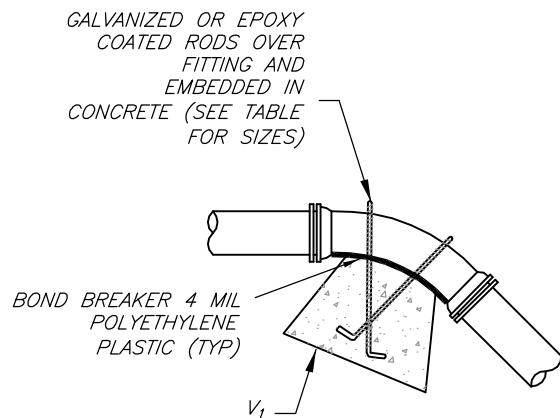
FITTING SIZE (IN)	V ₁				
	45° BEND (CY)	22 1/2° BEND (CY)	11 1/4° BEND (CY)	ROD SIZE	EMBEDMENT (FT)
6	2.0	1.1	0.5	#6	2.5
8	2.0	1.1	0.5	#6	2.5
10	3.1	1.7	0.9	#6	2.5
12	4.4	2.4	1.2	#6	2.5
14	6.1	3.3	1.7	#8	3.0
16	7.9	4.3	2.2	#8	3.0

VERTICAL DOWNWARD BENDS:

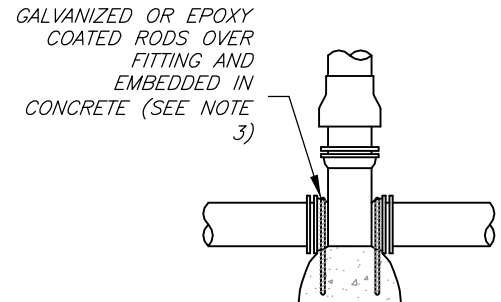
1. VERTICAL BENDS THAT REQUIRE A THRUST BLOCK VOLUME EXCEEDING 5 CUBIC YARDS, REQUIRE SPECIAL BLOCKING DETAILS. SEE DRAWINGS FOR VOLUMES SHOWN TO LEFT OF HEAVY BOLD LINE IN TABLE.
2. THRUST BLOCK VOLUMES (IN TABLE) FOR VERTICAL DOWNWARD BENDS HAVING UPWARD RESULTANT THRUSTS ARE BASED ON TEST PRESSURE OF 150 PSI, THE WEIGHT OF CONCRETE = 4050 LBS/CUBIC YARD, AND A SAFETY FACTOR OF 1.5. TO COMPUTE VOLUMES FOR DIFFERENT TEST PRESSURES AND CONCRETE WEIGHTS, USE THE FOLLOWING EQUATION:

$$\text{VOLUME} = (\text{TEST PRESSURE} / 150) \times (4050 / \text{CONCRETE WEIGHT}) \times (\text{TABLE VALUE})$$

3. VOLUME OF THRUST BLOCK IN CUBIC YARDS FOR VALVES SHALL BE THE SAME VOLUME USED FOR 11 1/4 BENDS.

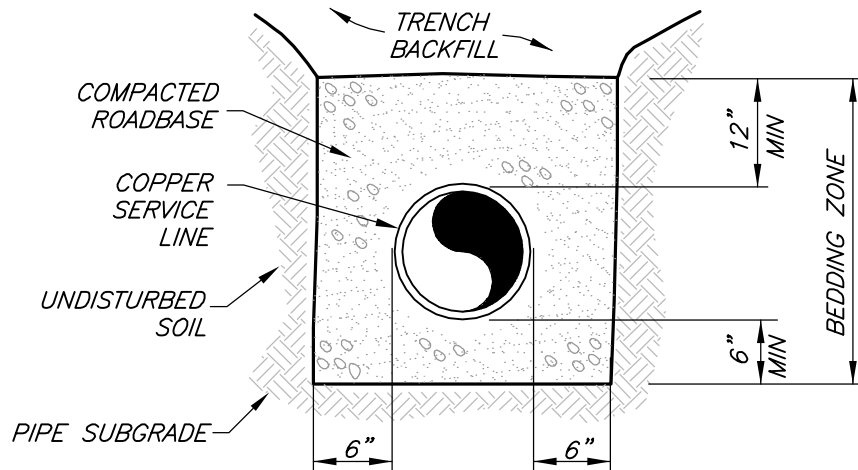


VERTICAL DOWNWARD BEND

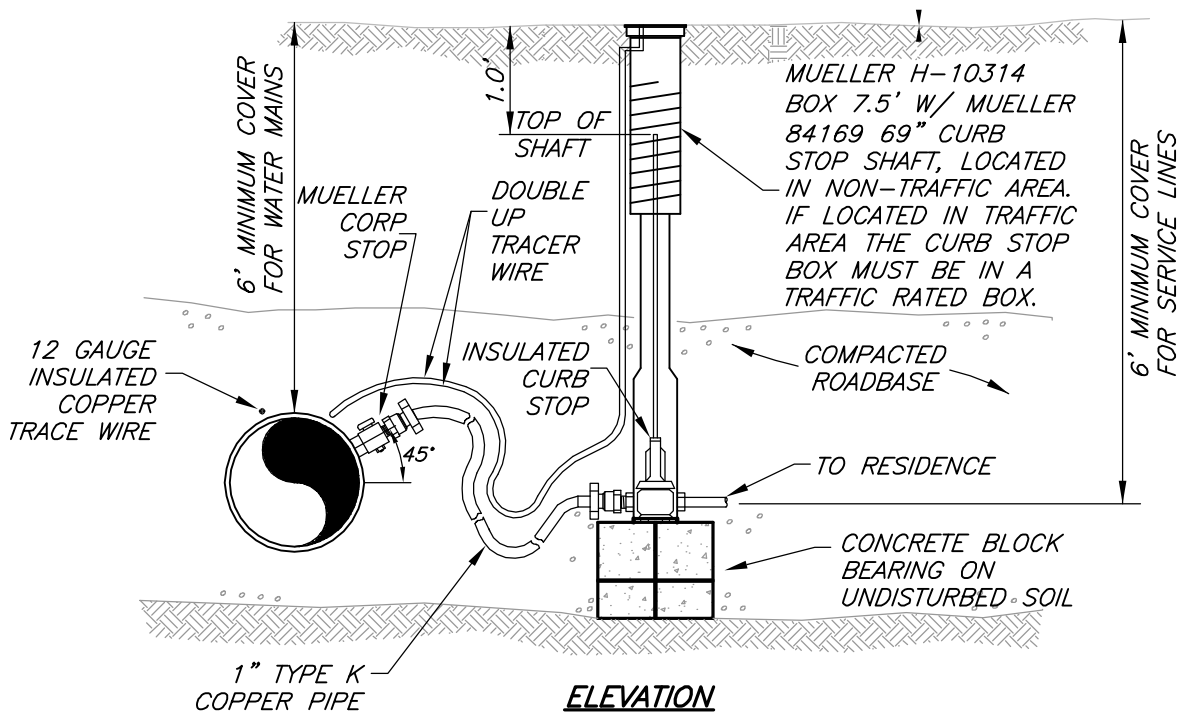


VALVE

DETAIL "W02"



SERVICE STUB-OUT BEDDING



ELEVATION

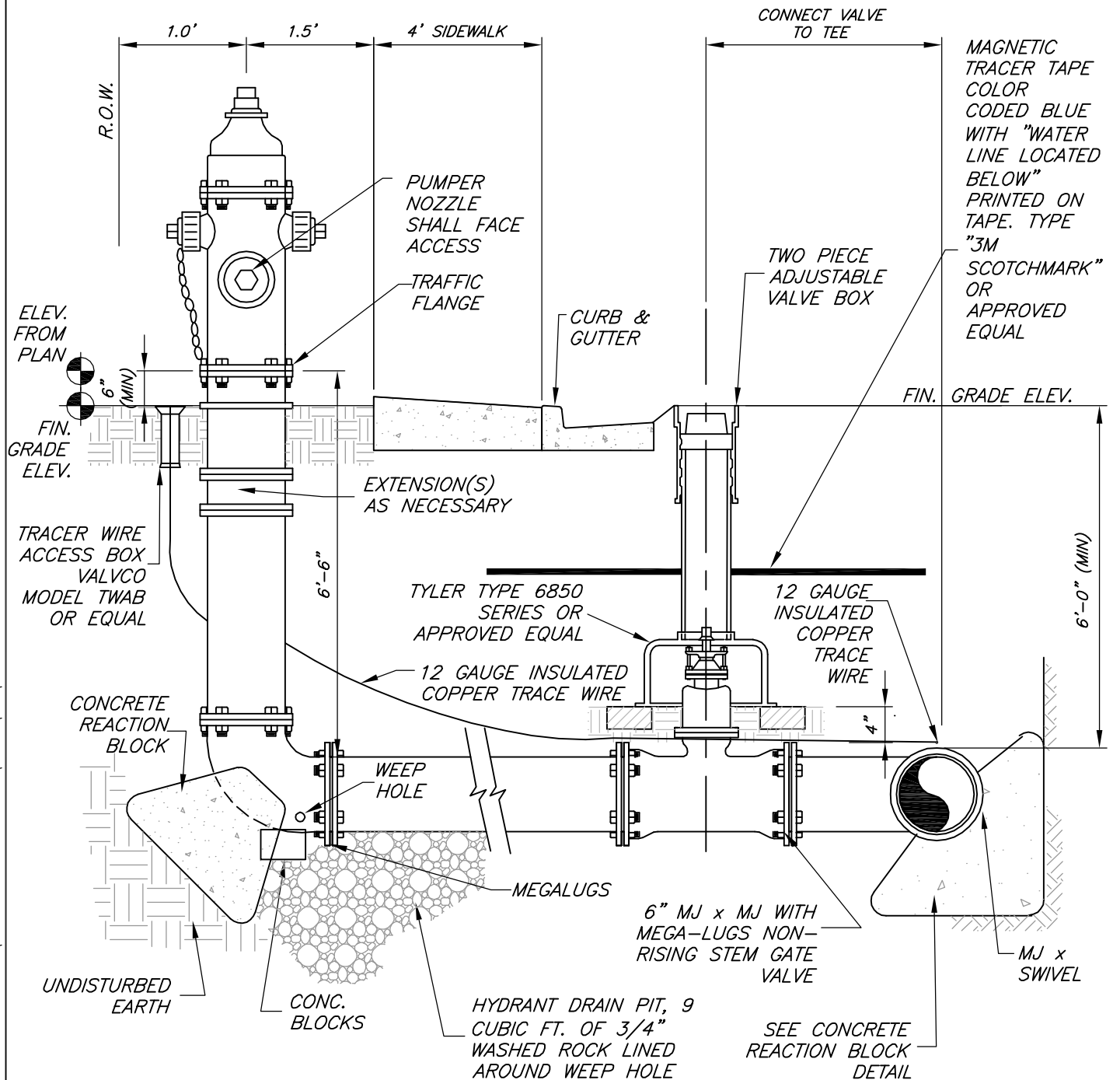
NOTES:

1. CURB STOP W/CONCRETE CAP TO BE LOCATED 6" FROM BACK OF WALK OUTSIDE OF SIDEWALK.
2. CURB STOP - ALL FITTINGS SHALL BE COMPRESSION FITTINGS.
3. CURB STOP - MANUFACTURER REFERENCE MUELLER B25204 OR APPROVED EQUAL.
4. SHAFT SHALL BE STAINLESS STEEL AND LOCATED 1 FOOT BELOW FINISHED GRADE.
5. CURB BOX AND LID MUST BE TRAFFIC RATED IF LOCATED WITHIN TRAFFIC AREA. CURB BOX SHALL BE LOCATED IN NON-TRAFFIC AREA, IF POSSIBLE.
6. ALL EX. CURB STOPS SHALL BE REPLACE WITH NEW CURB STOP WITH STAINLESS STEEL SHAFT.

WATER SERVICE STUB OUT

NOT TO SCALE

DETAIL "W03"



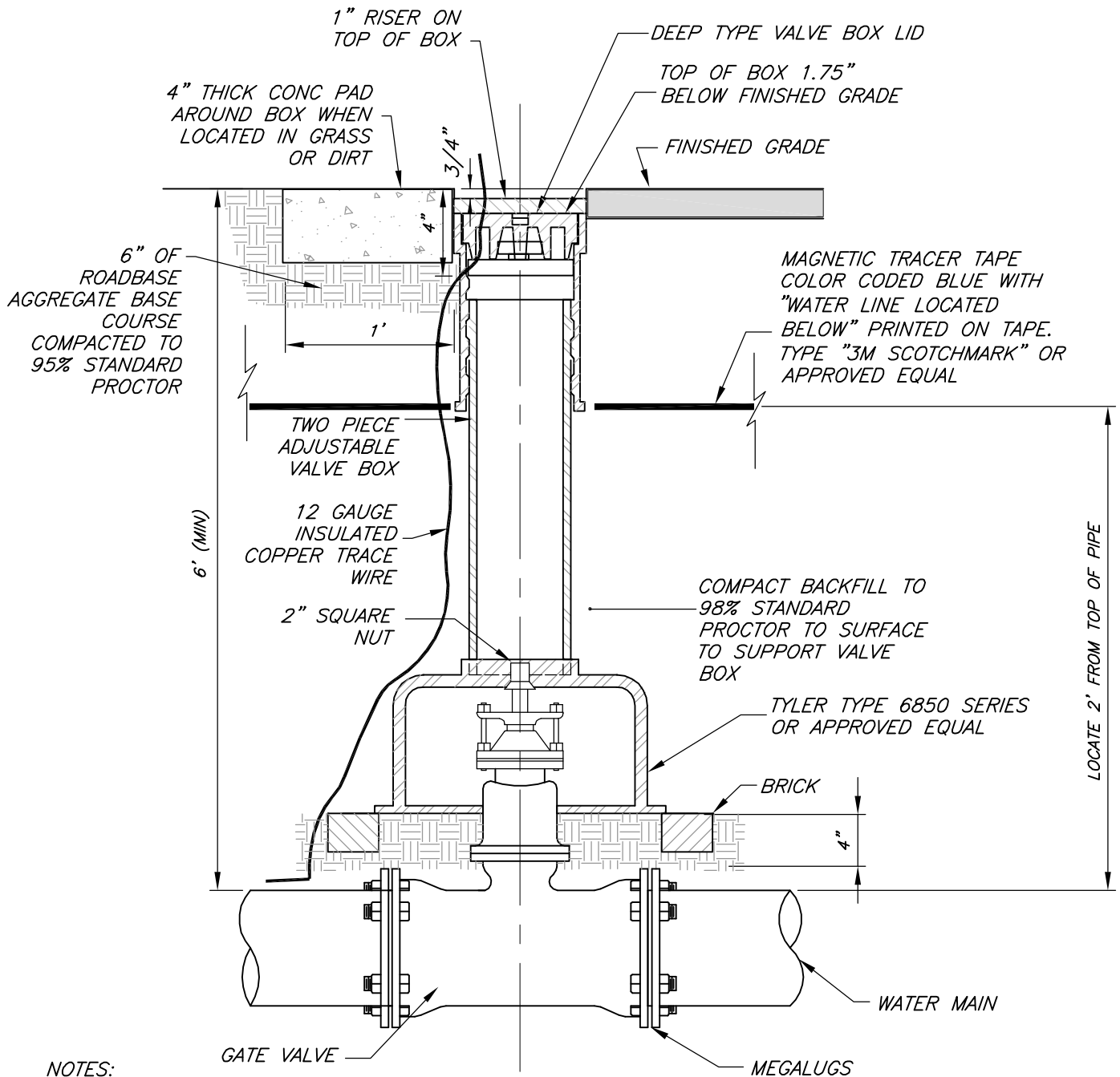
NOTES:

1. ALL JOINTS FROM MAIN TO HYDRANT SHALL BE RESTRAINED MECHANICAL JOINTS.
2. HYDRANT, VALVE AND FITTINGS TO BE 250 P.S.I. RATED.
3. POLYETHYLENE WRAP SHALL COVER D.I.P. ASSEMBLY FROM HYDRANT BASE TO WATER MAIN. DO NOT BLOCK WEEP HOLE.
4. ALL HYDRANT LEAD PIPING TO BE 6" CLASS 250 C900 UNLESS OTHERWISE NOTED.
5. ALL BOLTS SHALL BE CORE BLUE BOLTS.

FIRE HYDRANT ASSEMBLY INSTALLATION DETAIL

NOT TO SCALE

DETAIL "WO4"

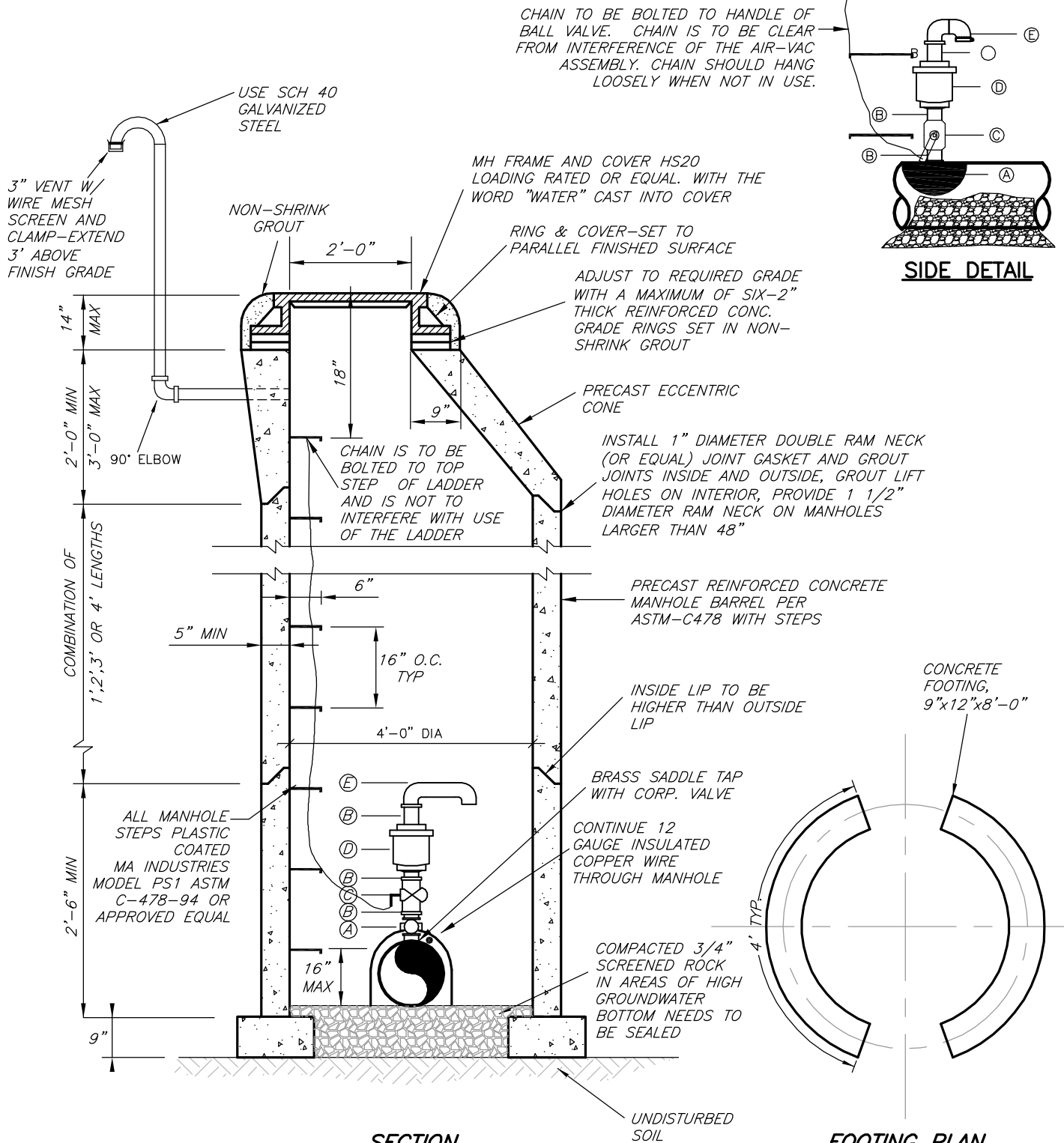


NOTES:

1. ALL VALVES ADJACENT TO FITTING SHALL BE MJ. IN LINE VALVES TO BE MJ x MJ. DESIGN LOCATIONS OF VALVES ARE OUTSIDE OF CONCRETE, CURB/GUTTER AND VALLEY PANS.
2. INSTALLED VALVES WHICH CONFLICT WITH CONCRETE AREAS SHALL BE RELOCATED AT THE CONTRACTOR'S EXPENSE.
3. THIS DETAIL DOES NOT APPLY TO HYDRANT ASSEMBLY VALVES.
4. THE TRACER WIRE SHALL BE EXTENDED TO THE SURFACE AT ALL VALVES AND FIRE HYDRANTS. THE WIRE SHALL BE EXTENDED TOWARDS THE GROUND ON THE OUTSIDE OF THE VALVE BOX UNTIL THE WIRE IS WITHIN FOUR INCHES (4") OF THE TOP OF THE LID, AT WHICH POINT IT SHALL BE BROUGHT BACK INSIDE THE BOX AND SECURELY FASTENED. SUFFICIENT SLACK IN THE OUTSIDE OF THE WIRE SHALL BE PROVIDED TO COMPENSATE FOR ANY FUTURE ADJUSTMENT TO THE VALVE BOX.
5. ALL BOLTS SHALL BE CORE BLUE BOLTS.

TYPICAL GATE VALVE
NOT TO SCALE

DETAIL "W05"



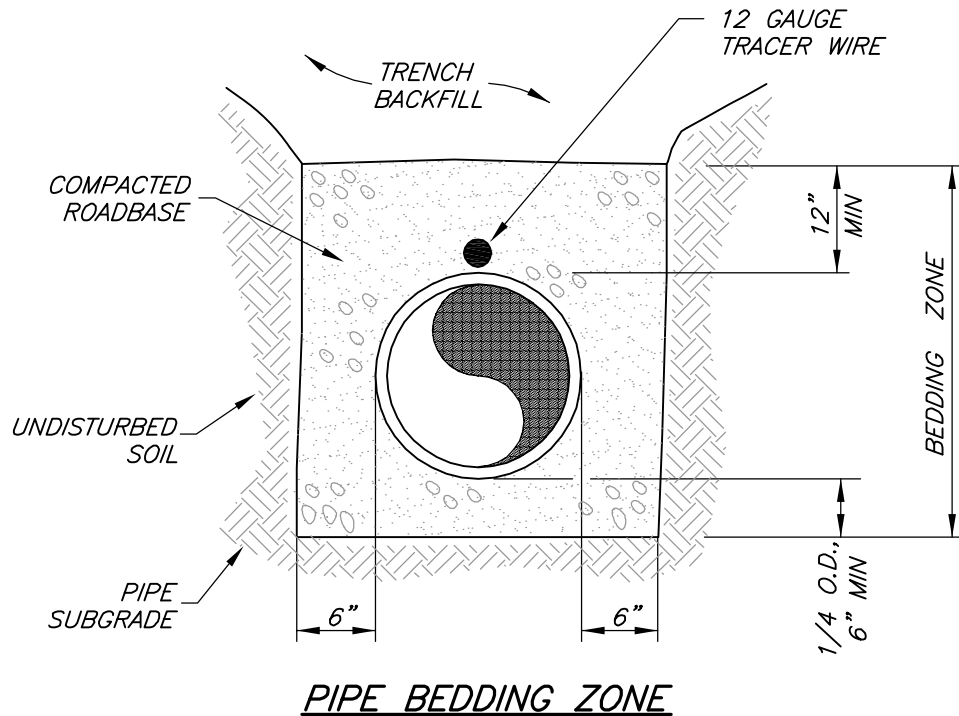
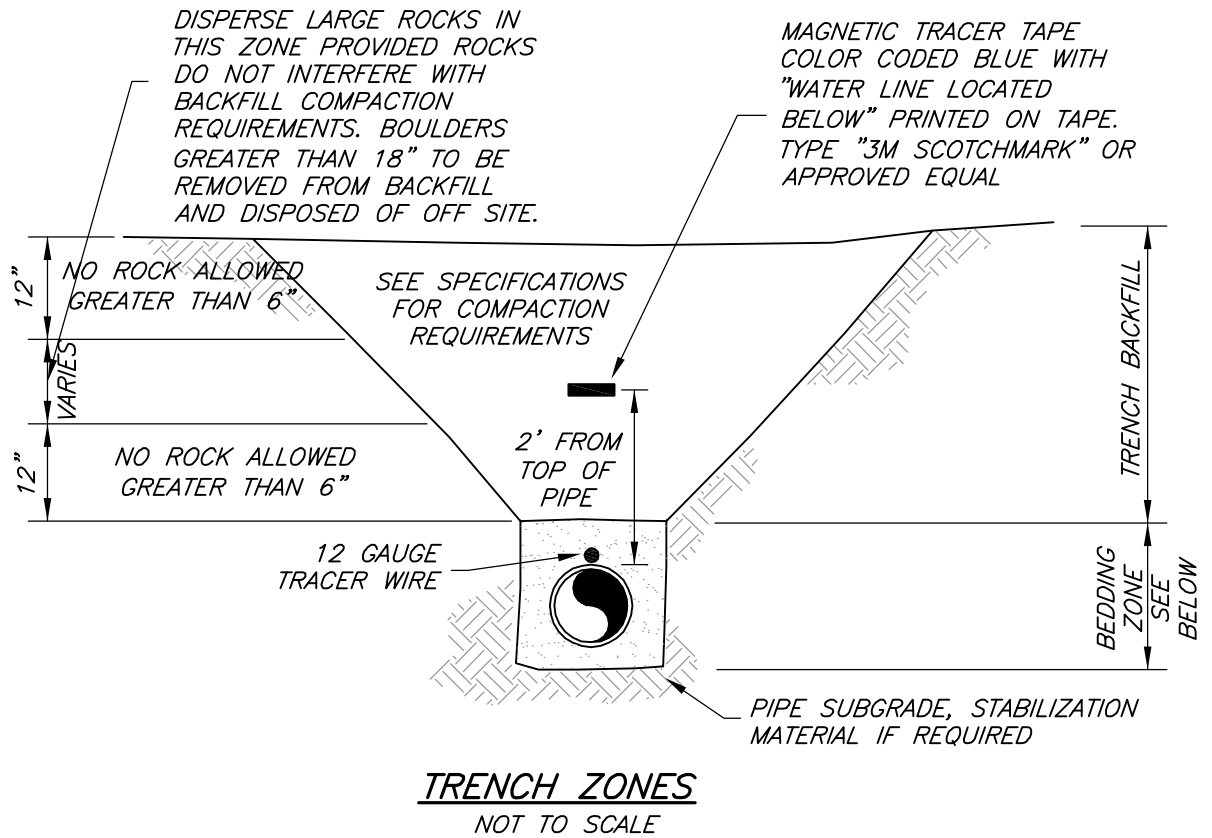
LEGEND

- (A) 2" CORPORATION TAPERED THREADS INLET
- (B) 2" X 4" THREADED BRASS NIPPLE
- (C) 2" THREADED BALL VALVE
- (D) 2" THREADED INLET APCO 144 AIR AND VACUUM RELEASE VALVE
- (E) 2" X 90° PLASTIC ELBOW

GENERAL NOTES

1. ALL CONCRETE WORK SHALL COMPLY WITH LATEST ACI-318 SPECIFICATIONS
2. AIR VALVE ASSEMBLY LARGER THAN 2" SIZE SHALL BE SPECIALLY DESIGNED AND MEET WATER DEPARTMENT REQUIREMENTS

DETAIL "W06"

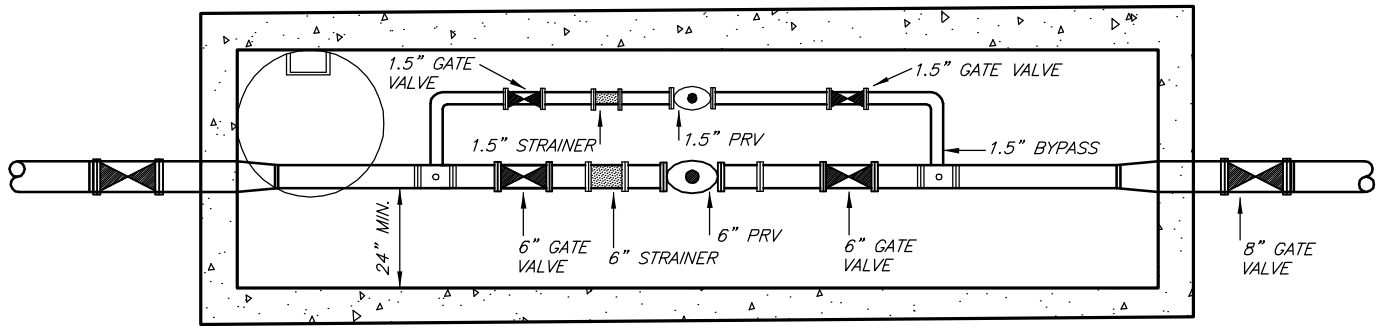


NOTE:

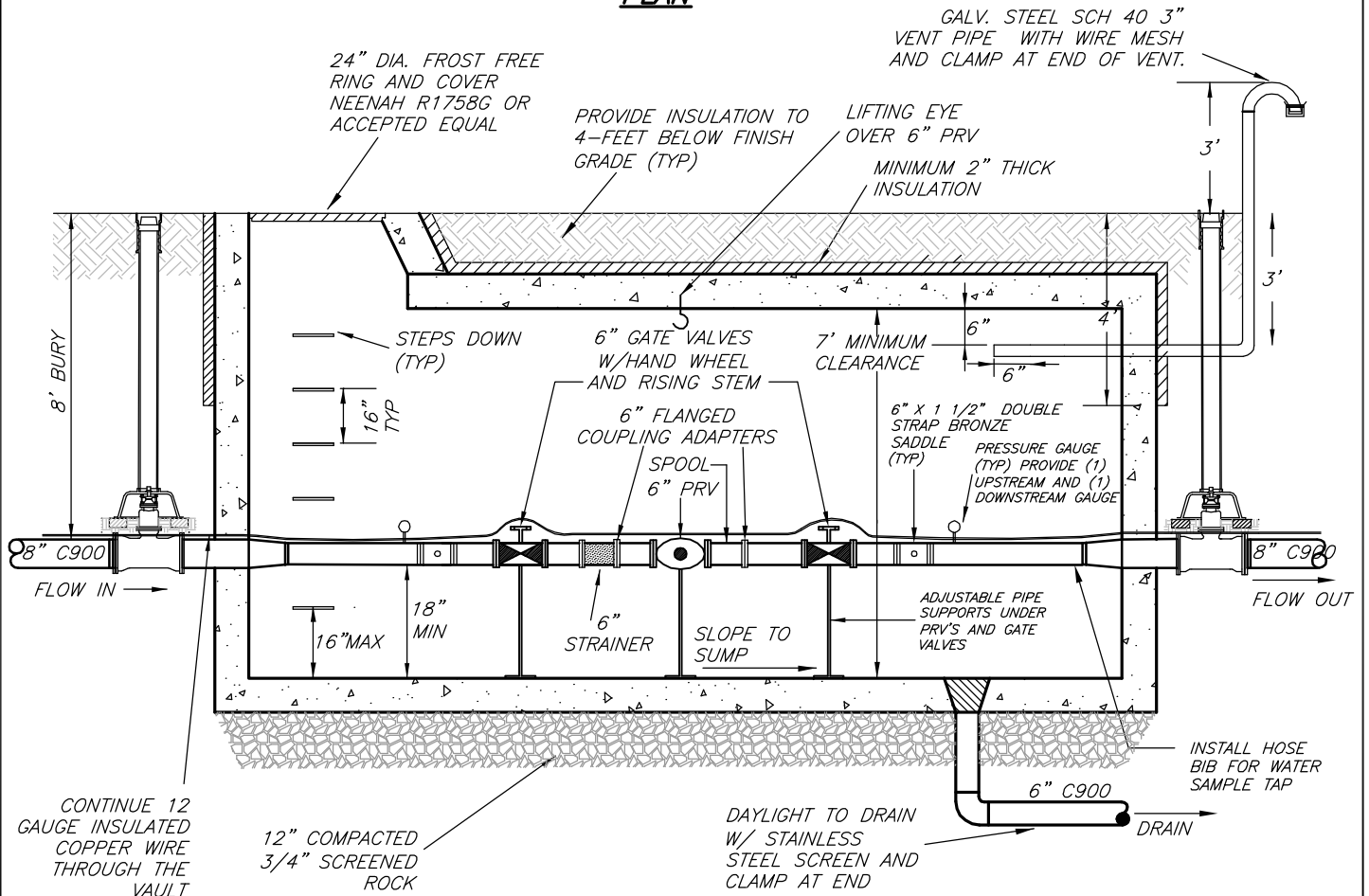
3/4 SCREENED ROCK IN WET AREAS IN PLACE OF ROADBASE ONLY APPROVED AS NEEDED

WATER PIPE BEDDING
NOT TO SCALE

DETAIL "W07"



PLAN



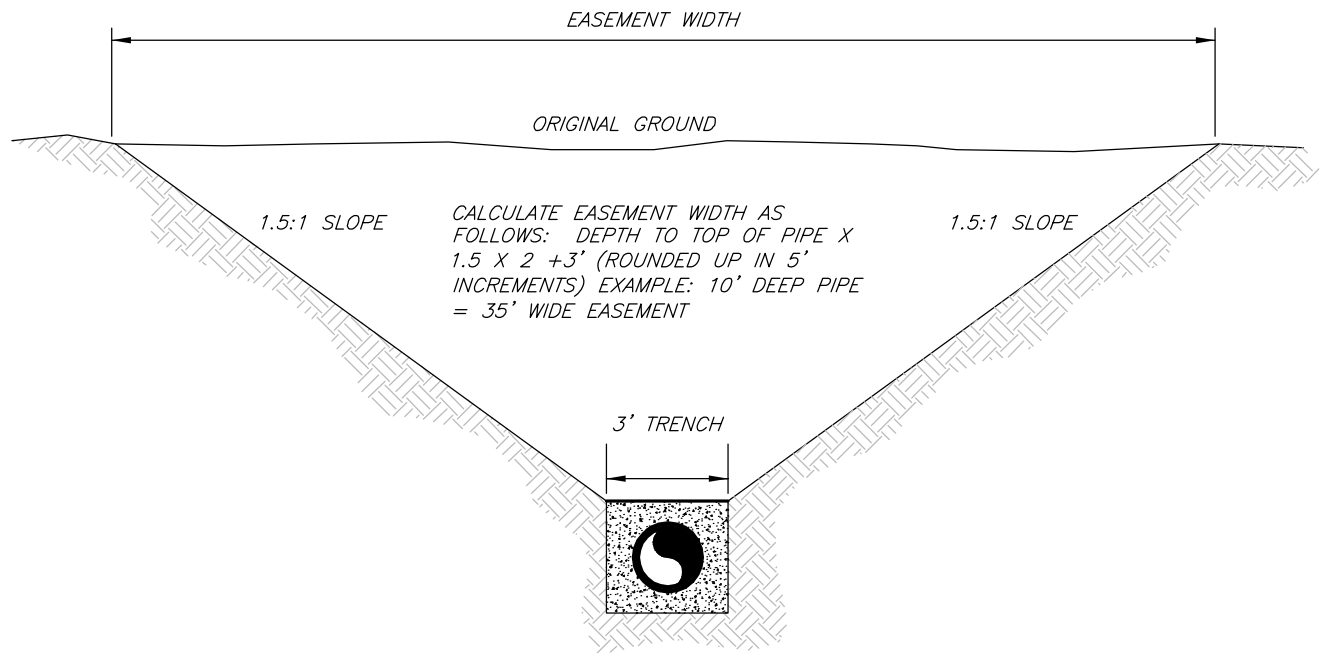
ELEVATION

MAIN LINE PRV VAULT

NOTES

1. VAULT SHALL BE POURED IN PLACE CONCRETE AND CAPABLE OF WITHSTANDING HS 20-44 TRAFFIC LOADING CONDITIONS
2. WHERE PIPES PENETRATE WALLS, USE LINK SEAL OR FILL ANNULAR SPACE W/ NON-SHRINK GROUT
3. COAT ALL EXTERIOR VAULT SURFACES WITH BITUMINOUS DAMPROOFING
4. ALL 1 1/2" PIPE SHALL BE BRASS W/ ALL OTHER PIPE AND FITTINGS BEING FLANGED DUCTILE IRON
5. ALL TIE-RODS SHALL BE 3/4" ALL-THREAD OR MEGA-LUGS ON EXTERIOR CONNECTIONS
6. CONTRACTOR SHALL SUBMIT VAULT PIPING SCHEMATIC W/ VAULT DIMENSIONS PRIOR TO ORDERING
7. IT SHALL BE THE OWNER'S RESPONSIBILITY TO VERIFY ALL PRV SIZING AND PRESSURE SETTINGS SIZES OF PRV'S SHOWN IS FOR ILLUSTRATION PURPOSES ONLY
8. THE CITY SHALL APPROVE FINAL SIZING OF ALL PRV'S AND VALVES
9. PIPE MATERIAL TO BE OR RESTRAINED JOINT OR FLANGED PIPE.
10. INCLUDE A BYPASS PRV IN PIPING.
11. PROVIDE 120 VOLT POWER TO VAULT

DETAIL "W08"



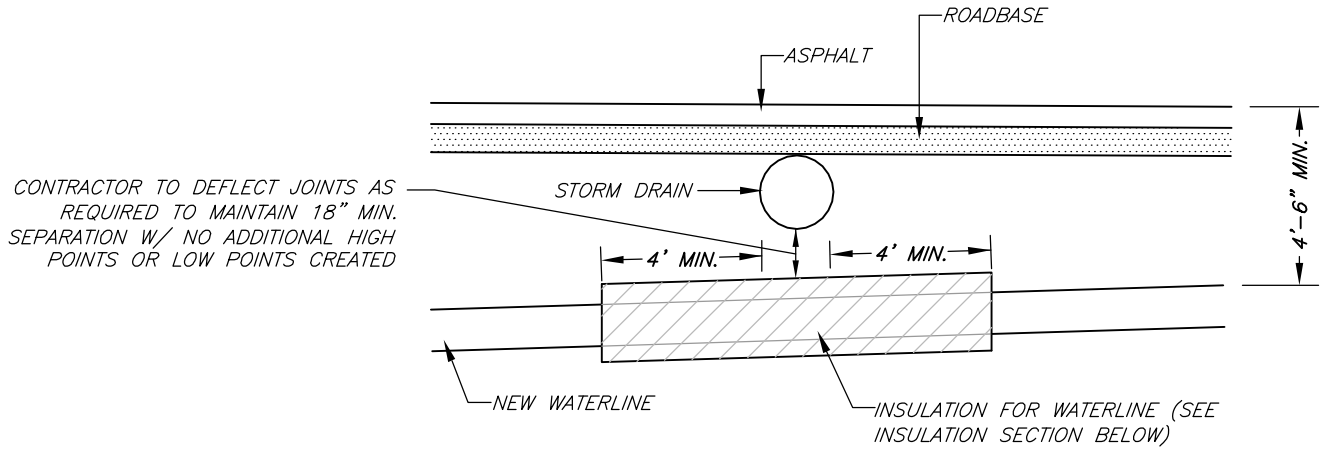
MINIMUM EASEMENT WIDTH

EASEMENT WIDTH

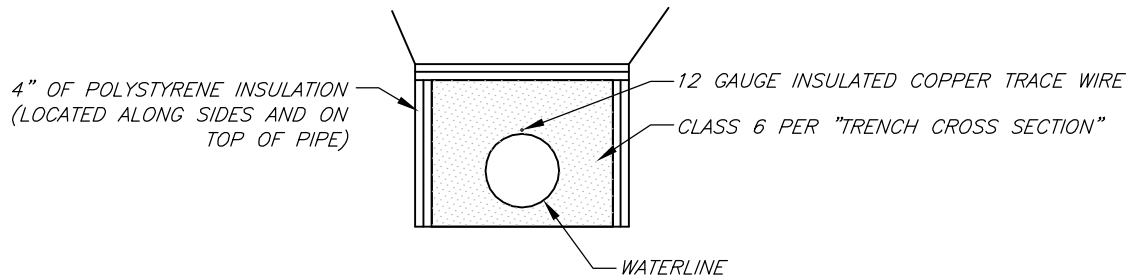
GENERAL NOTES:

1. MINIMUM EASEMENT WIDTH OF 20 FEET FOR 1 LINE
2. MINIMUM EASEMENT WIDTH OF 30 FEET FOR 2 LINES
3. NO PERMANENT IMPROVEMENTS SHALL BE INSTALLED WITHIN EASEMENT AREA SUCH AS LANDSCAPING, CONCRETE, ETC.

DETAIL "W09"



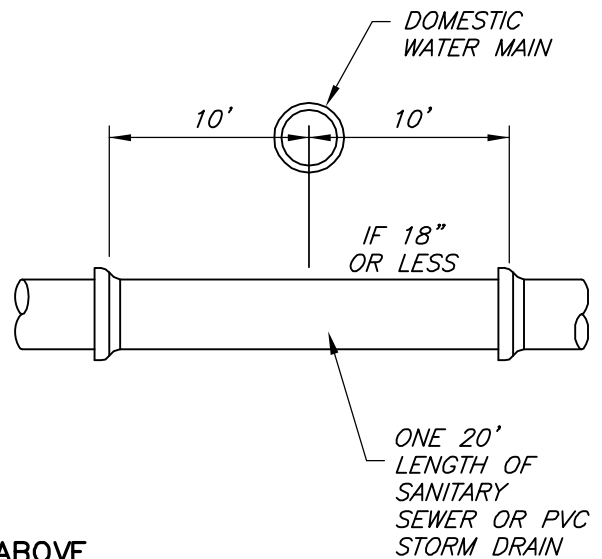
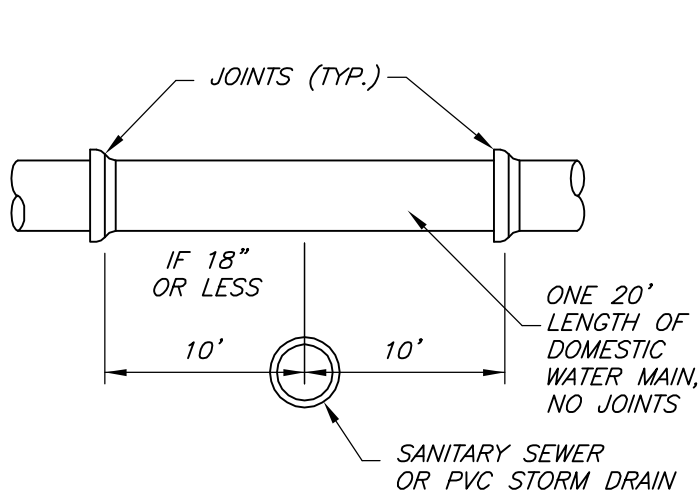
ELEVATION WATERLINE/CULVERT CROSSING
NO SCALE



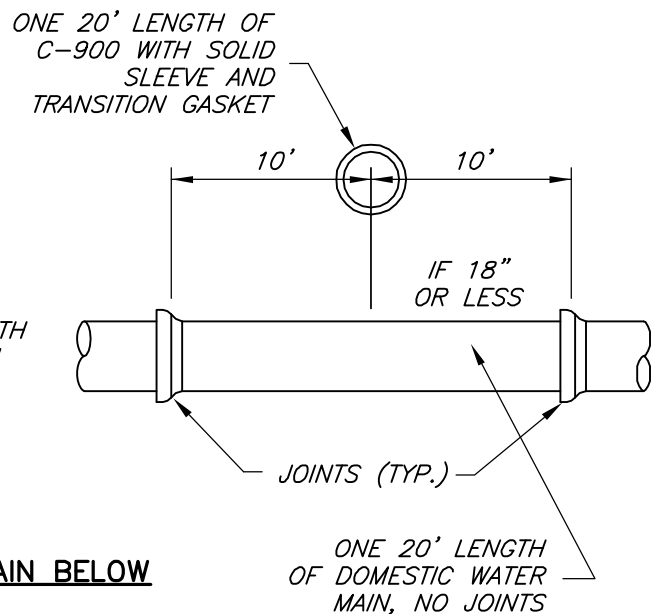
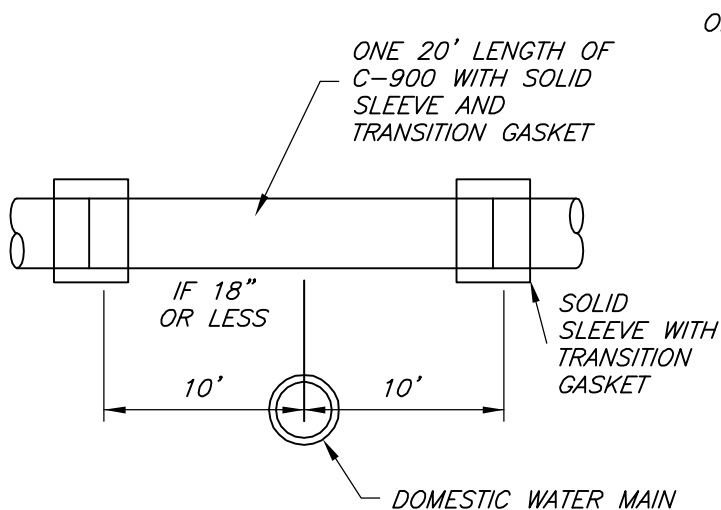
INSULATION SECTION
NO SCALE

INSULATION DETAIL

DETAIL "W10"



WATER MAIN ABOVE

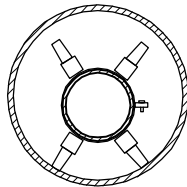


WATER MAIN BELOW

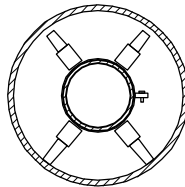
WATER/SEWER CROSSING

NOT TO SCALE

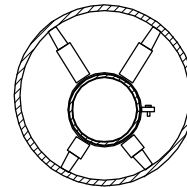
DETAIL "W11"



STANDARD

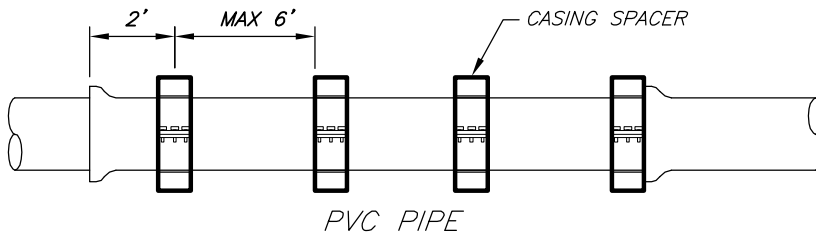


CENTERED

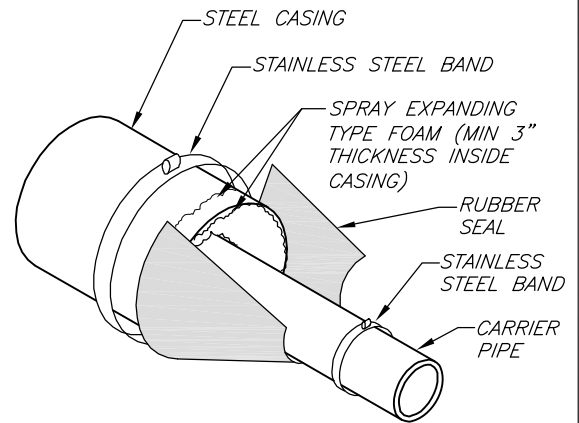


RESTRAINED

BASIC POSITIONS



PLACEMENT OF SPACERS ON CARRIER PIPE



END SEAL

PIPE CASING DETAIL

NTS

NOTES:

GENERAL: ONE SPACER SHALL BE PLACED NOT MORE THAN TWO FEET FROM EACH END OF THE CASING SUBSEQUENT SPACERS SHALL BE PLACED AT 10' INTERVALS WITHIN THE CASING.

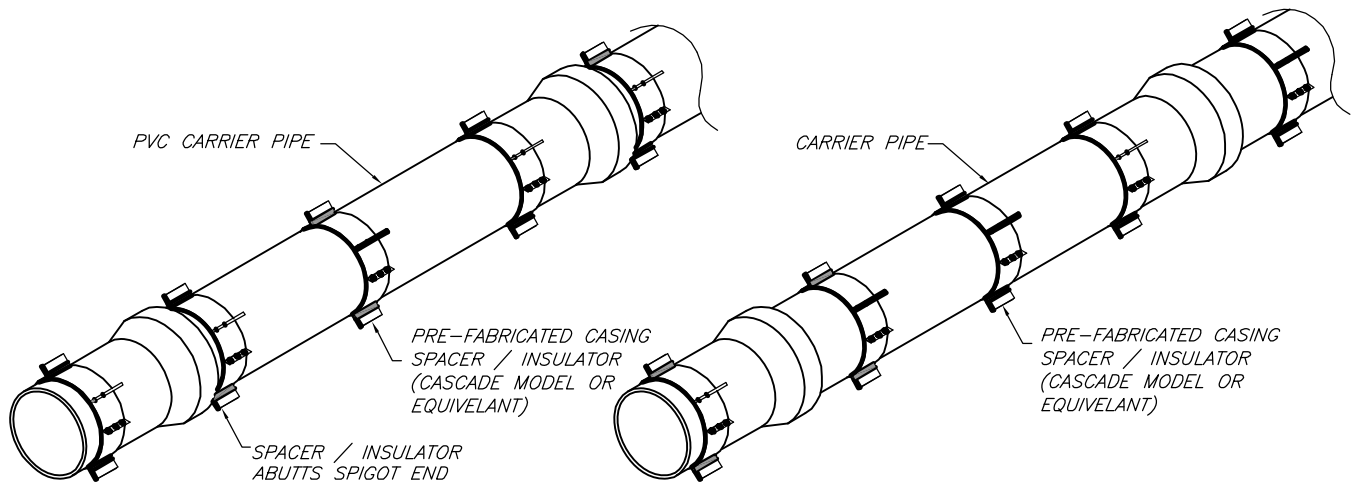
PVC CARRIER: ONE SPACER SHALL BE PLACED ON THE SPIGOT END OF EACH SEGMENT AT THE LINE MARKING THE LIMIT OF INSERTION INTO THE BELL. WHEN THE JOINT IS COMPLETE, THE SPACER SHALL BE IN CONTACT WITH THE BELL OF THE JOINT SO THAT THE SPACER PUSHES THE JOINT AND RELIEVES COMPRESSION WITHIN THE JOINT. SUBSEQUENT SPACERS SHALL BE PLACED AT 6' INTERVALS.

1. CARRIER PIPE SHALL BE INSERTED WITHIN CASING BY USE OF MODEL CCS STAINLESS STEEL CASING SPACERS AS MANUFACTURED BY CASCADE WATERWORKS MFG. CO. OF YORKVILLE, IL OR APPROVED EQUAL BY DISTRICT ENGINEER.

2. ALL PIPE JOINTS LOCATED WITHIN THE CASING AND THE FIRST JOINT EITHER SIDE OF CASING SHALL BE RESTRAINED BY USING SNAP LOCK TYPE GASKETS MANUFACTURED BY US PIPE OR APPROVED EQUAL BY DISTRICT ENGINEER. ALL RESTRAINED PIPE IS TO BE TYPE TYTON-JOINT AS MANUFACTURED BY US PIPE OR APPROVED EQUAL BY DISTRICT ENGINEER. ALL RESTRAINED PIPE IS TO BE INSTALLED USING THE RESTRAINED POSITION OF CARRIER INSTALLATION.

3. CONTRACTOR TO INSTALL PER SPECIFICATIONS SUPPLIED BY CASCADE WATERWORKS MANUFACTURING COMPANY OR APPROVED EQUAL BY DISTRICT ENGINEER.

DETAIL "W12"



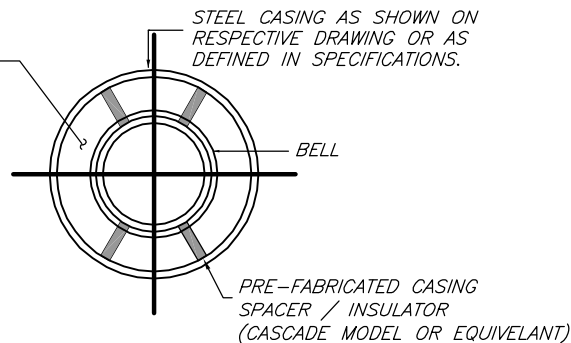
GENERAL NOTES

1. ONE SPACER SHALL BE PLACED NOT MORE THAN TWO FEET FROM EACH END OF THE CASING. SUBSEQUENT SPACERS SHALL BE PLACED AT 10' INTERVALS WITHIN CASING
2. PVC CARRIER: ONE SPACER SHALL BE PLACED ON THE SPIGOT END OF EACH SEGMENT AT THE LINE MARKING THE LIMIT OF INSERTION INTO THE BELL WHEN THE JOINT IS COMPLETE, THE SPACER SHALL BE IN CONTACT WITH THE BELL OF THE JOINT SO THAT THE SPACER PUSHES THE JOINT AND RELIEVES COMPRESSION WITHIN THE JOINT. SUBSEQUENT SPACERS SHALL BE PLACED AT 6' INTERVALS

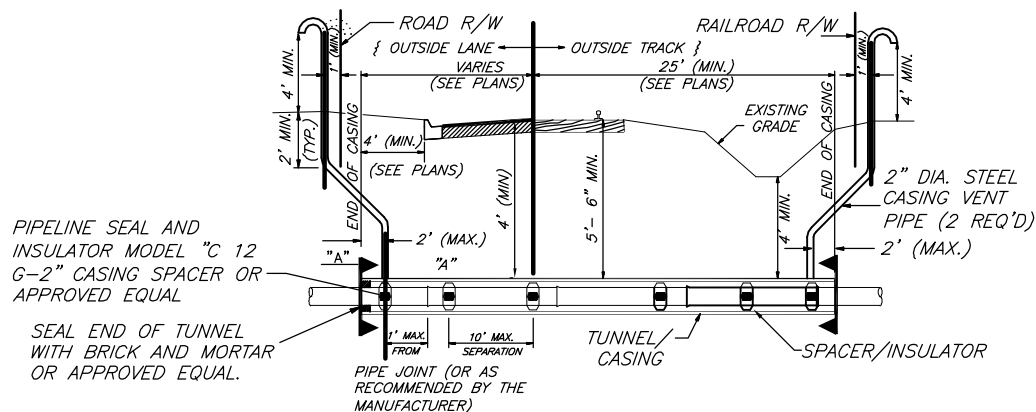
RECOMMENDED PLACEMENT ON PVC PIPE

RECOMMENDED PLACEMENT ON OTHER PIPE

SEAL CASING WITH BRICK AND MORTAR (SEE JACKING AND BORING DETAIL BELOW)



SECTION "A"

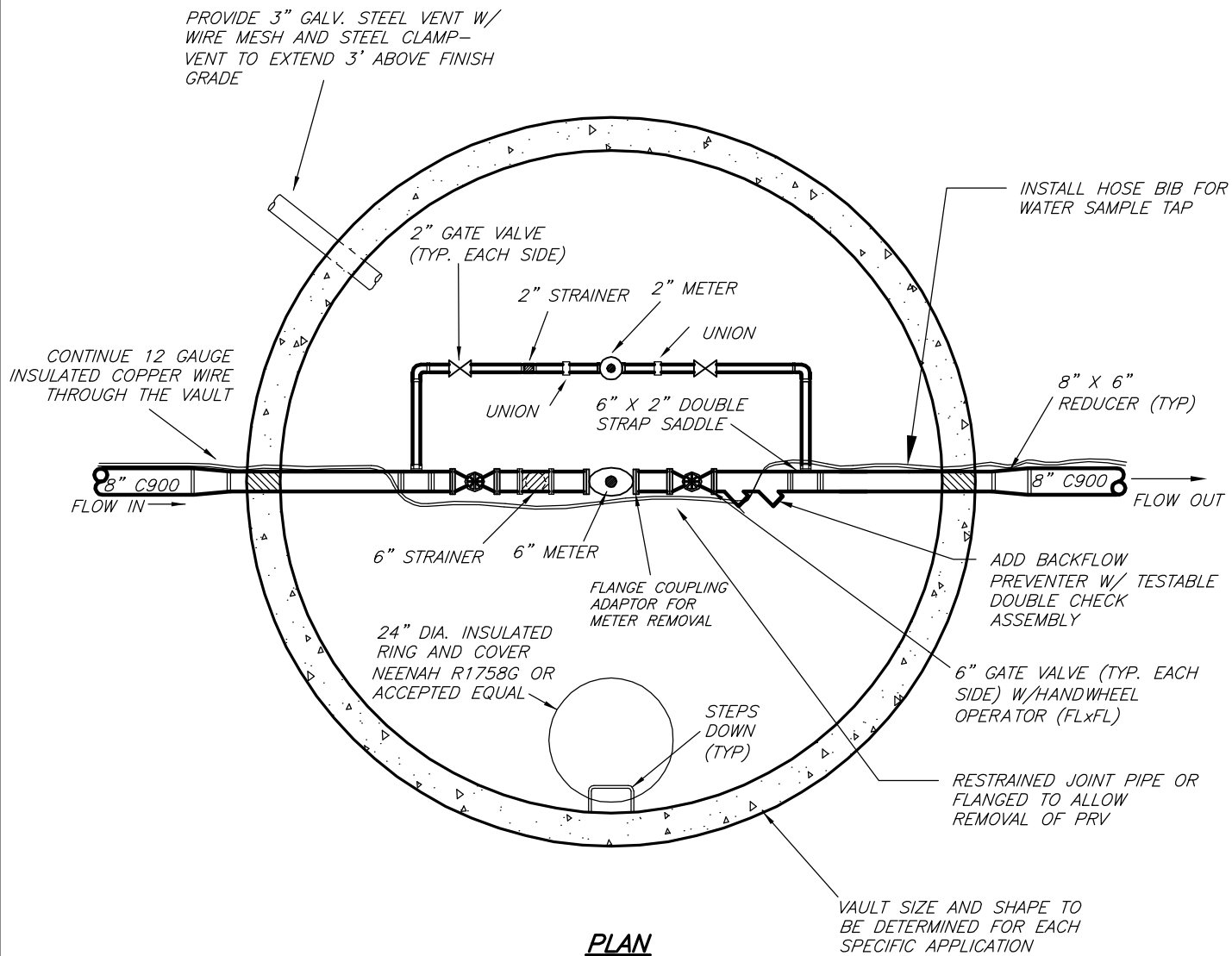


JACK AND BORE DETAILS FOR CROSSINGS N.T.S.

NOTES

1. WATER MAIN TO BE RESTRAINED THROUGH TUNNEL / CASING.
2. PIPELINE SHALL BE PROMINENTLY MARKED AT RAILROAD RIGHT-OF-WAY BY SIGNS WORDED, "HIGH PRESSURE MAIN BURIED BELOW".
3. VENT PIPES SHALL BE FITTED WITH SCREENED DOWN-TURNED ELBOWS.
4. VENT PIPES SHALL BE INSTALLED ONLY IF TUNNEL / CASING IS NOT FILLED.

DETAIL "W13"



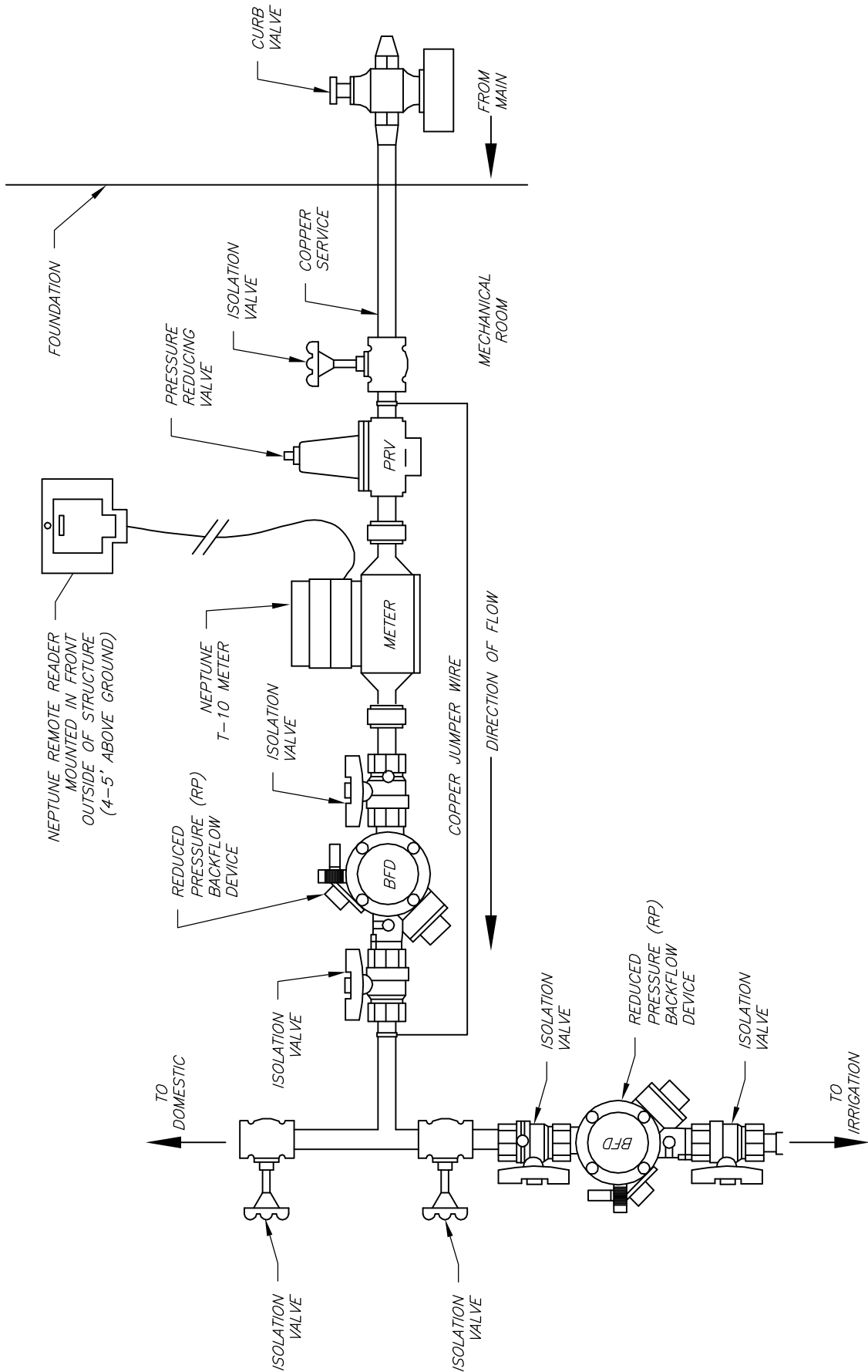
MAINLINE WATER METER

NOTES

1. VAULT SHALL BE PRECAST CONCRETE AND CAPABLE OF WITHSTANDING HS 20-44 TRAFFIC LOADING CONDITIONS
2. WHERE PIPES PENETRATE WALLS, USE LINK SEAL OR FILL ANNULAR SPACE W/ NON-SHRINK GROUT
3. COAT ALL EXTERIOR VAULT SURFACES WITH BITUMINOUS DAMPROOFING
4. ALL 2" PIPE SHALL BE BRASS W/ALL OTHER PIPE AND FITTINGS BEING FLANGED DUCTILE IRON
5. ALL TIE-RODS SHALL BE 3/4" ALL-THREAD OR MEGA-LUGS ON EXTERIOR CONNECTIONS
6. CONTRACTOR SHALL SUBMIT VAULT PIPING SCHEMATIC W/ VAULT DIMENSIONS TO DISTRICT PRIOR TO ORDERING MATERIALS OR EQUIPMENT
7. PIPE MATERIAL TO BE FLANGED OR RESTRAINED JOINT PIPE.

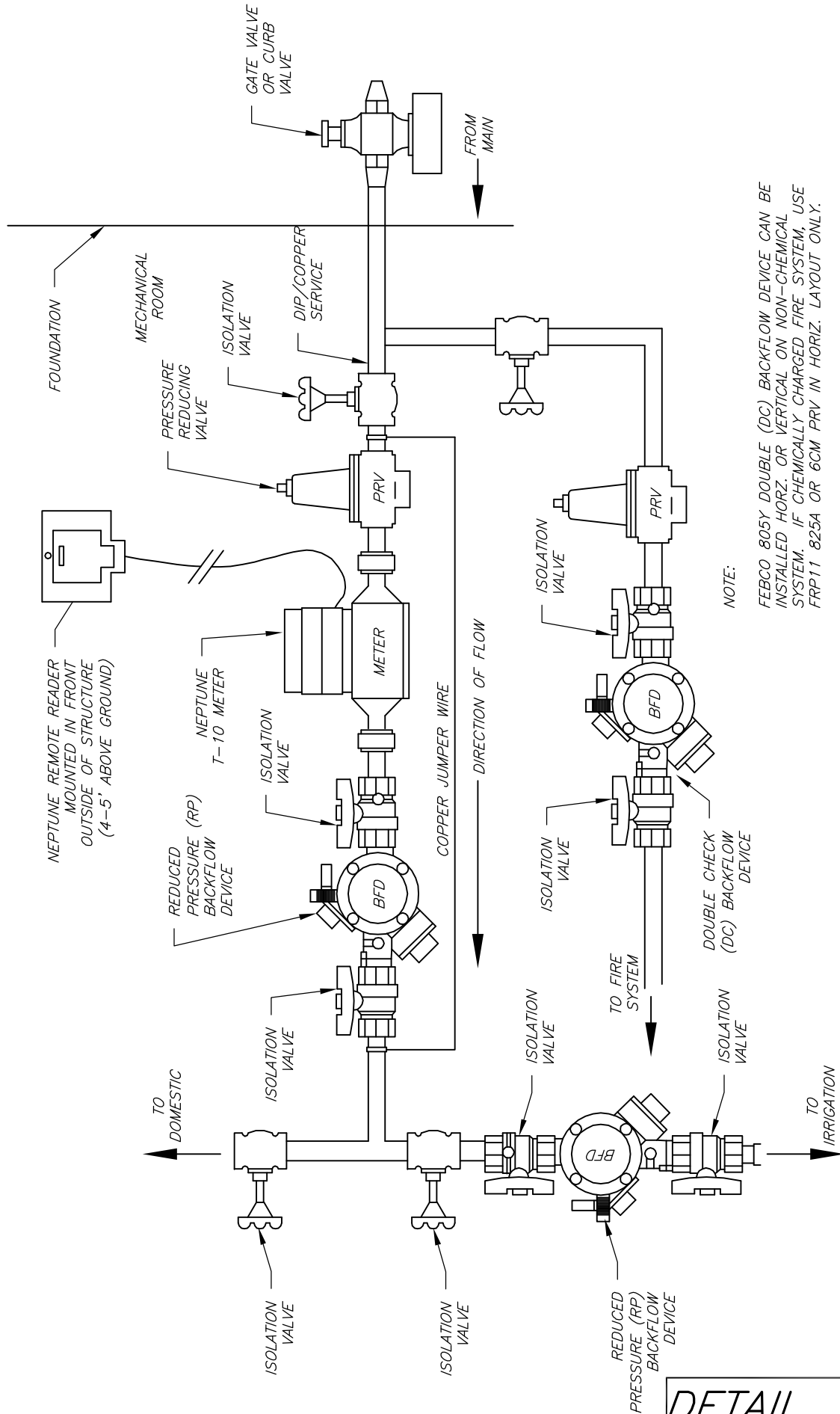
DETAIL "W14"

RESIDENTIAL WITHOUT FIRE SYSTEM



DETAIL "W15"

RESIDENTIAL/COMMERCIAL WITH FIRE SYSTEM

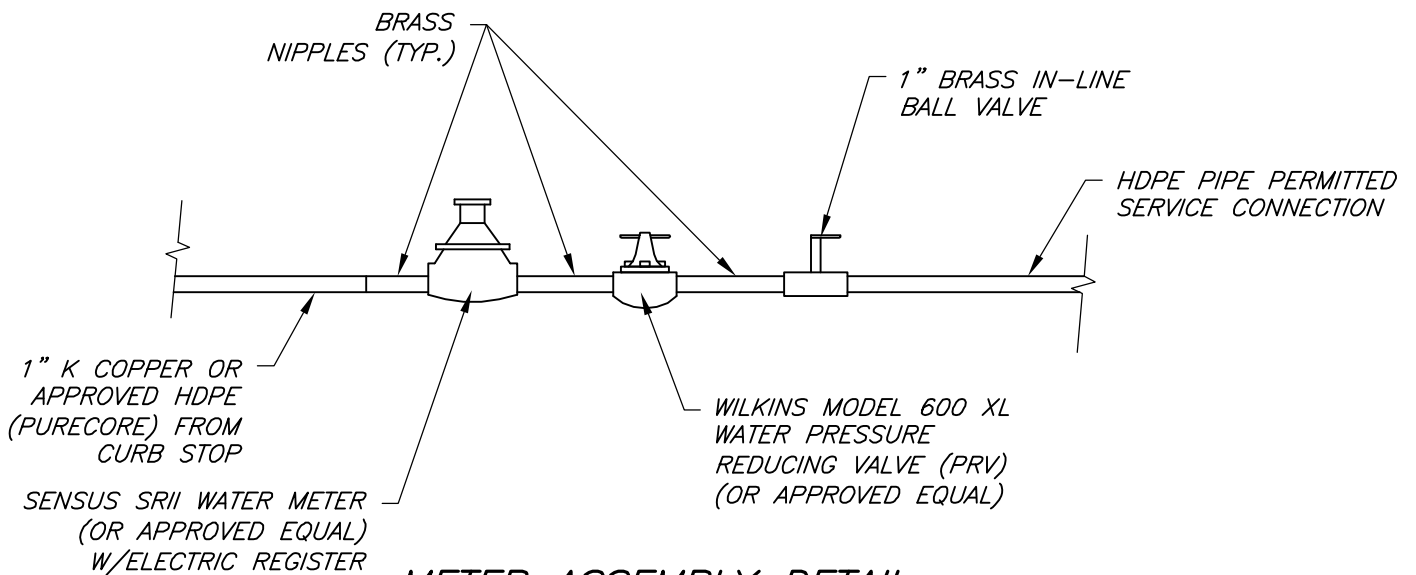


NOTE:
FEBCO 805Y DOUBLE (DC) BACKFLOW DEVICE CAN BE
INSTALLED HORZ. OR VERTICAL ON NON-CHEMICAL
SYSTEM. IF CHEMICALLY CHARGED FIRE SYSTEM, USE
FRP11 825A OR 6CM PRV IN HORIZ. LAYOUT ONLY.

DETAIL "W16"

NOTES:

1. PROVIDE AND INSTALL HEAT TAPE AND INSULATION ON EXPOSED WATER SERVICE LINES AND METER ASSEMBLIES. METER SHALL BE PROGRAMMED TO READOUT IN INCREMENTS OF 1000 GALLONS.
2. REMOVE EX. WATER METER AND METER TRANSCIVER UNIT FROM METER PIT, RECORD LOCATION/ADDRESS AND METER NUMBER, AND DELIVER TO CITY OF CRAIG. METER PIT SHALL BE ABANDONED BY REMOVING TOP 1 FOOT AND FILLING FULL OF SAND. MATCH EXISTING CONDITIONS, IE: GRASS, CONCRETE, GRAVEL, ETC. TO BE PAID FOR IN THE WATER SERVICE BID ITEM.
3. COMPACT SERVICE TRENCH TO 90% IN LANDSCAPED AREAS AND 95% IN HARDSCAPED AREAS.
4. IF EX. HOSE BIB OR YARD HYDRANT IS UNSERVICED BY NEW SERVICE LINE, A NEW WOODFORD FREEZLESS WALL FAUCET, MODEL 17PX-10-MH (OR APPROVED EQUAL) SHALL BE PROVIDED AND INSTALLED.



METER ASSEMBLY DETAIL

NOT TO SCALE

DETAIL "W17"

DIVISION 8



Division 8 Construction Process/Project Acceptance

INDEX

CONSTRUCTION PROCESS/PROJECT ACCEPTANCE

Title	Section
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Pre-construction Meeting.....	8.4
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Submittal Requirements	8.6
Permits	8.7
Construction Observation	8.8
Documentation Required.....	8.9
Utility Coordination	8.10
Periodic Recurring Meetings	8.11
Testing Requirements	8.12
Pre-paving/Pour Meeting.....	8.13
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Punch List Preparation	8.15
Warranty Period.....	8.16
Final Acceptance	8.17
Record Drawings.....	8.18

8.01 INTRODUCTION

- A. This Section defines the standard of care and documentation necessary to ensure the City inherits a quality project. It is applicable to all projects that have received approval through the City's land use process and will be dedicating infrastructure to the City.
- B. The following subsections consist of the major steps involved with a detailed description of each. The construction process and associated checklists include the minimum standards to be followed. Some items may be viewed as guidelines or recommendations and every item may not be applicable on a particular project. Mandatory requirements for acceptance should be apparent. Any uncertainties can be clarified by contacting the City Engineer.
- C. Before the City accepts the dedication of public infrastructure, project (Owners) representatives shall provide the required documentation discussed in this section necessary to ensure a satisfactory and complete project. This process is not meant to be burdensome. With the proper level of construction oversight, developers will find that these requirements can easily be met. Again, the intent here is QA/QC and to facilitate a timely project acceptance which benefits both the City and the developer.

8.02 SUBDIVISION IMPROVEMENTS AGREEMENT (SIA) COMPLIANCE

The SIA lists general and project specific requirements and timeframes. This section discusses how the SIA will be integrated into the construction process.

- 1. Copies should be distributed to all affected parties at pre-construction meeting.
- 2. Follow procedure in SIA for Letter of Credit/Security reductions.
- 3. Review SIA at time of Initial/Preliminary Acceptance and at Final acceptance to verify all work in compliance with SIA.

8.03 PRE-BID MEETING

This section provides a checklist of the items that are necessary to discuss during a pre-bid meeting. A pre-bid meeting shall be held when any infrastructure will be dedicated to the City of Craig. The Owner's or Owner's Engineer shall take and distribute notes of the key items discussed during the pre-bid meeting.

- A. Agenda Checklist (use all that apply)
 - 1. Introductions
 - 2. Scope of project.
 - 3. Potential revisions.
 - 4. Bonding/retainage information.
 - 5. Special construction issues – supplied equipment.
 - 6. Elements of the contract.
 - a. Specifications
 - b. Plans
 - c. Addenda dates and cutoff dates
 - d. Public Works Manual
 - 7. Schedule and sequencing issues.
 - 8. Coordination with City for meeting date/time, or notify 72 hours prior.
 - a. Soil and groundwater issues
 - b. Permits.

- c. Grading.
 - d. Dewatering.
 - e. Building.
 - f. Other?
 - i. Funding issues.
 - ii. State funds.
 - iii. Bonding.
 - iv. Staging & disposal.
 - v. Testing – who pays?
 - vi. Personnel & roles for review, payment, approval & construction.
 - vii. Documentation – Who, what?
 - viii. Video
 - ix. As-builts
 - x. Operation & maintenance construction management issues.
 - a. On-site office for City representative?
 - b. Weekly meetings?
 - c. Construction survey
 - i. What by whom?
- Utilities to site – Contractor or City/Owner?
- Temporary utilities.
- Power
- Water
- Toilets Important to have Contractor/Owner warranty track with City/Owner warranty.

8.04 PRE-CONSTRUCTION MEETING

- A. This section provides a checklist of issues that should be discussed in a pre-construction meeting. A pre-construction meeting shall be held for any project that will involve the dedication of public infrastructure to the City of Craig. The pre-construction meeting shall be held before any construction on public infrastructure starts and after a general contractor has been selected by the Owner. Representatives from the City of Craig, City's Engineer, Owner's Engineer, Owner, Contractor, major subcontractors, etc., as appropriate, shall be invited to the meeting. Either the Owner's Engineer or another person appointed by the Owner shall coordinate, take notes and distribute notes from the meeting. The pre-construction meeting minutes shall be one of the documentation requirements required from the City before preliminary acceptance is granted.

Agenda Checklist (use all that apply)

1. Introduction and sign-in.
2. Project personnel.
3. Lines of communication – resolution ladder.
4. Final construction drawings.
5. Who will be keeper of updated drawings?
6. Who will track changes?
7. Construction surveying – request timelines.
8. Permits.
9. Testing requirements.
 - a. Observation requirements
 - b. Documentation requirements.
 - c. Shallow utility issues.

- d. Utility locates & coordination.
- e. Discussion of work hours.
- f. Progress payments.
- g. Submittal requirements.
- h. Periodic construction meetings.
- i. Quality control requirements – Contractor/Owner.
- j. Project closeout procedures.
- k. Contractual insurance certificates.
- l. Contractor license.
- m. Construction schedule, sequence & phasing.
- n. Approval of baseline schedule.
- o. Attendees (as appropriate) Owner's representatives
 - a. City representatives.
 - b. Utility personnel.
 - c. Street personnel.
 - d. Owner's Engineer.
 - e. Utility company representatives.
- Meeting minutes
 - i. Who take notes?
 - ii. Note distribution.

8.05 CONSTRUCTION DRAWINGS

- A. This section provides requirements for construction level drawings. The requirements start when the final construction sets are issued at the startup of a project.
 - 1. Have drawings received final approvals?
 - 2. Have drawings been updated from Bid process?
 - 3. Construction drawing sets shall be submitted to the City and City Engineer, as appropriate.
 - 4. Construction drawings shall be stamped "FOR CONSTRUCTION" and each page shall have the stamp and signature of a professional engineer.
 - 5. Cover sheet shall be signed by the City Manager.
 - 6. City Engineer shall be notified in advance of construction if substantial design changes are required. This can be a Request-for-Information (RFI) for record keeping purposes.
 - 7. Any design changes to the initial set of drawings shall be clearly delineated by showing the change and date in the revision block and by reflecting the change with a cloud mark.
 - 8. Either the Owner's Engineer or Contractor shall keep track of changes for record drawings.
 - 9. Keep record set of drawings on site.

8.06 SUBMITTAL REQUIREMENTS

- A. Submittals are required for all major materials for public infrastructure dedicated to the City. The checklists in this section shall be followed. The procedures for submittals and the submittal logs should be set up and discussed during the pre-construction meeting.
 - 1. See Section 01300 of Technical Specifications in Public Works Manual.
 - 2. Owner's Engineer shall keep submittal logs.
 - 3. Copies of approved submittals and logs shall be sent to City and City's Engineer.

4. Owner's Engineer and Contractor shall both review and stamp acceptance on submittals.
5. Any submittal that includes design/build items, such as retaining walls, water tank structural drawings will require a P.E. stamp.

8.07 PERMITS

- A. During the pre-construction meeting the required permits shall be discussed. One of the leading causes of construction and project delays is due to lack of adequate permits necessary for the project.
Verify the following are in place, if needed:
 1. CDPS Stormwater Construction Permit.
 2. Army Corps of Engineers 404 Permit.
 3. Construction Dewatering Permit.
 4. CDOT Access, Utility, Surveying Permits, etc.
 5. City Grading Permit
 6. Building Permit
 7. Street Cut Permit
 8. Floodplain Development Permit
 - a. Approval letters from:
 - b. City of Craig
 - c. Verify that all rights-of-way and easements have been obtained to start and complete construction.
 - d. Excavation Permit for over ½ Acre
 - e. Re-vegetation Bond security
 - f. Water/Sewer Tap Permit
 - g. ROW permit

8.08 CONSTRUCTION OBSERVATION

- A. This section discusses process that should be followed for Construction Observation, from who should be responsible for observation to the required documentation throughout construction. In order for projects to be accepted by the City upon final completion, documentation of these procedures shall be required to demonstrate that project is complete and meets the quality standards of the City.
- B. Owner's Engineer must regularly observe project and be able to write letter for security releases and at project completion certifying that construction was accomplished in "substantial compliance" with the approved drawings, and appurtenant specifications, rules, regulations, City Code and Public Works Manual requirements.
 1. City's Engineer to make periodic visits to observe construction, evaluate Contractor's efforts, and ensure Owner's Engineer is properly monitoring construction.
 2. Utility department personnel to make periodic visits to observe utility installations.
 3. Owner's representatives, Engineer, City Engineer and utility personnel to be present during pressure testing, etc. (as agreed upon in project meetings)
 4. Owner's representatives, Engineer, City Engineer and utility personnel to be present during punch list walkthroughs.
 5. Owner's representatives to take job photos.
 6. Owner's Engineer to coordinate additional testing requirements.
 7. Take minutes of meetings at the periodic construction meetings.
 8. Minutes should include unresolved issues.

9. Owner's Engineer to write substantial completion letter to City and request Initial/Preliminary Acceptance.
10. City Engineer will then perform comprehensive on-site observation to confirm Owner's Engineer's letter is necessary for preliminary and final acceptance.
11. Need to fill out City of Craig Project Acceptance checklist as outlined in Section 7.18.

8.09 DOCUMENTATION REQUIRED

- A. At the beginning of the project, it is important that all parties involved in the construction process understand the documentation required for City acceptance at the end of the project.
- B. The Owner and Owner's Engineer shall be responsible for furnishing the City with a complete set of project records. Approved material submittals; should be transmitted prior to construction, meeting notes, inspection reports and test results should be furnished at regular intervals (bi-weekly or monthly as agreed upon). By the end of a project and before the City accepts dedication of the infrastructure, all of the documentation discussed in this section should be provided to the City.
 1. Bonding and insurance information.
 2. Pre-bid meeting notes.
 3. Pre-construction meeting notes.
 4. Periodic meeting notes.
 5. Site observation logs. (inspection reports).
 6. Testing records.
 7. Record drawings.
 8. TV tapes for sewerlines.
 9. Approved material info.
 10. Submittals and submittal logs.
 11. Job photos.
 12. Punch lists
 13. Owner's Engineer's Initial/ Preliminary Acceptance letter.
 14. City Engineer's Initial/ Preliminary Acceptance letter.
 15. City Council Preliminary Acceptance setting the two-year warranty period.
 16. Owner's request for Final Acceptance at 23 months.
 17. Warranty item punch list.
 18. City Engineer's Final acceptance letter
 19. City Council Final Acceptance.

8.10 UTILITY COORDINATION

- A. Shallow and deep utility coordination is extremely important to the outcome of the construction process. The City strongly recommends that the final utility design be incorporated into the approved construction drawings (rather than relying on separate drawings produced by the respective utility). Lack of utility coordination is a leading cause of construction budget and schedule overruns. The checklists below should be discussed during the pre-construction meeting.
 1. Who shall be responsible for line locations?
 2. Verification of existing facilities.
 3. Point of contact for fieldwork.
 4. Coordination of utility supplied materials and work.
 5. Notification process.

6. Disruption schedules (i.e., irrigation, water, water taps).

- B. Shallow utility construction is often the source of numerous punchlist items and City acceptance issues. The Owner is ultimately responsible for all work on the project, and appropriate coordination and inspection of shallow utility work is a must on every project.

8.11 PERIODIC RECURRING MEETINGS

- A. Continual, recurring and open communication between all parties is essential to a successful construction process. Recurring meetings between the parties throughout the construction phase is necessary to discuss and resolve issues before they become problems. The resolution of these issues should occur as soon as possible when they first arise - not at the end of a project. This section provides a checklist of issues related to periodic recurring meetings. Weekly meetings on site at the same time during the length of construction are preferable. Notes should be taken by the Owner's Engineer/representative and distributed to all parties.
1. Need to decide at pre-construction meeting where, who and how often construction meetings should occur.
 2. Distribution of notes shall be decided at pre-construction meeting.
 3. Discuss all design changes to construction documents.
 4. Discuss all changed conditions to the construction contract.
 5. Discuss project progress and schedule.
 6. Discuss unresolved items.
 7. Discuss all non-conforming work and the resolution to bring work into compliance.

8.12 TESTING REQUIREMENTS

- A. The process of testing throughout the project for soils density testing, asphalt and concrete tests, etc., shall be set up before the project starts. Minimum requirements are listed in the Technical Specification and checklists contained in this manual. The pre-construction meeting and periodic recurring project meetings shall discuss the procedures, ongoing results and any corrective measures required as a result of the testing processes.
1. Who will
 2. be responsible for the soils/concrete/asphalt testing?
 3. Discuss and agree upon the frequency of tests. (To be in accordance with approved plans, specifications and this Public Works Manual.)
 4. Documentation and test results to be submitted to City.
 5. Contract for testing shall be between Contractor/Owner.
 6. Stringline inspection for curb and gutter sections important.
 7. Proof roll subgrade.

8.13 PRE-PAVING/POUR MEETING

- A. Both the paving and curb and gutter construction processes are extremely important to the longevity and functionality of public streets. Pre-paving/pour meetings shall be held with the paving or curb and gutter subcontractors to discuss procedures. This is particularly true of asphalt paving operations as it oftentimes occurs in the fall as cold weather sets in during conditions that may not be acceptable for Hot Bituminous Pavement quality control. The checklists in this section should be discussed during these meetings.
1. Schedule a pre-paving/pour meeting no later than one week before paving begins.
 2. Paving/concrete subcontractor must attend.

3. Set up procedures for testing and quality control.
4. Must discuss weather issues, i.e., minimum/maximum temperatures, etc.
5. Discuss formwork/falsework inspection and rebar checks.
6. Must discuss subgrade and subbase testing procedures, i.e., geotechnical and proof rolling.
7. Must discuss road sections and maximum lift per course.
8. Stringline inspection for curb and gutter sections.

8.14 PROJECT INITIAL/PRELIMINARY ACCEPTANCE

- A. Initial/Preliminary Acceptance can occur after Substantial Completion of the project. Substantial Completion is defined as the point when "The Work (or a specified part thereof) has progressed to the point where, in the opinion of the Engineer, as evidenced by the Engineer's definitive Certificate of Substantial Completion, it is sufficiently complete, in accordance with the Contract Documents, so that the Work (or specified part) can be utilized for the purposes for which it is intended." Because Substantial Completion is a key concept in the acceptance of the Work, this section discusses the procedure that should be followed to establish Substantial Completion.
- B. Must be initiated by contractor who notifies Owner's Engineer that he is substantially complete.
- C. Owner's Engineer must confirm substantial completion; send letter and documentation listed below to City recommending acceptance and requesting walkthrough with City and other affected entities.
 1. Acceptance Request Letter
 2. Pre-final "As-built" Drawings
 3. Stamped certification letter from design engineer verifying all improvements were built to meet the requirements of the City of Craig.
 4. Copies of all inspection reports, test results, construction docs. etc shall be included if not previously transmitted.
 5. Support documentation (installation and operation manuals) of those facilities and equipment constructed/installed as part of project.
 6. Submittal detailing any and all specific requirements as listed below) and actions taken to meet these requirements.
 - a. Subdivision Improvement Regulations
 - b. Zone District Regulations
 - c. Commitments or Requirements made during Public Hearing
 - d. Contractual Agreements
 - e. Annexation Agreements
 - f. Any/All Other
 7. City and other representatives to perform site walkthrough and develop punch list items to be rectified prior to Initial/Preliminary Acceptance.
 8. City Engineer to send letter to City to recommend Initial/ Preliminary acceptance after satisfactory completion of all punch list items and receipt of all documentation.
 9. City Council's Initial/Preliminary acceptance triggers two-year warranty period.

8.15 PUNCH LIST PREPARATION

- A. This section provides the procedure to follow for the initial preparation and follow-through to completion of punch lists.

1. Owner's Engineer to prepare punch list.
2. Must have items from utility companies, etc.
3. Must have date initially added to list, date of completion for repairs, and date of signoff of originator of item.

8.16 WARRANTY PERIOD

- A. This section discusses the warranty period between the City and the Owner (Owner) of the project and infrastructure being dedicated to the City.
1. Warranty period shall be two years.
 2. Triggered by date of City Council's Initial/Preliminary acceptance. (Note: satisfactory tests results and partial security releases do not initiate the warranty period.)
 3. SIA typically reserves 10% of project cost for security during warranty.
 4. Owner's Engineer and reps shall keep track of scheduling a warranty period walkthrough at about 22 months. (Note: Security and warranty shall remain in effect if Owner fails to initiate walk-through and Final Acceptance procedures.)
 5. Important to have Contractor/Owner warranty track with City/Owner warranty.

8.17 FINAL ACCEPTANCE

- A. This section includes a checklist of items that are required prior to final acceptance by the City. These items should be understood at the start of the project and kept current throughout the construction.

Project Final Acceptance must include the following:

1. Letter from Owner's Engineer.
2. Letter from districts and City Engineer recommending acceptance.
3. Record drawings.
4. Updated plat.
5. CADD files.
6. Hard copy drawings.
7. SIA Letter of Credit Reduction letters.
8. Project documentation.
9. Completion of punch list
10. Initial/ Preliminary Acceptance and establishment of warranty period.
11. Warranty work documentation and Owner's request for Final Acceptance
12. Final walk-through and completion of punch list
13. City Engineer's recommendation of Final Acceptance
14. City Council ruling of Final Acceptance

8.18 RECORD DRAWINGS

- A. Record Drawings (commonly known as as-built drawings) are a requirement of Initial/Final Acceptance. Use design drawings as base drawings. It is important to keep these drawings current throughout the project and not to wait until project completion to start them. This section provides a checklist of items to be included in the Record Drawings.

Drawings to show the following:

1. Swing ties to end of water and sewer service lines.
2. Rim and invert elevations of sanitary and storm sewer manholes and inlets.
3. Location of all major utilities.
4. Elevation at end of sewer service lines.

5. Show all plat information, i.e., rights-of-way and easements.
6. Show all phone and cable pedestals, electric transformers, etc.
7. Show all shallow utilities.
8. Show CMP's and all drainage features.
 - a. Water infrastructure, including fire hydrants, curb valves, main line valves, bends, fittings, etc.
 - 1) Swing ties to water valves and curb stops.
 - 2) Field/redline changes incorporated/annotated in electronic files.
 - b. Secondary irrigation infrastructure.
 - c. Stamp drawings as record drawings.
9. Provide CADD drawings and scanned copies of drawings to City.

END OF SECTION