

# DESIGN STANDARDS AND CONSTRUCTION SPECIFICATIONS



Built On What Matters

**TOWN OF FREDERICK, COLORADO**

401 LOCUST STREET  
P.O. Box 435  
FREDERICK, CO 80530  
(720) 382-5500

2019 EDITION

PREPARED BY CIVIL RESOURCES, LLC  
AMENDED BY TOWN STAFF

<b>100</b>	<b>General Requirements</b>
<b>200</b>	<b>Earthwork</b>
<b>300</b>	<b>Concrete</b>
<b>400</b>	<b>Soils Investigation</b>
<b>500</b>	<b>Street Improvements</b>
<b>600</b>	<b>Non-Potable Water Distribution</b>
<b>700</b>	<b>Potable Water Distribution</b>
<b>800</b>	<b>Storm Sewer Improvements</b>
<b>900</b>	<b>Storm Drainage</b>
<b>1000</b>	<b>Non-Town Utilities</b>
<b>1100</b>	<b>Fences</b>
<b>1200</b>	<b>Construction Erosion Control</b>
<b>1300</b>	<b>Traffic Control</b>
<b>1400</b>	<b>Landscape Irrigation Systems</b>
<b>1500</b>	<b>Landscaping</b>



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**100 PURPOSE**

1. The purpose of these Standards and Specifications is to provide acceptable standards of design, construction, quality of materials, use, and maintenance of public improvements including, but not limited to; streets, parks, open space, parking lots, utility installation, and related appurtenances. All improvements must meet the requirements of these Standards and Specifications and all work must be acceptable to the Town of Frederick (the Town).
2. Any alterations to existing improvements shall comply with these Standards and Specifications unless specifically exempted by the Town Engineer in writing.
3. All items and work not covered by these Standards and Specifications shall be discussed with the Town and the Contractor shall receive written approval on such items prior to commencing.

**101 ACRONYMS AND ADOPTED CODES**

1. The following acronyms are used in these Standards and Specifications:

<b>Table 100-01 Acronyms</b>	
AASHTO	American Association of State Highway and Transportation Officials
ACI	American Concrete Institute
ADA	Americans with Disabilities Act
AISC	American Institute of Steel Construction
ANSI	American National Standards Institute
APWA	American Public Works Association
ASA	American Standards Association
ASTM	American Society for Testing and Materials
ATSSA	American Traffic Safety Services Association
AWWA	American Water Works Association
CDOT	Colorado Department of Transportation
CDPHE	Colorado Department of Public Health & Environment
CFR	Code of Federal Regulations
CMP	Corrugated Metal Pipe
CMPA	Corrugated Metal Pipe Arch
CRSI	Concrete Reinforcing Steel Institute
CUHP	Colorado Urban Hydrograph Procedure
CWCB	Colorado Water Conservation Board
DIP	Ductile Iron Pipe
DRCOG	Denver Regional Council of Governments
EPA	Environmental Protection Agency
FEMA	Federal Emergency Management Agency



FHWA	Federal Highway Administration
FIRM	Flood Insurance Rate Map
HDPE	High Density Polyethylene
HERCP	Horizontal Elliptical Reinforced Concrete Pipe
IBC	International Building Code
IFC	International Fire Code
IPC	International Plumbing
IMSA	International Municipal Signal Association
ITE	Institute of Transportation Engineers
MGPEC	Metropolitan Governments Pavement Engineers Council
MUTCD	Manual on Uniform Traffic Control Devices
NEC	National Electric Code
NEMA	National Electric Manufacturers Association
NFIP	National Flood Insurance Program
NPDES	National Pollution Discharge Elimination System
ODP	Official Development Plan
OSHA	Occupational Safety and Health Association
PDP	Preliminary Development Plan
PSCO	Public Service Company of Colorado
PUD	Planned Unit Development
PVC	Polyvinyl Chloride
RCBC	Reinforced Concrete Box Culvert
RCP	Reinforced Concrete Pipe
ROW	Right-of-Way
SCS	Soil Conservation Service
SPP	Structural Plate Pipe
SPPA	Structural Plate Pipe Arch
UBC	Uniform Building Code
UDFCD	Urban Drainage and Flood Control District
UNCC	Utility Notification Center of Colorado
USDCM	Urban Storm Drainage Criteria Manual
USGS	United States Geological Survey

- The following Standards/Codes, latest edition, have been adopted by the Town of Frederick and shall be used unless waived in writing by the Town Engineer:

**102 PROVISIONS**

**102.01 General**



1. Projects shall comply with all laws, regulations, codes, specifications, and ordinances applicable to the design and the furnishing and performance of the work.
2. In interpretation and application, the provisions of these Standards and Specifications shall be held to be minimum requirements for the promotion of the public health, safety, and welfare. Whenever the requirements of these Standards and Specifications are at a variance with the requirements of any other lawfully adopted laws, regulations, codes, specifications, or ordinances, the more restrictive or that imposing the higher standards shall govern.
3. Nothing in these Standards and Specifications shall constitute or be interpreted as a repeal of the Town's ordinances or resolutions, or as a waiver of the Town's legislative, governmental, or police powers to promote and protect the health, safety, and welfare of the Town and its inhabitants.
4. A portion of the Town's potable water system is under the authority of the Left Hand Water District or Central Weld Water District. All sanitary sewer constructed in the Town of Frederick is under the authority of St. Vrain Sanitation District. Please contact the Town of Frederick to verify the updated water and sanitary district boundaries.
5. As the approved materials list and the construction notes contained in the appendices of the Design Standards and Construction Specifications are subject to frequent updates, the Town Engineer has been authorized by the Board of Trustees to update, change, modify and revise these appendices as may be required from time to time. The Town Engineer shall use current engineering principles and current industry practices in determining what materials are approved and included in these appendices and what general notes are required on construction plans. Changes shall be posted on the Town's website and an official copy of the Design Standards and Construction Specifications shall be maintained in the Town Clerk's office.

#### **102.02 Permits**

The Contractor is responsible for obtaining all necessary permits for construction. No construction work will be started until the Contractor has received all appropriate permits. The Contractor shall submit a copy of each permit to the Town for informational purposes. All permits must be in accordance with Town, County, State, Federal, or other applicable requirements.

#### **102.03 Enforcement**

The Town is authorized to enforce all provisions of these Standards and Specifications and may appoint an inspector or other authorized representative to act on the Town's behalf.

1. Nonconformance Reports:



- a. A Nonconformance Report (NCR) will be issued to the Contractor for any defective materials, poor workmanship, or work not in conformance with the approved plans and other applicable criteria that is not immediately remedied by the Contractor.
  - b. NCRs require a written response from the Contractor outlining the proposed corrective action(s) for the nonconforming item(s). Where rework or repair is necessary to bring the nonconforming item(s) into compliance, such rework or repair shall not commence until the NCR is approved by the Town Engineer.
  - c. Repeated or unresolved NCRs shall be grounds for the Town to serve a stop work notice on the project. Construction acceptance on a project shall not be issued until all NCRs are resolved to the satisfaction of the Town Engineer.
2. Stop Work:
- a. In the event that any of the provisions of the approved plans or other applicable criteria of the Town are violated by the Developer or any of the Developer's Contractors or subcontractors, the Town may serve written notice of the Town's intention to stop work on the project. Unless the violations cease and satisfactory arrangements for correction(s) are made, the work shall be stopped immediately after serving written notice. In the event of any such termination, the Town shall immediately serve notice to the Developer and the Contractor. If not resolved within 30 days of the written notice, the Town may, at its sole discretion, take over the work and finish it at the expense of the Developer and/or Contractor.
  - b. In addition, it may become necessary for the Town to require an immediately stop of work on a project to protect the health, safety, and welfare of the citizens of the Town. Such instances may include, but are not limited to the creation of a public safety hazard, lack of required permits, inadequate traffic control, or obstruction of an emergency access. The Town, or any Town Representative, has the authority to stop work immediately after the Contractor has been served with written notice. The Contractor shall not resume work without written approval from the Town.
3. Liability:
- The Town, or the Town's authorized representatives charged with the enforcement of these Standards and Specifications, acting in good faith, will not thereby be rendered personally liable for any damage that may accrue to persons or property as a result of any act or by any reason of any act or omission in the discharge of their duties.
4. Noncriminal Violation:
- It shall be a noncriminal violation of these Design Standards for any person to do any act which is forbidden or declared to be unlawful, or to fail to do or perform any act required in these Design Standards.



- a. Penalty: Any person, firm or corporation convicted of violating the terms or conditions of the Design Standards adopted hereby may be fined by an amount not to exceed five hundred dollars (\$500.00). Each day during which such violation continues shall be deemed a separate charge.
- b. Additional Remedies: In addition to any of the foregoing remedies, the Town Attorney, acting in behalf of the Town Board, may institute injunction, abatement, or any other appropriate action to prevent, enjoin, abate or remove such violations. The Remedy provided for herein shall be cumulative and not exclusive and shall be in addition to any other remedies.

#### **102.04 Interpretation**

1. It is the intent and purpose of these Standards and Specifications to obtain high quality construction throughout, with the completed work in compliance to the requirements. Any work, materials, or equipment that may be reasonably inferred as being required to produce the intended result will be provided whether specifically called for.
2. Reference to standards, specifications, manuals, codes, laws, or regulations of any technical society, organization, association, or governmental authority, whether such reference be specific or by implication, shall mean the latest standards, specifications, manual, code, law, or regulation in effect at the time of Town project approval.
3. Wherever the words “as directed”, “as required”, “as permitted”, or words of like meaning are used, it shall be understood that the direction, requirements, or permission of the Town is intended. Similarly, the words “approved”, “acceptable”, and “satisfactory” shall refer to the approval of the Town. Wherever the terms, “shall”, or “must” are used, it is a mandatory requirement.
4. These STANDARDS AND SPECIFICATIONS shall not abrogate or annul any permits or approved drainage reports and construction plans issued or any easement or covenant granted before the effective date of these STANDARDS AND SPECIFICATIONS. However, if the review and approval of construction plans, specifications, and associated engineering reports by the Town has occurred more than twelve (12) months prior to execution of the Memorandum of Agreement for Public Improvements Agreement/or commencement of construction activities, the Town shall have the right to require another review process for the plans, specifications, and reports to insure compliance with these STANDARDS AND SPECIFICATIONS.

#### **102.05 Requests: for Information and Design Change Notices**

1. Any significant questions concerning implementation of approved plans or the other approved criteria shall be directed to the Town Engineer via a Request for Information (RFI). Work shall not continue on the area in question until a response to the RFI has been received.



2. Should circumstances warrant changes from approved plans the Contractor should propose the revision and submit it to the Town Engineer via an RFI. If approved, the modification will be distributed to the Contractor, Developer, and Design Engineer through a Design Change Notice (DCN). Work shall not continue on the proposed modification until an approved DCN has been issued by the Town Engineer and received by the Contractor.
3. Should any omissions or design errors be discovered after final approval of construction plans, the Town shall notify the Contractor, Developer, and the Design Engineer. Following such notification, no work shall be allowed in the affected area until the revisions are made by the Design Engineer, and an approved DCN has been issued by the Town Engineer.

#### **102.06 Violations**

No person, firm, or corporation shall construct, enlarge, alter, repair, relocate, improve, remove, excavate, convert, or demolish any public improvements or private improvements in common ownership or permit the same to be done in violation of these STANDARDS AND SPECIFICATIONS. Whenever any work is being done contrary to the provisions of these STANDARDS AND SPECIFICATIONS, the Town may order the work stopped by a written notice in accordance with these STANDARDS AND SPECIFICATIONS.

#### **102.07 Variances**

The provisions of these STANDARDS AND SPECIFICATIONS are not intended to prevent the use of any material or method of construction not specifically prescribed by these standards, provided any alternate has been previously approved and its use authorized in writing by the Town. Whenever there are practical difficulties involved in carrying out the provisions of these procedures, the Town may grant a variance for individual cases, provided that the Town shall first find that a unique reason makes these standards impractical and that the modification is in conformity with the intent and purpose of these standards, and providing that such variance does not lessen any design requirements or any degree of structural or operational integrity. The Town shall require that sufficient specifications, evidence, justification, and/or proof be submitted to substantiate any claims that may be made regarding the alternate material, detail, or technique. The Town, in its sole discretion, will decide upon the acceptability of any proposed variance.

#### **102.08 Amendments and Revisions**

These STANDARDS AND SPECIFICATIONS may be amended as new technology is developed and/or if experience gained in the use of these STANDARDS AND SPECIFICATIONS indicate a need for revision. The Town shall have full power and authority to promulgate rules, regulations, or new standards of a technical nature, which rules, regulations, or standards shall be effective immediately upon their approval by the Town Board. It is the responsibility of the Consultant/Contractor/Developer to obtain all revisions to these STANDARDS AND SPECIFICATIONS.



### **102.09 Severability**

If any section or article of these STANDARDS OR SPECIFICATIONS is found to be unconstitutional or illegal by any court, the said section or article shall have no bearing on the effectiveness of the rest of these STANDARDS OR SPECIFICATIONS.

## **103 SAFETY AND PROTECTION OF PUBLIC INTERESTS**

### **103.01 General**

The Contractor shall be responsible for initiating, maintaining, and supervising all safety precautions and programs in connection with the work and is solely responsible for the safety of the project site. The Town expects error-free project execution: no injuries, property damage, community or environmental impacts, or incidents that could have resulted in these occurrences under different conditions. Safety should be integrated into all management systems, project processes, and individual efforts. It is the Town's belief that all incidents are preventable.

### **103.02 Safety Requirements**

1. The Contractor shall comply with all applicable laws and regulations of any public body having jurisdiction for the safety of persons or property, or to protect them from damage, injury or loss; and shall erect and maintain all necessary safeguards for safety and protection. The Contractor shall pay particular attention to the following federal laws concerning construction safety:
  - a. Public Law 91-596, Occupational Safety and Health Act of 1970, Section 5(a)(1), "General Duty Clause"
  - b. 29 CFR 1910, General Industry Safety and Health Standards
  - c. 29 CFR 1926, Construction Industry Safety and Health Standards
  - d. 29 CFR 1904, Recording and Reporting Occupational Injuries and Illnesses
  - e. 49 CFR, Transportation
2. The Contractor shall include all necessary precautions for the safety of, and shall provide the necessary protection to prevent damage, injury, or loss to:
  - a. All employees on the work site, and other persons and organizations who may be affected thereby,
  - b. All the work, materials, and equipment to be incorporated therein,
  - c. Other property at the site or adjacent thereto, including, but not limited to, trees, shrubs, lawns, walks, pavements, roadways, structures, utilities and underground



facilities, not designated for removal, relocation or replacement in the course of construction,

- d. The public at large.

### **103.03 Public Convenience and Safety**

1. Unless otherwise specified, the contractor will give written notice, to the proper authorities in charge of streets; gas and water pipes; electric service, cable television, and other conduits; railroads; poles; manholes; catch basins; and all other property that may be affected by the contractor's operations at least 72-hours prior to any construction. The contractor will not hinder or interfere with any person in the protection of such property or with the operation of utilities at any time. The contractor must obtain all necessary information in regard to existing utilities, protect such utilities from injury, and avoid unnecessary exposure so that they will not cause injury to the public.
2. The contractor will obtain all necessary information in regard to the planned installation of new utilities and cables, conduits and transformers, make proper provision and give proper notification so that new utilities and appurtenances can be installed at the proper time and location without delay to the developer or contractor, nor cause unnecessary inconvenience to the owner or the public. New underground utilities and appurtenances will not be covered with pavement prior to the Town's inspection of such facilities. When the work involves excavation adjacent to any building or wall along the work, the contractor will give property owners due and sufficient written notice thereof, with a copy to the Town.

### **103.04 Protection of Property and Monuments**

1. The developer and contractor will use every reasonable precaution to prevent the damage or destruction of public or private property such as, but not limited to, poles, trees, shrubbery, crops, fences, monuments and all overhead structures such as, but not limited to, wires or cables which are either within or outside of the right-of-way. The contractor will protect and support all water, gas, sanitary sewer, storm sewer, electrical pipes, conduits, and all railway tracks, buildings, walls, fences, or other properties which are liable to be damaged during the execution of his work. The contractor will take all reasonable and proper precautions to protect persons, animals and vehicles from injury or damage and, wherever necessary or as directed by the Town, will erect and maintain a fence or railing around any excavation and place a sufficient number of amber lights about the work and keep them operational from twilight until sunrise. The contractor will employ one or more watchmen as additional security whenever they are needed or required by the Town. The contractor will not prevent the flow of water in the gutters of the street and will use proper means to permit the flow of surface water along the gutters while the work is in progress.
2. The contractor will protect and carefully preserve all land boundary and Town survey control monuments until the owner's authorized registered land surveyor has referenced their location for replacement. All monuments disturbed or removed by



the contractor through negligence or carelessness on his part or on the part of his employees or subcontractors will be replaced by a land surveyor registered in the State of Colorado, at the contractor's expense. The developer and contractor will be responsible for the repair of any damage or destruction of property resulting from neglect, misconduct, or omission in his manner or method of execution or non-execution of the work, defective work or the use of unsatisfactory materials. The contractor will restore such property to a condition equal to or better than that existing before such damage or injury was done by repairing, rebuilding, or replacing it as may be directed by the Town, or they will otherwise make amends for damage or destruction in a manner acceptable to the Town. The developer and contractor will be responsible for the repair of underground pipes, wires, or conduits damaged by them or their subcontractors.

3. The developer and contractor will be liable for all damage caused by storms and fire until the work is accepted into warranty.

### **103.05 Installation of Survey Monuments**

1. Permanent survey monuments, and lot pins shall be set at locations approved by the Town provided that such monuments shall be set not more than 1,400-feet apart along any straight boundary line; at all angle points; and at the beginning, end, and points of change of direction or change of radius of any curved boundary. In addition, 5/8-inch steel pins, or larger, shall be set at all lot corners. Affixed securely to the top of each monument shall be an aluminum cap marked with the Colorado registration number of the land surveyor responsible for the establishment of the monument.
2. The Professional Land Surveyor will assure that the monuments he establishes or re-establishes conform both in location and physical character with the specifications called for in Section 38-51-104, Colorado Revised Statutes. Each found monument verified in location shall be restored or rehabilitated as necessary so as to have it readily identifiable and reasonably durable.

### **103.06 Explosives**

1. When blasting is permitted and approved in writing by the Town, the developer and contractor will use the utmost care to protect life and property. Signals warning persons of danger will be given before any blast. Excessive blasting or overshooting will not be permitted. The Town will have authority to order any method of blasting discontinued which leads to overshooting, is dangerous to the public, or destructive to property, environment or natural features.
2. Before any blasting will be done by the contractor, a certificate of insurance indicating special blasting coverage in the following minimum amounts will be filed with the Town:

- a. Property Damage, each accident \$1,000,000





**104.02 Coordination**

1. Preparation and processing of submittals shall be coordinated with performance of construction activities. Transmit each submittal sufficiently in advance of performance of related construction activities to avoid delay.
2. Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals, and related activities that require sequential activity.
3. Coordinate transmittal of different types of submittals for related elements of the work so processing will not be delayed by the need to review submittals or resubmittals concurrently.
4. The Town reserves the right to withhold action on a submittal requiring coordination with other submittals until all related submittals are received.

**104.03 Processing**

1. To avoid the need to delay installation as a result of the time required to process submittals, allow sufficient time for submittal review, including time for resubmittals. Allow 14 calendar days for initial review. Allow additional time if the Town Engineer must delay processing to permit coordination with subsequent submittals.
2. If an intermediate submittal is necessary, process the same as the initial submittal. Allow 14 calendar days for processing each resubmittal.
3. No extension of contract time will be authorized because of failure to transmit submittals to the Town sufficiently in advance of the work to permit processing.

**104.04 Submittal Format**

Submittals required for platting, zoning, or other documents required by the Town of Frederick Zoning Code and Subdivision Regulations or for annexation shall follow the format proscribed in those documents, otherwise submittals shall be formatted as follows:

- a. Place a permanent label or title block on each submittal for identification. Indicate the name of the entity that prepared each submittal on the label or title block.
- b. All reports shall be bound in an 8-1/2 x 11-inch folder.
- c. Drawings shall be prepared on 24-inches high by 36-inches wide, spliceless, tapeless, and creaseless paper. A margin shall be drawn completely around each sheet leaving a margin 1/2-inch on three sides, and one inch on the fourth (left-hand side). Drawings shall be prepared using AutoCAD™ (release 14 or higher) and shall also be submitted electronically on a CD or by other acceptable electronic means. Where required, mylar shall be double matte with a uniform thickness of not less than 0.003-inches.



- d. Provide a space approximately 4-inches by 5-inches on the label or beside the title block to record the Contractor's review, approval markings, and the action taken as applicable:
- e. Include the following information on the label for processing and recording action taken; as applicable:
  - i. Project name
  - ii. Date
  - iii. Name and address of the Contractor's Engineer
  - iv. Name and address of the Contractor
  - v. Name and address of the Surveyor
  - vi. Name and address of the Soils Engineer
  - vii. Name and address of the subcontractor
  - viii. Name and address of the supplier
  - ix. Name of the manufacturer
  - x. Number and title of appropriate specification section
  - xi. Drawing number and detail references, as appropriate.
- f. All drawings and reports shall include the seal and signature of the Professional Engineer registered in the State of Colorado who is responsible for contents.
- g. All submittals shall include the following statement with the Town of Frederick Signature Block:

"We acknowledge that the Town of Frederick's review of this document is for general conformance with submittal requirements and current design criteria."
- h. The Cover Sheet of all Construction Plans shall have signature blocks for all appropriate Sanitation and Water Districts. Please contact the specific District for their requirements.
- i. See Articles 3 and 4 in the Town of Frederick Land Use Code for more information.
- j. All drawings and reports shall include Project Datum, where applicable. Project Datum shall be as follows: geodetic coordinates based on NAD 83 (1992);





2. On the transmittal, record relevant information and requests for data. On the form, or separate sheet, record deviations from contract document requirements, including variations and limitations. Include Contractor's certification that information complies with Contract Document requirements.

#### **105 WORKING HOURS**

1. Normal working hours shall be Monday through Friday from 7:00 AM to 4:00 PM except legal holidays, unless otherwise approved by the Town.
2. Normal working hours for the Town's inspector of public improvements shall be Monday through Friday from 8:00 AM to 4:00 PM except legal holidays, unless otherwise approved by the Town.

#### **106 COMMENCEMENT OF CONSTRUCTION**

1. Construction shall commence within two years of the approved date shown on the plans, or plans must be resubmitted for review and approval. If construction is halted for more than two years, plans must be resubmitted for review and approval. All improvements will be accurately surveyed and staked in accordance with the approved plans prior to their construction.
2. Traffic Impact Studies, Drainage Reports, Pavement Design Reports, etc. for a specific subdivision or parcel of land are valid for a period of one (1) years from date of approval unless significant development or activity has occurred that may impact the previous studies in the opinion of the Town Engineer. If construction documents for any phase or individual lot are not approved within this timeframe, revised reports with updated information are required to be submitted to the Town for review and approval.

#### **107 UTILITY COORDINATION**

1. The Contractor shall notify all utility companies and locate all existing utilities on and near the site prior to construction. All affected parties must be notified prior to the commencement of work in order to ensure that there will not be an unexpected interruption of service during construction.
2. The Contractor is responsible for coordinating work with all public utilities. All public utilities shall be installed in conformance with plans and specifications set forth by the governing body of the utility and within this document.
3. The Contractor shall contact all Emergency Services and the Saint Vrain Valley School District before closing a public roadway. The Town of Frederick will provide list.

#### **108 PRECONSTRUCTION CONFERENCE**



1. A mandatory preconstruction conference shall be held at least 48-hours prior to the start of new construction. The Contractor, Developer, Design Engineer, all subcontractors, a representative from the testing company, a Town Representative, as well as any interested utility representatives shall attend. Water and Sanitation Districts may hold separate preconstruction conferences.
2. The Preconstruction Checklist (Appendix A) should be completed for each contract. The Preconstruction Checklist should be included in the agenda for the Preconstruction Conference. All blocks on the form should be completed as appropriate during the meeting.

## **109 PLANS AT CONSTRUCTION SITE**

The Contractor shall be required to have a set of approved construction documents on site at all times during construction.

## **110 INSPECTION**

### **110.01 General**

1. If the Town's inspector of public improvements finds no set of approved plans on-site, he/she may stop construction until plans are brought on-site.
2. The Town is to have access to the construction site at all times. The Town shall have the authority to reject defective or inferior materials, or workmanship in cases where, in the opinion of the Town Engineer, it is judged to be unacceptable, substandard, defective, or suspect in accordance with these Standards and Specifications, and good engineering judgement. The Contractor shall immediately correct any defective material(s) or poor workmanship as determined by the Town. If the Town deems it necessary, any previously covered work will be exposed at the Contractor's expense.
3. The Town will have the authority to stop work whenever such stoppage may be deemed necessary. The Public Works Director/Town Engineer will resolve all questions which arise as to the quality and acceptability of materials furnished, work performed, interpretation of the plans and specifications, and acceptable fulfillment of the requirements of these STANDARDS AND SPECIFICATIONS.
4. Town inspectors are authorized to inspect all work and all material furnished. Inspections may extend to all or any part of the work and to the preparation, fabrication, or manufacture of the materials to be used. The inspector is not authorized to revoke, alter, or waive any requirements of these STANDARDS AND SPECIFICATIONS. They are authorized to call the attention of the contractor to any failure of the work or materials to conform to these STANDARDS AND SPECIFICATIONS. The Inspector will have the authority to reject materials until any questions at issue can be resolved by the Town.



5. The Inspector will, in no case, act as foreman or perform other duties for the contractor nor interfere with the management of the work done by the contractor. Any "advice" or "opinion" which the inspector may give the contractor will not be construed as binding upon the Town Engineer or the Town in any way or release the contractor from fulfilling all of the terms of these STANDARDS AND SPECIFICATIONS. The presence or absence of the inspector will not relieve, in any degree, the responsibility or the obligation of the contractor, owner or developer.
6. In case of suspension of work for any cause, the contractor, before leaving the job site, will take such precautions as may be necessary to prevent damage to the project, provide for public safety, normal drainage, and erect any necessary barricades, signs, or other facilities at his expense as directed by the Town and required by these STANDARDS AND SPECIFICATIONS. The contractor is responsible for ensuring that all construction and construction activities and materials are in compliance with these STANDARDS AND SPECIFICATIONS. The Contractor shall be solely responsible for all construction means, methods, techniques, sequences, and procedures. The contractor shall be responsible for the acts and omissions of his employees, subcontractors, and their agents and employees. The contractor shall be solely responsible for locating all existing underground installations, including service connections, in advance of excavating. Town utility maps are intended to be used for general information only, and the location of any utilities or property lines as shown on the utility maps are not necessarily accurate.
7. Work which does not conform to the approved construction plans and these STANDARDS AND SPECIFICATIONS and results in an inferior or unsatisfactory product will be considered unacceptable work. Unacceptable work, whether the result of poor workmanship, poor design, use of defective materials, damage through carelessness, or any other cause which is found to exist prior to the final acceptance of the work will be immediately removed and replaced or otherwise satisfactorily corrected by and at the expense of the developer or contractor. This expense includes total and complete restoration of any disturbed land or surface to original or better condition that existed before the repairs or replacement.

#### **110.02 Inspection Requirements**

1. Inspection shall be required as denoted in these Standards and Specifications. The Contractor shall provide at least 48-hours notification when work requiring inspection will be constructed. Inspection shall be at such hours that are convenient to the Town.
2. The Contractor has the following responsibilities in regards to authorized inspection and testing activities:
  - a. Cooperate with authorized laboratory and inspection personnel and provide access to work.
  - b. Provide for laboratory mix design data to be used for concrete and other material mixes which require control by testing laboratory.



- c. Furnish incidental labor and facilities:
  - i. To provide access to work to be tested
  - ii. To obtain and handle samples at project site or at source of product to be tested.
  - iii. To facilitate inspections and tests.
  - iv. For storage and curing of test samples.

**110.03 Testing**

1. Testing specifics are included in each section of these standards.
2. Unless otherwise notified, the Contractor is responsible for procuring the services of any testing laboratories necessary to perform the specified services and testing required in these Standards and Specifications. All testing laboratories shall be approved by the Town before utilization.
3. Tests shall be made by an accredited testing laboratory. Except as otherwise provided, sampling and testing of materials, laboratory method, and testing equipment shall be in accordance with the latest standards and methods of the American Society of Testing and Materials (ASTM).
4. The testing agency or its representatives are not authorized to revoke, alter, relay, enlarge, or release any requirements of these Standards and Specifications. The testing agency or its representatives are not authorized to approve or accept any portion of the work.
5. The Contractor shall provide equipment and facilities for conducting field tests and for collecting and forwarding samples. Any product deemed unfit for use shall not be incorporated into the work.
6. Where additional or specific information concerning testing methods, sample sizes, etc., is required, requirements are included under the applicable Sections of these Standards and Specifications.

**110.04 Test Reports**

Reports of tests conducted by testing laboratories shall be distributed directly by the testing laboratory as follows:

- a. 1 copy to Contractor
- b. 1 copy to Applicable supplier or subcontractor



- c. 1 copy to Town Engineer
- d. Other copies as directed

### **110.05 Emergency Work**

When, in the opinion of the Town, the contractor has not taken sufficient precautions for the safety of the public or the protection of the work to be constructed, or if adjacent structures or property which may be damaged by processes of construction on account of such neglect, and an emergency arises and immediate action is considered necessary in order to protect private or public interests, the Town, WITH OR WITHOUT NOTICE to the contractor or the developer, may provide suitable protection by causing work to be done and material to be furnished and placed as the Town may consider necessary and adequate. The cost and expense of such work and material so furnished will be borne by the contractor or developer and will be paid within 30 days of presentation of the bills. The Town may also draw from the developer's surety to cover any non-payment, including accrued interest and applicable overhead costs. The performance or non-performance of such emergency work under the direction of the Town will in no way relieve the contractor of responsibility for damages which may occur during or after such precaution has been taken.

## **111 MATERIALS AND EQUIPMENT**

### **111.01 General**

1. All materials and equipment shall be of good quality. All materials and equipment shall be applied, installed, connected, erected, used, cleaned, and maintained in accordance with the instructions of the applicable supplier and manufacture, except as otherwise provided in these Standards and Specifications. No provision of any such instructions will be effective to assign to the Town, or any of the Town's representatives, any duty or authority to supervise or direct the furnishing or performance of the work.
2. Any conflict between the manufacturer's instructions and these Standards and Specification shall be decided and settled by the Town Engineer.

### **111.02 Certification**

When deemed necessary by the Town, the Contractor shall submit a manufacturer's material certificate to the Town, as a permanent part of the project. The manufacturer certificate shall state that the product used on the project conforms to the Town of Frederick Standards and Specifications. No material shall be used until approved by the Town.

### **111.03 Testing**

If, in the Town's opinion, there is evidence that materials or methods used may not comply with these Standard and Specifications, the Town may require that additional testing be performed for confirmation. Testing methods will be specified by the Town and the expense shall be solely borne by the Contractor.



#### **111.04 Storage of Materials**

Materials will be stored so as to ensure the preservation of their quality and suitability for the work. Stored materials, even though approved prior to storage, will be subject to inspection prior to their use in the work and will meet all requirements of these STANDARDS AND SPECIFICATIONS at the time they are used. Stored materials will be located so as to facilitate inspection. With the prior written approval of the Town, portions of the right of way not required for public travel may be used for storage purposes and for the placing of the contractor's plants and equipment, but any additional space required will be provided by the contractor at his expense.

#### **111.05 Defective Materials**

Materials not in conformance with requirements of these STANDARDS AND SPECIFICATIONS will be considered defective and will be rejected. Rejected materials will be removed from the work site at the contractor's expense, unless otherwise permitted by the Town.

### **112 HOUSEKEEPING**

The Contractor shall keep the premises and surrounding area free from accumulation of waste material or rubbish caused by, or incidental to, the construction of the work. Contractor facilities, material storage, and equipment areas shall be kept in a neat and orderly condition and trash stored in tight receptacles. The Contractor shall take particular care to protect materials and debris from weather conditions that would cause them to become windborne. The Contractor shall be responsible for the removal and clean-up of all materials or debris that are blown off site.

### **113 TARPING OF HAUL VEHICLES**

The Contractor shall not convey, or cause to be conveyed through the streets of the Town, earth, manure, mortar, shavings, rubbish, waste paper, garbage, or loose material of any description except in tight receptacles, boxes, or truck bodies with covers which prevent the escape of any material contained therein.

### **114 FINAL CLEAN-UP**

1. The Contractor shall be responsible for the removal and proper disposal of all construction debris, dirt, and mud from all the public streets, private property, and parking lots within or adjacent to property area, whether caused directly by the Contractor's construction operation, or that of the subcontractors and/or material suppliers, or indirectly due to the work site condition.
2. All surplus materials and temporary structures shall be removed from the site by the Contractor. All debris and rubbish will be removed, and the areas occupied during operations shall be restored to their original condition.



## 115 DRAWINGS OF RECORD

Prior to receiving conditional acceptance, it shall be the responsibility of the Developer and Contractor to provide the Town with one (1) mylar copy and one electronic (.ctb) copy on CD of "Drawings of Record" (As-Built) plans showing revisions (at the same scale as the original construction plan set) stamped and signed by a registered Professional Engineer in the State of Colorado upon the completion of the project. At a minimum, record drawings shall indicate the horizontal or vertical layout of all underground water, sanitary sewer, and storm sewer facilities (including distances between valves, fittings, manholes, etc.), profiles of streets, sanitary sewer mains and storm sewer mains, details of special or unusual installations, and detention pond volumes. All utilities shall be on separate layers clearly labeled with all "As-Built" information contained in a cloud line type. Along with the AutoCAD files include a full set of PDFs and or DWFs on the CD. This procedure shall be followed for all changes, whether requested by the Town, the Design Engineer, the Contractor, the Developer, or other authorized parties. "Drawings of Record" plans must be submitted for record purposes even if no changes are made.

## 116 CONDITIONAL ACCEPTANCE

1. Construction shall not be accepted until verification has confirmed that all deliverables have been received, that the complete scope of work has been performed, that the level of quality is acceptable, and that all nonconformances and punch list items have been satisfactorily resolved. The Contractor shall also provide proof that there are no outstanding debts, liens, or potential liens in connection with the project.
2. The following documents are to be submitted to the Town before Conditional Acceptance may be granted:
  - a. A letter to the Town from the Developer or Contractor requesting Conditional Acceptance
  - b. "Drawings of Record" (As-Built) – 1 bound copy and a CD containing the electronic AutoCAD file and. ctb file (AutoCAD R 14 or newer) along with a full set of PDFs or DWFs.
  - c. Spreadsheet indicating actual construction costs
3. Upon receiving and verifying all of the above information and the repairs of all punch list items the Town shall issue a letter of Conditional Acceptance for the project. If the phase or filing of Conditional Acceptance request does not match the Phase or Filing map in the MOAPI, the Developer or Contractor shall include a map depicting the area they are requesting Conditional Acceptance for. This map shall show the limits of the conditional accepted work, including but not limited to, manholes, inlets etc.
4. The Town will not release building permits until Conditional Acceptance has been granted by the Town and all necessary documents have been reviewed and accepted by all appropriate Districts (Sanitation or Water District).



5. There shall be no partial acceptances of public improvements within new developments.

## **117 WARRANTY AND CORRECTION PERIOD**

Upon completion of the work, the Contractor shall deliver to the Town Engineer, in duplicate, a written warranty, addressed to the Town, properly signed and notarized, warranting that the Contractor and each subcontractor shall remedy any defects due to faulty materials or workmanship, and pay for consequential damage resulting therefrom, which appear in the work within a period of two years from the Date of Conditional Acceptance and in accordance with any special warranties as specified in individual Sections of these Standards and Specifications. The Town will give notice of observed defects with reasonable promptness. If identified deficiencies are not corrected within 30-days after notification the Town may correct all related items to the work and charge the Developer and/or the Contractor for the work.

### **117.01 Maintenance Responsibility**

1. The developer shall be responsible for the maintenance of all public improvements during the warranty period. The Public Works Director/Town Engineer will notify the developer of any maintenance that may be necessary during this time. Routine maintenance normally performed by the developer includes, but shall not be limited to, the cleaning of streets, patching of potholes, and removal of blockages from water, storm and sanitary sewer facilities. The cost of any routine maintenance not performed by the developer that must be performed by the Town will be billed to the developer at cost.

### **117.02 Emergency Repairs**

2. In the event of a water main break, sanitary sewer main blockage, street or bridge failure, or other emergency that may occur during the warranty period, it may become necessary for the Town to undertake immediate repairs to the facilities and/or make the area safe to residents, pedestrians, or motorists. The Town will attempt to contact the developer in the event of such emergency. However, if the developer or his representative cannot be contacted quickly or if the developer is unable to take immediate action to relieve the urgent situation, the Town may proceed with such action as deemed necessary by the Public Works Director/Town Engineer, and the developer will be billed for all costs of these actions.

## **118 FINAL ACCEPTANCE**

1. One (1) month prior to the end of the 2-year\* Warranty period, the Developer or Contractor shall notify the Town Engineer and shall schedule a Final Inspection of all Public Improvements. (\*Unless warranty period is specified to be over two years.)
2. Two years\* after Conditional Acceptance, the Town shall inspect the public improvements at the Developer or Contractor's request. Any construction not



meeting Town standards shall be brought into compliance by the Developer. When all Town standards have been met, Final Acceptance shall be granted. Work that is not under the Town's jurisdiction shall be corrected to the Standards required by the authority having the jurisdiction, i.e., Water and Sanitation Districts.

3. If Final Acceptance is not granted, all future maintenance and repair shall remain the responsibility of the Developer and Contractor. If identified deficiencies are not corrected and finally accepted within 30-days prior to the termination of the 2-year\* warranty period, the Town may correct all items related to the work and charge the Developer and/or Contractor for the work. (\*Unless warranty period is specified to be over two years.)

## **119 WORK IN PUBLIC RIGHT-OF-WAY**

### **119.01 Permit Required -- Right-of-Way Permit**

1. It shall be unlawful for any person to perform work within a public right-of-way of the Town of Frederick without first obtaining permission from the Town of Frederick. If the work to be performed involves a Town of Frederick utility in a State of Colorado Highway right-of-way, both a right-of-way permit from the Town and the appropriate permit from the Colorado Department of Transportation shall be required. An application for work done under a right-of-way permit shall be submitted to the Town on a form provided by the Town for each job. The application shall be submitted at least 48-hours prior to the planned start of work to allow for review and approval by the Town. Permittees may be required to increase this time up to 10-days when the work consists of more than a single spot excavation. An application form (when approved) shall constitute a valid "right-of-way permit." Incomplete permit applications will not be reviewed or processed by the Town.
2. The Town may require submittal of plans and specifications. No work shall commence until the Town has approved the plans and specifications and/or permit application, except in emergency conditions. A permit application shall be required for emergency conditions within 72-hours after the performance of the work and all conditions of a right-of-way permit shall apply.

### **119.02 Issuance of Permits**

The Town may grant permits to work in, construct, or excavate within the public way or to close traffic lanes or work in connection with a Town utility system to any Class D public way contractor filing an application as herein provided, which application shall pertain to work which shall comply with the requirements of this chapter. All permits shall be issued according to the provisions of the Official Code of the Town of Frederick for Class D public way contractors.

### **119.03 Liability for Damage**

Any person who shall undertake work pursuant to a permit issued under the provisions of this chapter, perform work under contracts with the Town, or perform work under the terms



of a Public Improvements Agreement, or by virtue of permission obtained from the Council in accordance with the provisions adopted by the said Council, shall be answerable for any damage or injury to persons, animals, or property as a result of any circumstances of such work. Prior to any excavation within the public right-of-way, the contractor shall contact UNCC, the Town of Frederick Public Works and Utilities Department and any other affected utility company for field location of any utility lines which may be in the vicinity of the work.

**119.04 Suspension or Revocation of Permits -- Stop Work Order**

1. Any permit may be revoked or suspended by the Town and a stop work order may be issued after notice to the permittee for:
  - a. Violations of any condition of the Public Improvements Agreement, or of the approved construction drawings or specifications; or
  - b. Violation of any provision of these STANDARDS AND SPECIFICATIONS; or
  - c. Violation of any other ordinance of the Town, state law, or federal law pertaining to the work; or
  - d. Existence of any condition or the occurrence of any act which may constitute or cause a condition endangering health, life, or safety, or serious damage to property.
2. A suspension or revocation by the Town and stop work orders shall take effect immediately upon notice to the person performing the work in the field and shall remain in effect until such time as the Town cancels the order in writing. A failure to abide by the terms of the suspension or revocation will be considered a violation of Town code.
3. Upon receipt of a stop work order, the contractor shall be responsible for taking such precautions as may be necessary to prevent damage to the project, prevent inconvenience or hazardous conditions for the general public, provide for normal drainage, and to erect any necessary barricades, signs, or other facilities which may be necessary or directed by the Town.

**119.05 Application Form**

1. Application for a permit to work in the public way shall be made on an original form provided by the Town and shall recite specifically and illustrate by sketch or plan the exact location, depth, extent, nature, and purpose of the excavation to be made and the duration of the time required for the work. The application shall include the name of the applicant requesting the permit and the applicant's business address, registration number, business phone number, after business hours phone number, and contact person. The application will include other pertinent information such as application date, the start and finish dates of work within the public way, the completion date, the permit fee, a Town contact phone number for inspection



requests, a traffic control plan if required, and any other relevant information required by the terms of the right-of-way permit.

2. Applicants shall pay a fee and deposit to the Town before issuance of such permit. The amount of that fee shall be established by the Town and displayed on the permit.

#### **119.06 Exhibition of Permit**

All required permits shall be kept at the site of the excavation while the work is in progress and shall be exhibited upon request to any police officer or other authorized representative of the Town. Failure to comply with this provision shall be grounds for a revocation of the permit and the issuance of a stop work order.

#### **119.07 Guarantee**

1. The permittee, by acceptance of the permit, expressly guarantees complete performance of the work therein described and guarantees all work done by him for a period of one year after the date of completion as shown on the permit form. The permittee agrees upon demand to maintain and to make all necessary repairs during the one-year warranty/maintenance period, and to hold harmless the Town of Frederick for any and all claims arising from such work. This guarantee shall include all repairs and actions needed as a result of:
  - a. Defects in workmanship or materials
  - b. Settling of fills or excavations
  - c. Failures caused by unknown reasons
  - d. Any unauthorized deviations from the approved plans and specifications
  - e. Failure to barricade
  - f. Failure to clean up during and after performance of work
  - g. Any other violation of these STANDARDS AND SPECIFICATIONS.
2. If repairs are required during the subsequent one-year warranty period, those repairs need only be guaranteed until the end of the initial one-year period starting with the date of initial completion. However, in the event the Town deems that the repairs are severe enough to constitute a reconstruction it may require that a new one-year guarantee be provided for subsequent repairs after the completion of the reconstruction. The permittee shall be responsible for providing materials and construction methods complying with these STANDARDS AND SPECIFICATIONS. If the permittee defaults in completion or conformance with these STANDARDS AND SPECIFICATIONS, the Town shall submit a letter to the permittee describing the default or non-conformance at least 10 days prior to authorizing Town personnel to



perform suitable repairs and reconstruction. Town personnel shall be authorized to remove and replace non-conforming work and/or materials to a reasonable distance beyond the limits of the non-conforming work as required to produce a suitable repair. The permittee shall be responsible for all costs incurred by the Town to accomplish the work in a safe and timely manner.

**119.08 Performance**

1. Inspection.
  - a. There shall be a minimum of two inspections for each permit. The first shall occur upon notification by the contractor that the work is ready for inspection and the second inspection will be made 30-days prior to the expiration of the one-year warranty period. At any time prior to completion of the one-year warranty period, the Town may notify the permittee of any needed repairs. Such repairs shall be completed within 24-hours if the defects are determined by the Town to be an imminent danger to the public health, safety, and welfare. Non-emergency repairs shall be completed within 10-days after notice.
  - b. The permit fee, except for one hundred and fifty dollars (\$150.00), will be refunded up to 30-days after the permitted work is approved by the Town. If the work is inspected and accepted by the Town after the permit expires the permit fee, except for one hundred and fifty dollars (\$150.00), will be refunded up to 30-days after the permit expiration.
2. Barricading and Traffic Control.
  - a. All work within a traveled public roadway area shall be protected at all times by safety devices as prescribed by the MUTCD and in such manner as to minimize the disruption of the flow of traffic in the vicinity of the work. Normally, only one side of a street may be closed at any given time. Traffic must be provided a minimum lane width of 10-feet in the construction area. Any plan for traffic control during construction must be approved by the Traffic Engineer prior to issuance of permit. Plans that indicate complete closures must show detour routes and must be approved by the Traffic Engineer at least one week prior to the issuance of the permit. The Town reserves the right to require longer lead times if it deems necessary.
  - b. All work within the roadway shall take place between 8:00 AM and 4:00 PM unless otherwise stipulated on the right-of-way permit.
  - c. As directed by the Town, street excavations must be backfilled prior to leaving the site at the end of the work day, even if the work has not been completed.
  - d. No person shall dig or cause to be dug any hole, drain, ditch, or any other excavation in any street, alley, sidewalk, or other public place within the Town without providing sufficient amber lights to be placed with a suitable barricade or temporary fence around such hole, drain, or other excavation in order to prevent persons, animals, and vehicles from sustaining injury. During the daytime the



barricades shall be maintained but warning lights are not required. All barricades and lights shall be left in place until a permanent patch or temporary cold-mix patch can be made to the excavation.

3. Removal of Safety Devices or Barricades.
  - a. No person shall damage, displace, remove, or interfere with any barricade warning light or any other safety device which is lawfully placed around or about any street, alley, sidewalk, or other excavations or construction work in the Town.

## 120 OTHER PERMITS

This section discusses only those permits and agreements which may be required by the Town of Frederick as part of the construction of the public improvements or private improvements in areas of common ownership (for example; landscaping, parking lots, etc.). It does not address other Town permits (for example; building permits, tap permits, etc.) or permits which may be required by other government entities (for example; CDOT, FEMA, EPA, etc.).

### 120.01 Grading Permit

The fee for this permit shall be as established by Town Code. This permit is required if any owner/developer wishes to begin grading within a particular development before the public improvements agreement is executed and good and sufficient surety is provided to the Town. It should be noted that the Town is under no obligation to issue a grading permit prior to the execution of the public improvements agreement. However, if the Town has approved the Development Plan, completed at least one review of the construction drawing package, and believes that the necessary revisions to that package are minor and that the review process is progressing in an acceptable manner, the Town may issue a land disturbance permit. In addition, the owner/developer will be required to sign a letter acknowledging that he is doing the grading at his own risk, and that any subsequent changes to that grading that may be required as a result of additional review comments will be his sole responsibility. Prior to the issuance of a grading permit, all provisions of these STANDARDS AND SPECIFICATIONS shall be complied with.

### 120.02 Temporary Water Service Permit

All water used in the Town for construction purposes is to be metered and charged to the user. The application for temporary water service shall be made at the Town's Utility Division. The application and fee for each temporary meter shall be in accordance with Frederick Municipal Code. A deposit must be made to the Town when the application is made. The deposit will be refunded to the applicant, less water usage charges and any consequential damages to the City provided equipment, once certification of water usage has been made. In such cases where water usage charges and equipment damages exceed the deposited amount, additional charges will be billed to the applicant. Water usage rates are established by the Fee Schedule. In the event a water metering device



cannot be provided to the applicant by the Town other means will be established by the Town to estimate water usage.

**121 DEFINITIONS/RESPONSIBILITIES**

1. APPROVED PLAN shall mean the latest revised construction plan approved by the Town, or other approval authority.
2. CONTRACTOR shall mean, a person, partnership, or corporation duly authorized to perform work or licensed and bonded in the Town in accordance with the Town Code.
3. DEVELOPER shall mean any person, partnership, joint venture, limited liability company, association, or corporation who participates as owner, promoter, developer, or sales agent in the planning, platting, developing, promoting, selling, or leasing of a development.
4. DESIGN ENGINEER shall refer to the engineer responsible for the design, plans and specifications of a project.
5. DESIGNATED PRIVATE CONSTRUCTION WORK includes: private sewer systems, water and sewer service lines to buildings, grading, drainage structures, retaining walls, parking lots, private streets and walks, fire lanes, driveways, and associated construction.
6. EXPRESSIONS Wherever the words “as directed”, “as required”, “as permitted”, or words of like meaning are used, it shall be understood that the direction, requirements, or permission of the Town Representative is intended. Similarly, the words “approved”, “acceptable”, “satisfactory” shall refer to approval by the Town Representative.
7. OWNER shall mean a person, company, firm, or corporation holding title to land that is being developed or modified within the Town.
8. PROFESSIONAL ENGINEER shall refer to a registered engineer licensed with the State of Colorado.
9. PUBLIC IMPROVEMENTS include: all work in the public right-of-way, Town property, easements dedicated to the Town, private property that will become Town property or an easement to the Town in the future, and projects or utilities that will become the Town’s responsibility to maintain.
10. STANDARDS AND SPECIFICATIONS shall refer to the Standards and Specifications for the Town of Frederick.
11. SUBCONTRACTOR Any person, company, firm, or corporation licensed and bonded in the Town in accordance with the Town Code which has a direct or indirect contract with the Contractor or other Subcontractor and furnishes and/or performs on-site labor, and/or furnishes materials in connection with the performance of the work.



12. SURETY shall mean the entity which is bound with and for the Contractor for the performance of the work as described in these specifications. (Bonded)
13. TESTING AGENCY Any individual, partnership, or corporation which is qualified and licensed to perform the required sampling, analysis, testing, and professional recommendation service.
14. TOWN shall mean the Town of Frederick, in the State of Colorado, acting by and through the Town Manager, Mayor, and Town Council.
15. TOWN CODE shall mean the official adopted Town Code of Frederick, Colorado
16. TOWN ENGINEER shall mean the current person, firm, or corporation representing the Town on the subject property.
17. TOWN REPRESENTATIVE shall mean the Public Works Director/Town Engineer or an authorized representative acting on behalf of the Town on the subject project.
18. TRAFFIC ENGINEER shall mean the Traffic Engineer of the Town.

## 122 REFERENCES

Standards Referenced in Section 100:	
Standard	Title
Public Law 91-596	Occupational Safety and Health Act of 1970
29 CFR 1910	General Industry Safety and Health Standards
29 CFR 1926	Construction Industry Safety and Health Standards
29 CFR 1904	Recording and Reporting Occupational Injuries and Illnesses
49 CFR	Transportation



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## 200 DESCRIPTION

This section defines the construction standards for earthwork and grading specifications to be used when completing earthwork including but not limited to clearing, grubbing, excavating, and embankment backfill within the limits of control for the Town.

### 201 GENERAL PROVISIONS

1. All earthwork operations shall be executed in a manner which will minimize dust, noise, excessive accumulation of debris, danger to the public, and interference with other construction. Positive drainage and adequate erosion control shall be provided at all times during the earthwork operations.
2. Upon completion of earthwork operations, the Contractor shall leave the site and soil clean to allow for proper installation of irrigation, plantings, and related site improvements. Completed grades shall be smooth and uniformly sloped, properly compacted, and provide proper drainage away from site improvements. All banks or slopes shall be maintained in a stable condition by approved methods to prevent slips, washouts, or erosion.
3. It is the Contractor's responsibility to be cognizant of and to apply for the necessary Federal, State, or Local permits including but not limited to stormwater management, flood control, dust control, construction dewatering, and grading.

### 202 DESIGN CRITERIA

1. Prior to the commencement of grading, a Geotechnical Engineer shall be retained by the Contractor for the purpose of observing earthwork procedures and testing the fills for substantial conformance with the recommendations of the Geotechnical Report and these specifications. The Geotechnical Engineer shall provide adequate testing and observation services so that they may determine that, in their opinion, the work was performed in substantial conformance with these specifications. It shall be the responsibility of the Contractor to assist their Geotechnical Engineer and keep him apprised of work schedules and changes so that personnel may be scheduled accordingly.
2. It shall be the sole responsibility of the Contractor to provide adequate equipment and methods to accomplish the work in accordance with applicable grading codes or agency ordinances, these specifications and the approved grading plans. If, in the opinion of the Town Engineer or Town representative, unsatisfactory conditions such as questionable soil materials, poor moisture condition, inadequate compaction, adverse weather, and so forth, result or will result in quality of work not in conformance with these specifications, the Town may reject the work.



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## 203 CLEARING, STRIPPING AND GRUBBING

### 203.01 General

1. Areas to be excavated and filled shall first be cleared, stripped and grubbed. **Clearing** shall consist of complete removal above the ground surface of trees, stumps, brush, bushes, man-made structures and similar debris. **Stripping** shall consist of removal of all weeds, grasses, topsoil, organic soil or other vegetation not removed during clearing operations. **Grubbing** shall consist of removal of stumps, roots, buried logs and other unsuitable material and shall be performed in areas to be graded. Roots and other projections exceeding 1-1/2-inches in diameter shall be removed to a depth of 3-feet below the surface of the ground. Borrow areas shall be grubbed to the extent necessary to provide suitable fill materials. Frozen materials shall be removed and stockpiled until thawed.

### 203.02 Construction Methods

1. Any asphalt pavement material removed during clearing operations should be properly disposed at an approved off-site facility. Concrete fragments that do not contain steel reinforcement may be placed in fills, provided they are placed in accordance with Section 208 in these Standards and Specifications.
2. Unless specifically designated to be saved and marked as such, all trees, stumps, brush, windfalls, logs and other objectionable matter located within clearing limits shall be marked, cut off and disposed of.
3. Topsoil should be stockpiled for future use in revegetating exposed slopes or in back lots where they will not affect the overall structural integrity of slopes or other settlement sensitive structures.
4. Strippings and topsoil shall not be used in structural fills or structural fill areas. Strippings and topsoil may be placed in landscape berms, detention pond areas, open space areas, parks, greenbelts, and along back of lots (i.e. rear lot lines) as approved by the Town Engineer.
5. After clearing, stripping and grubbing operations are complete, soft surficial soils, unstable soils, loose or porous soils, collapsible soils, or highly expansive soils shall be removed to the depth recommended in the approved Geotechnical Report. The depth of removal shall be observed and approved by the Contractor's Geotechnical Engineer. The subgrade surface exposed after removal of the unsuitable material shall then be plowed, ripped, or scarified to a minimum depth of 6-inches and until the surface is free from uneven features that would tend to prevent uniform compaction by the equipment to be used.
6. The refuse resulting from the clearing operation shall be hauled to a licensed waste site and shall be disposed of in such a manner as to meet all requirements of



- Federal, State, County, and Municipal regulations regarding health, safety, and public welfare.
7. In no case shall the Contractor use burning as a method of clearing or disposal.
  8. In no case shall any material be left on the project, placed onto abutting properties, or be buried in embankments or trenches on the project.
  9. The Contractor shall avoid as far as practicable, injury to trees, shrubbery, vines, plants, grasses and other vegetation growing on areas outside of the grading area, on parking islands or adjacent lots. If damage does occur the contractor is solely responsible for repair or replacement, in original or better condition, as directed by the Town Engineer or Special District at no additional cost to the town.

## **204 DEMOLITION AND REMOVAL OF STRUCTURES AND OBSTRUCTIONS**

### **204.01 General**

1. The Contractor will remove and satisfactorily dispose of all foundations, signs, structures, fences, old pavements, abandoned pipelines, traffic signal material and any other obstruction not designated to remain, except for utilities and those items for which other provisions have been made for removal.
2. Materials used in detour structures, supplied by the Contractor, will be the property of the Contractor. After the detour is abandoned, the Contractor will completely remove the detour structure and dispose of materials according to these Standards and Specifications.
3. Existing improvements, adjacent property, utilities, trees, and plants that are not to be removed shall be protected from injury or damage resulting from the Contractor's operations. If damage should occur, the Contractor shall make repair such that damaged materials are restored in original or better condition, as directed by the Town Engineer.
4. Immediately following demolition and removal of rubbish from the site, provided additional work is not required, the Contractor shall grade the area by filling, compacting, and leveling the site to existing adjacent grades, and implement erosion control devices in accordance with these Standards and Specifications and the approved construction documents.

### **204.02 Underground Obstructions and Protection of Utilities**

1. The Contractor shall notify Colorado 811 and contact each utility owner and request utilities to be located at least 48-hours prior to any earthwork. The Contractor shall



- verify all drawings of record and information obtained from the Town or other affected utility company.
2. In situations where conflicts may exist, the Contractor shall expose and verify the size, location, and elevation of underground utilities and other obstructions sufficiently in advance of construction to permit changes to be made to the construction drawings.
  3. In the case of a conflict the Contractor shall notify the Town and the affected utility company. The proposed work will be modified by the Design Engineer subject to the Town Engineer's approval.
  4. The Contractor shall protect sewer, water, gas, electric, phone, other pipelines, fiber optics, or conduits uncovered during the work.
  5. If such lines are found to be abandoned and not in use after examination by the Town Engineer and the utility owner, the Contractor shall remove utilities interfering with the work at the Contractor's expense. If such lines are found to be in use, the Contractor shall carefully protect and carry on work around them.
  6. Existing improvements, adjacent property, utilities, trees, and plants that are not to be removed shall be protected from injury or damage as a result of the contractor's operations. If damage should occur, the contractor shall make repair such that damaged materials are restored in original or better condition, as directed by the Public Works Director/Town Engineer, utility or property owner in question.
  7. If the Contractor removes any underground obstructions, the following shall apply:
    - a. Drainage culverts may be salvaged, stored, and reused in the original location if written approval is obtained from the Town Engineer. All other underground obstructions shall be replaced with new materials.
    - b. The area in which the underground obstruction was located shall be restored to original or better condition as defined above.

#### **204.03 Salvage**

All salvageable material will be clearly marked by the Town and shall be removed, without unnecessary damage, in sections or pieces which may be readily transported and will be stored in locations approved by the Town Engineer. These materials may include but shall not be limited to, manhole frames and covers, inlet grates, fence material, handrails, culverts, guardrails, roadway and parking appurtenances (traffic signals and attached hardware), including mast arms and span wire.

#### **204.04 Disposal**

Contractor to furnish written permission from the disposal facility.



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#### **204.05 Remaining Portions of Structures**

1. Where portions of structures are to be removed, the remaining parts will be prepared to fit new construction. The work will be done in accordance with plan details and materials left in place will be protected from damage. All damage to portions that are to remain in place will be repaired by the Contractor at their expense. Reinforcing steel projecting from the remaining structure will be cleaned and aligned to provide bond with the new extension. Dowels are to be securely grouted with approved grout.

#### **204.06 Bridges, Culverts, and Other Drainage Structures**

1. Bridges, culverts, and other drainage structures located under active roadways shall not be removed until a Traffic Control Plan has been approved by the Town Engineer in accordance with Section 1300, Traffic Control, of these Standards and Specifications.
2. Unless otherwise directed the substructures of existing structures shall be removed down to one foot below natural stream bottom or ground surface. Where such portions of existing structures lie wholly or in part within the limits of the one structure, they shall be removed as necessary to accommodate the construction of the proposed structure. Steel, precast concrete and wood bridges will be carefully dismantled without unnecessary damage. Steel members shall be match-marked with waterproof paint.
3. Where culverts are to be left in place or plugged, the ends shall be filled with flowable backfill in accordance with Section 300, Concrete, of these Standards and Specifications. Culvert ends are to be sufficiently filled to prevent future settlement of embankments.

#### **204.07 Pipe**

1. Unless otherwise specified all pipe shall be carefully removed and cleaned, and every precaution will be taken to avoid breaking or damaging the pipe.
2. When removing manholes, catch basins, and inlets, any live sewer connected with these items shall be properly reconnected, and a satisfactory bypass service will be maintained during such operations.

#### **204.08 Pavements, Sidewalks, Curbs, Etc.**

All concrete or asphalt that is to remain shall have a straight, true line with a vertical face. Concrete or asphalt may be cut with a cutting wheel, jackhammer, or saw. If the Contractor cannot maintain a straight, true break line by other means, sawing shall be used. The



sawing shall be done carefully and all damages to the concrete or asphalt to remain in place shall be repaired at the Contractor's expense.

## **205 SCARIFYING THE AREA TO BE FILLED**

1. All vegetation and frozen material shall be removed from the surface upon which the fill is to be placed and the surface shall then be plowed, ripped, or scarified to a depth of at least 6-inches, and smoothed until the surface is free from ruts, hummocks or other uneven features which would tend to prevent uniform compaction by the equipment to be used.
2. Where fills are made on hillsides or slopes, the slope of the original ground upon which the fill is to be placed shall be plowed or scarified per the approved Soils Report, or where the slope ratio of the original ground is steeper than 5 horizontal to 1 vertical feet, the bank shall be stepped or benched. Ground slopes that are flatter than 5 to 1 shall be benched when considered necessary as directed by the Geotechnical Engineer or the Town Engineer.

## **206 MAINTAINENCE OF SUBGRADE AND DRAINAGE**

1. It shall be the responsibility of the Contractor to pump or bail out water from excavations, whether rain or groundwater. Excavations must be kept free of water at all times. All required permits should be obtained and kept current.
2. It shall be the responsibility of the Contractor to take measures and furnish equipment and labor necessary to control the flow, drainage, and accumulation of water as required to permit completion of the work under this Section and to avoid damage to the work.
3. During construction the subgrade shall be maintained in such a condition that it will be well drained at all times. Side ditches or gutters emptying from cuts to embankments shall be constructed as to avoid damage to embankments by erosion. All excavations must be maintained to meet OSHA worker safety requirements. The Town of Frederick is not responsible for the safety of the jobsite.
4. If it is necessary during the course of the work to interrupt existing surface drainage, sewers, or underdrainage, temporary drainage facilities shall be constructed by the Contractor at their expense.
5. Water shall be prevented from entering into previously constructed pipe.
6. Except for storm drains, the pipe under construction shall not be used for dewatering.

## **207 EXCAVATION**



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**207.01 General**

1. "Borrow Excavation" shall consist of excavation made from borrow areas within the project limits and outside the normal grading limits for the completion of embankments. Borrow areas, or areas within the project limits from which the borrow may be obtained, will be designated on the Plans. Borrow excavation shall be made only at those designated locations and within the horizontal and vertical limits as stated or directed. On completion of borrow operations, the borrow area shall be adequately drained and finished to a neat and uniform grade acceptable to the Town Engineer.
2. "Imported Borrow Excavation" shall consist of excavation made from borrow areas outside the project limits and outside the normal grading limits for the completion of the project fills. The Contractor shall provide all erosion control, permits and re-seeding for the Imported Borrow area as required. Borrow areas, or areas outside the project pits from which the imported borrow may be obtain, will be designated. Any source chosen by the Contractor will be subject to the approval of the Town Engineer.

**207.02 Trenches**

1. Trenches shall be excavated by open-cut methods, except where boring or tunneling is indicated, shown on drawings, or approved by the Town Engineer.
2. Trench width shall be maintained to within 3-inches of that specified on plans.
3. Care shall be used when operating mechanical equipment in locations where it may cause damage to trees, buildings, culverts, or other existing property, utilities, or structures above or below ground.
4. Mechanical equipment shall be designed and operated in such a manner that the bottom elevation of the trench can be controlled with uniform trench widths and vertical sidewalls which extend from the bottom of the trench to an elevation 1-foot the top of the installed pipe.
5. Trench alignment shall be sufficiently accurate to permit pipe to be aligned properly with an 8-inch minimum clearance between the pipe and the sidewalls of the trench. The trench sidewall shall not be undercut in order to obtain clearance.
6. Contractor shall over-excavate a minimum of 6-inches below the bottom of the pipe wherever the trench bottom is rock, shale, or other unsuitable material. Over-excavation shall be backfilled and compacted with acceptable granular material. Granular material shall conform to these Standards and Specifications.
7. Preparation of Trench Bottom:



- a. Trench bottoms shall be graded uniformly to provide clearance for each section of pipe.
  - b. Loose material, water, and foreign objects shall be removed from the trench.
  - c. The contractor shall provide a firm subgrade which is suitable for application of bedding material.
  - d. Wherever unstable material is encountered in the bottom of the trench, said material shall be over-excavated to a depth suitable for construction of a stable subgrade. The depth suitable for construction of a stable subgrade shall be determined by the Public Works Director/Town Engineer. The over-excavation shall be backfilled with stabilization material and compacted as required by the Public Works Director/Town Engineer. Stabilization material shall conform to these Standards and Specifications.
8. Stockpiling Excavated Materials:
- a. Suitable material for backfilling shall be stockpiled in an orderly manner at a minimum of 4-feet from the edge of the trench.
  - b. Excess excavated materials not suitable or not required for backfilling shall be removed from the site and disposed.
  - c. Excavated material shall not be stockpiled against existing structures or appurtenances.
  - d. Excavated materials containing any hazardous materials shall be disposed of at an approved site in accordance with an abatement plan to be prepared by the developer/engineer or other qualified professional in accordance with all federal, state, and local ordinances.
9. Trenches shall be excavated to a width necessary to provide an 8-inch minimum working space between the pipe and the trench walls for proper pipe installation, joining, and bedding.
10. The maximum trench width at an elevation 12-inches above the top of the installed pipe shall be the pipe diameters of the pipe plus 24-inches, or 30-inches whichever is greater. If the width of the trench, 12-inches above the top of the pipe, exceeds the maximum allowable trench width, a higher strength pipe or special pipe bedding shall be provided as required by soil-loading conditions and as approved by the Public Works Director/Town Engineer.

## **208 FILL AREAS**

### **208.01 General**



Fill shall consist of the construction and placement of miscellaneous backfills, to the lines, grades, dimensions and typical section shown on the plans and/or as designated by the Town Engineer. Placement of fills and subgrades necessary for roadways, utilities, and other structures are discussed in their representative sections.

#### **208.02 Material**

1. Fill shall be constructed from suitable material, as per recommendations from the approved soils and geological reports, and taken from the designated excavation in conformity with the lines, grades and cross-sections shown on the plans. Stumps, trees, rubbish, vegetation, frozen lumps, or other unsuitable materials shall not be placed in embankments.
2. Materials used for fill, either imported or on-site, shall not contain hazardous materials as defined by applicable local, state or federal laws. The Town is not responsible for the identification or analysis of the potential presence of hazardous materials. However, if observations, odors or soil discoloration cause the Town to suspect the presence of hazardous materials, the Town may require the Owner to terminate grading operations within the affected area. Prior to resuming grading operations, the Owner shall provide a written report to the Town indicating that the suspected materials are not hazardous as defined by applicable laws and regulations.
3. Representative samples of soil materials to be used for fill shall be tested in a laboratory by a Soils Engineer hired and paid for by the Contractor to determine the maximum density, optimum moisture content, and, where appropriate, shear strength, expansion, and gradation characteristics of the soil.

#### **208.03 Construction Methods**

During grading, soil or ground water conditions other than those identified in the Geotechnical Report may be encountered by the Contractor. The Town and the Geotechnical Engineer hired by the Contractor shall be notified immediately to evaluate the significance of the unanticipated condition.

#### **208.04 Preparation**

1. Topsoil shall be stripped from areas which are to be disturbed by construction and stockpiled.
2. Topsoil shall be segregated from non-organic trench excavation material and debris.

#### **208.05 Pipe Bedding**

1. Placement and Compaction:



- a. Bedding material shall be distributed and graded to provide uniform and continuous support beneath the pipe at all points between bell holes or pipe joints. Pipe shall not be supported by the bells.
- b. To prevent lateral displacement, granular bedding material shall be deposited and compacted uniformly and simultaneously on each side of the pipe.
- c. Granular bedding material shall be compacted in accordance with these Standards and Specifications.
- d. Ground water barriers shall be constructed in such a manner to prevent passage of water through bedding material for the full depth of the granular bedding material and the full width of the trench.
- e. Ground water barriers, if shown on the approved construction plans, shall be approximately 4-feet long and spaced not more than 400- feet apart.
- f. Material for ground water barriers shall be as specified by the ditch company which controls the irrigation ditch to be crossed. If there is no ditch company, the Public Works Director/Town Engineer shall determine the material to be used.

#### **208.06 Backfilling and Compaction**

1. Trenches shall be backfilled promptly after the pipe has been installed and inspected. Backfill around manholes and valve boxes shall be compacted with hand-operated equipment.
2. Backfill material shall be deposited in uniform horizontal layers which may not exceed 6-inches (compacted depth) in all areas. Other thickness may be used with the prior written approval of the Public Works Director/Town Engineer.
3. Methods and equipment which are appropriate for the backfill of material shall be employed. Backfill equipment or backfilling methods which transmit damaging shocks to the pipe shall not be used.
4. Compaction shall not be performed by jetting or water settling.
5. If compaction cannot be obtained with job excavated material, trench backfill material shall be imported.
6. Topsoil shall be replaced to the depth of stripping over all areas which are to receive vegetation.
7. Excess excavated materials and materials not suitable for backfill shall be removed from the site.



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## 208.07 Field Quality Control

1. Field tests will be conducted to determine compliance of compaction methods with specified density in accordance with ASTM D 2922 (Tests for Density of Soil and Soil-Aggregate in Place by Nuclear Methods).
2. Compaction tests shall be performed at a depth of 1.5-feet above the top of the pipe and in 1-foot vertical increments up to the finish grade.
3. Compaction tests shall be performed at least once every 100-linear feet as measured along the length of the pipe.
4. If the Public Works Director/Town Engineer determines that reliable and uniform results are produced by the contractor's construction techniques, the frequency of testing may be changed to one every 200-feet.
5. Compaction shall be to the following minimum densities (reference ASTM D 698 or AASHTO T 99 unless otherwise indicated):
  - a. Barrier Material - 95% of Maximum Standard Density.
  - b. Pipe Bedding:
    - i. Compacted Granular Material - 80% of Maximum Relative Density (ASTM D 2049).
    - ii. Carefully Compacted Select Soil - 95% of Maximum Standard Density
    - iii. Barrier Material - 95% of Maximum Standard Density
  - c. Trench Backfill:
    - i. Paved roadways, sidewalks, and other areas - 95% of Maximum Standard Density
    - ii. Gravel Roadways - 95% of Maximum Standard Density
    - iii. Fields and All Other Areas - 90% of Maximum Standard Density
    - iv. Under Footings, Foundations, Structures, 100% of Maximum Standard Density or in Conformance with the Approved Soils Report and Recommendations
  - d. Moisture Content:
    - i. All compacted backfill shall be within plus or minus 2% of the optimum moisture content of the soil as determined by ASTM D 698.



- ii. Water shall be added to the material or the material shall be harrowed, disced, bladed, or otherwise worked to insure a uniform moisture content, as specified.

### **208.08 Compaction Equipment**

Compaction of soil or soil-rock fill shall be accomplished by sheepfoot or segmented-steel wheeled rollers, vibratory rollers, multiple-wheel pneumatic-tired rollers, or other types of acceptable compaction equipment. Equipment shall be of such a design that it will be capable of applying sufficient compactive effort to the soil or soil-rock fill to attain the specified relative compaction at the specified moisture content.

### **208.09 Depth and Mixing of Fill Layers**

The selected fill material shall be placed in layers that shall not exceed eight inches loose and when compacted shall not exceed six inches. Each layer shall be spaced evenly and shall be thoroughly mixed during the spreading to insure uniformity of material and moisture in each layer. The entire fill shall be constructed as a unit in level lifts. Rock materials greater than 12 inches in maximum dimension shall be placed in accordance with Section 208.14 of these specifications.

### **208.10 Fill Moisture Content**

Moisture content shall be maintained within the specified percentage deviation from optimum shown in Table 200-01. Optimum moisture content is defined as the moisture content corresponding to the maximum density of a laboratory-compacted sample performed according to ASTM D698. The contractor may be required to add moisture to the backfill material in the excavation if, in the opinion of the Town Engineer, it is not possible to obtain uniform moisture content by adding water to the fill surface. Additionally, the contractor shall not place backfill material which exceeds the maximum moisture content specification unless the material is left to aerate or is uniformly blended with drier material to achieve the specified moisture specification. The moisture content specifications for the groups of soils that may be placed in structural areas are shown on Table 200-01.

### **208.11 Fill Density**

After each layer has been placed, mixed and spread evenly, it shall be thoroughly compacted by the Contractor to a relative compaction within the range specified for the various soil types specified in Table 200-1. Relative compaction is defined as the ratio (expressed in percent) of the in-place dry density of the compacted fill to the maximum laboratory dry density as determined in accordance with ASTM D698.



### **208.12 Compaction of Fill Layers**

Compaction shall be by sheepsfoot rollers, segmented steel wheeled rollers, pneumatic tired rollers, smooth drum steel rollers, vibratory rollers, or other types of suitable compaction equipment. It is suggested that smooth drum vibratory or pneumatic tire rollers be used for granular soils and sheepsfoot or segmented rollers be used for cohesive soils. Compaction shall be accomplished while the material is at the specified moisture content. Compaction of each layer shall be continuous over its entire area and the compaction equipment shall make sufficient passes to insure that the required density has been obtained.

### **208.13 Compaction of Slopes**

1. Fill slopes shall be compacted by means of sheepsfoot rollers or other suitable equipment. Properly compacted soil fill shall extend to the design surface of fill slopes. To achieve proper compaction, it is recommended that fill slopes be over-built by at least 3-feet and then cut to the design grade. This procedure is considered preferable to track walking of slopes, as described in the following paragraph.
2. As an alternative to over-building of slopes, slope faces may be back rolled with a heavy-duty loaded sheepsfoot or vibratory roller at maximum 4-foot fill height intervals. Upon completion, slopes should then be track-walked with a D-8 dozer or approved similar equipment, such that a dozer track covers all slope surfaces at least twice.

### **208.14 Oversized Material**

1. Rocks larger than 12-inches but less than 4-feet in dimension may be incorporated into the compacted soil fill provided there is sufficient space and the presence of such rock is not likely to adversely impact further development. Rock placement shall be a minimum of 3-feet below the deepest utility or as determined by Town Engineer.
2. Rocks or rock fragments up to 4-feet in dimension may be individually placed. The placing of rock materials greater than 4-feet in dimension shall be evaluated during grading, as specific cases arise and shall be approved by the Town Engineer prior to placement.
3. For individual placement, sufficient space shall be provided between rocks to allow for passage of compaction equipment.
4. The Town Engineer and the Towns' inspector shall be notified of any oversized material that will be incorporated into compacted fill or otherwise buried underground.

### **208.15 Density Requirements**



The Contractor shall provide moisture conditioning and compaction as required to achieve at a minimum, the recommended density as specified in the soils and geological reports. No separate pay compensation shall be allowed for moisture conditioning and compaction. In addition, all phases of the base construction shall be subject to proof rolling. Areas found to be weak and those areas which have failed shall be ripped, scarified, wetted if necessary and re-compacted to the requirements for density and moisture at the Contractor's expense.

## **209 FIELD TESTING OF DENSITY AND MOISTURE CONTENT**

1. A qualified Geotechnical Engineer or technician under the direct supervision of a Geotechnical Engineer shall make field density and moisture tests of each layer of fill. Sufficient tests will be made to provide a basis for expressing an opinion as to whether the fill material is compacted as specified. The Town Engineer or Town representative will determine the frequency of testing in the field, depending on the conditions encountered. Where sheepsfoot rollers are used, the soils may be disturbed to a depth of several inches. Density tests shall be performed in the compacted materials below any disturbed surface and shall be performed in general accordance with ASTM D1556 and ASTM D2216 with 4 or 6-inch sand cone, or ASTM D2922 and D3917 with nuclear density devices and methods.
2. When these tests indicate that the density of any layer of fill or portion thereof is below that specified, the particular layer or areas represented by the test shall be reworked and retested until the specified density has been achieved.

## **210 FINISHED SLOPES AND ELEVATIONS**

The fill operations shall be continued in 6-inch compacted layers as specified above until the fill has been brought to the finished slopes and elevations shown on the accepted plans.

## **211 SEASONAL LIMITS**

1. No fill material shall be placed upon frozen subgrade, nor placed, spread or rolled while it is frozen or thawing or during unfavorable weather conditions. When work is interrupted by heavy rain, snow, or frost penetration, fill operations shall not be resumed until the Town Engineer indicates that the moisture content and density of the previously placed fill are as specified.
2. Embankment which has been subjected to freezing shall be refinished to grade, and compacted after the frost is out of the ground and the embankment is in suitable condition for work. Use of a loose cover lift is acceptable to provide frost protection, provided this loose material is not incorporated into the fill until it has been properly moisture conditioned and compacted to project specifications.



**212 PROTECTION OF WORK**

1. During construction, the Contractor shall properly grade all excavated surfaces to provide positive drainage and prevent ponding of water. Drainage of surface water shall be controlled to avoid damage to adjoining properties or to finished work on the site. The Contractor shall take remedial measures to prevent erosion of freshly graded areas until such time as permanent drainage and erosion control features have been installed. Areas subjected to erosion or sedimentation shall be properly prepared in accordance with the Specifications prior to placing additional fill or structures.
2. After completion of grading as observed and tested by the Geotechnical Engineer, no further excavation or filling shall be conducted without notifying the Town.

**213 SUMMARY OF COMPACTION AND MOISTURE REQUIREMENTS**

<b>Table 200-01 - Compaction and Moisture Requirements</b>			
<b>Structural Areas (Beneath Structures, Footings, Pavement, etc.)</b>			
<b>Soil Type</b>	<b>USCS Classification</b>	<b>Minimum Compaction (%)</b>	<b>Deviation From Optimum Moisture Content (%)</b>
Cohesive Soils	CL, CH, SC, GC	95	+1 to +4
	ML, MH	95	-1 to +2
Cohesionless Soils	SP, SM, SW, GP, GW, GM	95	-2 to +2
<b>Common Fill (Landscape Areas)</b>			
All Soils (Topsoil & Strippings)	CL, CH, SC, GC, ML, MH, SP, SM, SW, GP, GW, GM	90	-4 to +4

Notes:

1. The compaction and moisture requirements are based on Standard Proctor Density (ASTM D698).
2. Landscape fill areas do not include back of lots. Landscape areas encompass landscape berms, open space areas, detention areas, etc.
3. For fills greater than 16-feet in depth or height, minimum compaction requirements may need to be increased and will be determined by the Town Engineer.



**214 REFERENCES**

<b>Standards Referenced in Section 200:</b>	
<b>Standard</b>	<b>Title</b>
ASTM D424	Soil Classifications
ASTM D698	Standard Proctor
ASTM D1556	Density and Unit Weight by Sand Cone Method
ASTM D2216	Moisture Content of Soil and Rock by Mass
ASTM D2922	In-Place Density with Nuclear Density Gauge



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### **300 DESCRIPTION**

This section shall govern quality, storage, handling, proportioning, transportation, mixing, placing, and curing of materials for Portland cement concrete construction work within the limits of town property including but not limited to any street, parking lot, or alley right-of-way, or in any part of the water system, sanitary sewer system, or storm drainage system of the Town.

### **301 DESIGN CRITERIA**

Design criteria and construction requirements are described in this Section.

### **302 MATERIALS**

Concrete shall be composed of Portland cement or Portland cement and fly ash, water, aggregates (fine and coarse), and admixtures proportioned and mixed as hereinafter provided to achieve specified results.

#### **302.01 Cement**

Portland cement shall conform to ASTM C150, Standard Specifications for Portland Cement, Type I (General Purpose), Type II (General Purpose with Moderate Sulfate Resistance) or Type III (High Early Strength). In general, cement meeting the requirements of Type II shall be used in concrete that will be in contact with the soil, unless otherwise specified. Cement, which has become partially set or contains lumps of caked cement, shall be rejected.

#### **302.02 Fly Ash**

1. Fly ash for concrete shall conform to the requirements of ASTM C618, Coal Ash and Raw or Calcined Natural Pozzolan for use as a Mineral Admixture in Concrete, Class C or Class F. Class C fly ash will not be permitted where Type II cement is required.
2. Fly ash shall be from a preapproved source. Preapproval shall include submission of a report from the supplier documenting the results of testing the fly ash from the source in accordance with the Toxicity Characteristic Leaching Procedure (TCLP) described in 40 CFR 261, Appendix II. The report shall list the contaminants tested, the results for each contaminant tested, and the allowable levels for each contaminant tested. For any source of fly ash that has not been preapproved, the Contractor shall notify the Design Engineer of the source at least 30-days prior to use in the project. The source must be approved and the approval shall be submitted to the Town Engineer before using their fly ash.

#### **302.03 Water**

Water used in mixing or curing shall be reasonably clean and free of oil, salt, alkali, sugar, vegetable, or other substance injurious to the finished product. Water will be tested in accordance with, and shall meet the suggested requirements of AASHTO T26. Water known to be of potable quality may be used without test. Where the source of water is relatively shallow, the intake shall be so enclosed as to exclude silt, mud, grass, or other



foreign materials.

**302.04 Fine Aggregate**

1. Fine aggregate will be composed of clean, hard, durable, uncoated particles of sand, free from injurious amounts of clay, dust, soft or flaky particles, loam, shale, alkali, organic matter, or other deleterious matter and shall conform to the provisions of Standard Specifications for Concrete Aggregates ASTM C33.
2. The maximum percentage of deleterious substances shall not exceed the following values; as listed in Table 300-1:

<b>Table 300-1 Deleterious Substances, Fine Aggregate</b>	
<b>Substance</b>	<b>Maximum</b>
Coal, Lignite, or Shale	1.0
Clay Lumps	1.0
Material Passing No. 200 Sieve	4.0
Other deleterious substances	2.0
Sum of the above material	5.0

3. Fine aggregate shall be well-graded from coarse to fine and shall conform to the following gradation requirements, as listed in Table 300-2:

<b>Table 300-2 Fine Aggregate Gradation</b>	
<b>Sieve Size</b>	<b>Percent Passing by Weight (%)</b>
	<b>Type AASHTO M 6</b>
3/8-inch	100
No. 4	95 – 100
No. 8	---
No. 16	45 – 80
No. 50	10 – 30

**302.05 Coarse Aggregate**

1. Coarse aggregates for concrete shall consist of crushed stone, gravel, or other approved inert materials of similar characteristics, or combinations thereof, having strong and durable pieces. Coarse aggregates shall conform to the requirements of AASHTO M43. Aggregate shall be free from soft, thin, elongated, or laminated pieces, disintegrated stone, organic matter, clay, or other deleterious substances, in accordance with the following section and shall conform to the provisions of Standard Specifications for Concrete Aggregates ASTM Designation C33.
2. The amount of deleterious substances shall not exceed the following limits, as listed in Table 300-3:



<b>Table 300-3 Deleterious Substances, Coarse Aggregate</b>	
<b>Substance</b>	<b>Maximum</b>
Shale or Coal	1.0
Clay Lumps	0.5
Material Passing No. 200 Sieve	2.0
Deleterious substances such as friable, thin elongated, or laminated pieces	1.0
Sum of the above material and other deleterious substances	3.0

3. Coarse aggregate for concrete shall have a percentage of wear of not more than 40 when tested in accordance with AASHTO T96 or show a sodium sulfate loss not to exceed 12-percent when tested in accordance with AASHTO T140.
4. Coarse aggregate for concrete shall meet the following limits as listed in Table 300-4 for the concrete class specified. Other sizes or combinations of sizes may be used when specified.

<b>Table 300-4 Coarse Aggregate Gradation</b>			
<b>Sieve Size</b>	<b>Percent Passing by Weight (%)</b>		
	<b>Type No. 6</b>	<b>Type No. 57</b>	<b>Type No. 67</b>
1-1/2-inch	---	100	---
1-inch	100	95-100	100
3/4-inch	90 – 100	---	90 – 100
1/2-inch	20 – 55	25 – 60	---
3/8-inch	0 – 15	---	20 – 55
No. 4	0 – 5	0 – 10	0 – 10
No. 8	---	0 – 5	0 – 5

**302.06 Mortar**

1. Mortar shall be composed of Portland Cement, sand, and water proportioned and mixed as specified in this section. Mortar shall be furnished and placed in recesses and holes, on surfaces, under structural members, and at other locations specified in these specifications, the special provisions are shown on the plans.
2. The proportion of cement to sand, measured by volume, shall be 1:2 unless otherwise specified.
3. The maximum size of sand shall not be larger than ½ the size of the recess, holes or spaces where the mortar is to be placed. The mortar shall contain only enough water to permit placing and packing.
4. Concrete areas to be in contact with the mortar shall be cleaned of all loose or foreign material that would in any way prevent bond between the mortar and the concrete surfaces and shall be kept thoroughly moistened with water for a period of



not less than 24-hours immediately prior to placing mortar.

5. The mortar shall completely fill and shall be tightly packed into recesses and holes, on surfaces, under structural members, and at other locations specified. After placing, all surfaces or mortar shall be cured by the water method as provided in Section 310.04 (a), "Curing" for a period of not less than 5-days.
6. Keyways, spaces between structural members, holes, spaces under structural members, and other locations where mortar could escape shall be mortar-tight before placing mortar. No load shall be allowed on mortar that has been in place less than 72-hours unless otherwise permitted in writing by the Town Engineer.
7. All improperly cured or otherwise defective mortar shall be removed and replaced by the Contractor at his expense.
8. When required to prevent color difference, white cement shall be added to produce the color required.

### **302.07 Admixtures**

1. Admixtures to be used in concrete shall be subject to prior acceptance by the Town Engineer. The admixture shall maintain the same composition and performance throughout the work as the product used in the concrete proportioned established in accordance with ACI 211. Admixtures containing chloride ions shall not be used in prestressed concrete or concrete containing aluminum embedments.
2. An air entrainment agent shall be used in all concrete. The agent used shall conform to ASTM C260.
3. The Contractor shall use a water-reducing, set controlling concrete. A water-reducing admixture shall be used in all concrete and shall conform to ASTM Designation C494, specifically Types A, B, C, D, and E.
4. Mineral admixtures shall be limited to fly ash conforming to ASTM Specification C618.
5. Add 100% virgin polypropylene, fibrillated fibers to all concrete as specified on drawings. Volume per cubic yard shall equal a minimum of 0.1% (1.5-pounds per cubic yard). Fiber length shall be graded per manufacturer. Fibrous concrete reinforcement shall be manufactured by Fibermesh Company or equivalent acceptable to the Town Engineer. Product use shall be in accordance with manufacturer's instructions and recommendations.
6. All air-entraining agents shall be reasonably new material, thoroughly mixed and protected at all times from freezing. Admixtures other than air-entraining agents require permission of the Town Engineer. Calcium chloride-based admixtures will not be approved.



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### **303 MATERIAL STORAGE**

#### **303.01 Storage of Cement and Fly Ash**

Cement and fly ash shall be stored separately and in well ventilated, weatherproof buildings or approved bins that will protect the material from dampness or absorption. Storage facilities shall be easily accessible and each shipment of packaged cement shall be kept separated to provide for identification and inspection. The Town Engineer may permit small quantities of sacked cement to be stored in the open, for a maximum of 48-hours, on a raised platform and under waterproof covering.

#### **303.02 Storage of Aggregates**

Aggregates shall be stockpiled in sizes to facilitate blending. If the aggregate is not stockpiled on a hard, non-contaminant base, the bottom 6-inch layer of the stockpile shall not be used without recleaning the aggregate. Where space is limited, walls or other appropriate barriers shall separate stockpiles. Aggregate shall be stockpiled and protected from the weather a minimum of 24-hours prior to use to minimize free moisture content. When stockpiles are too large to protect from the weather, accurate and continuous means acceptable to the Town Engineer shall be provided to monitor aggregate temperature and moisture. Aggregates shall be stockpiled and handled such that segregation and contamination are minimized.

### **304 MIX DESIGN**

#### **304.01 General**

The Contractor shall submit design mix, laboratory trial mix, and aggregate data for each class of concrete being placed on the project. Concrete shall not be placed on the project before the design mix proportions and data have been reviewed and approved by the Design Engineer and approval shall be submitted to the Town Engineer. The test data shall show the mix design proportions, of all ingredients including cement, fly ash, aggregate, and additives, plus trial mix data including slump, air content, unit weight, yield, water-cement ratio, and 28-day compressive strength results as tested under laboratory conditions. The test data submitted shall be based on tests conducted by the Contractor. The trial mix proportions must produce 28-day compressive strengths at least 115% of the required 28-day field compressive strengths. Each design shall establish the mix proportions and sources of all ingredients. Aggregate test data will include gradations, percent passing the No. 200 sieve, sand equivalent, fineness module, specific gravity, absorption, and LA Abrasion test results. The Contractor shall be responsible for the design mix proportions and all subsequent adjustments necessary to produce the specified design strength.

#### **304.02 Classes of Concrete**

Classes of concrete shall be consistent with Table 601-1 *Concrete Table* in the Colorado Department of Transportation, Standard Specifications for Road and Bridge Construction, 2019.



### 304.03 Changes

The Contractor shall submit a new mix design when a change occurs in the source, type, or proportions of cement, fly ash, or aggregate.

### 304.04 Acceptance

Review and approval of the design mix by the Design Engineer or Town Engineer does not constitute acceptance of the concrete. Acceptance will be based solely on the test results of the concrete placed on the project.

## 305 CONSISTENCY AND QUALITY OF CONCRETE

1. The consistency and quality of concrete should allow for efficient placement and completion of finishing operations before initial set. Retempering shall not be allowed. Concrete shall be workable, cohesive, possess satisfactory finishing qualities, and of the stiffest consistency that can be placed and vibrated into a homogeneous mass within slump requirements, as specified in Table 300-5. Excessive bleeding shall be avoided, and in no case will it be permissible to expedite finishing and drying by sprinkling the surface with cement powder.
2. The consistency of concrete will be kept uniform for each class of work and will be checked by means of slump tests. At all times concrete will have a consistency such that it can be worked into corners and angles of the forms, and around joints, dowels, and tie-bars by the construction methods which are being used without excessive spading, segregation, or undue accumulation of water or laitance on the surface. If any concrete fails to conform to the proportions of the approved mix design, such concrete will not be incorporated in the work but will be discarded off the project site as waste material at the Contractor's expense. No water may be added at the job site without the permission of the Town Engineer. If approval is obtained and water is added at the job site, slump tests shall be run, and an additional set of test cylinders cast following the addition of the water.

Table 300-5 Classes of Concrete and Specifications			
Class	Air Content	Min 28 Day Strength (psi)	Max W/C Ratio
B	5-8%	4500	0.45

## 306 MIXING AND MIXING EQUIPMENT

### 306.01 General

All equipment, tools, and machinery used for hauling materials and performing any part of the work shall be in such condition to ensure completion of the work without delay. Mixing shall be done in a mixer of approved type and size that will produce uniform distribution of material throughout the mass, and shall be capable of producing concrete meeting



requirements of ASTM C94, Ready-mixed Concrete, and these Standards and Specifications. Mixing equipment shall be capable of producing sufficient concrete to provide required quantities. Entire contents of the drum shall be discharged before any materials are placed therein for a succeeding batch. Improperly mixed concrete shall not be placed. The mixer may be batched by either volumetric or weight sensing equipment and shall be equipped with a suitable timing device that will lock the discharging mechanism and signal when the specified time of mixing has elapsed.

### **306.02 Proportioning and Mixing Equipment**

1. For all miscellaneous concrete placements, a mobile, continuous, volumetric mixer or a volumetric or weight batch mixer of the rotating paddle type may be used. These mixers shall be designed to receive all concrete ingredients, including admixtures, in a continuous and uniform rate and mix them to the required consistency before discharging. Mixers shall have adequate water supply and metering devices.
2. Mixing times shall conform to the recommendations of the mixer manufacturer, and shall not be less than 2-minutes after all the materials, including the water, have been placed in the drum. During the period of mixing, the drum will be operated at the speed specified by the equipment manufacturer. The entire contents of the mixer will be discharged before recharge, and the mixer will be cleaned frequently. The concrete will be mixed only in quantities required for immediate use. No retempering of concrete will be permitted.

### **306.03 Ready-Mixed Concrete**

1. Use of ready-mixed concrete will be permitted provided the batching plant and mixer trucks meet the quality requirements specified herein. The use of ready-mixed concrete will in no way relieve the Contractor or Developer of the responsibility for proportion, mix, delivery, or placement of concrete. When ready-mixed concrete is used, additional mortar (1 sack cement, 3 parts sand and sufficient water) shall be added to each batch to coat the mixer drum. Ready-mixed concrete, batching plant, and mixer truck operations shall include the following:
  - a. A ticket system will be used that includes a copy for the Town Engineer. Each ticket will have machine stamped time/date of concrete batch, weight of cement, fly ash, sand and aggregates; exact nomenclature, and written quantities of admixtures and water. Any item missing or incomplete on the ticket may be cause for rejection of concrete. The Contractor will collect delivery or batch tickets from the driver for all concrete used on the project, and deliver them to the Town Engineer.
  - b. Sufficient trucks will be available to support continuous concrete placements. The Contractor will ensure that adequate standby trucks are available to support placement requirements.
  - c. A portion of mixing water required by the mix design to produce the specified slump may be withheld and added at the job site, but only with permission of the Town Engineer. When water is added under these conditions, it will be



thoroughly mixed before any slump or strength samples are taken. Additional cement shall not be added at the job site to otherwise unacceptable mixes.

- d. A metal plate(s) shall be attached in a prominent place on each truck mixer plainly showing the various uses for which it was designed. The data shall include the drum's speed of rotation for mixing and agitating, and the capacity for complete mixing and/or agitating only. A copy of the manufacturer's design, showing dimensions of blades, shall be available for inspection at the plant at all times. Accumulations of hardened concrete shall be removed to the satisfaction of the Town Engineer.
- e. Concrete will be continuously mixed or agitated from the time the water is added until the time of use and will be completely discharged from the truck mixer or truck agitator within 1-1/2-hours after batching.
- f. The loading of the transit mixers shall not exceed the capability as shown on the manufacturer's plate attached to the mixer or 63% of the drum volume, whichever is less. The loading of transit mixers to the extent of causing spillage on route to delivery will not be acceptable. Consistent spillage will be cause for disqualification of a supplier.
- g. Excess concrete remaining in the drum and washwater shall not be dumped on the project site unless approval of the dump location is first secured from the Town Engineer.
- h. The Town will have free access to the mixing plant at all times for the purpose of inspection.

#### **306.04 Hand Mixed Concrete**

Hand mixing of concrete will only be permitted for small placements, or in case of an emergency and only as authorized by the Town Engineer. Hand-mixed batches shall not exceed 4-cubic feet in volume. Material volume ratios shall not be leaner than one part cement, two parts coarse aggregate, one part fine aggregate, and enough water to produce a consistent mix with a slump not to exceed 4-inches. Admixtures shall not be used unless specifically approved by the Town Engineer.

### **307 REINFORCING STEEL**

#### **307.01 Bars**

1. Reinforcing steel shall conform to the requirements of the following specifications:
  - a. Deformed and plain billet-steel bars for concrete reinforcement AASHTO M31
  - b. Axle-steel deformed and plain bars for concrete reinforcement AASHTO M53
  - c. Fabricated steel bar or rod mats for concrete reinforcement AASHTO M54



- d. Welded steel-wire fabric for concrete reinforcement AASHTO M55
  - e. Welded deformed steel wire fabric AASHTO M221
  - f. Epoxy coated rebar AASHTO M284
2. Unless otherwise designated, bars conforming to AASHTO M 31 and M 53 shall be furnished in Grade 60 for No. 5 bars and larger and Grade 40 or 60 for bars smaller than No. 5. In AASHTO M 54, bar material conforming to AASHTO M 42 will not be permitted.

**307.02 Forming of Reinforcement**

1. Reinforcement shall be carefully formed to the dimensions indicated on the approved plans by the cold-bending method. The use of heat in bending bars shall not be permitted. Bars shall not be bent or straightened in a manner that will injure the material. Bars with kinks or bends not shown on the plans shall not be used. Cold bends will be made so that the inside diameter of the bend measured on the inside of the bar is as listed in Table 300-6:

Table 300-6 Bar Bend Diameters	
Bar Size	Inside Diameter
No. 3 through No. 8	6 x bar diameter
No. 9, No. 10, and No. 11	8 x bar diameter
No. 14 and No. 18	10 x bar diameter

2. The inside diameter of bend for stirrups and ties shall not be less than four bar diameters for sizes No. 5 and smaller, and five bar diameters for No. 6 and No. 8 inclusive.

**307.03 Welded Wire Fabric**

Welded wire fabric for concrete reinforcement will be of the gauge, spacing, dimensions and form specified on the plans or detailed drawings and will comply with ASTM A185, Specifications for Welded Steel Wire Fabric for Concrete Reinforcement or ASTM A497 Specification for Welded Deformed Steel Wire Fabric for Concrete Reinforcement.

**307.04 Fibermesh**

Approval of the Town Engineer must be obtained prior to using Fibermesh reinforcement in place of Welded Wire Fabric. (See Section 307.03).

**307.05 Shop Drawings**

Before fabrication of the reinforcement, the Contractor shall prepare complete bending, fabrication, setting drawings, and bar lists covering all required reinforcement steel. Drawings and bar lists shall be submitted to the Design Engineer for review and approval of



general conformity to specified requirements and the approval shall be submitted to the Town Engineer. The Design and/or Town Engineer's acceptance of shop drawings and bar schedules will not relieve the Contractor of fulfilling responsibilities as outlined in the approved plans and these Standards and Specifications.

### **307.06 Placing**

1. The placing, fastening, splicing and supporting of reinforcing steel and bar mat reinforcement shall be in accordance with the plans and the latest edition of "CRSI Recommended Practice for Placing Reinforcing Bars". In case of discrepancy between the plans and the CRSI publication stated above, the plans shall govern.
2. Steel reinforcement shall be accurately placed in the positions shown on the plans and firmly held during the placing and setting of concrete by means of spacer strips, stays, metal chairs or other approved devices or supports. When metal chairs are used, the part of the chair in contact with the form and at least 1-inch from the form shall be hot dip galvanized or plastic coated. Other coatings or treatments will be acceptable when specifically accepted by the Engineer. Precast concrete bricks or other accepted bricks or blocking may be used in structures to support reinforcement in footings or slabs placed on grade; however, the bricks or blocking shall not contact the reinforcement over a distance greater than the depth of a standard concrete brick.
3. Bars shall be securely tied at all intersections except where spacing is less than 1-foot in each direction, when alternate intersections shall be tied. Tying of steel by spot welding will not be permitted unless specifically authorized by the Town Engineer. The placing and securing of the reinforcement in any unit or section shall be accepted by the Town Engineer or a Town Representative before any concrete is placed in any such unit or section. At the time the concrete is placed, the reinforcing steel required shall be free from flaky rust, mud, oil or other coatings that will destroy or reduce the bond.
4. Reinforcing steel, before being placed, shall be thoroughly cleaned of mill and rust scale and of coatings that will destroy or reduce bonding. Reinforcing steel shall be accurately placed and secured against displacement by using annealed wire of not less than No. 18 gauge, or suitable clips at intersections. Where necessary, reinforcing steel shall be supported by metal chairs or spacers, precast mortar blocks, or metal hangers. Splicing of bars, except where shown on approved plans will not be permitted without approval of the Town Engineer.

### **307.07 Minimum Clear Cover**

The minimum clear cover for reinforcing steel is listed in Table 300-7, as specified in ACI 301:

**Table 300-7 Minimum Clear Cover**



Type	Minimum Cover
Bottom bars on soil bearing foundations and slabs	3-inches
Bars adjacent to surfaces exposed to weather on earth backfill - Greater than 3/4-inch in diameter	2-inches
Bars adjacent to surfaces exposed to weather on earth backfill - 3/4-inches or less in diameter	1-1/2-inches
Interior surfaces - slabs, walls, joints with 1-3/8-inch diameter or smaller	3/4-inches

**308 FORMS**

**308.01 General**

1. Whenever necessary, forms will be used to confine the concrete and shape it to the required lines. Forms will have sufficient strength to withstand, without deformation, the pressure resulting from placement and vibration of the concrete. Forms will be constructed so that the finished concrete will conform to the shapes, lines, grades, and dimensions indicated on the accepted plans. Any form which is not clean and has not had the surface prepared with a commercial form oil, that will effectively prevent bonding and that will not stain or soften concrete surfaces, will not be used.
2. The concrete forms shall be constructed to the lines and dimensions as shown on the detailed drawings and shall be of acceptable material and adequately braced and tied to support all of the loads and pressures of the wet concrete without distortion or leaks, and which will produce a smooth, even surface.
3. The form facing material shall produce a smooth, hard, uniform texture on the concrete. It may be plywood, tempered concrete-form-grade hardboard, metal, plastic, paper, or other approved material capable of producing the desired finish. The arrangement of the facing material shall be orderly and symmetrical, with the number of seams kept to the practical minimum. It shall be supported by studs or other backing capable of preventing excessive deflection. Material with raised grain, torn surfaces, worn edges, patches, dents, or other defects which will impair the texture of the concrete shall not be used. Tie holes and defects shall be patched. All fins shall be completely removed.
4. A water tight form tie with a neoprene seal shall be used on all walls or slabs that form a water holding space. Ties in these walls or slabs shall remain permanently in the concrete.
5. Drawings showing the general design and dimensions for forms for structures need not be submitted to the Town Engineer for acceptance unless the Town Engineer so requests such submittal. Design and construction shall be in accordance with "Recommended Practice for Concrete Formwork" (ACI 347), and "Formwork" (ACI 301, Chapter 4).



6. Before concrete is placed, the surface of the forms shall be oiled with a commercial form oil that will effectively prevent sticking of the concrete to the forms and will not stain the concrete. Form oil shall be approved for potable water applications. All bond breaking materials or processes shall be used only after acceptance by the Town Engineer. Care shall be taken in applying form oil to avoid contact with reinforcement steel. Embedded material which becomes coated with form oil shall be thoroughly cleaned or replaced at the expense of the Contractor. Supporting forms and shores shall not be removed from beams, floors, and walls until these structural units are strong enough to support their own weight and any approved superimposed load which at no time shall exceed the design live load. When the forms are stripped, there shall be no excessive deflection or distortion and no evidence of damage to the concrete, due either to removal of support or the stripping operation. See Table 300-8 for minimum form removal time.
7. Design Criteria:
  - a. The Contractor shall design the formwork for the loads, lateral pressures and allowable stresses outlined in Chapter 1 of ACI 347.
  - b. Form ties: Removeable end, permanently embedded body type (with waterseal washers for liquid retaining structures) in uniformly spaced and aligned vertical and horizontal rows. Ties shall be of sufficient strength and rigidity to support and maintain the form in proper position without auxiliary spreaders. When cones are provided on the outer ends, the permanently embedded portion shall be back a minimum of one inch from concrete surface. Cones shall be finished with non-shrink grout as approved by the Town Engineer.
  - c. Joints shall be keyed and formed unless specified otherwise by the Town Engineer.
8. Erection:
  - a. Erect forms substantially and sufficiently tight to prevent leakage of mortar and braced or tied to maintain 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 or alternate method approved by Town Engineer.
  - b. Provide temporary openings in column and wall forms and at other locations where necessary to facilitate cleaning, to limit the free fall of the concrete to a maximum of 5- feet, to allow compaction of the concrete and to allow inspection. Such openings shall not exceed 10-feet laterally to avoid moving concrete laterally more than 5-feet. If tremies of proper length to limit the free fall are used for depositing concrete in walls then temporary openings are not required.
  - c. After steel reinforcement has been constructed the Contractor shall leave forms such that the Town Engineer or a Town's representative may properly inspect the



reinforcement. No concrete shall be poured without inspection and approval of reinforcement by the Town.

- d. When top of wall will be exposed to weathering, do not extend the forms on one side above the top of the wall; bring to true line and grade. At other locations, bring forms to 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 screed or template.
  - e. Anchor bolts, castings, steel shapes, conduits, sleeves, waterstops, and other materials shall be accurately positioned in the forms and securely anchored. Install conduits in walls and floors between the two mats of reinforcing when present.
  - f. Place chamfer strips in forms to bevel exposed edges and projecting corners. Tool top edges of walls and slabs not indicated for beveling. Form beveled edges for all vertical and horizontal corners of equipment bases and column footings. Chamfer strip shall be 3/4-inch unless specified otherwise.
9. Maximum Allowable Tolerances - Variation from plumb
- a. Lines and surfaces of columns, piers and walls
    - 1) In any 10-feet of length 1/4-inch
    - 2) Entire length 1-inch
  - b. Control joint grooves and other conspicuous lines
    - 1) In any 20-feet of length 1/4-inch
    - 2) In 40-feet or more 3/4inch
10. Maximum Allowable Tolerances - Variation from level or specified grade
- a. Slabs, beams and roof
    - 1) In any 10-feet of length 1/4-inch
    - 2) In any 20-feet of length 3/8-inch
    - 3) Entire length 3/4-inch
  - b. The maximum deflection of facing materials reflected in concrete surfaces exposed to view shall be 1/240 of the span between supporting members.
  - c. Refer to ACI 301, Table 4.3.1 for additional requirements

### 308.02 Removal

1. Do not remove or disturb forms until the concrete has attained sufficient strength to safely support all live and dead loads. Forms shall remain on beams, slabs and similar sections until 28-day strength is attained. Determine strength from ASTM C900 for pullout test or job cured cylinder breaks. In any case, do not remove forms before the strengths are attained in Table 300-8.



2. Forms will not be disturbed until the following two conditions have all been satisfied:
  - a. The minimum strength has been attained as specified in Table 300-8
  - b. Approval of the Town Engineer

<b>Table 300-8 Minimum Time &amp; Concrete Strength for Form Removal<sup>1</sup></b>		
<b>Type</b>	<b>Min. Time</b>	<b><sup>2</sup>Min. Strength</b>
Curb and gutter	2-days	40%*f <sub>c</sub>
Side forms for footings and slabs	3-days	50%*f <sub>c</sub>
Side forms for non-structural walls, beams, and columns	3-days	75%*f <sub>c</sub>
Forms under structural beams and slabs requiring shoring	7-days	100%*f <sub>c</sub>
Vertical sides of beams and girders	7-days	100%*f <sub>c</sub>
Bottom forms and shoring for slabs, beams and girders: 10 to 20-foot span between permanent supports.	14-days	100%*f <sub>c</sub>
Bottom forms and shoring for slabs, beams and girders: over 20-foot span between permanent supports.	21-days	100%*f <sub>c</sub>

<sup>1</sup>Both the minimum time and minimum strength requirements must be met before forms are removed.

<sup>2</sup>f<sub>c</sub> is the design strength of the concrete.

### 309 JOINTS

#### 309.01 Materials

1. Joint materials will conform to AASHTO specification according to type as follows:

<b>Table 300-9 Joint Material Specifications</b>	
<b>Type</b>	<b>AASHTO</b>
Concrete joint sealer, hot-poured elastic	M173
Preformed expansion joint filler, bituminous type	M33
Preformed sponge rubber and cork expansion joint fillers	M153
Preformed expansion joint fillers, non-extruding and resilient bit	M213
Interior surfaces - slabs, walls, joints with 1-3/8-inch diameter or smaller	3/4-inches

2. Non-bituminous types shall be placed in widths shown on the accepted plans or 3/8-inch when not specified. Bituminous type shall be used for concrete paving and structural construction where joint sealer is not called for.
3. All concrete alleys require an expansion and contraction joint plan to be submitted to the Town. This plan shall depict the locations of all joints including spacing, type of



joint and construction method (i.e. tooled or sawed).

### **309.02 Expansion Joints**

1. Expansion joints will be provided at the following locations and shall be in place prior to the placing of concrete. Epoxy rebar dowels should be placed per Section 518 and 520.
  - a. At both edges of driveway, in accordance with Detail 500-18.
  - b. Between back of sidewalk and driveway slab or service walk;
  - c. Between new concrete and existing masonry building;
  - d. Between new and existing concrete;
  - e. Minimum every 200-feet in sidewalk;
  - f. Minimum every 200-feet in curb and gutter;
  - e. As shown on the approved plans and standard details; and
  - f. As directed by the Town Engineer.
2. Refer to Detail 500-19 for expansion joint details.

### **309.03 Contraction Joints**

1. Transverse joints shall be placed at maximum intervals of 10-feet to control random cracking. Joints shall be formed, sawed, or tooled to a minimum depth of 1/3 of the total thickness, but no less than 1-1/2-inches. Contraction joints shall be placed as follows, and in accordance with Detail 500-20:
  - a. Not more than 10-feet and no less than 6-feet apart in curb and gutter.
  - b. Not more than the walk width apart in non-monolithic concrete sidewalk
  - c. At least two joints equally spaced at not greater than 10-foot intervals as applicable in driveways
  - d. As shown on the drawings and details
  - e. As directed by the Town Engineer

## **310 PLACEMENT OF CONCRETE**

### **310.01 General**

1. Prior to pouring the concrete, the Contractor shall remove all trash, pieces of wood,



or other debris, and shall wet areas in which concrete is to be poured prior to concrete placement.

2. Placement shall conform to ACI 301, Chapter 8 "Placing," ACI 306 "Recommended Practice for Cold Weather Concreting," and ACI 305 "Recommended Practice for Hot Weather Concreting." No concrete shall be placed until all formwork, reinforcement, installation of parts to be embedded, bracing of forms, and preparation of surfaces involved in the placing have been approved by the Town Engineer. No concrete shall be placed in water, except with the written permission of the Town Engineer; the method of depositing the concrete shall be subject to the Town's approval. All surfaces of forms and embedded materials that have become encrusted with dried mortar or grout from concrete previously placed shall be cleaned of all such mortar or grout before the surrounding or adjacent concrete is placed. Immediately before placing concrete, all surfaces upon or against which the concrete is to be placed shall be free from standing water, mud, debris, or loose materials. The surfaces of absorptive materials against or upon which concrete is placed shall be moistened thoroughly so that moisture will not be drawn from the freshly placed concrete. The concrete shall be placed by equipment which will prevent segregation or loss of ingredients. The stream of concrete shall not be allowed to separate by permitting it to fall freely over rods, spacers, or other embedded materials.
3. All concrete poured in walls exceeding 5-feet in height shall be spouted or "tremmied" so that the maximum free fall shall be 5-feet.
4. Concrete shall be poured in continuous layers of approximately 12-inches and the total elapsed time between placing of successive layers shall not exceed 30-minutes.
5. All wood blocking, spreaders, and screens shall be removed as the concrete is poured and before the concrete sets.

### **310.02 Vibration**

1. Concrete will be thoroughly vibrated using mechanical vibrating equipment. However, concrete in floor slabs, sidewalks, or curb and gutter, not poured against form linings, will either be tamped or vibrated. Care will be taken in vibrating the concrete to vibrate only long enough to bring a continuous film of mortar to the surface. Vibration will stop before any segregation of the concrete occurs. Mechanical vibrators will be an approved type as specified in ACI 309, Guide for Consolidation of Concrete. Vibrators will not be used to move or spread the concrete.
2. Any evidence identifying a lack of consolidation or over consolidation will be sufficient reason to require the removal of the section involved and its replacement with new concrete at the Contractor's expense. The Contractor will be responsible for any defects in the quality and appearance of the completed work.

### **310.03 Finishing**



1. Exposed faces of curbs and sidewalks will be finished to true-line and grade as shown on the plans. Surfaces will be floated to a smooth, but not slippery finish. Sidewalks and curbs will be broomed, or combed and edged, unless otherwise directed by the Town Engineer. After completion of brooming and before concrete has taken its initial set, all edges in contact with the forms will be tooled with an edger having a 3/8-inch) radius. No dusting or topping of the surface or sprinkling with water to facilitate finishing will be permitted.
2. Immediately following the removal of the forms, all fins and irregular projections will be removed from all exposed faces. All construction and expansion joints in the completed work will be left carefully tooled and free of mortar and concrete. The joint filler will be left exposed for its full length with clean and true edges.
3. Immediately after removing the forms, the form ties shall be cut back 3/4-inch from the surface and patched with 1:2 cement-sand mortar. All honeycombs, voids, and other defects shall be so patched. The surfaces shall then be thoroughly wetted and rubbed with a No. 16 Carborundum stone or equal abrasive brining the surface to a paste. The rubbing shall be continued sufficiently to remove all form marks and projections, producing a smooth, dense surface without pits or irregularities. After setting sufficiently, the surface shall then be rubbed with a No. 30 Carborundum stone until the entire surface is of a smooth texture and uniform in color. Only exposed surfaces in habitable areas need be rubbed. Surfaces to be waterproofed or hidden from view shall be patched, but not rubbed.

#### **310.04 Curing**

1. Fresh concrete will be adequately protected from weather damage and mechanical injury during the curing periods. It shall be the Contractor's responsibility to determine the necessity for undertaking protective measures. The minimum for curing period shall be 5-days.
2. Immediately after placing fresh concrete, all concrete shall be cured by one of the following methods. The Town Engineer shall review the curing method proposed by the Contractor.
  - a. *Water Method:* All surfaces other than slabs shall be protected from the sun and the whole structure shall be kept wet for a period of at least 5-days following concrete placement. All concrete slabs shall be covered as soon as possible with suitable material so that concrete is kept thoroughly wet for at least five days. The concrete surface shall be kept moist at all times by fogging with an atomizing nozzle until the covering is placed.
  - b. Membrane Forming Curing Compound Method:
    - i. Curing compounds shall be white-pigmented, liquid, membrane forming compounds that shall conform to AASHTO M148 Type II, Class B. Membrane curing compound shall not be used on construction joints.
    - ii. The rate of application of curing compound will be as directed, but shall not



be more than 200-square feet per gallon. All concrete cured by this method shall receive two applications of the curing compound. The first coat shall be applied immediately after stripping of the forms. If the surface is dry, the concrete shall be thoroughly wet with water and the curing compound applied just as the surface film of water disappears. The second application shall be applied after the first application has set. During curing operations any unsprayed surfaces shall be kept moist with water.

- iii. When using a curing compound, the compound shall be thoroughly mixed within an hour of use. If the use of curing compound results in a streaked or blotchy appearance, its use shall be discontinued. Water curing shall then be applied until the cause of the defective appearance is corrected.
- c. Form Method: When cured using the form method, concrete shall be protected by forms for at least 5-days. Forms shall be kept moist as necessary during the curing period to insure that the concrete surface remains wet.
- d. Blanket Method: Electrically heated curing blankets or insulation blankets may be used in cold weather to maintain specified curing temperatures and to retain moisture in concrete. Blankets shall be lapped at least 8-inches and shall be free of holes. Blankets shall be secured at laps and edges to prevent moisture from escaping.

### **311 WEATHER PROTECTION**

#### **311.01 Cold Weather Concreting**

1. Placing of concrete in cold weather will be in accordance with ACI 306R, Cold Weather Concreting. Concrete shall not be placed, regardless of temperature conditions, if the supporting ground is frozen or contains frost. Use of salt or other additives to prevent frost will not be allowed. Concrete that has been frozen shall be completely removed and replaced as directed by and to the satisfaction of the Town Engineer. The temperature must be 40-degrees Fahrenheit and rising before any concrete is placed.
2. No concrete shall be placed, regardless of the present temperature, when the weather forecast calls for freezing temperatures before final set of the concrete, unless special means of heating and protection are approved in writing by the Town Engineer. Protection against freezing is the Contractor's responsibility regardless of the weather forecast or climatic conditions at the time of placing.
3. During cold weather conditions, concrete less than seventy-two hours old shall be protected in accordance with ACI 306R Table 3.1.
4. Heated enclosures may be used in lieu of protection requirements cited above. If used, such enclosures shall be maintained for at least 7-days.



### **311.02 Hot Weather Concreting**

Except by written authorization from the Town Engineer, concrete will not be placed if the temperature of the concrete cannot be maintained at 90-degrees Fahrenheit or lower. The placement of concrete in hot weather shall comply with ACI 305, Hot Weather Concrete. Retempering of concrete shall not be allowed.

### **311.03 Rate of Temperature Change**

Changes in temperature of the air immediately adjacent to the concrete during and immediately following the curing period shall be kept as uniform as possible and shall not exceed 5-degrees Fahrenheit in any 1-hour or 50-degrees Fahrenheit in any 24-hour period.

## **312 REPAIRS**

### **312.01 Repairs to Newly Placed Concrete**

After stripping of the forms if any concrete is not formed as shown on the accepted plans, is out of alignment or level, or shows a defective surface it will be considered as not conforming with the intent of these Standards and Specifications. It will then be removed and replaced by the Contractor at the Contractor's expense, unless the Town Engineer gives written permission to patch the defective area. In this case, patching will be done as described in the following paragraphs.

### **312.02 Patching**

Defects that require replacement or repair are those that contain honeycomb, damage due to stripping of forms, joints, and bulges due to movement of forms. Ridges and bulges will be removed by grinding. Honeycombed and other defective concrete not affecting the integrity of the structure will be chipped out and patched with a non-shrink, non-metallic grout with a minimum compressive strength of 5,000-psi in 28-days. All repair areas treated with an epoxy-bonding agent will have the approval of the Town Engineer before the repair filling is placed.

### **312.03 Bolt Holes, Tie-Rod Holes, and Minor Imperfections**

Bolt-holes, tie-rod holes, and minor imperfections as approved by the Town Engineer will be filled with dry-patching mortar composed of 1 part Portland cement to 2 parts of regular concrete sand (volume measurement), and only enough water to allow the ingredients to be cohesive. Mortar repairs will be placed in layers and thoroughly compacted by suitable tools. Care will be taken in filling rod and bolt holes so that the entire depth of the hole is completely filled with compacted mortar.

### **312.04 Repairs to Existing Sidewalk**

Where repairs are made in existing sidewalks, all edges of the old sidewalk allowed to remain will be sawcut to the full depth of the concrete. No rough edges will be permitted where new construction joins the old section. Unless directed by the Town Engineer, no section less than 6-feet in length will be placed or left in place. Where new sidewalk



construction abuts existing sidewalk the work will be accomplished so that there is no abrupt change in grade between the old section and the new work. Existing and new sidewalk shall be doweled together.

### **313 BACKFILLING**

After forms have been removed and the concrete has gained at least 80% specified design strength, the space adjoining the concrete will be promptly backfilled with suitable material, properly compacted, and brought flush with the surface of the concrete and adjoining ground surface. In embankments, the backfill will be level with the top of the concrete for at least 2-feet and then sloped as shown on the accepted plans, or as directed by the Town Engineer.

### **314 FLOWABLE BACKFILL**

1. This section specifies requirements for design, materials, production, and placement of low strength, flowable pozzolanic backfill, also known as flowfill, flowcrete, or fly ash slurry. Flowable backfill is an alternative to conventional compacted earth backfill. Typical applications for this type of backfill are as follows:
  - a. Utility trenches
  - b. Bridge abutments, retaining walls, etc.
  - c. Structural (foundation subbase, subfooting, pipe bedding, etc.)

#### **314.01 Mix Design**

1. A mix design shall be prepared in a testing laboratory by a Colorado Registered Professional Engineer competent in the field of materials engineering. In lieu of a mix design, documentation of field test data may be submitted. Samples of the mix, with its formula, shall be made available to the Town for testing prior to construction. Town reviewed mixes may be considered prequalified for subsequent usage. Flowability and strength requirements shall be as follows:
  - a. Slump: 7-inches minimum
  - b. 28-day Strength: 30 - 90-psi
  - c. 90-day Strength: 35 - 95-psi

#### **314.02 Materials and Production**

Flowable backfill shall be produced from a job mix formula as specified above. When coarse aggregate is used, 100% shall pass the 1-inch sieve, and it shall comprise not more than 40-percent of the total aggregate content. Other aggregate products such as aggregate base, crushed rock, pea gravel, or reject sand which has not more than 20% passing the No. 200 sieve and is free of organic material and other deleterious substances,



may be accepted by the Town Engineer if a flowable, workable mix can be produced without segregation of the aggregate.

### **314.03 Placement**

1. Before depositing flowable backfill, debris shall be removed from the space to be occupied by the flowable backfill. Vibratory or other compaction equipment shall be used only when necessary to fill inaccessible voids.
2. Flowable backfill shall be allowed to cure for 24-hours before placing permanent pavement on it. Traffic shall not be allowed on flowable backfill during the first 6-hours after placement. Temporary pavement or fill can be used after a 6-hour initial set.

### **315 CLEANUP**

The exposed surfaces of the concrete will be thoroughly cleaned upon completion of the work, and the site will be left in a neat and orderly condition.

### **316 INSPECTION AND TESTING**

#### **316.01 General**

1. It is the responsibility of the contractor to contact the Town Engineer a minimum of 48-hours (two full working days) in advance of the required inspections which include:
  - a. Subgrade – The Town Engineer shall verify that the material which concrete shall be placed on as shown on the approved plans is not frozen, excessively wet, or excessively dry at the surface and meets compaction requirements.
  - b. Forms – The Town Engineer shall verify that the forms are set to proper alignment, braced adequately, and set for required thickness.
  - c. Reinforcing steel – The Town Engineer shall verify that the rebar is properly placed and spaced, at least 50% of the intersections are tied, and proper distances from surface grade and forms are maintained.
  - d. Concrete Delivery and Testing – The Town Engineer shall confirm that mix design submittals meet Town of Frederick requirements and that the contractors testing/sampling frequency and minimum/maximum air temperatures comply with these STANDARDS and SPECIFICATIONS
  - e. Cure and Flush – The Town Engineer shall verify that finished concrete is properly cured and finished.
2. Requirements of this section will apply to testing services for all concrete curb and gutter, sidewalk, pavement, slope paving, retaining walls, structures, and for all miscellaneous concrete testing.
3. Concrete materials and operations will be tested as directed by the Town Engineer and as herein stipulated. The required testing services will be performed by a designated testing agency acceptable to the Town Engineer and all testing agencies



- will meet the requirements of ASTM E 329, Agencies Engaged in the Testing and/or Inspection of Materials Used in Construction.
4. A representative of the testing agency will inspect, sample, and test material and production of concrete as required by the Town Engineer. When it appears that any material furnished or work performed by the Contractor fails to fulfill specification requirements, the testing agency will report such deficiency to the Town Engineer and the Contractor.
  5. The testing agency will report all test and inspection results to the Town Engineer and Contractor immediately after they are performed. All test reports will include the exact location of the work at which the batch represented by a test was deposited. The report of the strength test will include detailed information on storage and curing specimen prior to testing, the project number, and the location of the concrete (curb, manhole inlet, sidewalk, paving, etc.).
  6. The testing agency or its representative is not authorized to revoke, alter, relay, enlarge, or release any requirements of the Standards and Specifications, nor approve or accept any portion of the work.
  7. Finish shall be true flat planes within 1/4-inch in 10-feet, as determined by a 10-foot long straight edge placed in any direction on the slab.

**316.02 Testing Provided by the Contractor**

1. The following services shall be performed by the designated testing agency at the expense of the Contractor:

<b>Table 300-11 Concrete Testing</b>			
<b>Test</b>			<b>Frequency</b>
<b>Compressive Strength</b>			<ul style="list-style-type: none"> <li>▪ As often as needed for quality control, as determined by the Town Engineer.</li> <li>▪ Make 5 cylinders for each pour of 20-cubic yards or more, but not less than one set of tests and 5 cylinders for each structure or project component or as directed by the Engineer.</li> <li>▪ Flatwork and C&amp;G make 5 cylinders for each pour of 40-yards or more.</li> <li>▪ All concrete pours must make a minimum of 5 cylinders.</li> </ul>
<b>Qty</b>	<b>Time</b>	<b>Cure</b>	
1	HOLD	field	
1	HOLD	lab	
1	7-day	lab	
1	14day	lab	
1	28-day	lab	
<b>Slump</b>			<ul style="list-style-type: none"> <li>▪ 1 per set of cylinders taken</li> <li>▪ 1 per truck for first 3 trucks of every pour and until 3 trucks test consistently</li> <li>▪ Often as needed for quality control</li> <li>▪ As directed by the Town Engineer</li> </ul>
<b>Air Content</b>			<ul style="list-style-type: none"> <li>▪ 1 per set of cylinders taken</li> <li>▪ 1 per truck for first 3 trucks of every pour and until 3 trucks test consistently</li> </ul>



- |  |                                                                                                                                  |
|--|----------------------------------------------------------------------------------------------------------------------------------|
|  | <ul style="list-style-type: none"><li>▪ Often as needed for quality control</li><li>▪ As directed by the Town Engineer</li></ul> |
|--|----------------------------------------------------------------------------------------------------------------------------------|

2. When the work fails to pass inspection or previous tests fail to meet specifications, additional tests shall be taken as directed by the Town Engineer.
3. Testing or sampling not completed as specified may be cause for rejection of the concrete, which shall be removed and replaced at the Contractor's expense. Alternatively, and only at the discretion and direction of the Town Engineer, core samples may be obtained. Obtaining and testing cores will be in accordance with ASTM C42, Obtaining and Testing Drilled Cores and Sawed Beams of Concrete, and paid for by the Contractor. Concrete in the area represented by a core test will be considered adequate if the average strength of the cores is equal to at least 85% of the specified strength, and if no single core is less than 75% of the specified strength. Core holes will be filled with low slump concrete or mortar. Cores may be tested in the dry condition in accordance with ACI 301.

### **317 CONCRETE STRUCTURE DESIGN CRITERIA**

#### **317.01 Curb and Gutter Section**

All curb and gutter shall be constructed as identified on the approved plans, and in accordance with the standard details included in the back of Section 500.

#### **317.02 Sidewalks**

Sidewalks shall be 6-inch thick and constructed to the dimensions shown on the approved construction plans and in accordance with the standard details included in the back of Section 500. All areas of sidewalk that will be crossed by driveways will be constructed with 6-inch thick concrete in residential areas and 8-inch thick concrete in commercial areas.

#### **317.03 Crosspans and Curb Return**

Crosspans and curb return shall be constructed as shown in the standard details included in the back of Section 500. Where unusual conditions prevail, additional reinforcing steel and special joints may be required by the Town Engineer.

#### **317.04 Curb Cuts and Driveways**

1. Curb cuts shall be provided at all driveway locations and at additional locations, as shown on the approved plans. Construction of curb cuts shall be as shown on the detail drawings. Spacing will be as shown on the approved plans and/or as approved by the Town Engineer. Curb cuts should not be used for commercial, industrial or high volume residential driveways. In general, when the number of parking spaces serviced by the driveway exceeds 10, radius returns are required.
2. Where curb cuts are allowed based on traffic considerations, concentrated storm



water runoff must not be discharged across the sidewalk. These flows must be directed to a sidewalk chase section, constructed in accordance with the detail included in the back of Section 500. If this is not possible due to grading restraints, radius returns and a crossspan shall be used.

### **317.05 Curb Ramps**

1. State law requires that pedestrian ramps be installed at all intersections and at certain mid-block locations for all new construction of curb and sidewalk [CRS 43-2-107(2)]. Pedestrian ramps shall be constructed in accordance with all current ADA Regulations. Pedestrian ramps may be shown at all curb returns or called out by a general note on the development and construction plans, but must be shown (located) on all "T" intersections. Whenever referencing a pedestrian ramp, call out the specific detail drawing to construct that ramp. The ramp portion shall have a truncated dome in accordance with the most current ADA standards.
2. Drainage structures shall not be placed in line with pedestrian ramps. Location of pedestrian ramps shall take precedence over location of the drainage structure.

### **317.06 Bridges and Major Drainage Structures**

1. All culvert pipe, box culverts, and bridges which will ultimately be maintained by the Town shall conform to the following:
  - a. AASHTO "Standard Specifications for Highway Bridges"
  - b. Colorado Department of Transportation's "Standard Specifications for Road and Bridge Construction"
  - c. Colorado Department of Transportation's "Bridge Manual," Volumes I and II.
2. All structures shall be designed to an HS-20 loading.
3. Testing of concrete for major structures shall be in accordance with Section 316 of these Standards and Specifications.
4. All box culverts and bridges shall have the year of construction permanently indented on the downstream headwall face in legible numbers. The numbers shall be 3-inches high by 1-1/2-inch wide and approximately 3/8-inch deep in the headwall face.
5. All box culvert and bridge designs shall be certified by a Professional Engineer registered in the State of Colorado who is competent to perform such designs.

### **318 MATERIALS**

1. *Bed Course Material:* Bed course material for sidewalks, curbing, and bikeways shall consist of cinders, sand, slag, gravel, crushed stone or



- other material of such gradation that all particles shall pass through a sieve having 3/4-inch square openings.
2. Reinforcing Steel: Reinforcing steel shall conform to the requirements of Section 307-Reinforcing Steel of these Standards and Specifications.
  3. Joint Filler: Joint filler shall conform to the requirements of Section 309, Joints, of these Standards and Specifications.
  4. *Concrete*: Unless otherwise indicated, concrete for curb, gutter, sidewalk and bikeways shall be 4500-psi at 28-day strength. All crosspans and sidewalks/bikeways greater than and including 8 feet wide shall be constructed of 4500-psi concrete at 28-day strength along with fibermesh reinforcement. All other structures shall be CDOT Class D unless otherwise indicated.

**319 REFERENCES**

<b>Standards Referenced in Section 300:</b>	
<b>Standard</b>	<b>Title</b>
AASHTO M6	Fine Aggregate for Portland Cement
AASHTO M26	Water for Use in Concrete
AASHTO M31	Deformed and Plain Billet-Steel Bars for Concrete Reinforcement
AASHTO M33	Preformed Expansion Joint Filler for Concrete, Bituminous Type
AASHTO M43	Sizes of Aggregate for Road and Bridge Construction
AASHTO M53	Axle-Steel Deformed And Plain Bars for Concrete Reinforcement
AASHTO M54	Welded Deformed Steel Bar Mats For Concrete Reinforcement
AASHTO M55	Steel Welded Wire Reinforcement, Plain, For Concrete
AASHTO M148	Curing Compounds for Concrete
AASHTO M153	Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction
AASHTO M173	Concrete Joint Sealer, Hot Poured Elastic Type
AASHTO M213	Preformed Expansion Joint Fillers for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types)
AASHTO M221	Steel Welded Wire Reinforcement, Deformed, for Concrete
AASHTO M284	Epoxy-Coated Reinforcing Bars: Materials and Coating Requirements
AASHTO T96	Resistance to Degradation of Small Size Course Aggregate by Abrasions and Impact in the LA Machine
AASHTO T140	Compressive Strength of Concrete Using Portions of Beams Broken in Flexure
ACI 211	Concrete Mix Design
ACI 301	Specifications for Structural Concrete
ACI 305	Hot Weather Concreting
ACI 306	Cold Weather Concreting
ACI 309	Standard Practice for Consolidation of Concrete
ACI 347	Recommended Practice for Concrete Formwork
ASTM A185	Steel Welded Wire Reinforcement, Plain, for Concrete



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ASTM A615	Deformed and Plain Billet-Steel Bars for Concrete Reinforcement
ASTM C33	Standard Specifications for Concrete Aggregates
ASTM C94	Standard Specifications for Ready-Mix Concrete
ASTM C150	Standard Specifications for Portland Cement
ASTM C260	Standard Specifications for Air-Entraining Admixtures for Concrete
ASTM C494	Chemical Admixtures for Concrete
ASTM C618	Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use as Admixtures in Concrete
ASTM C900	Standard Test Method for Pullout Strength of Hardened Concrete
ASTM E329	Agencies Engaged in the Testing and/or Inspection of Materials Used in Construction



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**400 GENERAL**

**400.01 General Requirements**

1. Three categories of testing and reports are required for all Public Improvements and projects requiring right-of-way grading and paving; Geotechnical Report, Final Pavement Design (refer to Section 500, Street Improvements) Report, and extra testing (e.g., imported fill).
  - a. Geotechnical Report - This report evaluates the characteristics of the soils and the general issues of groundwater, soil stability, and swell consolidation potential (refer to Section 405 for Groundwater Report). A geotechnical report is required for street and related improvements within the right-of-way, public easements, or slope easements. This report is required as part of the preliminary plat submittal.
  - b. Final Pavement Design Report - This report is required for all projects with roadway improvements, right-of-way grading and paving. The soil investigation associated with this report will occur after overlot grading is completed. This report must be submitted and approved prior to any concrete or paving installation (refer to Section 500 Street Improvements).
  - c. Extra Testing - If fill material is required for the project, this material shall also be tested before placement and must be approved by the Town Engineer.
2. Supervision by Engineer - All sampling and testing of soils shall be performed under the direct supervision of the Professional Engineer who stamps and signs the report.

**401 SOIL TESTING FOR GEOTECHNICAL REPORT**

**401.01 Timing of Soil Borings**

1. Initial Borings - Any information from initial soil borings must be summarized in the geotechnical report. The entire site shall be sampled for initial testing to obtain a preliminary overall geologic "picture" of the site.
2. Structures - Soil borings for design of structures shall be taken prior to the design of the structure.
3. Imported Fill for Right-of-Way Grading - All fill material shall be tested by a qualified soils testing company hired by the Contractor and approved by the Town of Frederick prior to its use on the project. The material should meet minimum requirements and be equal to or better than existing conditions. No material shall be imported which has a liquid limit greater than 40 and plasticity index greater than 20 unless otherwise approved by the Town Engineer.

**401.02 Frequency of Testing**



1. A minimum of two borings shall be provided for each project. The number of borings should be dependent on project size and the geotechnical engineer's recommendations. The Town Engineer may require more frequent testing.
2. Testing frequency for structures shall satisfy AASHTO Bridge Design requirements and CDOT Materials Testing requirements.

#### **401.03 Location and Depths of Samples**

1. Samples shall be taken as close as possible or within the limits of the roadways and/or slopes and extend to a minimum depth of 10-feet below finished grade.
2. Borings shall extend deeper if needed to determine if bedrock or high groundwater levels are design concerns. (Minimum depth to bedrock shall be 3-feet below the finished pavement surface.)
3. The Geotechnical Engineer shall use industry standard care in determining the number of samples that are needed to characterize soils.
4. Samples for structures shall be as close as possible or within the proposed footing of the structure and shall be taken to a minimum depth of 10-feet below the footing elevation. Additional depth may be required for piers or piles.

### **402 SOIL GROUPING**

#### **402.01 General**

To simplify subgrade support testing, soil samples may be combined to form soil groups consistent with the AASHTO classification, group index, and location for the area investigated with written approval from the Town Engineer. Groupings shall not mix samples with different AASHTO classifications. (For example, soils with swell potential greater than 2% may not be grouped).

#### **402.02 Composite Samples**

1. Composite samples may be obtained by mixing portions of each sample within a soil group to provide a uniform sample of the soil group only with the written approval of the Town Engineer. Composite samples remolded in the laboratory shall not be used for swell/consolidation testing.
2. A minimum of one soluble sulfate test shall be run on each composite sample.

### **403 TESTING**

#### **403.01 Required Tests**



The tests marked with an “X” in the table below are required for the subgrade soils investigations or final pavement design testing. Refer to Section 500 Street Improvements for Final Pavement Design.

Table 400-1 - Required Tests		
Test	Geotechnical	Final Pavement
	Report	Design Report
Visual	X	X
Liquid Limit	X	X
Plastic Limit	X	X
Moisture	X	X
Percent Passing No. 200	X	X
Gradation (Granular Soils)	X	X
AASHTO Classification	X	X
Subgrade Support		
R-Value		X
Swell Evaluation (Preliminary Considerations)	Indicator: Low/Moderate/High For Moderate or High, Run Swell Tests	Mitigation and Detailed Analysis
Percentage of Soluble	X	X
Standard Penetration Test	X	X
Groundwater Level	X	X
Bedrock Level	X	X

**403.02 Classification Testing**

Soils shall be classified visually and tested to determine engineering properties. Sand and gravel samples shall be analyzed for gradation where needed to comply with classification requirements.

**403.03 Subgrade Support Testing**

- Individual subgrade or composite samples shall be tested for subgrade support value. The geotechnical report shall clearly state whether or not the subgrade soil is capable of supporting the proposed construction and design traffic loads. Recommendation for subgrade stabilization, if required, shall also be provided. The final pavement report shall contain specific mitigation. Refer to Section 500, Street Improvements, for requirements.
- The following table shows minimum allowable subgrade R values based on the minimum ESAL amounts shown in Section 510. All subgrade upon which street or other paving will be placed shall be shown by a geotechnical engineer to have at least the minimum R values shown below. If the subgrade does not meet the minimum R



values shown below, then subgrade stabilization, as directed by the geotechnical engineer and approved by the Town Engineer, shall be required.

<i>Classification</i>	<i>Industrial</i>	<i>Commercial</i>	<i>Multi-Family</i>	<i>Single-Family</i>
Arterial	23	21	18	18
4-Lane Collector	18	18	18	18
2-Lane Collector	15	15	10	10
Low Density Rural	8	—	—	—
Local Street	12	10	8	7
Fire Lane	10	10	8	—
Parking, Cars Only	6	6	6	6
Parking, All Others	12	12	6	6

**403.04 Right-of-Way Fill Material Testing**

1. All imported fill material shall be evaluated for swell and R-value and approved by the Town Engineer prior to use in the right-of-way.
2. All imported fill shall have an R-value and plasticity index equal to or better than the subgrade material within the right-of-way.
3. Imported fill shall not have a liquid limit greater than 40 and plasticity index greater than 20 or a high to very high swell potential.

**404 GEOTECHNICAL REPORT**

**404.01 Basic Report Requirements**

A geotechnical report shall be submitted with the preliminary plat. The report shall show results from all required testing in Table 400-1. The report shall also include a description of site characteristics, e.g., topography, drainage features, etc.

**404.02 Detailed Report Requirement**

In addition to the basic report requirements, each soils report shall include the following Items (refer to Section 500, Street Improvements, for pavement design report requirements).

List of Required Items

- a. Site location and description
- b. Laboratory test reports with evaluations (classification tests)
  - i. Visual classification
  - ii. Liquid limit - AASHTO T89 or ASTM D4318



- iii. Plastic limit - AASHTO T90 or ASTM D4318
  - iv. In-situ moisture content
  - v. Percent passing No. 200 sieve - AASHTO T11 or ASTM C117-90
  - vi. Gradation of granular (sand & gravel) materials - AASHTO T27, ASTM D422 or ASTM C136
  - vii. AASHTO classification and group index - AASHTO M145 h. Standard Penetrations Test
  - viii. Swell Evaluation
- c. Boring logs
  - d. Soil and groundwater conditions. The expected seasonal elevation variation shall be summarized.
  - e. Depth to bedrock. To indicate shallow bedrock. Include mitigation requirements if bedrock is within 3-feet of subgrade.
  - f. Percentage of soluble sulfates.
  - g. Recommendations and discussions
  - h. Mitigation plans
  - i. Additional tests. These may be required for trench backfill evaluation, fill evaluation, etc.
  - j. Elevation of groundwater encountered in each boring
  - k. Engineer seal and signature. Required by a qualified geotechnical engineer.

## **405 SUBSURFACE WATER INVESTIGATION**

### **405.01 When a Subsurface Water Investigation is Required**

1. If groundwater is encountered within 10-feet of the original ground surface, a subsurface water investigation report shall be submitted for approval by the Town Engineer. This report is required to ensure mitigation of high groundwater effects upon public improvements within the right-of-way. This information may be a separate report or may be included in the geotechnical report.
2. This report requirement may be waived if the Applicant and Designer certify that the street subgrade elevations will be a minimum of 3-feet above the “maximum” predicted (seasonal highest) water table. This certification shall be written, stamped and signed by a Professional Engineer and submitted to the Town of Frederick.



3. This report is not required for temporary dewatering activity needed to facilitate construction of buried utilities. However, all applicable state requirements must be followed.

#### **405.02 Report Requirements**

The subsurface water investigation report shall include the following information.

- a. Site location and description. Include locations of any irrigation ditches, streams, ponds, lakes, and wetlands.
- b. Elevation of water table, direction of flow, flow rates, groundwater barriers, and seasonal high water level.
- c. Potential sources of groundwater. Include proximity to all water sources.
- d. Water rights associated with ponds, ditches, seeps, etc...
- e. Other relevant subsurface information such as water ownership (water rights), groundwater quality (contamination or other undesirable characteristics)
- f. Potential future groundwater conditions
- g. Subsurface drainage recommendations, including its effects on all conditions, including sensitive habitat.
- h. Cone of influence.
- i. Control measures and designs:
  - i. Subsurface Drains. If subsurface drains are recommended, the drains must have a gravity discharge without any possibility of back flow or blockage of the outlet. Any subsurface drain system shall be owned and maintained by the Developer or the Developer's assigned successor(s). These drains may discharge into the Town's storm drainage system, including inlets or detention ponds, upon approval of the Town Engineer. Anticipated impacts to the groundwater table on adjacent properties must be quantified.
  - ii. Drain Lines. The drain lines may be installed in the sanitary sewer trench, at an elevation of one sewer diameter lower than the sanitary sewer line.
  - iii. Drain Line Separation from Sewer. The drain line shall be marked to specifically distinguish the drain from the sanitary sewer line.
  - iv. Pipe. The drain line shall be an approved pipe material, for long-term (100-years minimum) design life, with appropriate cleanouts.



v. Drain Outlet. The outlet of the drain into an inlet structure or detention pond shall be designed to prevent any possibility of backflow and blockage of the drain line.

j. Professional Engineer's seal and signature.

#### **406 SOIL PROBLEM MITIGATION**

Mitigation plans for soil problems revealed by the soils investigation shall be submitted to the Town Engineer.

##### **406.01 Mitigation Plans and Approval**

1. All substandard soils found in the investigation (e.g., expansion, shallow bedrock, heave, soil instability, subsidence, etc.) shall be addressed in the mitigation plans. All mitigation procedures must be approved by the Town Engineer prior to their implementation.
2. Moisture treatment alone may not be sufficient. If soil problem mitigation is made, the soil treatment shall extend to the back of curb, or to the back of walk for attached or monolithic walks. For detached walks, separate mitigation procedures may be required.
3. Approval of Chemical Treatment. Mitigation procedures that alter existing soil conditions (such as lime, fly ash, or cement treatment) shall follow an approved mix design process. Additional testing is required to appropriately apply chemicals to soil and effectively mitigate existing soil conditions. Procedures and testing must be approved in writing by the Town Engineer.

##### **406.02 Mitigation for Swell**

If the average swell is 2% or greater, the pavement design report must provide mitigation measures. The mitigation measures shall reduce destructive swell potential under the public improvements, including landscaping, to an acceptable level of less than 2%. The swell test report shall specify sample conditions, surcharge pressures, and other key testing factors.

##### **406.03 Mitigation of Unstable Subgrade**

Possible measures for mitigation may include the following:

1. Over-excavation and replacement with suitable non-expansive or low-expansive material to a depth sufficient to mitigate expansion is a common mitigation method.
2. Chemical treatment to eliminate unstable characteristics of the soil is another common mitigation method, such as cement or flyash.
3. Condition with moisture and compact to an appropriate level of compaction for the unstable condition, including stability requirements.



4. Other procedures may be proposed for review and approval by the Town Engineer. The chosen method must work for the full life expectancy of the improvements.

**407.00 REFERENCES**

<b>Standards Referenced in Section 400</b>	
<b>Standard</b>	<b>Title</b>
ASTM C117	Standard Test Method for Material Finer than 75- $\mu$ m (No. 200) Sieve in Mineral Aggregates by Washing
ASTM C136	Standard Test Method for Sieve Analysis of Soils
ASTM D422	Standard Test Method for Particle Size Analysis of Soils
AASHTO T11	Material Finer than 75- $\mu$ m (No. 200) Sieve in Mineral Aggregates by Washing
AASHTO T27	Sieve Analysis of Fine and Coarse Aggregates
AASHTO T90	Determining the Plastic Limit and Plasticity Index of Soils, Single User Digital Publication
AASHTO M145	Classification of Soils and Soil-Aggregate Mixtures for Highway Construction Purposes, Single Use Digital Publication



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**500 MINIMUM DESIGN CRITERIA**

**500.01 General**

1. All street, alley, sidewalk, and bikeway systems will comply with these specifications, the State Specifications where applicable, and with the approved plans. Sidewalks and curb ramps shall comply with most recent ADA accessibility requirements, including but not limited to, truncated domes.
2. Street layout, alignment, and classification shall conform with the Town of Frederick Subdivision Regulations and the Comprehensive Plan.
3. Consideration shall be given, within the established framework of local streets, to provide for uniformity of street widths, proper alignment, and conformity to existing street patterns. The street design shall be directly related to the traffic needs. The streets, intersections, driveways, and pedestrian facilities shall be designed to provide for the greatest safety for both pedestrians and motorists.
4. All alleys shall be concrete and provide paved access to a paved street at both ends (see Detail 500-06).
5. In situations where redevelopment occurs along an existing unpaved alley, the Developer shall be responsible for paving the alley along the frontage of the property, and extending the paving to the closest intersection of the alley with a public street.
6. Transportation Impact Studies are required in order to adequately assess the impacts of a development proposal on the existing and/or planned street system. Unless waived by the Town Engineer, a written Transportation Impact Study will be required for all development proposals when trip generation is expected to exceed 50 vehicles during the peak hour or 500 Average Daily Traffic (ADT), or in the case where a localized safety or capacity deficiency exists as determined by the Town Engineer. Roadway improvements are based upon the traffic projections shown in the approved Traffic Study and the State Highway Access Code.
7. All developments shall provide access in accordance with the requirements of the Town of Frederick Land Use Code and the State Highway Access Code for intersection spacing.
8. Unless waived by the Town Engineer in writing, a Pavement Design Report conforming to the Standards set forth in this Section is required for all roadway construction.
9. Streets of less than the entire right-of-way and pavement width are not permitted, unless approved in writing by the Town Engineer.



10. All roundabouts shall adhere to the standards and recommendations contained in the FHWA publication *Roundabouts: An Informational Guide, FHWA-RD-00-067*.
11. Residential streets will not be conditionally accepted until the top lift is placed. The top lift shall be Grade SX. The top lift (1.5-inch) of all residential streets may require a mill and overlay with Grade SX prior to final acceptance.
12. These Standards and Specifications shall apply to both public and private improvements.

## **501 RIGHT-OF-WAYS AND STREET CROSS-SECTIONS**

### **501.01 General**

1. Sufficient right-of-way will be provided as required for the traffic needs and cross-section and maintenance of the street including cut or fill slopes, auxiliary lanes, sidewalks, public landscaping, signing, utilities, and other aspects of the development. The right-of-way will extend a minimum of 6-inches beyond the back of the detached sidewalk.
2. Standard right-of-way and street widths shall meet or exceed the minimums set forth in the Design Criteria. Additional right-of-way and roadway width may be required to accommodate traffic or other development needs such as turn lanes, acceleration/deceleration lanes, extra lanes, pedestrian or bicycle facilities, landscaping, utilities, or construction requirements such as cut or fill slopes.
3. Except at intersections or where superelevation is required, all roadways shall have a minimum 2% crown. Parabolic or curved crowns are not allowed. In no case shall the pavement cross slope at warped intersections exceed the grade of the through street.

### **501.02 Design Criteria (Straight Zoning)**

1. Standard right-of-way and street widths shall meet or exceed the following minimum criteria:



<b>Table 500-01 - Minimum ROW and Roadway Width</b>				
<b>Street Type</b>	<b>Land Use</b>	<b>Design ADT</b>	<b>Right-of-Way Minimum Width</b>	<b>Minimum Flowline Width</b>
Major Arterial	Weld County Road 7, 11, 13, 20	9,000+	120-ft	76-ft
Arterial (2)	All	9,000+	100-ft	72-ft
Collector (2)	All	1,000 - 9,000	75-ft	48-ft
Local	Commercial/Industrial	0 - 250	64-ft	40-ft
Local	Residential Standard	300 - 1,000	60-ft	34-ft
Alley	All	N/A	20-ft	15-ft
Emergency Access	All	N/A	20-ft	20-ft

Notes:

1. In all cases where traffic volumes are anticipated to exceed the design average daily traffic (ADT) shown above, the street and right-of-way width will be increased to the next higher classification, or increased in accordance with the specific design needs of the proposed street.
2. Because of the wide range of volumes and uses that can be experienced with arterial and collector streets, the Town Engineer will review on a case by case basis to determine the actual right-of-way and street width needs.
3. The above table assumes the typical street cross-sections. See details at the end of this section.

**501.03 Design Criteria (Planned Unit Developments)**

1. The streets shall be designed in conjunction with the overall intent of the PUD. The following requirements will apply:
  - a. The design of all streets shall at a minimum meet the typical cross-sections shown on Details 500-01 through 500-06 and Table 500-01.
  - b. On local residential streets, travel lanes shall be a minimum of 10-feet in width, exclusive of curb and gutter.



- c. Not providing for on-street parking in the design of the street section requires the written approval of the Town. In determining whether approval will be granted, the Town shall consider what measures the Developer has taken to eliminate the need for on-street parking.
- d. Sufficient right-of-way width shall be provided as required for the traffic needs and cross-section and maintenance of the street including cut or fill slopes, auxiliary lanes, sidewalks, public landscaping, signing, utilities, and other aspects of the development. Unless otherwise approved, right-of-way will extend a minimum of 0.50-feet beyond the back of the sidewalk.

## **502 HORIZONTAL ALIGNMENT**

### **502.01 General**

- 1. Horizontal alignment shall provide for the safety of pedestrians, bicyclists, and motorists.
- 2. The street pattern in a subdivision shall be the most advantageous configuration to serve adjoining areas and the entire neighborhood or district. Where appropriate to the design, proposed streets shall be continuous and in alignment with existing, planned or platted streets.
- 3. Proposed streets shall be extended to the boundary lines of the subdivision, except where prohibited by topography or other physical conditions, or where the Town Engineer deems such extension is not necessary for connection to adjacent properties. Where streets will be extended beyond the property line, sufficient engineering data shall be provided to establish feasibility of extension meeting all Town standards. Construction of the proposed streets may include grading and drainage transitions at the edge of the development.
- 4. Streets shall be placed in accordance with the Town of Frederick Land Use Code where applicable.
- 5. Spiral curves may be used in the design of arterial roadways only with written approval of the Town Engineer.
- 6. Sharp horizontal curves at or near the top of pronounced crest or bottom of vertical curves should be avoided.

### **502.02 Handicap Ramps**

Handicap ramps with truncated domes are required at all intersections. Curb ramps shall be constructed as shown in the most recent version of CDOT M&S Standards. Only truncated dome plates will be allowed, truncated dome pavers will not be allowed.



**502.03 Design Criteria**

1. All proposed streets shall conform with the horizontal curve standards outlined as follows:

<b>Table 500-02 - Minimum ROW and Roadway Width</b>			
<b>Street Type (Design Speed)</b>	<b>Typical Speed Limit Posted</b>	<b>Minimum Centerline Radius (ft)</b>	<b>Minimum Tangent Between Reverse Curves (ft)</b>
Major Arterial	35-45	675	400
Minor Arterial	35-45	575	300
Collector	25-35	260	150
Local Industrial	25-35	260	100
Local Commercial	25-35	260	100
Local Residential	25	195	--
Alley	15	60	--
Emergency Access		--	--

- a. Reversing curves are only allowed in the Town of Frederick with written approval from the Town Engineer.
- b. These horizontal curve standards are for the design speeds shown assuming 4% superelevation for arterial streets and no superelevation on collector or local streets. The Town may require curves designed for higher design speeds as conditions require.
- c. Where curves are designed with superelevation, the superelevation shall be in accordance with the recommendations of A.A.S.H.T.O. and approved by the Town. The rate of superelevation, the superelevation runout length, the crown runout length, and the point at which the full superelevation is reached shall be clearly shown on the construction plans. Superelevation is not permitted on collector or local streets.
- d. A.A.S.H.T.O. stopping sight distances must be maintained at all times. These horizontal curve standards are for situations where there will be adequate stopping sight distance on the curve. In areas where obstructions limit sight distance, curve lengths may need to be greater than listed.
- e. Access onto a curve is only allowed with written consent of the Town Engineer.



2. There shall be a minimum tangent where a curvilinear street is approaching an intersection. This distance shall be a minimum of 150-feet for a collector street approaching an arterial street. The minimum tangent distance for local street intersections and a local street approaching a collector street shall be 100-feet.
3. Curb radii shall conform with the following table:

<b>Table 500-03 - Minimum Flowline Radius</b>			
<b>Through Street</b>	<b>Intersecting Street</b>		
	<b>Minor/Major Arterial (ft)</b>	<b>Collector (ft)</b>	<b>Local (ft)</b>
<b>Arterial / Major Arterial</b>	50	30	25
<b>Collector</b>	30	25	20
<b>Local</b>	25	20	15

- a. All curb returns shall have a minimum slope of 1.0% and a maximum of 3.0%. If the curb return includes a handicap ramp the cross slope must conform with all current ADA requirements.

## **503 VERTICAL ALIGNMENT**

### **503.01 General**

1. Vertical alignment and grades shall take into consideration the existing topography, drainage needs, and shall provide for the safety of pedestrians and motorists. Unless modified in these Standards, vertical alignment shall be designed in accordance with A.A.S.H.T.O. criteria.
2. Continuous changing of grades that create a "roller coaster" effect shall not be permitted.

### **503.02 Design Criteria**

1. All proposed streets shall conform with the minimum and maximum allowable grade standards shown in the following table:



<b>Table 500-04 - Minimum and Maximum Grades for Roadways</b>		
<b>Street</b>	<b>Land</b>	<b>Min/Max % Grade</b>
Arterial/Major Arterial	All	0.5/5.0
Collector	All	0.5/5.0
Local	Industrial/Commercial	0.5/5.0
Local	Residential Standard	0.5/5.0
Cul-de-sacs	Residential	1.0/5.0
Alley	All	0.5/5.0
* All Fire/Ambulance access shall conform to the Frederick-Firestone Fire Protection District Standards.		
** The maximum grades shall only be used in extreme topographic conditions.		

2. Connections with existing streets shall be made in a way that will create a smooth transition. Connection with existing roadways shall be smooth transitions conforming to normal vertical curve criteria if the algebraic difference in grade between the existing and proposed grade exceeds eight-tenths (0.008 ft/ft) of a percent. When a vertical curve is used to make this transition, it shall be fully accomplished prior to the connection with the existing improvements and shall also comply with the grade requirements at intersection approaches.
3. Existing grade shall be shown for at 300-feet with field verified as-builts showing stations and elevations at 25-foot intervals. In the case of connection with an existing intersection, these as-builts are to be shown within a 300-foot radius of the intersection. This information will be included in the plan and profile that shows that proposed roadway. Limits and characteristics of the proposed improvement are the primary concern in the plan view. Such characteristics include horizontal alignment, off-site intersections, limits of the improvement, etc.
4. Previously approved designs for the proposed improvement are not an acceptable means of establishing existing grades. However, they are to be referenced on the construction plan where they occur.
5. The basis of the as-built elevations shall be the design elevations (both flowline or both top of curbs, etc.) when possible.
6. The higher volume street at an intersection shall govern the through grade, and cross-sections. The maximum allowable approach grade at the intersection of two arterials is 2%. At all other intersections, the maximum approach grade shall be 3%. In both cases the maximum grade shall be designed with a minimum distance as designated by the following table:



<b>Table 500-05 - Maximum Grade Approach Lengths at Intersections</b>			
<b>Approaching Street</b>	<b>Local (ft)</b>	<b>Collector (ft)</b>	<b>Arterial (ft)</b>
Local	50	50	75
Collector	----	75	150
Arterial	----	----	200

Notes:

- a. Distances shown are measured from the flowline intersections.
- b. All private commercial driveways shall follow all of the standards for local roadways.
- c. If design constraints will not allow the minimum length of the maximum grade or the maximum grade to be achieved, the type of access and access control will be as directed by the Town Engineer.
- d. In intersections where there will be crosspans, the transition of the crown into the crossspan shall occur in 50-feet for areas where the approach grade is between 2% - 3%. The transition of the crown in the crossspan shall occur in 35-feet for streets where the approach grade is less than 2%. There shall be no crosspans on collector and arterial streets. Unless otherwise approved by the Town, there shall be no crosspans on local streets with an average daily traffic volume greater than 500 other than at stop conditions. The use of grade breaks in lieu of vertical curves is discouraged. However, if a grade break is necessary and the algebraic difference in grade does not exceed 0.008 ft/ft, the grade break will be permitted. The maximum grade allowed at the point of tangency at a curb return for local and collector roadways shall be 2.0% and for arterial roadways a maximum of 1.0%.

7. Crest vertical curves shall comply with the following criteria:

<b>Table 500-06 - Minimum Length of Crest Vertical Curves</b>			
<b>Change In % Grade</b>	<b>Arterial (50 / 55-mph) (ft)</b>	<b>Collector (40-mph) (ft)</b>	<b>Other (35-mph or less) (ft)</b>
0.00 – 0.80	None	None	None
1.00 – 2.00	320	160	90
2.00 – 3.00	480	240	90
3.00 – 4.00	640	320	120
4.00 – 5.00	800	400	150
5.00 – 6.00	960	480	180
6.00 – 7.00	1,120	560	210
7.00 – 8.00	1,280	440	240
8.00 – 9.00	----	720	270



Notes:

- a. Lengths above do not allow passing on crest of vertical curves. Design may warrant a passing move on collectors or arterials, which would lengthen the vertical curves. The required lengths for passing will be provided on a case by case basis by the Town.
  - b. These vertical curve lengths are for the design speeds as shown. The Town may require curves designed for different design speeds as conditions require.
  - c. All vertical curves shall be labeled in the profile with the length, K value, VPC, VPT, VPI, low point and high point along with the station and elevation of these components.
  - d. All vertical curves shall conform with A.A.S.H.T.O. requirements.
8. Sag vertical curves shall comply with the following criteria:

<b>Table 500-07 - Minimum Length of Sag Vertical Curves</b>			
<b>Change In % Grade</b>	<b>Arterial (50 / 55 mph) (ft)</b>	<b>Collector (40 mph) (ft)</b>	<b>Other (35 mph or less) (ft)</b>
0.00 – 1.00	None	None	None
1.00 – 2.00	220	140	90
2.00 – 3.00	330	210	120
3.00 – 4.00	440	280	160
4.00 – 5.00	550	350	200
5.00 – 6.00	660	420	240
6.00 – 7.00	770	490	280
7.00 – 8.00	880	560	320
8.00 – 9.00	----	630	360
9.00 – 10.00	----	700	400

Notes:

- a. These vertical curve lengths are for the design speeds as shown. The Town may require curves designed for different design speeds as conditions require.



## **504 INTERSECTIONS**

### **504.01 General**

1. Intersections (which shall include all street access points, both public and private) shall be designed to provide for the safety of pedestrians and motorists.
2. At street intersections, property lines shall be truncated as shown in the details at the end of this section to provide adequate right-of-way for curb ramps, utilities, and site distance triangles.
3. Intersection design shall take into consideration auxiliary turn lanes as required by the approved Transportation Impact Study, or as required for site specific conditions, as determined by the Town Engineer.
4. Intersection spacing shall be in accordance with the State Highway Access Code, latest edition, and the Town of Frederick Land Use Code.
5. All proposed intersections shall be at right angles unless topography and other limiting factors of good design and safety otherwise require. No intersection shall be at an angle of less than 75-degrees.
6. The higher volume street at an intersection shall govern the through grade. In the case of two intersecting streets with the same classification, the Town Engineer may determine the through street.
7. The elevation at the PCR of the curb return on the through street is always set by the grade of the through street in conjunction with the pavement cross slope.
8. Carrying the crown of a side street into the through street is permitted only when drainage considerations warrant such design.
9. A more detailed review will be performed on the intersection of two arterial roadways to maximize drivability.
10. All intersections requiring a traffic signal shall include Opticom sensors for emergency vehicles. The Opticom shall be Model Number 722 Optical Detector and 754 Phase Selector manufactured by 3M unless otherwise directed by the Frederick-Firestone Fire Protection District or the Town of Frederick Police Department.

### **504.02 Design Criteria**

1. Alignment Design Criteria outlined in this document.



2. All intersections shall be designed and constructed with pedestrian curb ramp access on all corners. Curb ramps shall conform with the most current ADA standards and CDOT M-Standard Plans.
3. The major considerations in alignment design are safety, grade, profile, road area, design speed, sight distance, topography, drainage, and performance of heavy-duty vehicles. The road alignment should provide for safe and continuous operation at a uniform design speed. New road layout shall bear a logical relationship to existing or platted roads in adjacent properties.

Adequate intersection design necessitates the provision of safe ingress and egress from one street or driveway to the other, based in part on the ability of a driver to see oncoming vehicles or pedestrians. The following guidelines shall be used in the design of intersections, private driveways and public streets which intersect other traffic carrying facilities.

*Sight Distance Triangle:*

At the intersection of two public streets or a private driveway and a public street, sight distance shall be evaluated across a "sight distance triangle" where obstructions are restricted according to the following criteria. Within the area of the triangle there must be no wall, fence, sign, foliage, berm, or other structure that will obscure the driver's view of traffic approaching that intersection. The structures or berms within the sight distance triangle can extend no higher than 30-inches above the curb elevation and no lower than eight feet above the curb. Exceptions to this requirement exist for public facilities such as fire hydrants, utility poles and traffic control devices. These facilities must be located to minimize visual obstruction.

The evaluation of sight distance shall be made on two different types of sight distance areas. The first is shown in Figure 500-01 for the intersection of two public streets. The sight distance triangle in this case is formed by the intersection of two lines plotted along the curb line of the intersecting streets using the specified lengths. The diagonal connects the other ends of those lines. Where one or the other of the intersecting streets/driveways has no curb, the lines are plotted along the edge of the traveled way.

The second sight distance triangles are formed by lines plotted along the edge of the traveled way of both the major and minor roads and the diagonal lines that connect the other ends of those lines as shown in Figure 500-02. Distance d1 is measured to vehicles approaching from the right and d2 is measured to vehicles approaching from the left. The sight lines (d1 & d2) have their origin at the stopped driver's eye, 14.5-feet behind the edge of the traveled way.

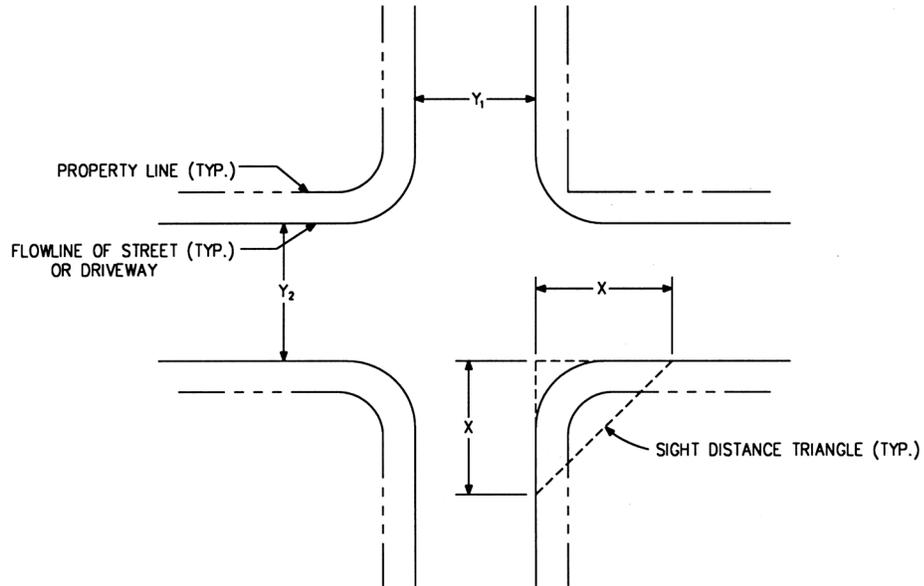
Tables 500-8 and 500-09 show recommended sight distances d1 & d2 for passenger vehicles and semi-tractor trailer trucks for several different vehicle operating speeds. For complex roadway configurations, road grades exceeding 3% or skewed intersections refer to *AASHTO - A Policy on Geometric Design of Highways and Streets* latest edition. The tables were developed according to the following general criteria:



- a. Vehicles turning left or right can accelerate to the operating speed of the intersecting street without causing approaching vehicles to reduce speed by more than 70-percent of their initial speed.
  - b. Vehicles turning left can clear the near half of the street without conflicting with vehicles approaching from the left.
  - c. The distance requirements are based on the driver's eye being 3.5-feet above the roadway and an object height of 3.5-feet. For semi-tractor trailers, a 6-foot driver's eye height and a 3.5-foot object height are assumed.
  - d. The operating speed on each approach is assumed to be (in the order of desirability):
    - i. The 85th percentile speed;
    - ii. The speed limit, if based on a traffic engineering study;
    - iii. The design speed in the case of a new facility.
4. Determination of need for traffic control devices, including stop signs and traffic signals shall be made by the Town in accordance with the MUTCD and other applicable Town regulations.
5. When the criteria for sight distance cannot be met, the Town may prohibit certain turns by exiting vehicles to provide safe operating conditions. These standards apply to accesses on State Highways and Town streets.



SIGHT DISTANCE TRIANGLES



NOTE: IF  $Y_1 \neq Y_2$  USE THE LARGER OF THE TWO TO DETERMINE THE "LEG LENGTH" OF THE SIGHT DISTANCE TRIANGLE

FLOWLINE TO FLOWLINE (Y)	LEG LENGTH (X)
$\leq 36$ FT.	35 FT.
$\leq 44$ FT.	45 FT.
$\geq 45$ FT.	55 FT.

Figure 500-01



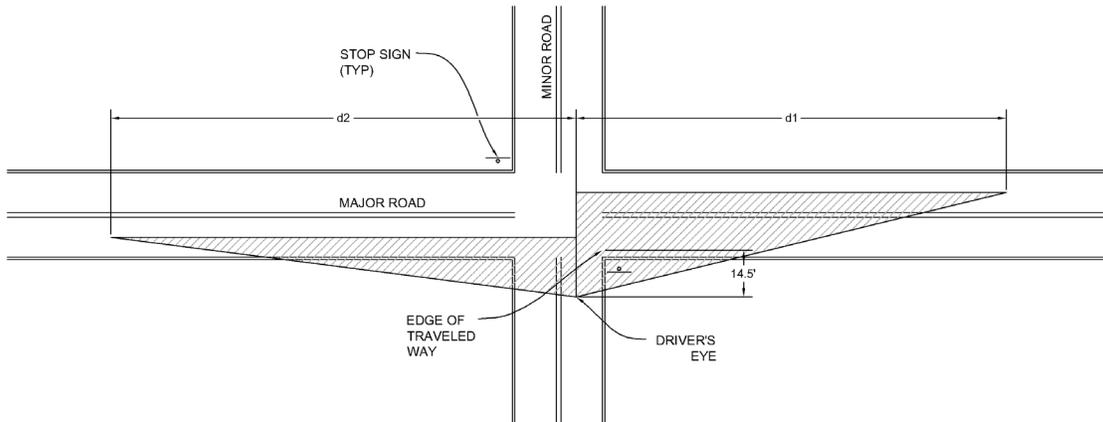


FIGURE 500-02  
 SIGHT TRIANGLES

<b>Table 500-08 - Sight Distance for Passenger Cars Exiting from Private Access or Public Streets onto Two-Lane Roads</b>		
<b>Speed (mph)</b>	<b>Safe Sight Distance, <math>d^1</math> (ft)</b>	<b>Safe Sight Distance, <math>d^2</math> (ft)</b>
20	225	195
25	280	240
30	335	290
35	390	335
40	445	385
45	500	430
50	555	480
55	610	530
60	665	575



<b>Table 500-09 - Sight Distance for Semi-Trailers Exiting from Private Access or Public Streets onto Two-Lane Roads</b>		
<b>Speed (mph)</b>	<b>Safe Sight Distance, d<sup>1</sup> (ft)</b>	<b>Safe Sight Distance, d<sup>2</sup> (ft)</b>
20	345	315
25	430	390
30	515	470
35	600	545
40	685	625
45	770	695
50	855	780
55	940	860
60	1020	930

**504.03 Spacing Criteria**

1. All intersection spacing shall meet or exceed the criteria set forth in the State Highway Access Code, latest edition, and the Town of Frederick Land Use Code.
2. Drive cut spacing requirements is illustrated in detail 500-17 of this section of the Design Standards.

**504.04 Auxiliary Lanes**

1. The need for auxiliary lanes shall be determined from the approved Traffic Impact Study. The Town Engineer reserves the right to require auxiliary lanes where the Town deems it necessary to improve public safety and or traffic flow.
2. All auxiliary lanes shall meet or exceed the standards in the A.A.S.H.T.O. "A Policy on Geometric Design of Highways and Streets", latest edition (also called the *Green Book*).

**505 PEDESTRIAN ACTIVATED FLASHING SIGNAL**

Pedestrian Activated Flashing Signals shall meet the requirements of the MUTCD Interim Approval for Optional Use of Pedestrian-Actuated Rectangular Rapid-Flashing Beacons at Uncontrolled Marked Crosswalks (IA-21)



## **506 CUL-DE-SACS**

### **506.01 General**

1. All cul-de-sacs shall meet the requirements of the Frederick-Firestone Fire Protection District.
2. Permanent dead-end streets shall be in the form of a cul-de-sac. Dead-end streets without a cul-de-sac shall not be allowed unless designed to connect with a future street and only with written approval of the Town Engineer.
3. The maximum length of the cul-de-sac as measured along and between the radius point and the right-of-way line on the abutting street shall be per the International Fire Code adopted by the Town, or a maximum of 15 residential dwelling units, whichever is greater.

### **506.02 Design Criteria**

1. All cul-de-sacs shall have a minimum flowline radius of 50-feet.
2. Sufficient right-of-way will be provided as required for the traffic needs and cross-section and maintenance of the cul-de-sac including cut or fill slopes, auxiliary lanes, sidewalks, public landscaping, signing, utilities, and other aspects of the development.
3. Cul-de-sacs which have internal islands shall be subject to review and approval by the Frederick-Firestone Fire Protection District and Town of Frederick. In general, the circulation aisle between the island and the exterior curb shall have a 50' outside radius and a 30-foot inside radius. There shall be no parking within these circulation aisles.
4. Where cul-de-sacs have internal islands with irrigated landscaping, adequate design measures shall be made to drain the landscaped area to avoid damage to the adjacent pavement.
5. All other design criteria shall be based on the design criteria for the particular street classification.

## **507 STRUCTURAL CROSS-SECTION**

### **507.01 General**

1. The purpose of this section is to present the pavement design criteria required for use on all streets and public parking areas in the Town of Frederick. Private improvements require approval by the Town if serving three (3) or more dwelling



units shall also comply with the Town's Standards unless otherwise waived by the Town Engineer in writing.

2. The Typical Rural Street cross-section may only be used with written approval of the Town Engineer for private and public roads.
3. Public roads serving more than three (3) dwelling units must be asphalt.
4. The top lift of pavement is required before Conditional Acceptance will be granted unless otherwise specified in the MOAPI.
5. General soils investigations and report requirements are outlined in Section 400. This Section defines requirements for soil testing and backfill requirements for all cut and fill areas within the right-of-way or public easements. The final pavement design report shall include follow-up testing for subgrade soil expansion, subsurface water, and R-value, in accordance with the specifications in this chapter.

#### **507.02 Existing Streets**

For existing streets, the Town Engineer may require deflection tests or other testing of the existing pavement and base structure to determine if any overlay is feasible, or if reconstruction is necessary. When a road is widened the section of road to the centerline shall be milled and overlaid if possible to tie in the new pavement with the existing pavement.

#### **507.03 A.A.S.H.T.O. Design**

The design criteria and procedures presented follow American Institute of State Highway and Transportation Officials (A.A.S.H.T.O.) 1993 Guide for the Design of Pavement Structures.

#### **507.04 Pavement Type**

1. Streets are to be constructed of either asphaltic concrete pavement (AC) or Portland cement concrete pavement (PCC). AC may consist of aggregate, anti-strip agent, Reclaimed Asphalt Pavement (RAP), Workability Mixture Additive (WMA) and asphalt binder. AC or PCC shall be placed on base course material, subbase material (where required), and compacted subgrade.
2. All asphalt roadways built in the Town of Frederick shall be built using Superpave Performance Graded asphalt.



### **507.05 Treated Subgrade**

The use of treated subgrade, treated base, and/or full depth asphalt pavement may be acceptable when designed and submitted by the designer, and approved by the Town Engineer in accordance with these standards.

### **507.06 Roundabouts**

The pavement thickness design for the roundabouts shall be based on the sum of the 20-year design volumes from all legs. A separate design analysis is required. No default thicknesses are available. Refer to note 10 in Section 500.01.

### **507.07 Pavement Design Submittal and Review**

1. Two copies of the Pavement Design Report must be submitted to the Town Engineer
2. All Pavement Design Reports shall include in the title the subdivision name and filing number. Also, include the Lot and Block numbers if the report does not apply to the entire filing. If the report does not relate to a specific subdivision, the name of the proposed development shall be listed.
3. When submitting a Pavement Design Report, the submitter shall provide the following information to the Town Engineer: name of the consultant, address (including zip code), telephone number, and fax number of the consultant; name of contact person, address (including zip code, telephone number, and fax number of the contact person.
4. All Pavement Design Reports shall include a Vicinity Map.
5. Town approval for Pavement Design Reports are valid for two years. An approved pavement design is REQUIRED before paving construction is allowed. If an approved Pavement Design Report is needed after two years from the original approval date, the consultant must revise the report to comply with the current Town of Frederick criteria or submit a letter referencing the original report stating that the recommendations in the original report remain valid and continue to comply with the current Town of Frederick criteria.

## **508 GEOTECHNICAL REPORT**

Rigid and Flexible pavement design shall be based on a geotechnical report stamped, signed, and dated by a Colorado registered Professional Engineer competent in the field of Geotechnical Engineering.



**508.01 Soil Borings**

1. Soil borings shall be advanced in the proposed or existing road. The subgrade shall be within 6-inches of its final elevation prior to any soil investigations intended to be used for final pavement design.
2. A minimum of one boring shall be obtained for any roadway segment. The distance between borings shall not exceed 250-feet along local and collector streets and fire lanes. One boring shall be made for every 15,000-square feet of public parking areas. The Town Engineer may require more frequent testing.
3. Borings shall be advanced to a minimum depth of 5-feet below the proposed subgrade elevation with every 4th boring a minimum of 9-feet below the proposed subgrade elevation.
4. Borings shall extend deeper if bedrock or high groundwater are design concerns.
5. Soil samples shall be taken based on the proposed subgrade elevations.
6. All borings shall be sampled using a "California Barrel" style thin-walled type of sampler AASHTO T206 for fine grained soils and coarse grained soils. A split-spoon sampler may be used when recovery is not possible with the "California Barrel" style sampler.
7. A scaled drawing with the boring locations plotted within 5-feet horizontally is required.

**508.02 Minimum Information Required**

1. Ground water elevations, if encountered
2. Drill logs with subgrade elevations
3. Gradation curves, AASHTO T27 (each sample of granular soils)
4. Atterberg Limits, AASHTO T89 and T90 (each soil type in each boring)
5. Soil classification, AASHTO M145 and ASTM D2487
6. Percent passing the No. 200 Sieve, AASHTO T11 (each soil type in each boring)
7. Natural moisture/density, AASHTO T265 (each CAL drive sample)
8. Moisture-density curves
9. Sulfate tests, AASHTO T290 (1 test per 500-feet of fine grained soils)
10. Swell/consolidation tests, ASTM D4546 at 200-psf (except non-cohesive soils, one test every third boring, each road segment, or fraction thereof)



11. Effective resilient modulus of roadbed soils,  $M_r$ , for design of flexible pavements and effective modulus of subgrade reaction,  $K$ , for design of rigid pavements
12. Boring logs shall include boring number, standard penetration test results, free water, and any abnormal conditions
13. A map showing location or limits of different soil types
14. In addition, the Geotechnical Engineer shall investigate and recommend solutions to problems of:
  - a. Swell potential
  - b. Frost heave in silty soils
  - c. Potential ground water problems
  - d. Sulfates
  - e. Any other matter that may adversely affect the design and life of the pavement

**509 SUBGRADE CHARACTERISTICS**

**509.01 Swell Potential**

1. All soil groups, excluding A-1 through A-4, shall be tested to determine swell or settlement potential. Tests shall be run on the “California Barrel” samples in accordance with ASTM D4546 at a surcharge of 200-psf. Test results shall be included in the pavement design report. Test results which are suspected of being too high or too low for the soil type shall not be considered in the design of the pavement, but shall be reported. Any deletion of data shall be justified in the report. The swell/settlement potential for a given soil shall be the calculated average of each of the classification groups.
2. As a minimum the report shall stipulate the following: the required depth of moisture treatment and chemical stabilization (if required) of the subgrade shall be determined by the highest average percentage of swell as recorded as a whole number as indicated in the table below:

<b>Table 500-10 - Subgrade Treatment</b>		
<b>Swell Potential</b>	<b>Minimum Depth of Moisture Treatment</b>	<b>Minimum Depth of Chemical Stabilization</b>
< 3%	Moisture treat to a depth of 1-foot	--
≥ 3%, < 5%	Moisture treat to a depth of 2.5-feet or	--



	Moisture treat to a depth of 1.5-feet	Chemical treat to a depth of 1-foot
≥ 5%	Moisture treat to a depth 1.5-feet	Chemical treat to a depth of 1-foot

Notes:

1. Indicates average percentage of swell as recorded to the nearest whole number
2. Moisture treatment shall achieve a moisture content and compaction as specified in Section 400
3. Soils with >5% swell shall also require swell mitigation per Section 406, in addition to moisture treatment.
4. The above depths for Moisture Treatment and Chemical Stabilization are minimums only. If greater depths are recommended in the approved Pavement Design Report they shall be used.

**509.02 Hveem Stabilometer**

1. The poorest soil (based on AASHTO Classification) found in each street segment shall be used to determine the subgrade support value using Hveem Stabilometer (R-value) testing. Only one R-value test needs to be run for each soil type that will be used for design at the development. Hveem stabilometer tests shall be conducted in accordance with AASHTO T190. The design R-value shall be at 300-psi exudation pressure. The reported data shall include the following:
  - a. Test procedure reference
  - b. Dry density and moisture content for each sample
  - c. Expansion pressure for each sample
  - d. Exudation pressure, Corrected R-value curve showing the 300-psi design R-value

**510 TRAFFIC – EQUIVALENT SINGLE AXLE LOADS (ESAL)**

**510.01 ESALs**

1. ESAL is defined as total number of equivalent 18,000-pound single axle load applications for the design lane during a 20-year design period. Calculated ESALs must be equal to or greater than the minimum ESALs listed in Table 500-11 below.



The Town Engineer may increase the minimum ESAL at any location, if in his opinion traffic conditions warrant.

<b>Table 500-11 - Minimum ESAL (x10<sup>6</sup>)</b>				
<b>Road Classification</b>	<b>Single-Family Residential</b>	<b>Multi-Family Residential</b>	<b>Commercial and Business</b>	<b>Industrial</b>
Arterials	2.2	2.2	3	4
4-Lane Collector	1.5	1.5	2.2	2.2
2-Lane Collector	0.5	0.2	0.4	1.1
Low Density Rural	0.07	--	--	--
Local Street	0.06	0.07	0.2	0.7
Fire Lane	--	0.07	0.2	0.2
Parking, Cars Only	0.04	0.04	0.04	0.04

Notes:

1. An axle-load analysis must be approved by the Town Engineer if less than the minimum indicated ESALs are to be used.

2. Parking Areas

Traffic loads from Table 500-11 may be assumed.

3. Residential

If a traffic study for a residential roadway is not available, traffic loads can be determined using the following equation:

$$ESAL_{R20} = 62,000 + 80 R$$

Where R = number of residential density units serviced by the street.

4. Commercial

For roadways where an individual commercial site is 10-acres or more, traffic loading shall be determined by an approved traffic study only. For commercial roadways with sites less than 10 acres, traffic loading can be calculated as follows:

$$ESAL_{C20} = 62,000 + 80 R + 260,000 C_A$$

Where C<sub>A</sub> = Commercial Acres serviced by the street

5. Industrial



For roadways where an individual industrial site is 10-acres or more, traffic loading shall be determined by an approved traffic study only. The Town may require a traffic study for any industrial roadway. For industrial roadways with sites less than 10 acres, traffic loading can be calculated as follows:

$$ESAL_{120} = 260,000 C_A + 260,000 I_A$$

Where  $I_A$  = Industrial acres serviced by the street.

Pavement design traffic studies are a method of determining 20-year design ESALs. ESAL calculations in traffic studies shall be based on the AASHTO “Guide for Design of Pavement Structures”, latest edition. The traffic study, when required, shall be submitted with the pavement design and subject to review and acceptance.

**510.02 Zoning Classifications**

1. Roadway zoning classifications are based on the projected land use of the areas served by the subject segment of roadway.
2. Residential roadways service areas with a minimum of 80% residential zoned property.
3. Commercial and Industrial classifications service areas with 20% or more of the land to be used as Commercial or Residential. If less than 80% of the area served is residential, the Classification will be either Commercial or Industrial. If any of the non-residential area is served is Industrial, the classification will be Industrial. If none of the residential area is Industrial, the classification will be Commercial. Any classification with a calculated Equivalent Single Axle Load (ESAL) of  $1.5 \times 10^6$  or more will be considered Arterial.

**511 MINIMUM PAVEMENT THICKNESS**

If the calculated pavement sections indicate thinner sections than the Minimum Pavement Sections listed in Table 500-12 below, the Minimum Pavement Sections shall govern. The Town Engineer may increase the minimum pavement section at any location if, in his opinion, conditions warrant. All asphalt roadways will be paved with a minimum of two (2) lifts, regardless of minimal thickness.

<b>Table 500-12 - Minimum Pavement Thickness</b>			
<b>ESAL (x10<sup>6</sup>)</b>	<b>PCC* (in)</b>	<b>Asphalt (in)</b>	<b>Aggregate Base (in)</b>
> 1,800,000	7.5	6.5	8
500,000 - 1,800,000	7	6	7
200,000 - 500,000	6	3.5	7
< 200,000	5	3	6
Parking Areas	5	3	6



\* Concrete streets are only allowed with specific written approval of the Town Engineer

**512 PAVEMENT MATERIALS**

Asphalt Cement Concrete (AC) shall be plant mix hot bituminous pavement (also known as HBP). Use of other than AC, PCC, or gravel base requires submittal of appropriate test data for approval by the Town Engineer.

**513 PAVEMENT DESIGN PROCEDURE**

1. All pavement designs (non-rigid and rigid) should be performed in accordance with the most current version of the AASHTO "Guide for Design of Pavement Structures" (AASHTO Guide).
2. Alternatives to the use of the above-mentioned AASHTO Guide may be presented for approval as follows: computer programs/printouts that present results in accordance with the equations and procedures outlined in the AASHTO guide will be allowed for review. The printout must reiterate all design parameters. The report must justify to the satisfaction of the Town Engineer any deviation from the design parameters specified herein.

**513.01 Pavement Design Factors (Based on AASHTO)**

1. Reliability (R)
  - a. 95% for arterials, all fire lanes, all commercial and industrial roadways.
  - b. 90% for local and collector roadways and parking lots other than commercial and industrial. Except local roadways and private drives where the area to be served by the roadway is 90% or more developed, R=85% may be used.
2. Overall Standard Deviation (So)
  - a. 0.45 for flexible pavements
  - b. 0.35 for rigid pavements
3. Design Serviceability Loss

Table 500-13 - Design Serviceability Loss		
Flexible	Rigid	Area
2.2	2.5	Local and collector roadways, other than commercial and industrial, private drives and parking lots.



1.7	2	Arterials, fire lanes, all commercial and industrial roadways.
-----	---	----------------------------------------------------------------

4. Concrete Elastic Modulus ( $E_c$ )  
3.6 \* 10<sup>6</sup> psi
5. Mean Concrete Modulus of Rupture ( $S'_c$ )  
600-psi
6. Load Transfer Coefficient (J)  
If combination curb and gutter are placed on both sides of the pavement use 3.6, otherwise use 4.2
7. Drainage Coefficient ( $C_d$ )  
1.0
8. Loss of Support (LS)  
2.5 for use in Figure 3.6 of the AASHTO Guide to correct the Effective Modulus of Subgrade Reaction, K, for potential loss of support.

#### 514 PAVEMENT DESIGN REPORT REQUIREMENTS

1. Design nomographs and/or computer program printouts
2. Map showing the location of each different pavement section and soil type
3. Design calculations for each pavement section
4. Original stamp and signature of the Geotechnical Engineer
5. Swell potential discussion
6. Discussion of any unusual design or construction problems or requirements
7. All information indicated in Section 508.

#### 515 GENERAL - CONSTRUCTION

1. "Streets" as used in this specification shall include the pavement section, right-of-way, sidewalks, driveways, bikeways, alleys and alley approaches.
2. All materials and construction shall be done in conformance with the Town of Frederick Standard Specifications and the approved plans. Where these Standards



do not address situations, materials, or construction requirements the Town of Frederick shall utilize the requirements of the Colorado Department of Transportation, "Standard Specifications for Road and Bridge Construction" and any applicable HBP mix design and material requirements of Item 9 of the most recent version of Metropolitan Governments Pavement Engineers Council (MGPEC) Pavement Design Standards. Requirements contained in the "Standard Specifications for Road and Bridge Construction" are intended to supplement these Town standards.

- a. The term "State Specifications" and "CDOT" in these standards refers to Colorado Department of Transportation, Division of Highways, State of Colorado "Standard Specifications for Road and Bridge Construction". Sections 100 through 109 and measurement and payment provisions of the "State Specifications" shall not apply unless otherwise noted. Reference in these specifications to the "Division" shall be understood to refer to the Town of Frederick and its authorized personnel.
- b. The Town of Frederick standards and specifications shall take precedence over conflicting provisions in the CDOT standard specifications and other referenced standards.

#### **515.01 Connection with Existing Roadways**

1. Where new construction ties into existing improvements, such as edges of pavement, sidewalks, curbs, etc., the Contractor shall line out and cut or saw the existing improvements to a true line and to an approved depth with a vertical face at the line of removal. Where the existing improvements are damaged, the Contractor shall remove the damaged improvements and shall tie-in to improvements which are in good condition as determined by the Inspector.
2. The design grade, and existing ground at that design grade, of all roadways that dead end due to project phasing, subdivision boundaries, etc., shall be continued in the same plan and profile as the proposed design for at least 300-feet or to its intersection with an arterial roadway.
3. If the off-site roadway adjacent to the proposed development is not fully improved, the developer is responsible for the design and construction of a transition for the safe conveyance of traffic from his improved section to the existing roadway. The following formula shall be applied to the taper of lane change necessary for this transition:

$$L = WS^2/60$$

Where:

L = Length of Transition in Feet

W = Width of Offset in Feet



S = Speed Limit or 85th Percentile Speed

The Town of Frederick Engineering Division should be contacted to establish unusual transition criteria. This contact is the responsibility of the applicant.

4. If the roadway adjacent to the proposed development is not fully improved the lanes in the direction of travel which are adjacent to any widening or improvement required as part of the development improvements must be milled and overlaid to the centerline. If a mill and overlay is not feasible the road must be reconstructed as needed.

#### **515.02 Sequence of Construction**

1. All installation and proper compaction of buried utilities shall be completed prior to the construction of the subgrade, base course, pavement, curb, gutter, crosspans, sidewalks, bikeways and driveways. However, with approval of the Engineer, in situations where a water service line has been added, modified, or inadvertently missed, water service lines may be installed after the curb, gutter and sidewalks have been placed at least 7-days, providing no damage is done to the street improvements. The Contractor shall adjust valve boxes and manholes to final grade after installation of the curb and gutter as described below. Electrical services Dry utility road crossing sleeves shall be installed after the water services but prior to the installation of curb radii. Except where previous arrangements for use of conduit have been made and approved by the Town Engineer.
2. Prior to commencing paving operations, a pre-paving meeting shall be held.
3. After lower lift paving is installed, no cuts shall be made without the approval of the Town Engineer or Town Representative. If utility installation is required after installation of curb, gutter, sidewalk or pavement; boring, jacking, or other alternative means of construction will be utilized.
4. If a pavement cut is permitted after installation of the top lift of pavement, the Town may require heater scarifying (infra-red) of patch joints, overlaying of the street, or other techniques approved by the Town to avoid any reduction in useful life of the pavement.

#### **515.03 Fixture Adjustment**

1. The Contractor shall adjust all manholes, valve boxes and other fixtures encountered within the area to be paved to conform to the finished surface of the pavement to be built as per the street plans and details and in accordance with all requirements outlined in these specifications. Clean the outside of the fixtures of loose, foreign material for the depth of the pavement prior to the paving. The Contractor shall adjust manhole castings, valve boxes and other fixtures outside the paved areas, but within the street right-of-way, to conform with the finished cross section after construction. Inspect valve boxes by placing a valve key on the operating nut to



assure a proper alignment. All adjustments shall be to proper alignment and grade to the satisfaction of the Town Engineer or Town Representative.

2. Manholes, valve boxes and other fixtures shall be adjusted to the interim street grade after the installation of the lower lift of pavement to produce a safe and rideable surface around the fixture. Prior to placing the final lift of asphalt, manholes, valve boxes, and other fixtures shall be adjusted to the final street grade.

#### **515.04 Protection and Cleaning**

1. The Contractor shall take proper precautions for the protection of all existing improvements which are to remain in place and all other identifiable installations that may be encountered during construction which are to remain and not be replaced.
2. The Town Engineer shall be the sole judge as to whether items may be reset and reused. If, in the opinion of the Town Engineer, items that were allowed to be reused and reset are damaged during construction the items shall be replaced by the Contractor.
3. The Contractor is responsible for site cleaning during the entire construction period. After paving operations have been completed, the Contractor shall clean and remove all leftover and waste materials. All curbs shall be properly backfilled and the adjacent ground left in a neat and uniform condition, acceptable to the Town Engineer.

#### **515.05 Clearing and Grubbing**

1. This work shall consist of clearing, grubbing, removing and disposing of vegetation and debris within the limits of the right-of-way, easement areas, and such other areas as may be indicated on the drawings or required by the work, except such vegetation and objects designated to remain.
2. The Contractor shall remove and dispose of protruding obstructions, stumps, roots and matted roots over 4-inches in diameter to two feet below the finished grade. Backfill all holes resulting from the removal of obstructions, stumps, and roots and compact the backfill to 95% of Standard Proctor, ASTM D698. Undisturbed stumps, roots, and nonperishable solid objects located 2-feet or more below the subgrade may remain in place.
3. The Contractor shall clear and strip all surface vegetation, sod, and topsoil from subgrades for permanent construction, fills and embankments. Undisturbed stumps, roots, and nonperishable solid objects located two feet or more below the subgrade may remain in place.
4. The Contractor shall trim or remove and dispose of branches of trees extending over the roadway to a clear height of 15-feet above the roadway surface. All removal and



trimming shall be done in accordance with good tree surgery practices and with approval of the Town Engineer.

### **515.06 Removal of Structures and Obstructions**

1. This work shall consist of the removal, wholly or in part, and the satisfactory disposal of buildings, foundations, fences, signs, structures, old pavements, abandoned pipelines, and other obstructions which are not designated on the drawings to remain.
2. Where culverts or sewers are to be abandoned in place under local streets, the culvert and sewer ends are to be sufficiently filled or crushed to prevent the future settlement of embankments and backfills. Fill the ends of concrete, plastic or masonry culverts with concrete and crush the ends of metal culverts. The removal and plugging of culverts shall include the removal of head walls and other appurtenances that are necessary to accommodate the work.
3. All culverts or sewers to be abandoned under collector and arterial streets shall be flow-filled where they are located longitudinally within the public right-of-way. Unless otherwise approved by the Town Engineer, the culverts or sewers that cross the public right-of-way under collector and arterial streets shall be removed.
4. The Contractor shall not remove sidewalks, streets, driveways, culverts, or other drainage structures in use by traffic or pedestrians until satisfactory arrangements acceptable to the Town have been made to accommodate traffic and drainage.
5. Culverts designated to remain shall be cleaned at the end of construction by removing all sediment and debris from within the culvert and appurtenant structures.
6. All structures designated to partially remain within the right-of-way shall be removed to a depth of 2-feet below the proposed subgrade.

## **516 EXCAVATION AND EMBANKMENT**

### **516.01 General**

1. This section covers excavation, hauling, disposal, placement, subgrade preparation, shaping, backfill, compaction, and embankments.
2. For these specifications "Roadbed" is defined as the graded portion of a roadway prepared as a foundation for the pavement structure, gutters, and sidewalks.
3. The Contractor shall complete all necessary clearing and grubbing and removal of obstructions prior to beginning grading operations.



4. The Contractor shall not begin site grading until the work has been properly staked. The Contractor shall not excavate beyond the dimensions and elevations established.
5. Completed or partially completed areas of work that are disturbed by subsequent construction operations or by adverse weather shall be scarified, reshaped, and recompact to the required density.

**516.02 Materials**

1. Generally, soil materials for roadway construction shall be as recommended in the approved soils report. The following soils materials are the minimum requirements for the materials to be used in the construction of roadways.
2. Embankment and fill material shall consist of soil, granular sand, gravel, cobble and boulder material, free from frozen material, organic material, trash, glass, broken concrete, other corrosive or deleterious material. The Contractor shall import approved material as necessary. Prior to placement of any imported material, the Contractor shall submit test results to the Town for review and approval indicating compliance with the requirements of the soils report and design standards.

Approval of embankment and fill material is contingent on the material having a resistance value when tested by the Hveem Stabilometer, or equivalent resilient modulus value, of at least that specified in the approved plans and a maximum dry density of not less than 90-pounds per cubic foot. The material must be stable and have a liquid limit less than 40 and a plastic index less than 15 when tested in accordance with AASHTO T-89 and T-90, respectively. Size restrictions are as follow:

- a. No material shall have a dimension larger than 6-inches. In the top 18-inches of fill, no material shall have a dimension larger than 4-inches.
- b. These size restrictions are contingent upon the material being evenly distributed in finer material such that uniform soil consolidation is achieved. If uniform soil consolidation is not being achieved the Engineer may reduce the size of materials allowed or change the embankment and fill material requirements.

Where unstable subgrade is encountered, the Contractor shall take steps necessary to stabilize the material by techniques such as over excavation and backfill with imported material, use of geotextile fabrics, or other combinations. The contractor shall notify the Engineer of the proposed solution to stabilize the subgrade. If required by the Town, the Developer's Design Engineer will make recommendations on stabilization techniques and materials.



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**516.03 Subgrade**

1. The Contractor shall scarify the subgrade to the depth specified in the approved soils report and compact to the density specified within the approved soils report. In no case shall the depth be less than 12-inches, or the compaction less that specified in these specifications.
2. The Contractor shall not place any embankment, fill, base course, pavement or other permanent improvements on frozen or muddy subgrade. Compact and consolidate subgrades such that they are free from mud and sufficiently stable to remain firm, dense and intact.
3. Wherever material is encountered that is wet or otherwise unstable and is incapable of supporting structures or the roadbed the material shall be over excavated to a depth suitable for construction of a stable subgrade. The Contractor shall backfill over excavated areas with a stabilization material approved by the Town Engineer. An approved filter fabric shall be used where required around the Stabilization Material and on the subgrade to stabilize the subgrade and prevent fines from migrating into the Stabilization Material.
4. Level and roll the subgrade so the materials will be uniformly compacted and bond well with the first layer of the base course, backfill, fill or embankment.
5. Shape the surface of the subgrade under areas of base course, and pavement surfaces so that they are not more than 1/4-inch above or 1/2-inch below the required subgrade elevation. Shape the surface of the subgrade under structures such that they are not more than zero inches above or 1-1/4-inches below the required subgrade elevation. Fill areas of the subgrade that are low with the material to be placed upon the subgrade. Shape the subgrade to prevent the ponding of water from drainage and rain.
6. Where pipe will pass through backfill, embankment or fill; the Contractor shall place and compact the backfill, embankment or fill to an elevation at least one foot above the top of the proposed pipe prior to beginning trenching.
7. Remove exposed cobbles, stones or boulders greater than 4-inches in size that create an irregular surface at the subgrade under base course material. Backfill the resulting voids with base course material and compact to the specified density.

**516.04 Excavation**

1. The Contractor shall remove and dispose of excess excavated materials and materials that are not suitable for use within the public right-of-way.
2. Foundations and the pavement structure shall be founded on original, undisturbed soil or on structural backfill extended to the undisturbed soil. Unless otherwise approved by the Engineer and stipulated in the approved soils report, foundations and the pavement structure shall not be founded on existing fill if encountered at the



- project site. If existing fill is encountered at the subgrade, the Contractor shall excavate to original undisturbed soil and bring the grade to the required elevation with approved material. Existing fill material if encountered at the site shall be removed. Existing fill may be stockpiled for reuse in backfills and embankments if it meets the requirements of the specifications. The Contractor shall remove unsuitable soil material as directed by the Engineer. The disposal of unsuitable soil material is the responsibility of the Contractor.
3. Excavate rock that is encountered at the site to a minimum depth of 6-inches below subgrade within the limits of the roadbed.
  4. The Contractor shall blend the intersection of cut slopes with the slopes of adjacent natural ground surfaces in a uniform manner. The tops of cut slopes shall be flattened and rounded in accordance with the approved plans. Slopes shall be graded as shown on the Approved Plans, shall not exceed a 4:1 slope unless otherwise approved by the Engineer, and shall be graded to drain.

#### **516.05 Backfill, Fill and Embankment**

1. The Contractor shall import approved material if compaction cannot be obtained with job excavated material, or if job excavated material does not meet the criteria in Table 200-01, or the requirements of the geotechnical report. The Contractor shall provide the proper documentation showing that the existing and imported materials meet the appropriate criteria.
2. Place the backfill, fills and embankments on suitably prepared subgrades. Distribute material so as to preclude the formation of lenses of material differing from the surrounding materials. Lifts shall have uniform thickness prior to compaction and shall not exceed 8-inches in uncompacted thickness. Spread and level material that is deposited in piles or windrows prior to compaction. Continuously mix, level, and manipulate the material as compaction progresses to assure uniform moisture and density.
3. The Contractor shall insure that the methods of compaction shall not overturn or place excessive pressure against structures such as retaining walls, abutments, wing walls, or culvert head walls where backfill, fills or embankment is placed on only one side of structures. When backfill, fill or embankment is placed on all sides of a concrete structure, the embankment shall be brought up equally on all sides of the structure. The fill adjacent to the abutment of a bridge shall not be placed higher than the bottom of the backwall until the superstructure is in place.
4. Where embankments encroach on stream channels, ponds or lakes, the largest available rock from the excavation shall be placed along the toes of slopes to protect the embankments against erosion from water action. The Engineer may require the use of riprap along channels, ponds and lakes. All environmental and grading permits shall be obtained from the US Army Corps of Engineers, Colorado Department of Public Health and Environment and Town of Frederick prior to construction adjacent to stream channels, ponds or lakes.



5. Rock embankment, if allowed, shall not be constructed above an elevation two feet below the finished subgrade. The balance of the embankment shall be placed in layers not to exceed 8-inches loose thickness and compacted as specified for embankments. When rock fill is placed over any structure, the structure shall be covered with a minimum of two feet of compacted earth or other approved material before the rock is placed.
6. Cross hauling or other action as appropriate will be required by the Town Engineer when necessary to insure that the best available material is placed in critical areas of embankments.
7. The Contractor shall use equipment suited to the soil being compacted. Compaction by use of water ponding or jetting or use of a hydro-hammer is strictly forbidden.

#### **516.06 Finish Grading**

1. After the pavement, permanent surface improvements, structures, backfills and fills have been completed the Contractor shall grade non-paved areas to slopes, contours or elevations indicated on the Drawings. Finish grading shall ensure proper positive flow and drainage. Conduct final rolling operations to produce a stable, uniform and smooth cross-section. Provide effective drainage with slopes of at least 2% unless otherwise indicated.
2. Where topsoil is to be placed in the non-paved areas the Contractor shall provide allowance for topsoil placement. Finish grade areas to receive topsoil to within not more than 0.1-feet above or below the required subgrade elevations. Compact areas to receive topsoil as specified and grade such that they are free from irregular surface changes.

#### **516.07 Compaction and Testing**

1. The Contractor, at their expense, shall test the subgrades, fills, backfills and embankments for compliance with the requirements for thickness and compaction density. Provide, as a minimum, one (1) density test for each 150-linear feet of subgrade, one (1) density test for each 100-lineal feet of curbside, and one (1) density test for each 500-cubic yards of embankment, fill or backfill. The Town Engineer may designate the locations for testing and may require more tests when in the Town's opinion they are required. Remove and replace unacceptable materials and repair unacceptable areas of thickness or compaction as required by the Engineer. Compaction tests do not relieve Contractor of the requirement for a firm, stable surface.
2. Field compaction densities shall be as indicated in the soil report but not less than the following minimum Standard Proctor densities, reference ASTM D698.
  - a. All compaction within the public right-of-way shall be equal to 95% compaction at plus or minus 2% optimum moisture content.



- b. Do not compact topsoil.
3. Proof roll the subgrade and base course prior to the placement of the subsequent course after the specified compaction densities have been obtained. Proof rolling shall be done with an approved vehicle having an average minimum axle load of 18,000-pounds per axle. Use of graders or front-end loaders is not acceptable. Areas that show movement and unstable areas shall be corrected. Proof rolling shall be done within 24-hours of the compaction density testing and within 24-hours of placement of any asphalt or concrete surface. Any moisture (i.e.-snow or rain) that enters the soil after the density tests and proof roll have passed but has not been paved yet must be retested for density and re-proof rolled before pavement may be constructed.

#### **516.08 Aggregate Base Course**

1. The Contractor shall mix the aggregate by methods that insure a thorough and homogenous mixture.
2. The subgrade and base course shall be free from standing water during construction. Remove any water encountered during construction to the extent necessary to provide a firm and stable subgrade and base course. Divert surface runoff or use other means necessary to accomplish the above. Do not deposit, tamp, roll or otherwise mechanically compact the aggregate base course in water. Do not construct aggregate base course with frozen material or on frozen subgrade.
3. Aggregate base course shall be crushed stone or crushed gravel conforming to Section 703.03 of "State Specifications" with an minimum "R" value of 70. The soils report shall identify areas that in the soils engineer's opinion need to be treated with mineral filler or hydrated lime. Commercial mineral filler if required shall conform to Section 703.01 of the "State Specifications". Hydrated lime shall conform to Section 712.03 of the "State Specifications".
4. If the required compacted depth of the aggregate base course exceeds 6-inches, it shall be constructed in two or more layers of approximately equal thickness. The maximum compacted thickness of any one layer of aggregate base course shall not exceed 6-inches. The surface of each layer shall be maintained during the compaction operations so that a uniform texture is produced and the aggregates are firmly keyed. Water shall be uniformly applied during compaction in the quantity necessary for proper consolidation of the material, or the material shall be harrowed, disked, bladed, or otherwise worked to insure a uniform moisture content. Immediately prior to paving, proof roll the aggregate base course to verify the base course stability. Areas that are not stable must be corrected and proof rolled again until all areas pass.
5. Herbicides, conforming to the requirements of Section 217 of the "State Specifications", shall be applied to the aggregate base course and/or subgrade no more than 1 day prior to paving. The rate of application shall be as recommended by



- the herbicide manufacturer. Herbicides shall not be used where they may contaminate water used for irrigation or drinking purposes.
6. As a minimum, the Contractor shall provide one field compaction test for each lift of aggregate base course for every 150-linear feet of base course placed. The Engineer may designate the locations for testing. The aggregate base course shall be compacted to 95% minimum density, Modified Proctor, ASTM D1557 or AASHTO T180. All compacted aggregate base course shall be within 2% (+) of the optimum moisture content of the soil as determined by ASTM D1557. The Engineer may require more tests when in their opinion they are required due to visibly unstable areas. Remove and replace unacceptable materials and repair unacceptable areas of thickness or compaction as required by the Engineer. Compaction tests do not relieve Contractor of the requirement for a firm, stable surface.
  7. The in-place compacted thickness of aggregate base course shall be no more than 1/4-inches less than the thickness shown on the approved drawings.
  8. Test the finished surface of the compacted aggregate base course for smoothness using 10-foot straightedge applied parallel with, and at right angles to centerline of the paved area. Any deviation in excess of 1/4-inch shall be corrected to the satisfaction of the Engineer.

## **517 PLANT MIXED BITUMINOUS PAVEMENT**

### **517.01 General**

1. Prior to beginning paving each calendar year, the Contractor shall submit to the Town Engineer for review and approval a mix design for each mix. The Town Engineer may also require mix designs from the Contractor during the year because of changes in the physical properties of the aggregate, source of the aggregate, or other changes in the mix.
2. The job mix formula for each mixture shall establish a single percentage of aggregate passing each required sieve size, a single percentage of bituminous material to be added to the aggregate and a single temperature for the mixture at the discharge point of the plant. The job mix formula shall also identify all additives, optimum asphalt content and the final gradation shown on 0.45 power graph. Mix designs shall also provide the results of a moisture susceptibility test (Lottman) performed at optimum oil content in accordance with CP-L 5109, method B. Where reclaimed asphalt is used in the job mix, the design report shall address the use of reclaimed asphalt and the percent of asphalt in the reclaimed asphalt. Submit the following with the job mix formula.
  - a. The proposed job mix gradation for each mixture which shall be wholly within the Gradation Range Table before the production (job mix) tolerances are applied.



- b. The aggregate source, gradation, additive blending, aggregate physical properties, and percentage of each element used in the production of the final mix.
- c. The name of the refinery supplying the asphalt cement, source and grade of performance graded binder, source of lime, and the source and type of anti-strip additive.

<b>Table 500-14 - Mixture Properties Requirements</b>		
Property	Traffic Level (ESALs)	
	<100,000	>100,000 to 3,000,000
Design gyrations, N design	50	75
Air Voids (Va) % at N design (AASHTO T-132)	3.5	3.5
Hveem Stability (AASHTO T-246 ) (Grading ST, SX & S only)	28 minimum	28 minimum
Voids Filled with Asphalt (Va), MS-2	70-80	65-80
Accelerated Moisture Susceptibility, tensile strength ratio, (Lottman) (AASHTO T-283 Method B)(for S,SX,SG mixes)	80 minimum	80 minimum
Dry Tensile Strength, psi (AASHTO T-283)	30 minimum	30 minimum
Voids in Mineral Aggregates (VMA) % (AASHTO PP-19)	3.50%	3.50%

- 3. After the job mix formula is established, all mixtures furnished for the project shall conform to the approved job mix formula within the range of production tolerances.
- 4. Mix design (production) verification shall occur prior to the start of the project. Mix design (production) verification shall be performed by LABCAT Level C accredited technicians to verify the volumetric properties of the mix. If the mix has been produced for another project within the last 90 days, data from that project can be submitted for verification. The mix verification test reports shall be submitted to the Town prior to mix placement.
- 5. Volumetric properties shall be within the following tolerances. The tolerances in the following table are for mix design verification only (from plant produced material from the specified mix design). See Job Mix (Production) Formula Tolerances table for production tolerances.

<b>Table 500-15 - Mix Design (Production) Verification Tolerances</b>	
Air Voids	±1.2%
VMA	± 1.2%



Asphalt Cement Content	± 0.3%
Stability	Applicable Minimum

6. Change in Source or Grade

Should a change in the source of Lime occur, or more than one temperature grade change on either the high or low end of Asphalt Binder (AC) occur, a one point verification test (at optimum asphalt content) of the mix must be performed to verify that the applicable criteria is still met. If this testing shows noncompliance, a new Design Job Mix shall be established before the new AC or Lime source is used. Any change in aggregate type or source will require a new mix design. The one point verification test may be performed on lab mixed samples or on Plant mixed samples.

Production test results shall comply with the following table:

<b>Table 500-16 - Job Mix (Production) Formula Tolerances</b>	
Passing No. 3/4-inch and Larger	6%
Passing No. 4 and No. 8	5%
Passing No. 30	4%
Passing No. 200	2%

Notes:

1. There is 1.0% tolerance for the maximum sieve size.
2. Mixes with No.200 sieve material produced over 7% is allowed only when Air Voids are kept within 1.2% of the Air Voids at mix design optimum and VMA still meets requirements.
3. Hveem Stability must meet the minimum value specified in Superpave Mixture Properties table.
4. Pavement Gradation SG may contain up to 35% reclaimed asphalt pavement and Gradation S and SX shall not contain more than 25% reclaimed asphalt pavement where approved by the Town Engineer. Reclaimed asphalt pavement where allowed shall meet the requirements of MGPEC Item 20.

**517.02 Materials**

1. Hot plant mixed bituminous pavement aggregate shall conform to the material requirements of Item 20 of the most recent version of Metropolitan Governments Pavement Engineers Council (MGPEC) Pavement Design Standards. Use Grade



SG aggregate mix for the bottom lift, aggregate mix S for the bottom lift of composite sections, and use Grade SX for the surface course and overlays.

2. Joint and crack sealant shall conform to Section 408.01 through 408.03 of the "State Specifications".

**517.03 Construction Requirements**

1. "State Specifications" refers to the Colorado Department of Transportation Standard Specifications for Road and Bridge Construction.
2. Before starting the paving, the Contractor shall insure that utility lines, piping, general grading and heavy trucking are complete so such operations will not damage paving work. No less than one day prior to paving, the Engineer MUST receive all test results stating that the subgrade and/or aggregate base is approved.
3. Prior to placing the pavement, the Contractor shall adjust manhole frames, valve boxes and other fixtures.
4. Weather limitation requirements for construction of hot bituminous pavement shall be in accordance with the following table:

<b>Table 500-17 – Minimum Surface Temperature Limitations for Asphalt Placement (°F)</b>				
<b>Compacted Layer Thickness (in.)</b>	<b>Top Layer</b>		<b>Lower Layers</b>	
	<b>APM</b>	<b>WMA</b>	<b>APM</b>	<b>WMA</b>
Product				
<1-1/2	60	50	50	40
1-1/2 - <3	50	45	40	35
> 3	50	40	40	35

\* Air temperature is taken in the shade. Surface temperature is taken on the subgrade or base.

\* Do not place the mixture at a temperature lower than 245-degrees Fahrenheit or 290-degrees Fahrenheit for mixes containing polymer modified asphalt.

5. Requirements for construction of hot bituminous pavement shall be in accordance with Section 401.08 through 401.19 of the "State Specifications", except as modified herein.
6. Apply a tack coat, prior to bituminous paving, to the contact edges of previously constructed bituminous layers, Portland cement concrete surfaces, and metal surfaces abutting or projecting into the bituminous pavement. Tack coat the surface of the previously constructed bituminous layer when more than eight hours passes



- between paving of lifts. Distribute the tack coat at rate in accordance with Table 20.5-1 of Item 20 of the most recent version of the MGPEC Standards . Allow the tack coat and prime coat to dry until tacky to touch prior to bituminous paving. Paving equipment shall be in accordance with Section 407.05 and 407.07, and surface preparation shall be in accordance with Section 407.06 of the "State Specifications".
7. Unless approved otherwise by the Town Engineer, bituminous pavement shall be placed in ribbons 12-foot wide. After the first ribbon is placed and rolled, place succeeding ribbons and extend screen to overlap previous strips by not less than six inches. The Contractor shall arrange paving operations so there will be no exposed longitudinal joints between adjacent travel lanes at the end of a day's run for all local roadways. Longitudinal joints for collector and arterial roadways shall be constructed in accordance with all applicable CDOT Specifications.
  8. After final rolling, Contractor shall not allow vehicular traffic on pavement until pavement has cooled sufficiently to avoid damage to the surface.
  9. In areas where the Town Engineer allows patching the Contractor shall cut out the old bituminous pavement and clean, fill and compact the area with fresh, hot plant mix bituminous pavement. Remove the deficient areas the full depth of bituminous pavement to one foot outside the entire area of the failure or as marked in the field by the Town Engineer. Cut the sides of the patched area vertically, perpendicular and parallel to the direction of traffic flow. All subgrade material shall be compacted to 95% of standard proctor. All aggregate base course shall be compacted to 95% minimum density, Modified Proctor, ASTM D1557 or AASHTO T180. Remove and dispose of the spoiled material and clean the area thoroughly. Apply tack coat to exposed surfaces and base course before placing new pavement. Replace the bituminous pavement in the patched area with full depth hot plant mixed bituminous pavement in lifts not exceeding 3-inches in compacted thickness. Compact the lifts to between 92% and 96% of Maximum Theoretical (Rice) density.

#### **517.04 Test Requirements/Tolerances**

1. Density, Gradation and Extraction - Test and monitor the bituminous pavement compaction density with a nuclear gauge on a continuous basis during the paving operation. The Town Engineer may require that core samples of the compacted bituminous pavement be taken by the Contractor at random locations on the project for testing of compaction and compliance with the design mix. Where the core samples have been taken, new material shall be placed and compacted into the holes by the Contractor to conform with the surrounding areas.
2. Compaction density shall be to between 92% and 96% of Maximum Theoretical (Rice) density. One test per 150-linear feet of pavement shall be required per day with a minimum of six tests per project. Tests shall also be taken by the Contractor to indicate the aggregate gradation, percent of air voids, and percent asphalt to verify compliance to approved pavement design. The Contractor shall perform, as a minimum, Rice test and gradation and extraction test per day of paving operation, unless the paving for the day is less than 100-tons. The test results shall be signed



by a Professional Engineer employed by an independent testing company paid for by the Contractor. The in-place pavement shall be tested for compliance with the requirements for surface smoothness. The Town Engineer may order additional testing at the Contractor's expense if the Town feels it is necessary to determine that the pavement is acceptable or to determine the extent of unacceptable pavement. Repair or remove and replace unacceptable pavement as required by the Town Engineer.

<b>Table 500-18 Schedule for Minimum HBP Materials Sampling and Testing</b>		
<b>Test</b>	<b>Standard</b>	<b>Minimum Frequency</b>
Sampling	AASHTO T168, ASTM D979 and ASTM D3665	1/1000 tons or fraction thereof (not less than one test per day)
Density	AASHTO I166, T238, T230	One Test for Each 250-Lineal Feet/Lane
Thickness (Core)	ASTM D3549	One Test for Each 1,000-Lineal Feet/Lane
Air Voids and VMA	ASSHTO T166, PP19	1/1000 tons or fraction thereof ( not less than one test per day)
Gradation	AASHTO T27, T11	1/1000 tons or fraction thereof ( not less than one test per day)
Hveem Stability	AASHTO T245, T246	1/1000 tons or fraction thereof ( not less than one test per day)
PG Binder – AC Content	CP-L 5120 or AASHTO T164	1/1000 tons or fraction thereof ( not less than one test per day)
Lottman Stripping, TSR and Dry Density	ASSHTO T283	One per project per mix used
Maximum Theoretical Specific Density (Rice)	AASHTO T209	1/1000 tons or fraction thereof ( not less than one test per day)

- The Town may check pavement temperatures, segregation, rolling patterns and other construction means and methods, which affect the performance of the pavement system. The Contractor shall provide assistance in sampling and testing at all facilities and at the job site.

**517.05 HBP Compaction**

- The temperature of the mixture immediately behind the screed shall be at least 245-degrees Fahrenheit (290-degrees Fahrenheit for polymer modified asphalt) and breakdown compaction shall be completed before the mixture temperature falls 20-degrees Fahrenheit.
- Rolling: Both steel wheel and pneumatic tire rollers are required. 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.



3. Compaction shall begin immediately after the mixture is placed and be continuous until the required density is obtained.
4. If the required density is not achieved and the surface temperature falls below 185-degrees Fahrenheit, or there is obvious surface distress or breakage, no further compaction effort will be permitted unless approved by the Engineer. The criteria for mixtures containing polymer modified asphalt cements shall be 235-degrees Fahrenheit.
5. Suspend pavement operations when density requirements are not met.
6. Remove all roller marks 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.
7. Compact all HBP paving to between 92% and 96% of Maximum Theoretical (Rice) Density (CP 51: Maximum Specific Gravity of Bituminous Paving Mixtures) with the average of five random and consecutive density tests equaling at least 93% of T209.
8. Compaction of less than 92% of maximum theoretical (Rice) density will be cause for removal and replacement.
9. Use the most recent maximum theoretical (Rice) density in calculating Relative Compaction according to AASHTO
10. Core the pavements for field density tests in accordance with Colorado Procedure 44, Method B, or for field calibration of nuclear density equipment in accordance with the Appendix of Colorado Procedure 81 (ASTM D2950).
11. At a minimum, take cores for nuclear density equipment calibration at the beginning of placement of each pavement layer or change of mixture materials or gradation.
12. Untested areas during placement will also require cores to be taken to verify compaction.
13. Thickness: The in-place compacted thickness for hot plant mix bituminous pavement shall not vary from the required design thickness by more than 1/4-inches less than the required design thickness and shall have no limitation on the greater thickness.
14. Tolerances: The surface tolerance for pavement shall not be greater than 3/16-inch, as measured with a 10-foot straight edge. If 10% or more of the final pavement surface fails to meet these tolerances, or requires repairs in the form of patching, the Developer shall be required to overlay the entire surface prior to final acceptance.



## **518 PORTLAND CEMENT CONCRETE PAVEMENT**

### **518.01 Materials**

1. Concrete pavement shall conform to the requirements for Class "P" concrete as specified in Section 601.02 and 601.03 of the "State Specifications". All concrete shall be ready mixed concrete. No concrete shall be field mixed. The proposed mix shall be tested in accordance with ACI code requirements. Two copies of the certified test reports shall be submitted to the Town Engineer, for acceptance, prior to ordering of concrete.
2. Proportioning of the concrete shall conform to Section 601.05 of the "State Specifications". The Contractor shall include Class F fly ash in concrete for paving. The quantity of Class F fly ash shall be equal to 20% of the weight of cement shown in Table 601-1 in the Colorado Department of Transportation Standard Specifications for Road and Bridge Construction and shall be included in addition to the full weight of cement shown in the Table. The voluntary substitution of fly ash as permitted in Section 601.05 is not permitted.
3. Additives for concrete, other than those specified in the mix design, shall not be used without prior approval of the Town Engineer. When approved for use, chemical admixtures or additives shall comply with applicable ASTM or AASHTO standards. Calcium chloride or admixtures containing chloride shall not be allowed in reinforced concrete.
4. The batching of concrete shall conform to Section 601.06 of the "State Specifications".
5. The mixing of concrete shall conform to Section 601.07 of the "State Specifications".
6. Equipment used for concrete mixing, conveyance and placement shall conform to Section 412.07 of the "State Specifications".

### **518.02 Construction Requirements**

1. Before starting the paving, the Contractor shall insure that utility lines, piping, general grading and heavy trucking are complete so such operations will not damage paving work.
2. Prior to placing the pavement, the Contractor shall adjust manhole frames, valve boxes and other fixtures.
3. Submit to the Engineer for approval a construction joint pattern showing types of each joint and joint spacing prior to paving operations. The pattern shall be based upon the Colorado Department of Transportation, M-Standard M-412-2, except that Expansion Joint Detail A shall be revised to a non-thickened section and shall include a smooth dowel sized  $1/8$  the concrete slab thickness at the mid-thickness of



- the slab, and 14-inches long placed at 12-inch centers with an expansion cap on one side of the joint.
4. Construction requirements for concrete pavement shall be in accordance with Section 412.08 through 412.21 of the "State Specifications", except as modified herein.
  5. The Contractor shall submit to the Engineer the ready mix delivery tickets for each load upon request by the Engineer indicating the following:
    - a. Supplier's name and date.
    - b. Truck number.
    - c. Project number and location.
    - d. Concrete class designation.
    - e. Cubic yards batched.
    - f. Mix design identification.
    - g. Type, brand, and amount of cement and fly ash.
    - h. Brand and amount of all admixtures.
    - i. Weights of fine and coarse aggregates.
    - j. Moisture content of fine and coarse aggregates.
    - k. Gallons of batch water.
    - l. Time at which water was added.
    - m. Elapsed time between when water was added and concrete load was in place.
    - n. Amounts of initial and supplemental water added.
    - o. Name of individual authorizing supplemental water.
    - p. Numerical sequence of delivery by indicating cumulative yardage delivered on each ticket.
    - q. Provide the following titles with blank space to record discharge time, water-cement ratio, air content, slump, and revolutions.
  6. Prior to concrete placement the Contractor shall remove all construction debris and extraneous matter from within the forms. Stays, bracing and blocks, serving temporarily to hold the forms in correct shape and alignment, shall be removed as the concrete placement progresses. All concrete shall be placed on a clean damp



- surface, free from standing water, and properly consolidated subgrade. Concrete shall not be placed with a free fall greater than 4-feet to prevent segregation of the concrete.
7. The time elapsing from the time water is added to the mix until the concrete is deposited in place at the site of the work shall not exceed the following time limits:
    - a. Air temperature 45-degrees Fahrenheit to 80 degrees Fahrenheit - 90-minutes maximum.
    - b. Air temperature over 80-degrees Fahrenheit with a retarder added to the mix - 90-minutes maximum.
    - c. Air temperature over 80-degrees Fahrenheit without a retarder added to the mix - 60-minutes maximum.
  8. The opening of concrete pavement to vehicular traffic, including the Contractor's vehicles, will not be permitted until the compressive strength of the concrete test cylinders, tested in conformity with the latest ASTM Standard Method of Test for "Compressive Strength of Molded Concrete Cylinders," Designation C39 is at least 3,000-pounds per square inch. If permanent shoulders or curbs are not in place, a 6-foot wide temporary earth shoulder shall be placed against the outside pavement edges before traffic is allowed on the pavement. Prior to opening to vehicular traffic all joints shall be properly sealed and the roadway shall be cleaned. The opening of concrete pavement to vehicular traffic shall not constitute a final acceptance of the pavement. No steel blades shall be used to clean concrete surface.

### **518.03 Test Requirements**

1. The Contractor shall provide the necessary testing of concrete for acceptance by the Town including the testing of concrete cylinders for compression testing and air and slump tests. Sample concrete test cylinders shall be made in sets of five. One cylinder shall be broken at 7-days, one cylinder at 14-days and 28-days, and two held on reserve for test if there is a failure on one of the 28-day tests. If the 28-day cylinders do not meet the specified minimum compressive strength then a representative number of concrete cores, as determined by the Engineer, shall be taken by the Contractor to determine if the in-place concrete meets the specified strength.
2. Concrete cylinders for strength tests shall be molded and cured in accordance with the "Practice for Making and Curing Concrete Test Specimens in the Field", ASTM C31 and tested in accordance with "Test Method for Compressive Strength of Cylindrical Concrete Specimens", ASTM C39.
3. Concrete shall be tested per Table 300-11 in Section 316.02 of these Standards.
4. Mark or tag each sample of compression test cylinders with the date and time of day the cylinders were made. Identify the location in the Work where the concrete



represented by the cylinders was situated or stationed. Identify the delivery truck or batch number, air content, and slump. Submit to the Town Engineer 2 copies of each test result.

5. Concrete shall meet the minimum acceptance standards of the State Specifications. Concrete that does not meet the acceptance criteria shall be removed and replaced.
6. The surface tolerance for Portland cement concrete pavement shall not be greater than 3/16-inch, as measured with a 10-foot straight edge. For collector and arterial streets, the Town reserves the right to require a profilograph test with the specifications established by the CDOT standard specifications for the design criteria of the street.

## **519 STREE WIDENING**

All street widening shall meet the requirements of these Standards and Specifications. The entire road from existing edge of asphalt to the centerline of the road shall be milled and overlaid after the road is widened.

## **520 STREET RESTORATION (PATCHING AND MATCHING EXISTING)**

All areas to be paved must be proof rolled before pavement is constructed. Proof rolls are required on subgrade and base courses prior to placement of subsequent courses. If the area is too small for a proof roll, field density tests shall be provided.

### **520.01 Aggregate Base Course**

Materials for aggregate base course shall conform to the requirements of Section 703.03 of the "State Specifications", Class 6 or Class 4.

### **520.02 Pavement Placement**

1. All materials and construction techniques associated with pavement patches shall conform with the materials and construction requirements specified in these Standard Specifications for hot bituminous plant mix pavement and Portland cement concrete pavement.
2. Patching materials and construction requirements for bituminous pavement shall meet the requirements for hot plant mix bituminous pavement of this specification except as modified herein. Patching shall be for the full depth of the existing bituminous pavement in place plus 1-inch.
3. Apply a tack coat to the contact edges of previously constructed bituminous layers, aggregate base course, Portland Cement concrete surfaces, and metal surfaces abutting or projecting into the bituminous pavement.



4. Patches for Portland cement concrete pavement shall consist of Portland cement concrete Class "P". To increase the load transfer and protect the pavement against differential settlement the Contractor shall drill the existing concrete pavement and provide expansion dowels in accordance with the Standard Details, minimum, distance on center at the mid-depth of the concrete. The dowels must be able to move from expansion and contraction of the concrete. To facilitate this movement, the dowels portion that protrude into the patch shall be painted and covered with a 1/16-inch coating of grease. The minimum size concrete patch allowed shall be as detailed under "Removal of Concrete Surfaces" in the general conditions.

#### **520.03 Surfaces Tolerances**

All patches shall be constructed true to grade with the existing pavement section. Variation from grade shall not exceed 1/4-inch. If the variation exceeds one-quarter inch, the pavement and backfill shall be repaired or replaced to the satisfaction and at the option of the Town Engineer.

#### **520.04 Temporary Patches**

When weather limitations prevent the placement of pavement patches as defined herein, the Contractor shall obtain the approval of the Town Engineer to install a temporary patch of cold mix asphalt or other suitable material. As soon as conditions allow, the Contractor shall remove the temporary patch and install a permanent patch in accordance with these specifications. The Contractor shall be responsible for maintaining temporary patches in a manner satisfactory to the Town Engineer until they are replaced. In case of an emergency the Town Engineer may elect to repair the temporary patch and backcharge the Contractor for the repair of the patch.

#### **520.05 Time Limit for Patching Street Cuts**

All patches shall be made within 3-days of completing the street cut. The Town Engineer may require the patch to be made sooner if in the Town's opinion it is a traffic hazard.

### **521 RIGHT-OF-WAY CONSTRUCTION**

#### **521.01 Permit Issuance**

1. Permittee must submit a complete Right-of-Way Application and include the required submittals for review and consideration of the proposed project. It is the responsibility of the Permittee to inform its Contractor of all permit requirements and provisions.
2. The Contractor shall have an approved Right-of-Way Permit before the commencement of work.



3. The Contractor must have a copy of the Right-of-Way Permit on site during construction of the project.

#### **521.02 Notification**

1. The Permittee of Contractor are responsible for contacting parties potentially affected at least 24-hours prior to an excavation or Right-of-Way closure.
2. The Contractor shall notify the Town's Public Works Department, 720-382-5500, a minimum of 24-hours prior to beginning work.
3. If pipe is running within an easement, not Town owned Right-of-Way, permission must be obtained by the effect property owners.

#### **521.03 Existing Utilities**

1. The Contractor is responsible for arranging for utility locates from all parties potentially affected by the proposed construction. (Contact the Utility Notification Center of Colorado at 811 or 1-800-922-1987 at least two days in advance of digging.)
2. Permittee must remove all utility locates such as flags and marker pins from the Right-of-Way once the construction is complete.

#### **521.04 Inspection**

1. The Permittee shall notify the Town's Engineering Department upon completion of work to schedule a follow-up inspection with at least 24-hour notice and to close out the permit.
2. Final inspection is required for a refund of Right-of-Way Permit deposit.
3. The Town of Frederick shall have the right to order Permittee or its Contractor to stop work anytime the Town believes that a violation of this Permit has occurred or if there is a danger to the safety of the public if the work continues.

#### **521.05 Suspension of Work**

The Town of Frederick Department of Public Works or Engineering Department shall have the authority to suspend work, wholly or in part, because of the failure of Permittee or Contractor to properly execute the work in accordance with this Permit. Notwithstanding the issuance of this Permit, the Town of Frederick reserves the right to make or to require Permittee or Contractor to make any changes, additions, repairs or required relocation of any facilities within the dedicated Right-of-Way at any time.



**521.06 Traffic Control Plan (TCP)**

1. The Permittee shall submit a Traffic Control Plan (TCP) prepared and signed by an American Traffic Safety Services Association (ATSSA) certified individual unless otherwise approved by the Town Engineer.
2. Contractor is responsible for placing traffic signs and maintaining the approved traffic control plan, consistent with the Manual on Uniform Traffic Control Devices (MUTCD) standards, at all times during the period of this permit.
3. The liability for any injury or damage that occurs as a result of improper signage in conjunction with this work falls completely on the Contractor.
4. Routing and safety measures in the event of pedestrian traffic within the work area is the responsibility of the contractor.

**521.07 Additional Permits**

Permittee shall be responsible for obtaining all other State, Federal, or Local permits which may be required of Permittee and/or its Contractor to install and/or maintain its Project. Permittee shall provide evidence of such other permits upon request by the Town of Frederick Public Works Department or Engineering Department.

**521.08 No Damage to Existing Infrastructure**

1. No culverts, irrigation structures, drain lines, utility lines, or any other projects or facilities within the Right-of-Way are to be cut or damaged. In the event Permittee or its Contractor damages an existing facility, Permittee shall first notify the owner and either immediately repair and replace the damaged facility or pay the owner to repair and replace the same in accordance with the desires of the owner.
2. All disturbed areas shall be returned to pre-construction conditions or better, including drainage, surface improvements and vegetation. All trench, excavation backfill and all other related work, must follow the Town of Frederick Construction Specifications.

**521.09 Permittee Responsibly**

1. The Permittee or its Contractor understand that all backfilling, patching and related work that is performed on Town Right-of-Way are bound by a 2-year warranty period. If defects, cracks, potholes, or other imperfections shall appear within 2-years of the expiration of this permit, the Permittee or Contractor shall be required to make repairs at the Permittee or Contractor expense.



2. The construction, operation, maintenance and repair of the Project installed by Permittee, and all other improvements described in this Permit, shall be at its own expense and without the aid or use of Town of Frederick funds.
3. Permittee (or its successors and assigns), remains solely responsible for all matters pertaining to the Project. These responsibilities include, but are not limited to the following: repair and maintenance of the physical components of the Project; removal of the physical components of the Project upon abandonment of the use or following the request of the Town of Frederick to remove the Project; cooperation with the Town of Frederick and other Permittees whose projects are placed in the Town's Right-of-Way.
4. It is mutually understood and agreed that this Permit and all the terms and conditions hereof shall extend to and be binding upon the Permittee and its successors, and assigns.

#### **521.10 Daily Construction Requirements**

1. No open trenches or excavations will be allowed to exist overnight or weekend.
2. Proper safety measures must be in place during the entirety of the project.
3. All traffic signs must be in place per the approved Traffic Control Plan (TPC) or removed or covered if not applicable to nightly activities.
4. Access to the Project location from the Town's Right-of-Way shall remain clear and free of debris.

#### **521.11 Future Line Location**

The installation of non-ferrous lines in the Right-of-Way shall require a suitable means to facilitate future line location such as, but not limited to, metallic warning tape installed above the line and/or the installation of tracer wire per Town of Frederick Design Standards and Construction Specifications.

#### **521.12 Minimum Cover**

1. All bores must be at a minimum depth of 36-inches plus the diameter of the line below the lowest point of the Right-of-Way to avoid problems with frost heave.
2. Culverts must have a minimum cover of 18-inches and be constructed of reinforced concrete pipe (RCP).



### **521.13 Backfill Requirements**

1. All paved roadway street cuts shall be backfilled with flowfill concrete unless otherwise approved by the Town Engineer.
2. Compaction of backfills and road surfaces shall be compacted in accordance with the Town of Frederick Design Standards and Construction Specifications.
3. If any wet or non-compactable materials are produced from excavations, they shall be completely removed from the Right-of-Way and replaced with compactable materials. The Right-of-Way shall then be returned to the original grades and cross sections. Town of Frederick Public Works Department shall have the authority to determine what materials shall be discarded and what materials shall be acceptable as replacement.
4. Potholes in gravel surfaces shall be filled completely with road base and compacted. Potholes in asphalt or concrete surfaces shall be filled with a cement/grout to existing thickness plus 1-inch or filled with a compactable base material and the final placement a HMA or concrete material of existing thickness plus 1-inch.

### **521.14 Reseeding**

Permittee shall reseed, with a seed mix approved by Town of Frederick Planning Department, all areas within the Right-of-Way in which vegetation was removed or disturbed during the installation of its Project.

### **521.15 Permittee's Obligation Regarding the Project Completion**

1. Permittee shall complete road restoration including, but not limited to, clean-up (including utility markers), repair of damaged facilities, trench compaction, and replacement of gravel.
2. All disturbed portions of the Right-of-Way or damaged road surfaces are to be returned to their original condition prior to demobilizing. If the Right-of-Way is not returned to original conditions, the Town of Frederick may perform or contract such remedial work and Permittee shall pay for all work or forfeit its surety bond in order to pay for all work done.

## **522 SIGNING, STRIPING AND STREET MARKINGS**

### **522.01 General**

This section covers materials and methods to be used for the installation of traffic control signs, lane striping, and street markings.



**522.02 Quality Assurance**

1. All traffic control signs shall conform to the requirements of the Manual on Uniform Traffic Control Devices (MUTCD) with regard to sign type, size, location, and mounting specifications. All signs to be approved by the Public Works department prior to installation.
2. All striping and pavement markings shall comply with the MUTCD and Section 627 of the CDOT 2012 Safety Standards, Revised 2019.
  - a. Striping shall be aligned with and parallel to the roadway.
  - b. Alignment shall not vary more than 2-inches in 100-feet of roadway.

**522.03 Submittals**

1. Provide a CDOT Certificate of Compliance (COC) of the epoxy striping material per CDOT Standard Specifications, Section 713.17.
2. Provide manufacturers certification that the different types of glass beads required for epoxy and thermoplastic meets the requirements of CDOT Standard Specifications, Section 713.08
3. Provide manufacturers certification that all of the thermoplastic marking material meets the requirements of CDOT Standard Specifications, Section 713.12 and 713.14.

**522.04 Lane Striping**

1. Permanent Lane Striping Material
  - a. All lane striping to be completed using epoxy paint and glass beads.
  - b. Comply with CDOT Section 708 and 713.17.
  - c. Contactor shall not stripe until the final asphalt lift has cooled for at least 72-hours.
  - d. Pavement surface shall be clean and free of soil or other debris that will prevent permanent adhesion of the epoxy to the pavement. Contractor shall use compressed air or high pressure water to remove any debris. If water is used the pavement surface shall be allowed to completely dry prior to applying paint. If deemed necessary by the Town Engineer, painting on existing pavement may require sandblasting to “freshen” the surface and improve paint adhesion.
  - e. Application methods shall comply with CDOT Section 627. Only an experienced applicator shall operate the equipment.



- f. Striping width shall be in conformance with the dimensions shown on the Drawings. Application rate shall be between 100-SF/Gal (min.) and 110-SF/Gal (max). Ambient air temperature and pavement surface temperature shall be a minimum of 35-degrees Fahrenheit for application.
2. Temporary Striping Material
    - a. Comply with CDOT Section 713.15.
    - b. Temporary striping may not be in service for more than 9-months.
    - c. Temporary marking tape shall consist of conformable (metal foil) weather and traffic resistant yellow or white colored reflective material.
    - d. All temporary striping material to be removed prior to subsequent covering by asphalt lift or permanent striping.

### **523.05 Thermoplastic Pavement Marking Material**

All symbols, cross walks, stop bars, letters, etc. to be created with thermoplastic material.

1. Thermoplastic Marking Material
  - a. Comply with CDOT Section 713.12.
  - b. Use for STOP bars and cross walks only.
  - c. Contractor shall not apply until the final asphalt lift has cooled for at least 72-hours.
  - d. Pavement surface shall be clean and free of soil or other debris that will prevent permanent adhesion of the material to the pavement. Contractor shall use compressed air or high pressure water to remove any debris. If water is used the pavement surface shall be allowed to completely dry prior to applying the material.
  - e. The type and application rate of epoxy resin primer shall be as recommended by the thermoplastic pavement marking manufacturer.
  - f. Application methods shall comply with CDOT Section 627.06. Only an experienced applicator shall operate the equipment.
  - g. Application width shall be in conformance with the dimensions shown on the Drawings. Material shall be applied to achieve a 3/32-inch minimum thickness at the edges and 1/8-inch minimum thickness in the middle. Ambient air temperature and pavement surface temperature shall be a minimum of 50-degrees Fahrenheit for application.



2. Preformed Thermoplastic Material
  - a. Comply with CDOT Section 713.14.
  - b. Use for all symbols, numbers, and letters.
  - c. Contractor shall not apply until the final asphalt lift has cooled for at least 72-hours.
  - d. Pavement surface shall be clean and free of soil or other debris that will prevent permanent adhesion of the material to the pavement. Contractor shall use compressed air or high pressure water to remove any debris. If water is used the pavement surface shall be allowed to completely dry prior to applying the material.
  - e. The type and application rate of epoxy resin primer shall be as recommended by the thermoplastic pavement marking manufacturer.
  - f. Application methods shall comply with CDOT Section 627.06. Only an experienced applicator shall operate the equipment.
  - g. Application width shall be in conformance with the dimensions shown on the Drawings. Material shall be applied to achieve a 3/32-inch minimum thickness at the edges and 1/8-inch minimum thickness in the middle. Ambient air temperature and pavement surface temperature shall be a minimum of 50-degrees Fahrenheit for application.

#### **524 TRAFFIC CONTROL SIGNS**

1. Signs shall be installed in the locations represented on the Drawings and in conformance with the MUTCD. Details for the orientation of the sign with respect to the edge of asphalt and the minimum height of the sign are included in the Drawings as well as in the MUTCD.
2. Posts shall be buried at minimum of 2-feet and shall be concrete encased below grade. Posts shall be installed vertical both parallel to and perpendicular to the roadway. Post holes shall be at least twice the diameter of the posts to provide adequate concrete anchorage.

#### **525 TRAFFIC IMPACT STUDY REQUIREMENTS**

1. *Study Purpose and Site Description* - The study shall include a brief description of the development application proposal (i.e. annexation, rezoning, subdivision, site plan application etc.) It shall also include a brief description of the development proposal including the site location, the size of the land parcel, general terrain features, the types of land uses being proposed and the proposed access points.



2. *Study Area* - The boundaries of the study area will be based on engineering judgment and an understanding of existing traffic conditions surrounding the site. The limits should be agreed upon at the pre-submittal meeting with staff. The boundaries of the study area shall be based on the size and extent of the proposed development and its relation to significant streets and intersections. Large developments may require a study area extending beyond one mile due to the magnitude of potential impacts.

As a minimum, the study area will include:

- a. Adjacent streets.
- b. Adjacent arterial/arterial or arterial/collector intersections.
- c. Site access points.
- d. Internal roads.

A vicinity map that shows the site and the study area boundaries in relation to the surrounding transportation system must be included in the study. All arterial and collector streets in the study area and access points to the site should be shown on the map.

Key intersections in the study area that will be analyzed in the study shall be identified at the pre-submittal meeting. The key intersections should be identified on the map.

3. *Study Horizons* - Three study horizons are required for analysis: The current conditions, short term and long term.

The current (existing) conditions should be analyzed to establish a baseline of traffic conditions.

The short-term horizon represents the planned opening year of the project. Both a background analysis and analysis with the project completed should be completed to assess the short-term impacts of the project. Assumptions about street improvements not associated with the study project in the short term should be based on projects shown in the Town of Frederick's Comprehensive Plan (FCP) or projects that have already been financially obligated to a developer.

The long term planning horizon represents conditions 20-years out. The Town of Frederick's Planning Area is shown in the Town's Comprehensive Plan (FCP). For land uses in compliance with the FCP this analysis should be completed using the information as shown in the FCP. For land uses that are not in compliance with the FCP analyses for both the adopted land uses in the FCP and the proposed land uses should be completed so that the impact of the land use change can be evaluated.



When an overall traffic impact study is completed for a phased development the study shall look at all three study horizons. Addenda for each phase of development should only look at the current conditions and the short-term horizon.

4. Analysis Time Periods - Normally, the analysis time periods will be the weekday a.m. and p.m. peak hours. Under some circumstances the Town may require analyses to occur at other times as appropriate.
5. Existing/Base Conditions
  - a. Existing and Proposed Land Uses - A complete description (including a map) of the existing land uses in the study area as well as their current zoning, shall be included in the study. In addition, the future uses of all vacant land within the study area that may be developed within the projection year of the project must be identified. For the short term horizon only land where development applications have been approved should be considered as developed within the projection year. For the long-term horizon, land uses shown in the FCP should be assumed as developed within the projection year.
  - b. Existing and Proposed Transportation System - The study shall describe the existing roadways and intersections in the study area including the road geometry and intersection traffic control. For the short-term horizon, assumptions about road improvements not related to the development shall be based on the improvements already financially obligated to a developer. For the long-term horizon all improvements shown in the FCP within the study area should be assumed.
  - c. Existing Traffic - Current a.m. and p.m. peak hour traffic volumes shall be obtained for the roadways and intersections within the study area. "Current" means counts less than a year old. A map or series of maps of the existing roadway network shall be prepared showing the existing conditions and volume counts including lane geometry, traffic control, access points, turning movement volumes, and calculated peak hour factors.
  - d. Background Traffic - For the short term horizon, background traffic shall be the sum of existing traffic volumes plus the addition of traffic from any not yet built but approved developments in the study area plus background traffic growth. The annual percentage of background traffic growth should be agreed upon at the pre-submittal meeting.

For the long-term horizon, background traffic shall be based on the most recent traffic forecasts. Maps of both the short term and long term roadway network shall be prepared showing the projected conditions and projected volume counts including lane geometry, traffic control, access points, a.m. and p.m. peak hour turning movement volumes and calculated peak hour factors.

6. Site Related Traffic
  - a. Trip Generation - A summary table listing each type of land use, the size or amount involved, the trip generation rates used and the resultant total trips must be provided. Trip generation rates shall be calculated using data contained in the



latest edition of the Institute of Transportation Engineers' (ITE) Trip Generation Manual or from a local trip generation study following procedures prescribed in the ITE Trip Generation Manual. If a local trip generation study is used to determine the trip generation rate, documentation of the trip generation study and the resulting rate should be included in an appendix of the traffic impact study.

The ITE Trip Generation Manual presents data on trip generation rates in various formats. A weighted average trip generation rate is shown. Also, when possible, a regression equation is presented that defines the line representing "best fit" of the data. Trip generation rates should be determined as outlined below.

Use Regression Equation When:

1. A regression equation is provided.
2. The independent variable is within range of data and either the data plot has at least 20 points.
3. Or the  $R_2$  is greater than or equal to 0.75, equation falls within the data cluster in the plot and the standard deviation is greater than 110% of the weighted average rate.

Use the Weighted Average Rate When:

1. At least three data points.
2. Independent variable is within range of data.
3. Standard deviation is less than or equal to 110% of the weighted average rate.
4.  $R_2$  is less than 0.75 or no equation provided.
5. Weighted average rate falls within data cluster plot.

Collect Local Data When:

1. Study site is not compatible with ITE land use code definition.
2. Only 1 or 2 data points; preferably when five or fewer data points.
3. Independent variable does not fall within range of data.
4. Neither weighted average rate line or fitted curve fall within data cluster at size of development.

Trip making reduction factors may be used after first generating trips at full ITE rates. These factors fall into two categories: those that reassign some portion of generated



trips to the background stream of traffic, and those that remove or move generated trips. In all cases, the underlying assumptions of the ITE Trip

Generation rates must be recognized and considered before any reductions are claimed.

The first category is when trips to the proposed development currently exist as part of the background traffic stream, referred to as pass-by trips. Pass-by percentages identified by ITE or in other industry publications may typically be used. But, the source of the percentages must be identified and the Town must approve use. Pass-by traffic must continue to be assigned to site driveways and access points, but is not additive to the background traffic stream. An appendix that illustrates the assignment of pass-by trips must be included in the report.

The second category for adjustments is for internal site trips, transit use, and transportation demand management (TDM) actions. Reductions of these types may be allowed if analytic support is provided to show how the figures were derived. The Town must approve any reductions that are claimed. Optimistic assumptions regarding transit use and TDM actions will not be accepted unless accompanied by specific implementation proposals that will become a condition of development approval. Such implementation proposals must have a high expectation of realization within a 3-year period after project initiation.

Trip Distribution - The percentage of trips to/from the proposed development to/from destinations in the region must be clearly shown graphically in the report. The consultant shall be responsible for estimating trip distribution. Marketing studies, sub-area transportation studies, documented existing traffic patterns and professional judgment may be used to make trip distribution assumptions. Whatever method(s) are used, the procedures and rationale used should be fully explained and documented in the study.

Different trip distribution assumptions can be used for different land uses in mixed-use developments. If more than one set of distribution assumptions are made they should be shown on separate graphics.

Trip Assignment - Site generated traffic shall be assigned to the street system according to the trip distribution percentages determined in the previous step.

The traffic assignment must be clearly shown graphically in the report.

7. Analysis and Identification of Impacts
  - a. The project impacts shall be determined through an analysis procedure that follows the sequence of tasks outlined below.
    - i. Assessment of existing conditions.
    - ii. Assessment of short term background conditions.



- iii. Assessment of short term conditions with the planned land use shown in the FCP for the land being proposed for development (only needed when the proposed development is requesting a land use amendment).
  - iv. Assessment of short term conditions with the proposed development.
  - v. Assessment of long term background conditions.
  - vi. Assessment of the long term conditions with the proposed development when a land use amendment is being requested.
- b. Highway Capacity Analysis - Assessment techniques for existing conditions, short term background and short term with the development will include a capacity and level of service (LOS) analysis for the key intersections identified in the study area during the identified analysis time periods. For signalized intersections the analyses shall be completed using the operational analysis methodology shown in the latest edition of the Highway Capacity Manual published by the Transportation Research Board. Both volume to capacity ratio (v/c ratio) and level of service for each movement shall be reported in a table or diagram for each signalized intersection analyzed. The overall intersection level of service shall also be reported. The Town's goal for traffic congestion states that all signalized intersections should be maintained at overall LOS D or better. In addition, the goal requires that all movements that have 5% or more of the total entering intersection volume should be maintained at LOS D or better and have a volume to capacity ratio less than 1.0. Therefore, any signalized intersections or movements at signalized intersections that exceed these thresholds should be noted.

The capacity and level of service analysis at signalized intersections shall be performed using the following assumptions:

- i. Peak hour factors should be calculated on an approach by approach basis from the turning movement count data collected for the analysis.
- ii. Right turns on red should not be considered unless specific data documenting the percentage of turns on red is collected.
- iii. Unless approved by the Town at the pre-submittal meeting all arrival types shall be assumed to be type 3 as defined in the Highway Capacity Manual.
- iv. Signal controller unit extension should be assumed to be 3.0 for through movements and 2.0 for left turn movements.
- v. Startup lost time should be assumed to be 2.0-seconds unless otherwise approved by the Town.
- vi. Extension of effective green should be assumed to be 3.0-seconds unless otherwise approved by the Town.



- vii. Traffic signal timing parameters for the existing conditions will be the actual signal timing in effect unless determined otherwise by the Town. Traffic signal timing parameters for the short term background conditions and the short term conditions with the development will use signal cycle lengths between 80 and 120-seconds. Cycle lengths and Individual green intervals will be calculated to provide the least overall intersection delay while maintaining all movements below the congestion goal thresholds whenever possible. Clearance intervals shall be the actual times currently in effect for all scenarios analyzed. Where different signal phasing from the existing is used for the analysis this change shall be noted in the list of traffic impacts. Where traffic signals are part of a coordinated signal system or where proposed new signals are within a half mile of another signal the cycle lengths used for analysis should be the same at all intersections analyzed.
- viii. Saturation flow rate will be assumed to be 1900-pcphgpl.
- ix. Lane widths should be assumed to be 12-feet wide unless other data shows otherwise.
- x. Percent of trucks should be determined by observation for all movements unless approved otherwise by the Town.
- xi. Saturation flow adjustment factors should be as per the Highway Capacity Manual.
- xii. Where dual left turns exist or are proposed they shall be assumed to operate in a protected only mode.
- xiii. Free running right turns that are not affected by the signal timing should be excluded from the analysis.

8. Level of service analysis

- a. Analysis for unsignalized intersections shall be done in accordance with the methodology for unsignalized intersections in the latest edition of the Highway Capacity Manual. The results of the unsignalized intersection analysis should be shown in the table or diagram used for signalized intersection results. The following assumptions should be used for the analysis of unsignalized intersections:
  - i. Duration of analysis period is assumed to be 15-minutes.
  - ii. Peak hour factors should be calculated on an approach by approach basis from the turning movement count data collected for the analysis.
  - iii. Percent of trucks should be determined by observation for all movements unless approved otherwise by the Town.



- iv. Saturation flow rate will be assumed to be 1700-pcphgpl.
  - v. Critical gap and follow up time shall be in accordance with the values given in the Highway Capacity Manual.
- b. Assessment techniques for both long term background and long term with the proposed development will require analysis using the planning methodology for signalized intersections and the unsignalized intersection methodology for unsignalized intersections as outlined in the latest edition of the Highway Capacity Manual. The condition (i.e. under capacity, near capacity, over capacity etc.) for signalized intersections and the level of service for unsignalized intersections should be reported in a table or diagram. The following assumptions shall be used for the long-range signalized intersection analysis.
- i. A peak hour factor of 0.9 shall be used.
  - ii. Cycle lengths between 80 and 120-seconds shall be used.

Assumptions for the long-range unsignalized intersection analysis shall be the same as for the short-term analysis.

- c. Access Evaluation - Assessment techniques for existing conditions, short term background, short term with the development, long term background and long term with the development will also include an evaluation of each proposed access point. Accesses should be considered intersections and included in the level of service/capacity analysis described above. Safety is the top priority at access points. The Town has developed standards for the spacing and design of access points to provide optimum safety. General spacing requirements is illustrated in Detail 500-XX Accesses should be reviewed to ensure compliance with Town (and CDOT if on a State Highway) standards. Proposed access points that do not meet the pertinent standards should be noted. In addition, all access points should be evaluated to determine what auxiliary lanes are required in accordance with Town standards and the State Highway Access Code (where applicable).
- d. Evaluation of Signal Progression in Coordinated Signal Systems – According to Town Standards, intersections with the potential for signalization should be spaced no closer than one half mile. If a development proposes an access or intersection that is projected to be signalized and is less than a half mile from other signals or other planned signals a progression analysis shall be conducted to demonstrate that a new signal can be installed without negatively impacting progression.

The analysis shall consider all existing signals or possible future signals within one mile in each direction from the proposed signal location. On existing coordinated arterials, it must be demonstrated that the existing bandwidth in each direction can be maintained with the new signal installed. Where a new coordinated system will occur as a result of the new signal it must be demonstrated that a bandwidth of at



least 45% can be achieved in each direction unless otherwise directed by the Town. The following assumptions shall be used for the progression analysis:

- i. A cycle length between 80 and 120-seconds should be used for analysis.
  - ii. Actual prevailing speeds on the arterial shall be used for travel speed.
  - iii. Split assumptions shall be based on projected turning movement volumes and designed to maintain all movements with at least 5% or more of the total intersection traffic at LOS D or better and below v/c ratio of 1.0 in keeping with the Town of Frederick Congestion Goal. Where pedestrian volumes are expected to be high (to be determined in the pre-submittal meeting), side street splits long enough to accommodate pedestrians shall be used assuming a 4.0-fps walking speed.
  - iv. Where left turn arrows are anticipated, protected/permissive phasing should be assumed unless dual left turns are projected. Then, protected only left turn phasing should be assumed.
  - v. Lagging left turns will not be allowed for protected left turn phases.
  - vi. Any access where the required bandwidth cannot be achieved should be noted. Any such access shall remain unsignalized and have turning movements limited by driveway design and/or median islands to prevent the need for signalization. Time-space diagrams shall be included in an appendix to the study.
9. Other analysis required on a case by case basis – Where the Town deems it appropriate, other types of analysis may be required in the traffic impact study. Other types of analysis may include but are not limited to: Sight distance evaluation, transit and TDM opportunities, pedestrian/bicycle needs, environmental evaluations and evaluation of neighborhood impacts.

**526 STREET LIGHTING STANDARDS**

- 1. Street lighting and associated underground street lighting supply circuits shall be installed. Roadway lighting shall conform to the illuminance or luminance design values shown in Table 3-5a of the AASHTO Roadway Lighting Design Guide, 2005, which has been reproduced in part below. These values are for continuous lighting. Conflict lighting at intersections shall be twice these values. A photometric study drawing is required to be included with the construction plans for all subdivisions.

<b>Table 500-19 - Illuminance of Roadways</b>		
<b>Road Classification</b>	<b>Average Maintained Illuminance Asphalt Road Surface foot-candles (cd/m<sup>2</sup>)</b>	<b>Illuminance Uniformity Ratio (avg/min)</b>



<b>Arterials</b>	Commercial	1.2	3
	Intermediate	0.9	3
	Residential	0.6	3.5
<b>Collectors</b>	Commercial	0.8	3
	Intermediate	0.6	3.5
	Residential	0.4	4
<b>Local</b>	Commercial	0.6	6
	Intermediate	0.5	6
	Residential	0.4	6

2. Types of allowed light poles and fixtures. Unless otherwise approved by the Town Engineer, all light poles shall be of types indicated in the approved materials list in Appendix 1. Roadway lighting shall be mounted with poles of either 15 or 30-feet, as approved by the Town Engineer, corresponding to a luminaire height of either 15 or 30-feet. The height of the roadway lighting shall conform to the general character of the development. The height of the roadway lighting shall be chosen while considering possible luminaire wattages from 70 to 250-watts, such that the illuminance levels (shown in the above table) or luminance levels (shown in Table 3-5a of the AASHTO Roadway Lighting Design Guide, 2005) are provided.
3. Pedestrian lighting. At a minimum, pedestrian lighting shall be provided at intersections of pedestrian trails and at intersections of trails with roadways. Such lighting shall be of a type and character that provides for both pedestrian safety and aesthetic conformance to the adjacent development.
4. Height standards for lighting. Light fixtures, other than street lighting, shall be mounted on poles no higher than the maximum height for structures allowed in that zone district, unless a different height is approved by the Town Engineer. Lighting mounted on a building or structure shall not exceed the height of the building or structure. Bollard-type lighting fixtures shall be between 3 and 4-feet high, unless otherwise approved by the Town Engineer.



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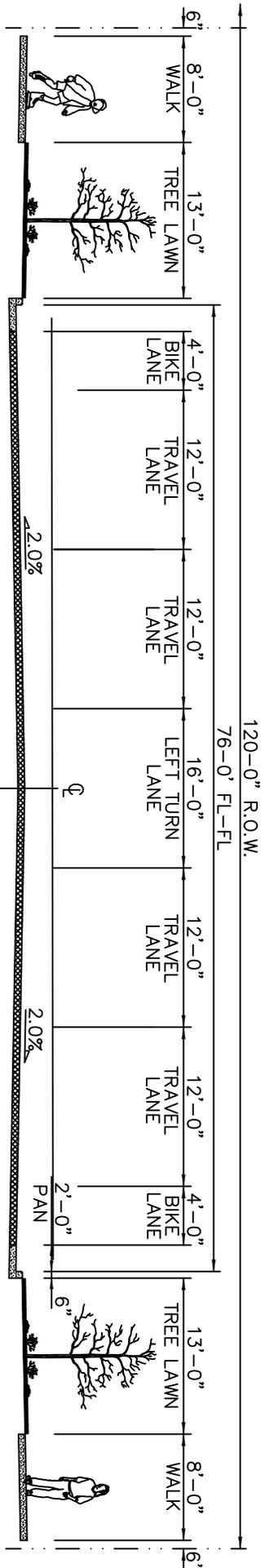
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**SECTION 500 - STREET IMPROVEMENTS**

500-01	TYPICAL MAJOR ARTERIAL CROSS-SECTION
500-02	TYPICAL ARTERIAL STREET CROSS-SECTION
500-03	TYPICAL COLLECTOR STREET CROSS-SECTIONS
500-04	TYPICAL LOCAL STREET CROSS-SECTIONS
500-05	TYPICAL COMMERCIAL/INDUSTRIAL STREET CROSS-SECTIONS
500-06	TYPICAL ALLEY & RURAL STREET CROSS-SECTIONS
500-07	STANDARD DETAIL FOR RAISED MEDIAN WITH SPLASH APRON-SPILL OR CATCH CURB
500-08	STANDARD DETAIL FOR RAISED MEDIAN-SPILL OR CATCH CURB
500-09	MEDIAN ISLAND & PEDESTRIAN REFUGE AREA
500-10	TRAFFIC CALMING DEVICE
500-11	CUL-DE-SAC DETAIL
500-12	DETACHED SIDEWALK DETAIL
500-13	BIKEWAY DETAIL
500-14	VERTICAL CURB AND GUTTER DETAIL
500-15	VERTICAL CURB & GUTTER DETACHED WALK
500-16	STANDARD DRIVEWAY APPROACH
500-17	DRIVEWAY SPACING
500-18	CROSSSPAN DETAIL
500-19	EXPANSION JOINT DETAIL
500-20	CONTRACTION JOINT DETAILS
500-21	COLD JOINT DETAILS
500-22	LOCAL INTERSECTION RIGHT OF WAY
500-23	PEDESTRIAN HANDRAIL DETAIL
500-24	TYPE R MODIFIED CHASE
500-25	CHASE DRAIN
500-25A	CHASE DRAIN DETAIL
500-26	ACCESS ON RURAL ROADWAYS- W/O C&G
500-27	BIKE LANE APPROACHING VEHICLE RIGHT TURN LANE
500-28	SURVEY MONUMENT BOX
500-29	CONDUIT TRENCH
500-30	CONDUIT LOCATIONS
500-31	ASPHALT PAVING AROUND CROSSSPAN
500-32	UTILITY TRENCH PATCHING
500-33	SMALL DOME STREET SIGN DETAILS
500-34	TYPICAL STREET SIGN INSTALLATION DETAIL
500-35	ALTERNATIVE SLEEVE BASE & RETROFIT UPPER CONNECTION DETAILS



- THE STREETS DESIGNATED AS MAJOR ARTERIALS ARE:
1. WELD COUNTY ROAD 7 (AGGREGATE BOULEVARD)
  2. WELD COUNTY ROAD 11 (SILVER BIRCH BOULEVARD)
  3. WELD COUNTY ROAD 13 (COLORADO BOULEVARD)
  2. WELD COUNTY ROAD 20 (BELLA ROSA PARKWAY)



**NOTES:**

1. SLOPE PAVEMENT 2% FROM CROWN TO LIP OF GUTTER.
2. TYPICAL SECTIONS SHOW MINIMUM REQUIREMENTS. ADDITIONAL ROADWAY WIDTHS AND RIGHT OF WAY MAY BE REQUIRED TO ACCOMMODATE TRAFFIC OR OTHER DEVELOPMENT NEEDS SUCH AS TURN LANES, ACCEL/DECEL LANES, EXTRA LANES, PEDESTRIAN OR BICYCLE FACILITIES, LANDSCAPING, UTILITIES OR CONSTRUCTION REQUIREMENTS.
3. WHEN FLOWLINE ELEVATIONS ARE NOT EQUAL, PAVEMENT SHALL BE SLOPED 2% FROM THE HIGHER GUTTER LIP. THE MAXIMUM STREET CROSS SLOPE IS 3%.
4. ATTACHED SIDEWALKS/BIKEPATHS ON MAJOR ARTERIAL ROADWAYS ARE NOT ALLOWED.
5. NO DRIVEWAY ACCESS ALLOWED ON MAJOR ARTERIAL ROADWAYS.
6. CERTAIN TREES ARE NOT ALLOWED IN TREE LAWNS. PLEASE CONTACT THE TOWN OF FREDERICK PLANNING DEPARTMENT.
7. TREES MAY NOT BE LOCATED WITHIN 30' OF A TRAFFIC SIGN IN THE DIRECTION OF TRAVEL ONLY.
8. TREES MAY NOT BE LOCATED WITHIN 100' OF A TRAFFIC SIGNAL IN THE DIRECTION OF TRAVEL ONLY.
9. SIDEWALK CROSS SLOPE SHALL NOT EXCEED 2%.

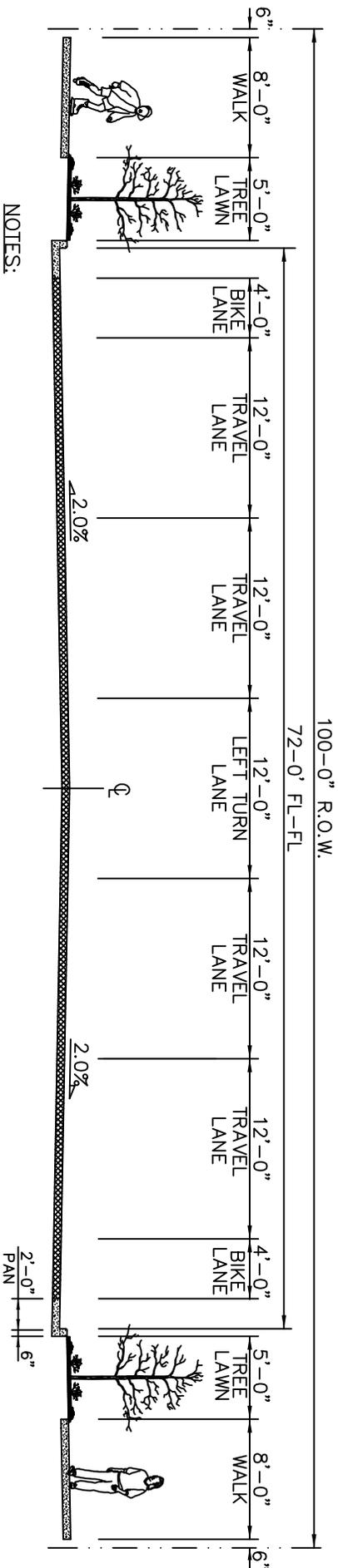
**TYPICAL MAJOR ARTERIAL STREET CROSS-SECTION**

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500-01

\*ARTERIAL ROADWAYS ARE GENERALLY LOCATED ON SECTION LINES BUT MAY BE REQUIRED ELSEWHERE AS DIRECTED BY THE TOWN ENGINEER.



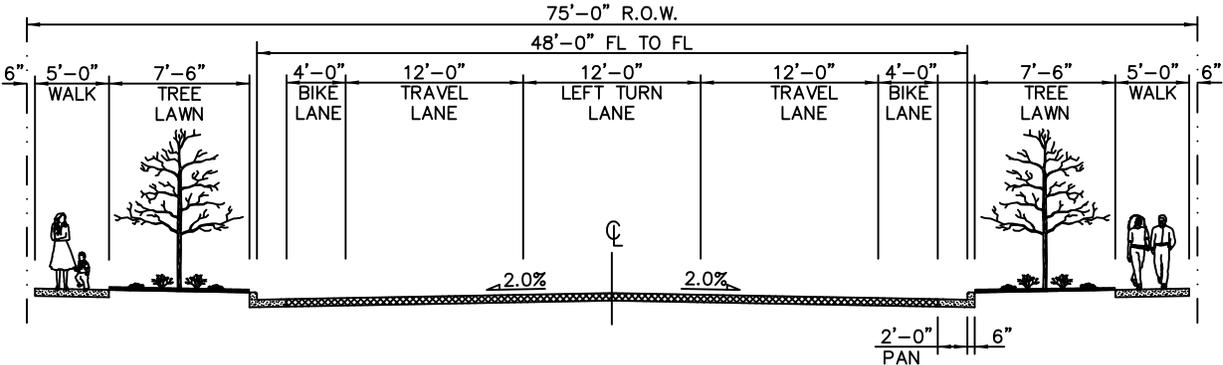
**NOTES:**

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3. WHEN FLOWLINE ELEVATIONS ARE NOT EQUAL, PAVEMENT SHALL BE SLOPED 2% FROM THE HIGHER GUTTER LIP. THE MAXIMUM STREET CROSS SLOPE IS 3%.
4. ATTACHED SIDEWALKS/BIKEPATHS ON ARTERIAL ROADWAYS ARE NOT ALLOWED.
5. NO DRIVEWAY ACCESS ALLOWED ON ARTERIAL ROADWAYS.
6. CERTAIN TREES ARE NOT ALLOWED IN TREE LAWNS. PLEASE CONTACT THE TOWN OF FREDERICK PLANNING DEPARTMENT.
7. TREES MAY NOT BE LOCATED WITHIN 30' OF A TRAFFIC SIGN IN THE DIRECTION OF TRAVEL ONLY.
8. TREES MAY NOT BE LOCATED WITHIN 100' OF A TRAFFIC SIGNAL IN THE DIRECTION OF TRAVEL ONLY.
9. SIDEWALK CROSS SLOPE SHALL NOT EXCEED 2%.

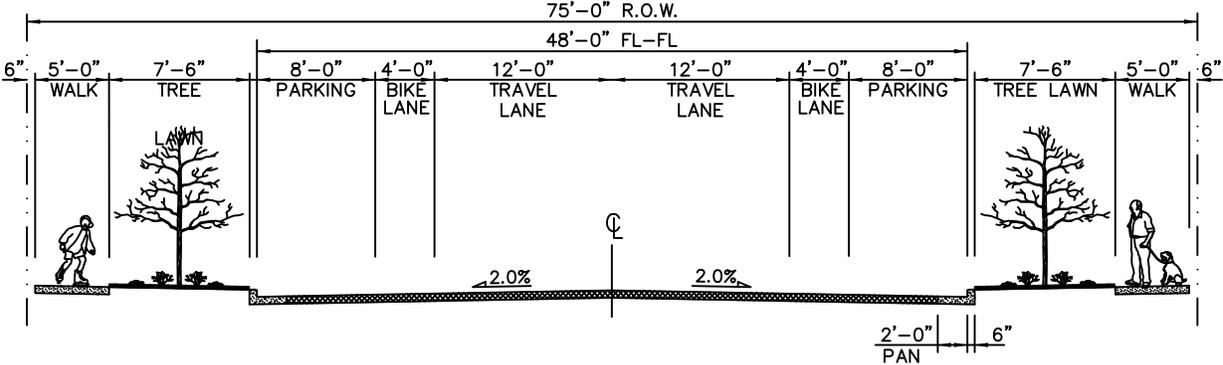
**TYPICAL MINOR ARTERIAL STREET CROSS-SECTION**

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COLLECTOR (AT INTERSECTIONS)



COLLECTOR (MID BLOCK)

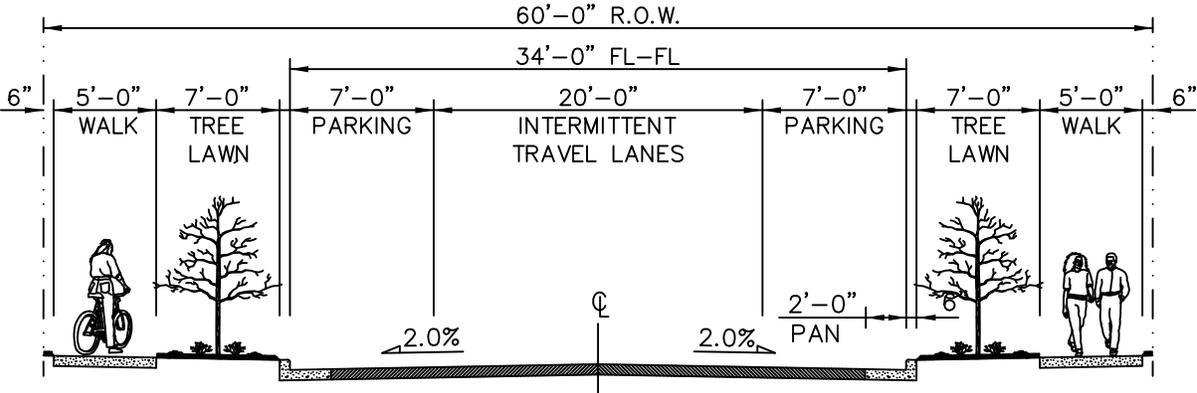
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3. WHEN FLOWLINE ELEVATIONS ARE NOT EQUAL, PAVEMENT SHALL BE SLOPED 2% FROM THE HIGHER GUTTER LIP. THE MAXIMUM STREET CROSS SLOPE IS 4%.
4. ATTACHED SIDEWALKS/BIKEPATHS ON COLLECTOR ROADWAYS ARE NOT ALLOWED.
5. DRIVEWAY ACCESS IS NOT ALLOWED ON COLLECTOR ROADWAYS.
6. CERTAIN TREES ARE NOT ALLOWED IN TREE LAWNS. PLEASE CONTACT THE TOWN OF FREDERICK PLANNING DEPARTMENT.
7. TREES MAY NOT BE LOCATED WITHIN 30' OF A TRAFFIC SIGN IN THE DIRECTION OF TRAVEL ONLY.
8. TREES MAY NOT BE LOCATED WITHIN 100' OF A TRAFFIC SIGNAL IN THE DIRECTION OF TRAVEL ONLY.
9. THE APPROVED TRAFFIC STUDY WILL DETERMINE THE STORAGE AND TAPER LENGTHS FOR TURN LANES AT INTERSECTIONS.
10. SIDEWALK CROSS SLOPE SHALL NOT EXCEED 2%.

**TYPICAL COLLECTOR STREET CROSS-SECTIONS**

NTS





LOCAL WITH DETACHED SIDEWALK

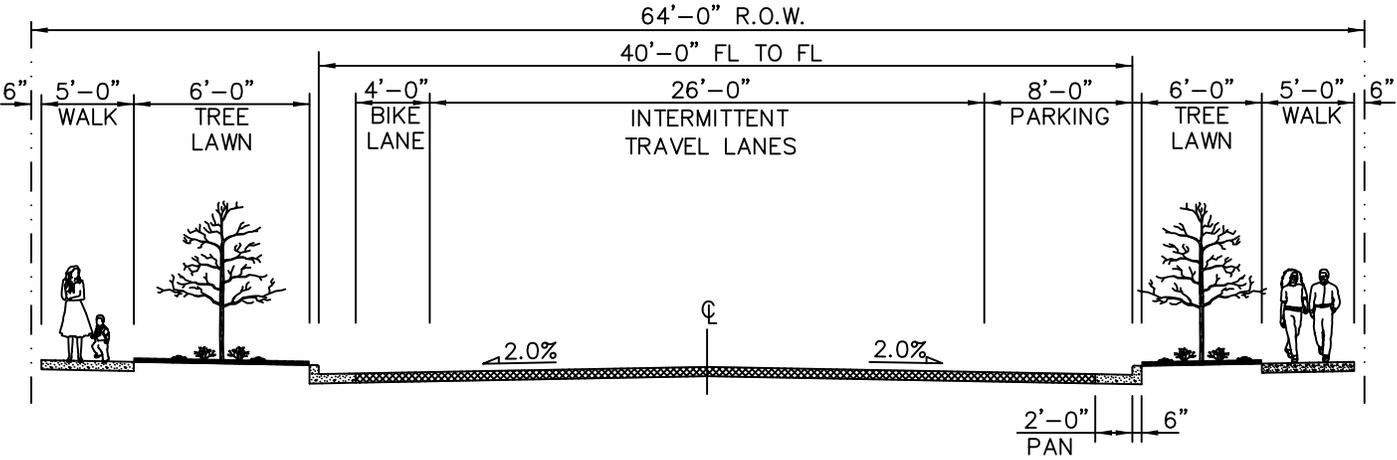
NOTES:

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2. TYPICAL SECTIONS SHOW MINIMUM REQUIREMENTS. ADDITIONAL ROADWAY WIDTHS AND RIGHT OF WAY MAY BE REQUIRED TO ACCOMMODATE TRAFFIC OR OTHER DEVELOPMENT NEEDS SUCH AS TURN LANES, ACCEL/DECEL LANES, EXTRA LANES, PEDESTRIAN OR BICYCLE FACILITIES, LANDSCAPING, UTILITIES OR CONSTRUCTION REQUIREMENTS.
3. WHEN FLOWLINE ELEVATIONS ARE NOT EQUAL, PAVEMENT SHALL BE SLOPED 2% FROM THE HIGHER GUTTER LIP. THE MAXIMUM STREET CROSS SLOPE IS 4%.
4. CERTAIN TREES ARE NOT ALLOWED IN TREE LAWNS. PLEASE CONTACT THE TOWN OF FREDERICK PLANNING DEPARTMENT.
5. TREES MAY NOT BE LOCATED WITHIN 30' OF A TRAFFIC SIGN IN THE DIRECTION OF TRAVEL ONLY.
6. TREES MAY NOT BE LOCATED WITHIN 100' OF A TRAFFIC SIGNAL IN THE DIRECTION OF TRAVEL ONLY.
7. SIDEWALK CROSS SLOPE SHALL NOT EXCEED 2%.

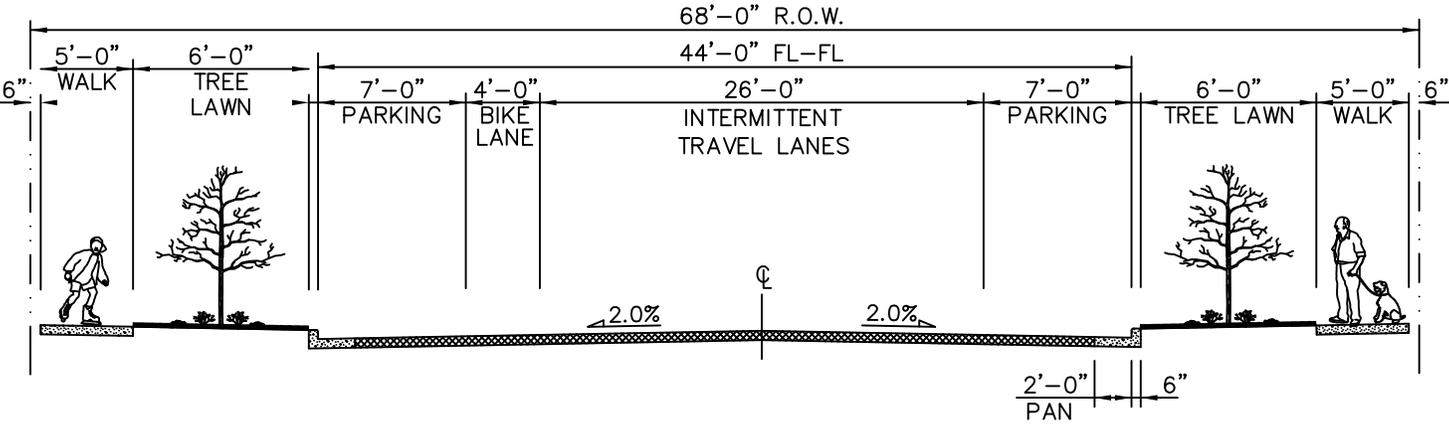
TYPICAL LOCAL STREET CROSS-SECTIONS

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COMMERCIAL/INDUSTRIAL WITH PARKING ONE SIDE



COMMERCIAL/INDUSTRIAL WITH PARKING BOTH SIDES

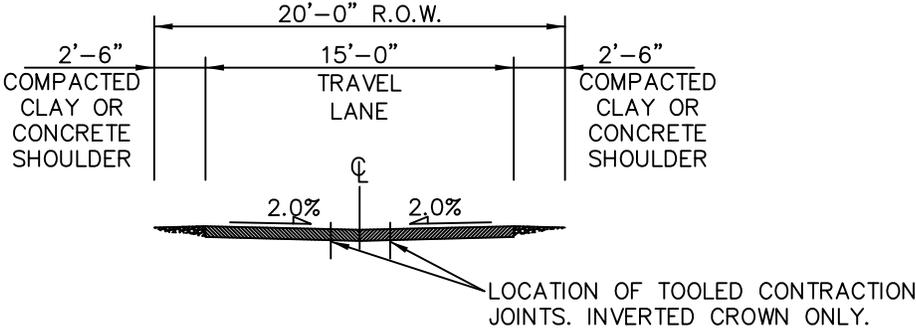
NOTES:

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3. WHEN FLOWLINE ELEVATIONS ARE NOT EQUAL, PAVEMENT SHALL BE SLOPED 2% FROM THE HIGHER GUTTER LIP. THE MAXIMUM STREET CROSS SLOPE IS 4%.
4. THE COMMERCIAL/INDUSTRIAL CROSS-SECTION WITH PARKING ON ONE SIDE OF THE STREET MAY ONLY BE USED WITH WRITTEN APPROVAL FROM THE TOWN ENGINEER.
5. CERTAIN TREES ARE NOT ALLOWED IN TREE LAWNS. PLEASE CONTACT THE TOWN OF FREDERICK PLANNING DEPARTMENT.
6. TREES MAY NOT BE LOCATED WITHIN 30' OF A TRAFFIC SIGN IN THE DIRECTION OF TRAVEL ONLY.
7. TREES MAY NOT BE LOCATED WITHIN 100' OF A TRAFFIC SIGNAL IN THE DIRECTION OF TRAVEL ONLY.
8. SIDEWALK CROSS SLOPE SHALL NOT EXCEED 2%.

TYPICAL COMMERCIAL/INDUSTRIAL STREET CROSS-SECTIONS

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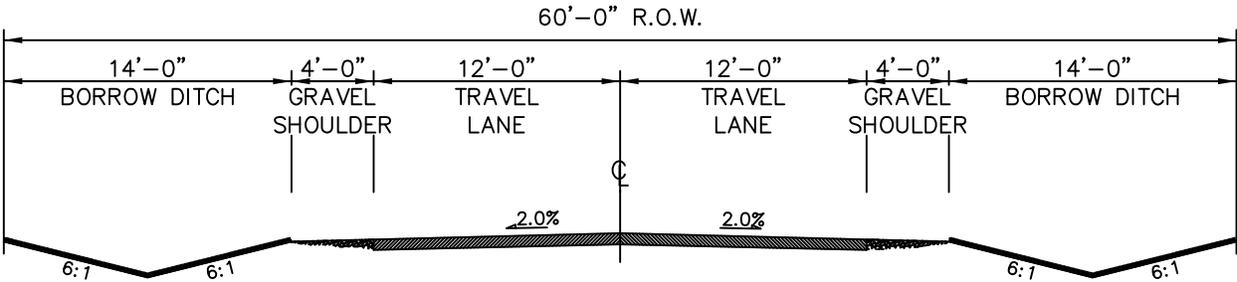




ALLEY

NOTES:

1. ALL ALLEYS SHALL BE CONCRETE.
2. NO UTILITIES SHALL BE CONSTRUCTED IN ALLEYS UNLESS APPROVED IN WRITING BY THE TOWN ENGINEER.
3. ALLEYS MAY HAVE AN INVERTED 2% CROWN. WITH THIS OPTION TOOLED CONTRACTION JOINTS ARE REQUIRED THE ENTIRE LENGTH OF THE ALLEY, 1.5' FROM THE CENTERLINE, BOTH SIDES.
4. EPOXY REBAR SHALL BE REQUIRED SHALL BE REQUIRED 4' IN LENGTH EVERY 4' DOWN THE CENTERLINE (FLOWLINE)
5. CONTRACTION JOINTS (LATERAL) SHALL BE REQUIRED EVERY 10'.



RURAL LOCAL

NOTES:

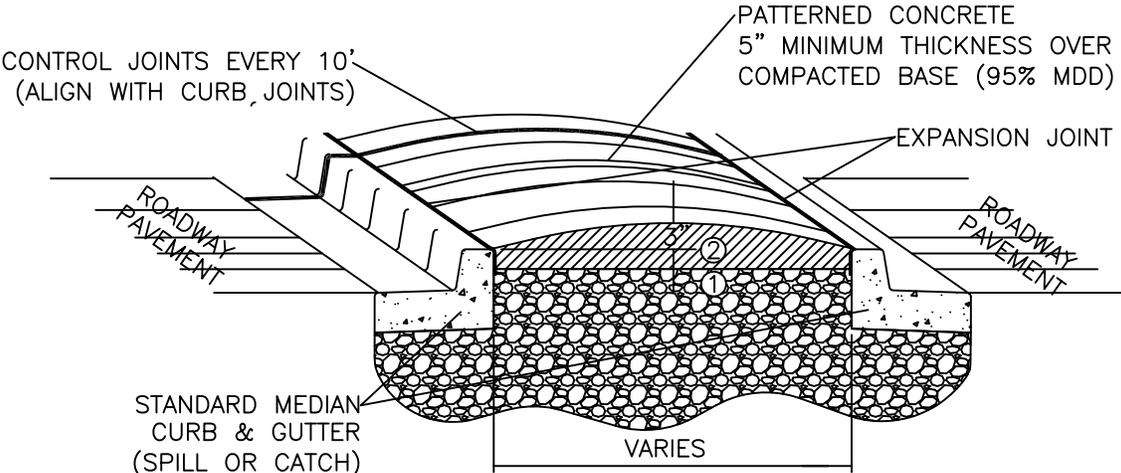
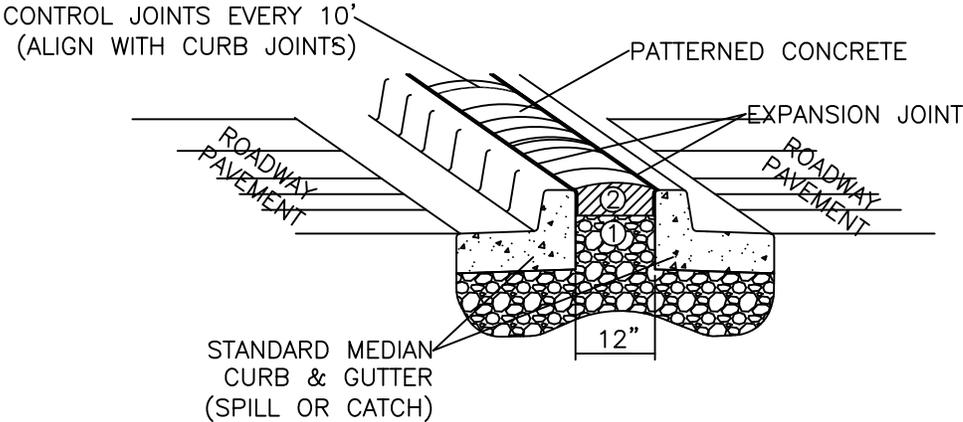
1. THIS CROSS SECTION MAY ONLY BE USED WITH WRITTEN APPROVAL OF THE TOWN ENGINEER.
2. ADDITIONAL ROW MAY BE REQUIRED IN THE EVENT THE 100-YEAR RUNOFF TRIBUTARY TO THE BORROW DITCHES EXCEEDS THE CAPACITY OF THE DITCHES.
3. THE TRAVEL LANES MAY BE GRAVEL OR ASPHALT BASED ON THE TRAFFIC IMPACT STUDY. GRAVEL TRAVEL LANES WILL ONLY BE ALLOWED IF THE AVERAGE DAILY TRIPS ON THE ROADWAY ARE LESS THAN 200 PER DAY AND WITH WRITTEN APPROVAL OF THE TOWN ENGINEER.

**TYPICAL ALLEY & RURAL STREET CROSS-SECTIONS**

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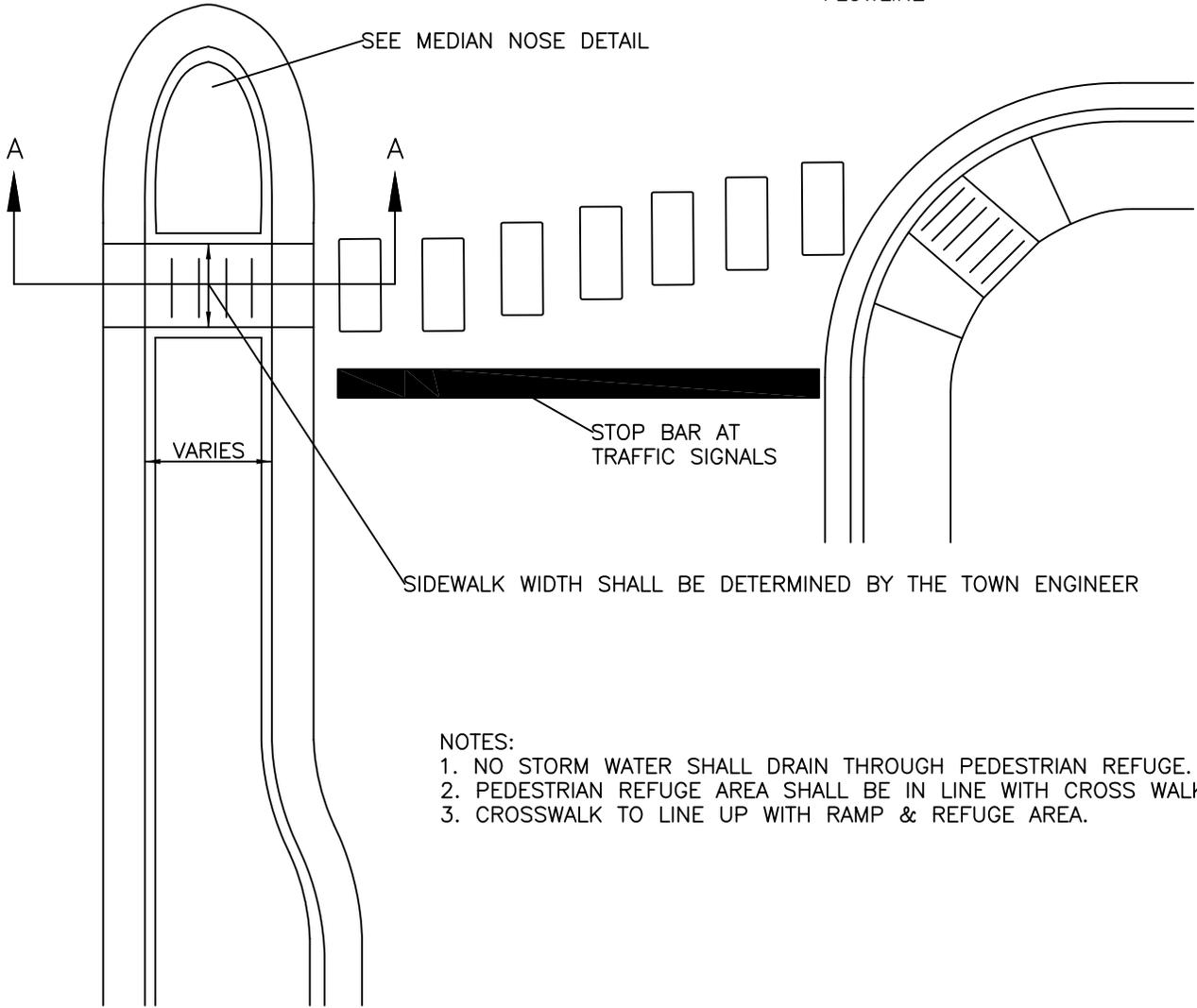
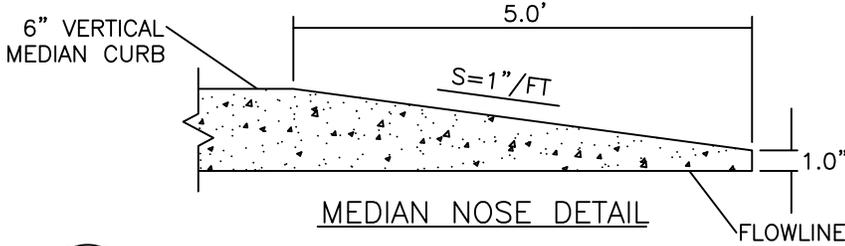
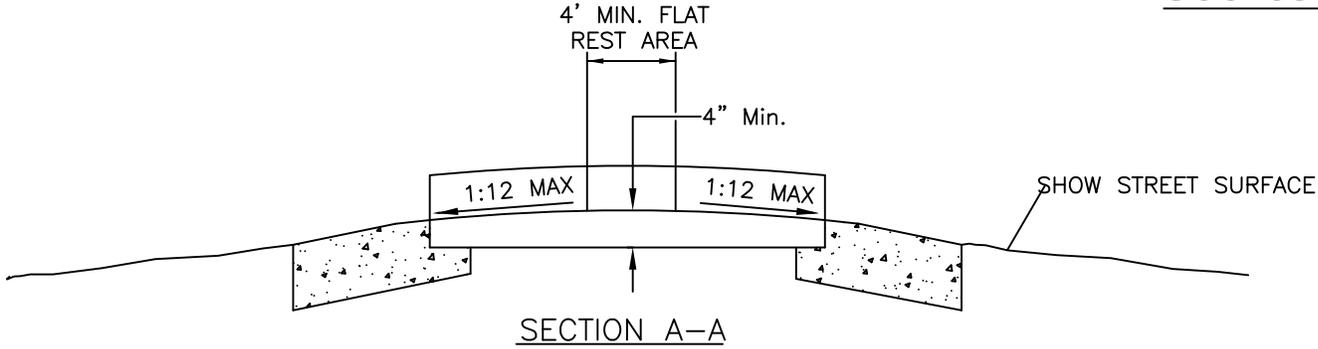
- ① PATTERNED CONCRETE SHALL BE SMALL CANYON STONE TEXTURED PATTERN WITH A SECOND HIGHLIGHTING COLOR COMPLEMENTING FEDERAL COLOR 33105. ALL HIGHLIGHTING COLORS SHALL BE APPROVED BY THE TOWN.
- ② CONCRETE SHALL BE COLORED COMPLIMENTING FEDERAL COLOR 32516 AND BE UNIFORMLY DISTRIBUTED THROUGH THE CONCRETE. THREE SAMPLE COLOR PANELS SHALL BE PROVIDED TO THE TOWN FOR APPROVAL.

- NOTES:**
1. CONTRACTOR SHALL COORDINATE THE LOCATIONS OF ALL SIGN POSTS. CORING INTO CONCRETE IS NOT PERMITTED.
  2. ANY MEDIAN TREES SHALL BE TRIMMED SO THE MINIMUM BRANCH HEIGHT IS 8' ABOVE THE GUTTER.
  3. THE TOWN ENGINEER MAY REQUIRE A DRAINAGE SYSTEM IF AN IRRIGATION SYSTEM IS PROPOSED WITHIN THE MEDIAN.

**STANDARD DETAIL FOR RAISED MEDIAN  
SPILL OR CATCH CURB**

NTS





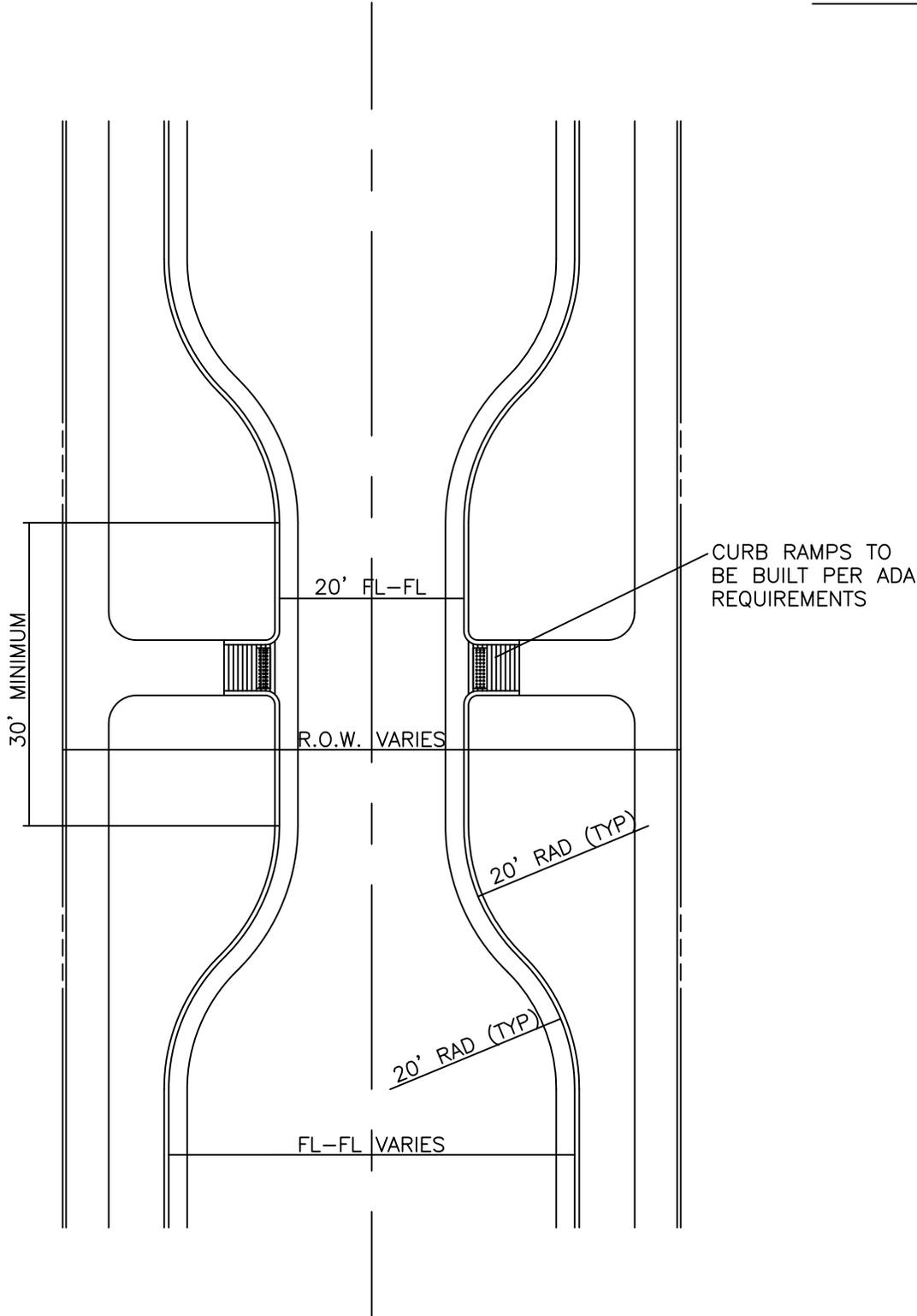
NOTES:

- 1. NO STORM WATER SHALL DRAIN THROUGH PEDESTRIAN REFUGE.
- 2. PEDESTRIAN REFUGE AREA SHALL BE IN LINE WITH CROSS WALKS.
- 3. CROSSWALK TO LINE UP WITH RAMP & REFUGE AREA.

MEDIAN ISLAND & PEDESTRIAN REFUGE AREA

NTS

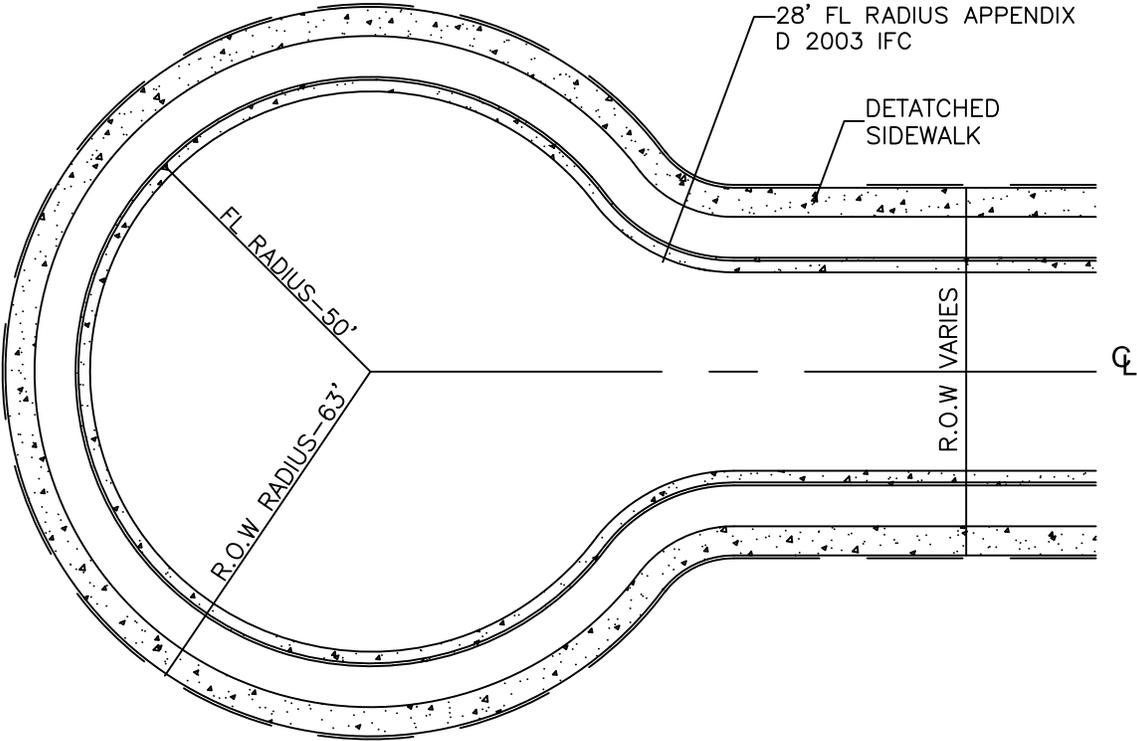




- NOTES:**
- 1. TRAFFIC CALMING DEVICES SHALL ONLY BE USED ON LOCAL OR COLLECTOR ROADWAYS ONLY WITH WRITTEN APPROVAL OF THE TOWN ENGINEER.
  - 2. ROLLOVER CURB IS NOT ALLOWED IN TRAFFIC CALMING DEVICES.
  - 3. ROADWAY SHALL BE POSTED NO PARKING IN TRAFFIC CALMING DEVICE.

**TRAFFIC CALMING DEVICE**  
NTS



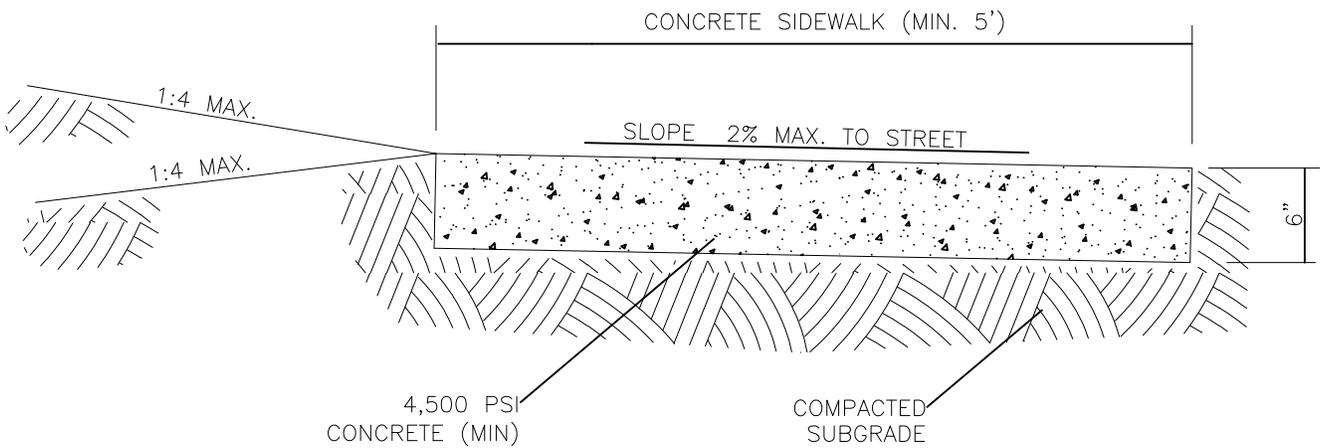


**NOTES:**

- 1. RADIUS TO R.O.W. IS FOR DETACHED SIDEWALK AROUND THE CUL-DE-SAC. ATTACHED SIDEWALK MAY BE USED WITH WRITTEN APPROVAL OF TOWN ENGINEER ONLY.
- 2. 3% MAXIMUM CROSS SLOPE ON ALL CUL-DE-SACS.
- 3. ALL DIMENSIONS OF CUL-DE-SAC SHALL CONFORM TO APPENDIX D IN THE 2015 (OR MOST RECENT VERSION) INTERNATIONAL FIRE CODE.
- 4. SIDEWALK CROSS SLOPE SHALL NOT EXCEED 2%.

**CUL-DE-SAC DETAIL**  
NTS



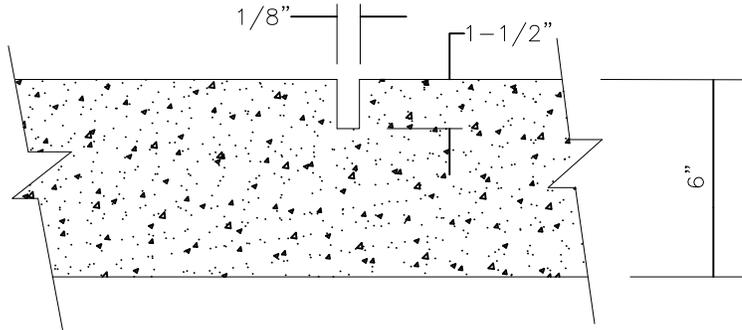
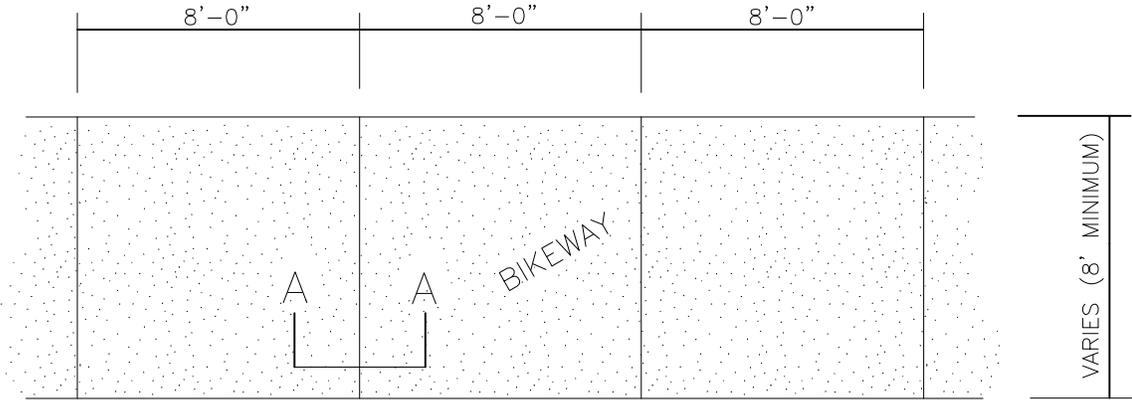


**NOTES:**

- 1. TOOLED CONTRACTION JOINTS SHALL BE EVENLY SPACED BETWEEN 5' AND 10' APART OR AS DIRECTED BY TOWN ENGINEER.
- 2. EXPANSION JOINTS SHALL BE SPACED EVERY 200' MINIMUM AND AT THE FOLLOWING LOCATIONS:
  - A) AT BOTH EDGES OF A DRIVEWAY
  - B) BETWEEN THE BACK OF SIDEWALK AND DRIVEWAY
  - C) BETWEEN EXISTING CONCRETE AND A NEW CONCRETE POUROR AS DIRECTED BY THE TOWN ENGINEER.
- 3. EXPANSION JOINTS SHALL BE IN PLACE PRIOR TO PLACING THE CONCRETE.
- 4. SIDEWALK CROSS SLOPE SHALL NOT EXCEED 2%.

**DETACHED SIDEWALK DETAIL**  
NTS



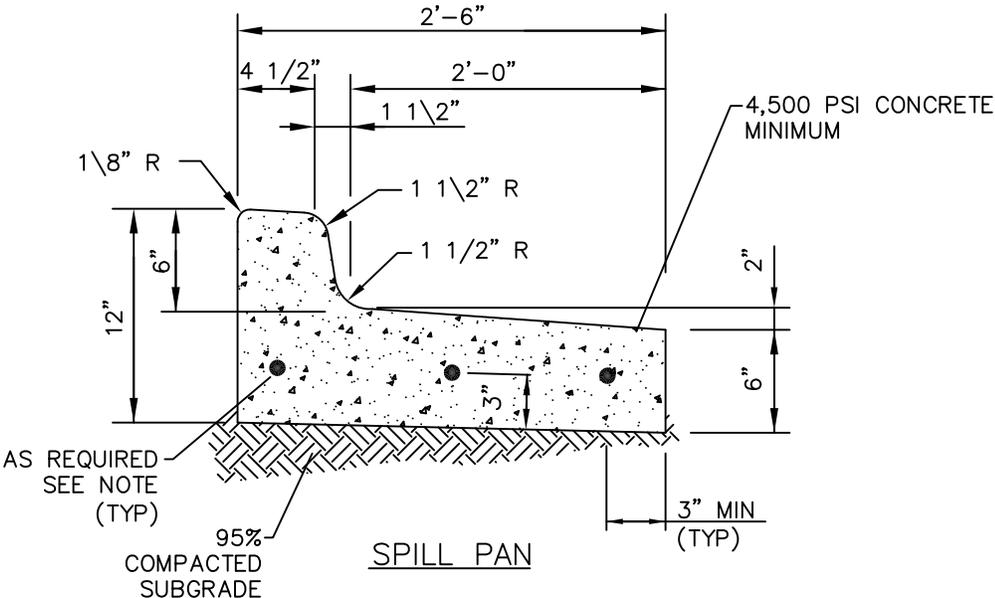
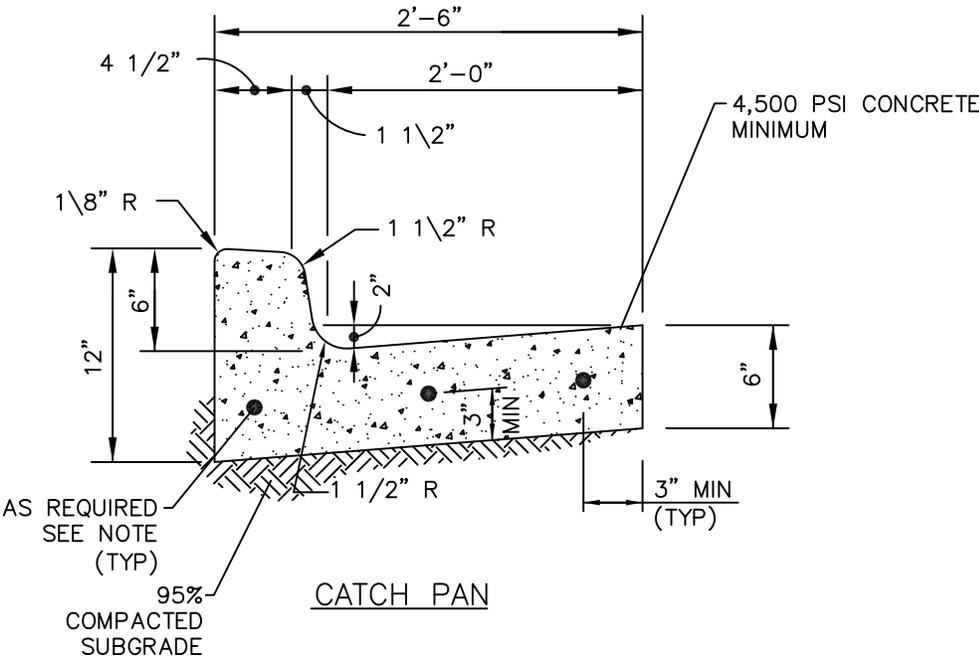


SECTION A-A

- NOTES:
- 1. SAWCUT OR 1-1/2 " ZIPSTRIP JOINTS AT 8' O.C.
  - 2. EXPANSION JOINTS REQUIRED AT CURB RAMPS AND AT 100' SPACING.
  - 3. 4,500 PSI CONCRETE WITH FIBER MESH.
  - 4. MINIMUM 6" THICK CONCRETE UNLESS OTHERWISE SPECIFIED ON THE CONSTRUCTION PLANS.
  - 5. FINISH TO BE LIGHT BROOM.

**BIKEWAY DETAIL**  
NTS



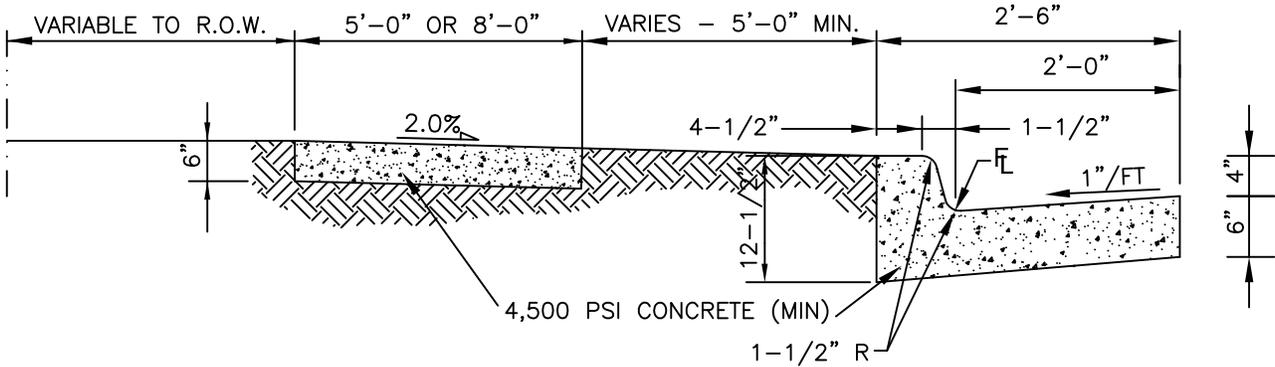


- NOTES:**
1. NO. 4 EPOXY REBAR SHALL BE INSTALLED IN ALL CURB RETURNS WITH 25' OR LARGER RADII. THE REBAR SHALL BE FROM BEGINNING TO END OF THE CURB RETURN
  2. THE TRANSITION FROM COMBINATION CURB, GUTTER AND SIDEWALK TO 6" VERTICAL CURB AND GUTTER SHALL BE OVER A MINIMUM LENGTH OF 12'.
  3. A 1' PAN MAY BE USED IN COMMERCIAL APPLICATIONS WITH THE APPROVAL OF THE TOWN ENGINEER.

**VERTICAL CURB AND GUTTER DETAIL**

NTS





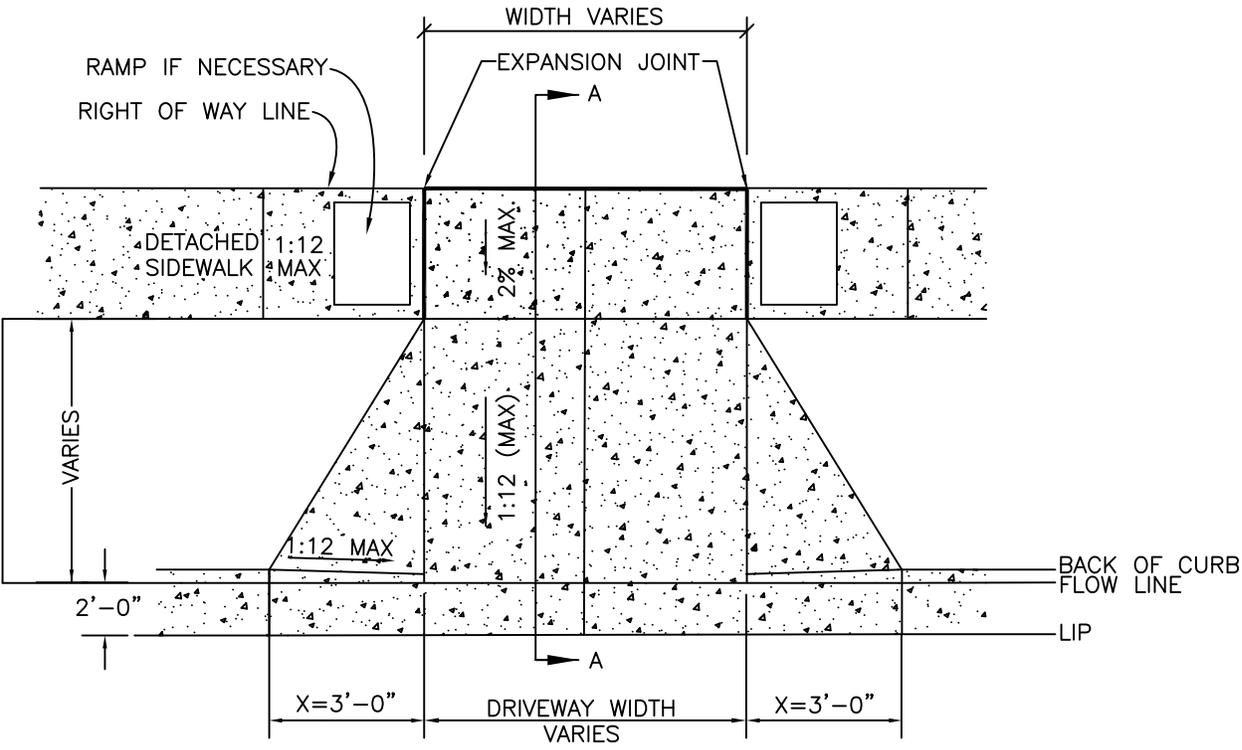
6" VERTICAL CURB, GUTTER AND DETACHED WALK

NOTES

- 1. SIDEWALK WIDTH SHALL BE SPECIFIED ON THE CONSTRUCTION PLANS.
- 2. SEE DETAIL 500-01, 500-02, 500-03, 500-04 AND 500-05 FOR TYPICAL STREET CROSS SECTIONS
- 3. SIDEWALK CROSS SLOPE SHALL NOT EXCEED 2%.

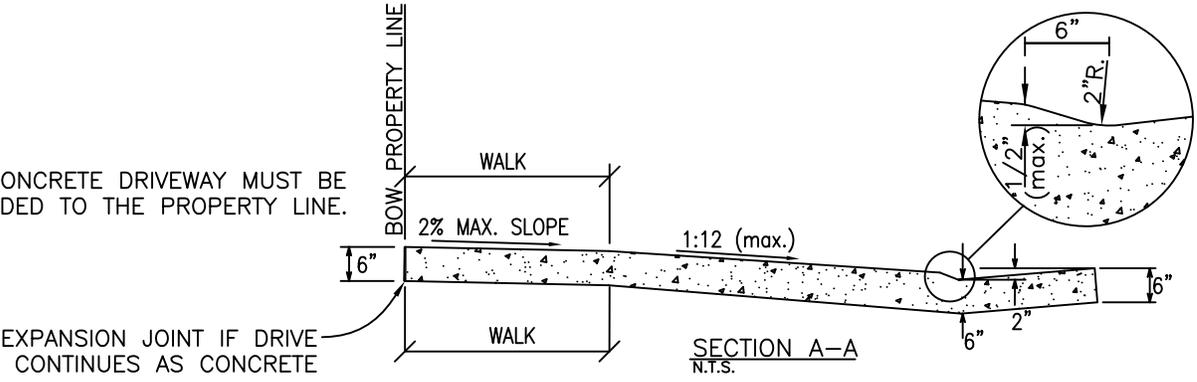
VERTICAL CURB & GUTTER  
DETACHED WALK  
NTS





NOTE:

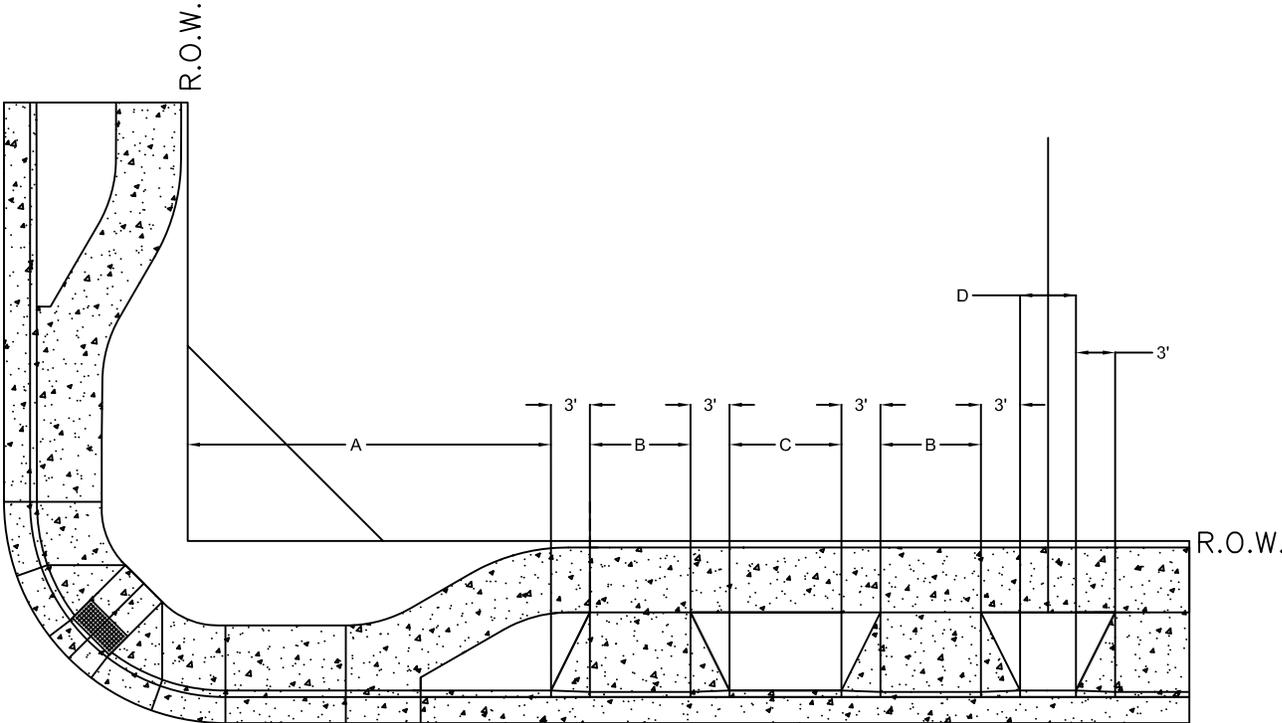
1. CONCRETE DRIVEWAY MUST BE PROVIDED TO THE PROPERTY LINE.



STANDARD DRIVEWAY APPROACH

NTS





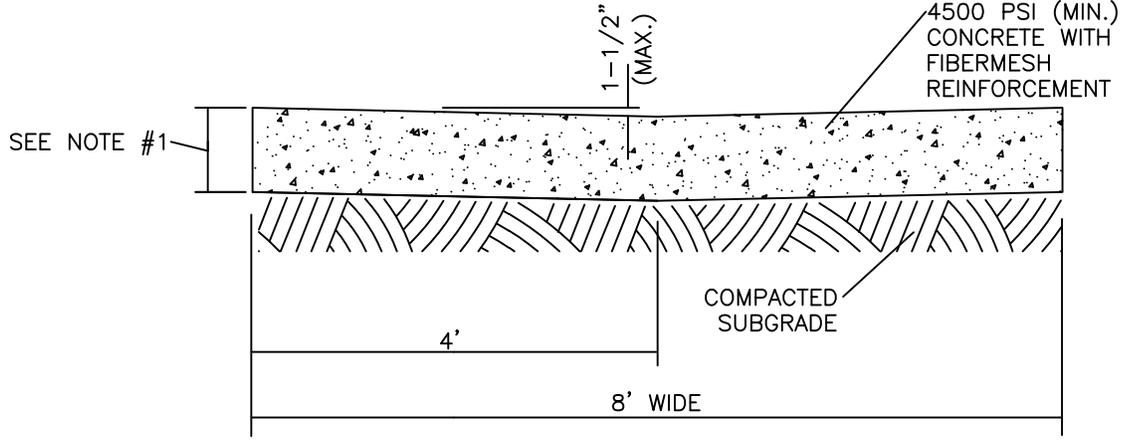
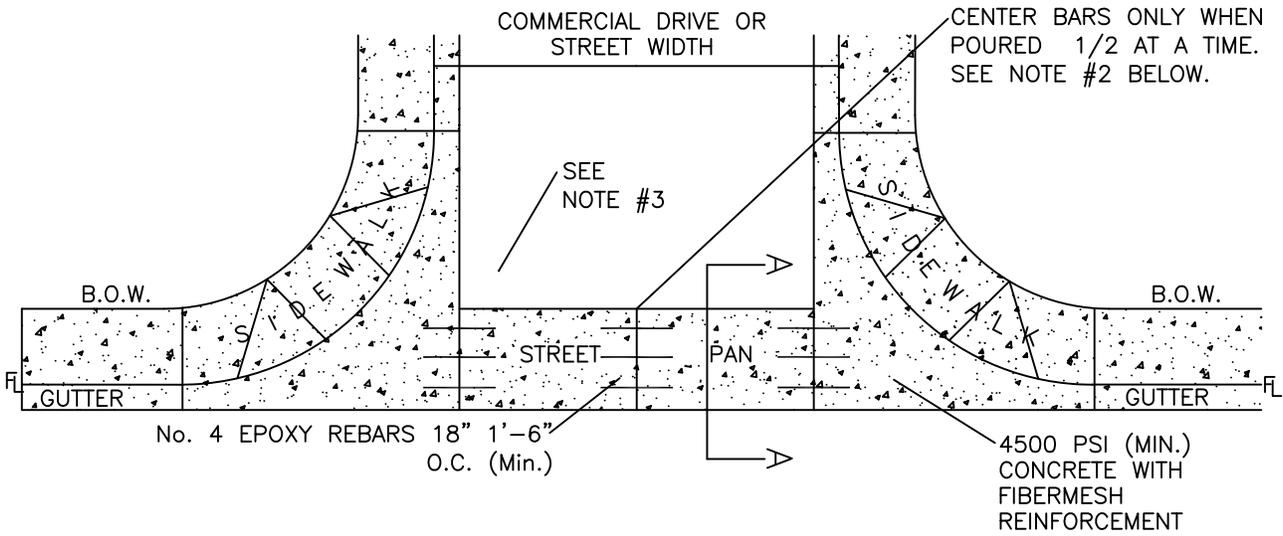
Property Type	Dimension			
	A	B	C	D
Multi-family, Commercial, Industrial	125' Minimum	10' Minimum 30' Maximum	30' Minimum	5'
Single Family Residential	50' Minimum	30' Maximum	30' Minimum	5'

**NOTES:**

1. The Multi-family, commercial, or industrial property access is assumed to be onto a local or collector street adjacent to any classification of road.
2. The single family residential access is assumed to be onto a local street adjacent to an intersection with a collector street.
3. If a multi-family, commercial, or industrial property accesses onto an arterial street the driveway must be a minimum of two hundred fifty (250) feet from any intersection on the arterial street, or from another properties access as measured from the intersection of right-of-way lines.
4. If a single family residential property accesses a local street adjacent to the intersection of an arterial the driveway must be one hundred twenty-five (125) feet from the intersection of the right-of-way lines.
5. A 10' Maximum width Circular Drive with the accesses spaced by at least thirty (30) feet in a residential area may be allowed.

**DRIVEWAY SPACING**  
NTS





SEC.A-A

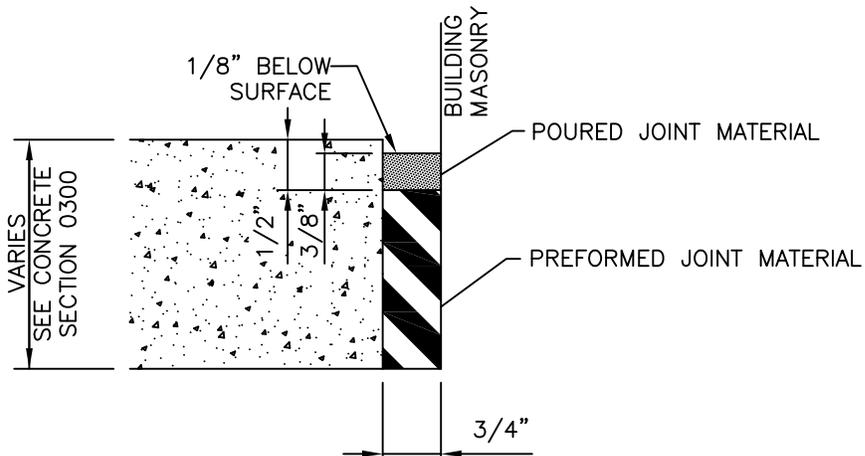
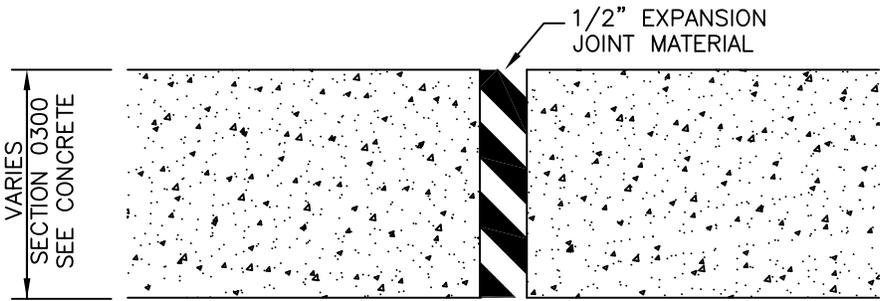
NOTES:

1. ALL CROSSPANS IN RESIDENTIAL AREAS SHALL BE 8" THICK AND 10" THICK FOR COMMERCIAL AREAS.
2. CROSSPANS MAY BE POURED 1/2 AT A TIME ONLY WITH WRITTEN APPROVAL OF THE TOWN ENGINEER.
3. REFER TO DETAIL 500-31 FOR ASPHALT PAVING AROUND CROSSPAN.
4. CROSSPAN SHALL NOT OVERLAP WITH SIDEWALK CROSSWALK

CROSSPAN DETAIL

NTS





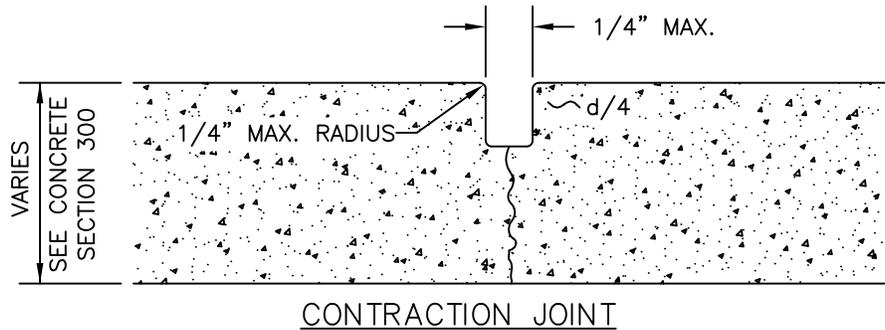
EXPANSION JOINT  
NOT TO SCALE

NOTES:

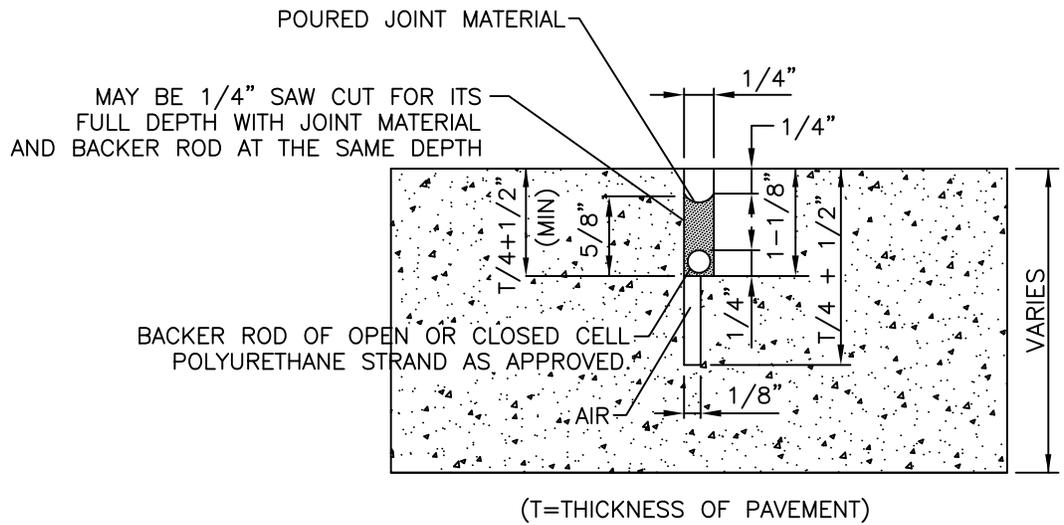
- 1. 1/2" EXPANSION JOINT MATERIAL SHALL BE PLACED AS REQUIRED AND SHALL EXTEND THE FULL DEPTH OF CONTACT SURFACE.
- 2. EXPANSION JOINTS SHALL BE INSTALLED WHEN ABUTTING EXISTING CONCRETE OR A FIXED STRUCTURE.

EXPANSION JOINT DETAIL  
NTS





CONTRACTION JOINT



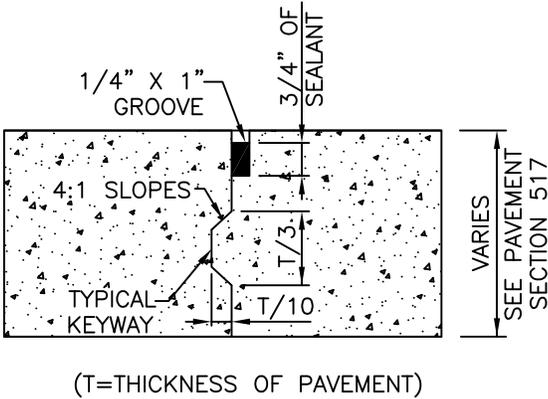
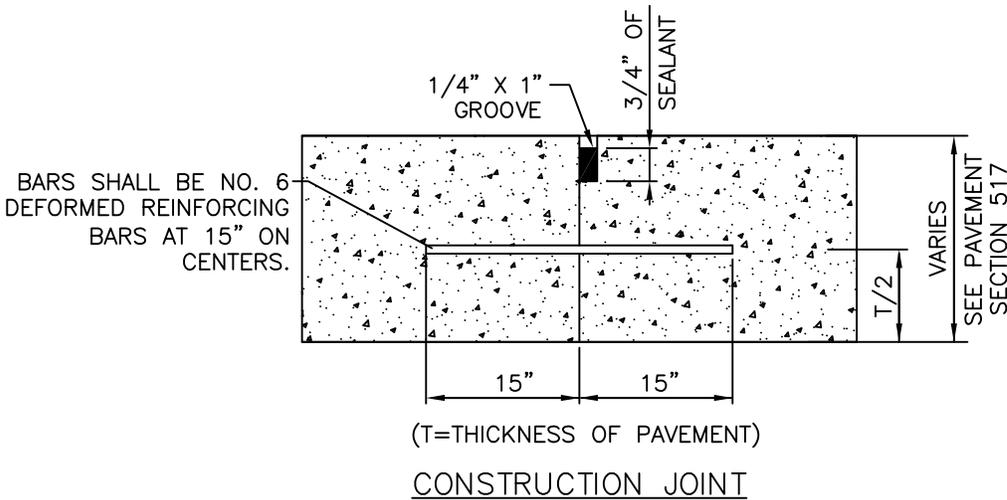
PAVEMENT LONGITUDINAL CONTRACTION JOINT

NOTES

- 1. MAXIMUM CONTRACTION JOINT SPACING FOR CURB, GUTTER AND SIDEWALK IS 10'. CONTRACTION JOINTS IN ATTACHED SIDEWALKS SHALL BE STAGGERED SO THEY DO NOT ALIGN WITH THE CONTRACTION JOINTS OF THE CURB & GUTTER (DOES NOT APPLY TO CURBWALKS).
- 2. SAWCUT JOINTS (IF USED) SHALL BE AFTER CONCRETE HAS SUFFICIENTLY HARDENED, BUT BEFORE NO LONGER THAN 48 HOURS AFTER PLACEMENT.

CONTRACTION JOINT DETAILS  
NTS



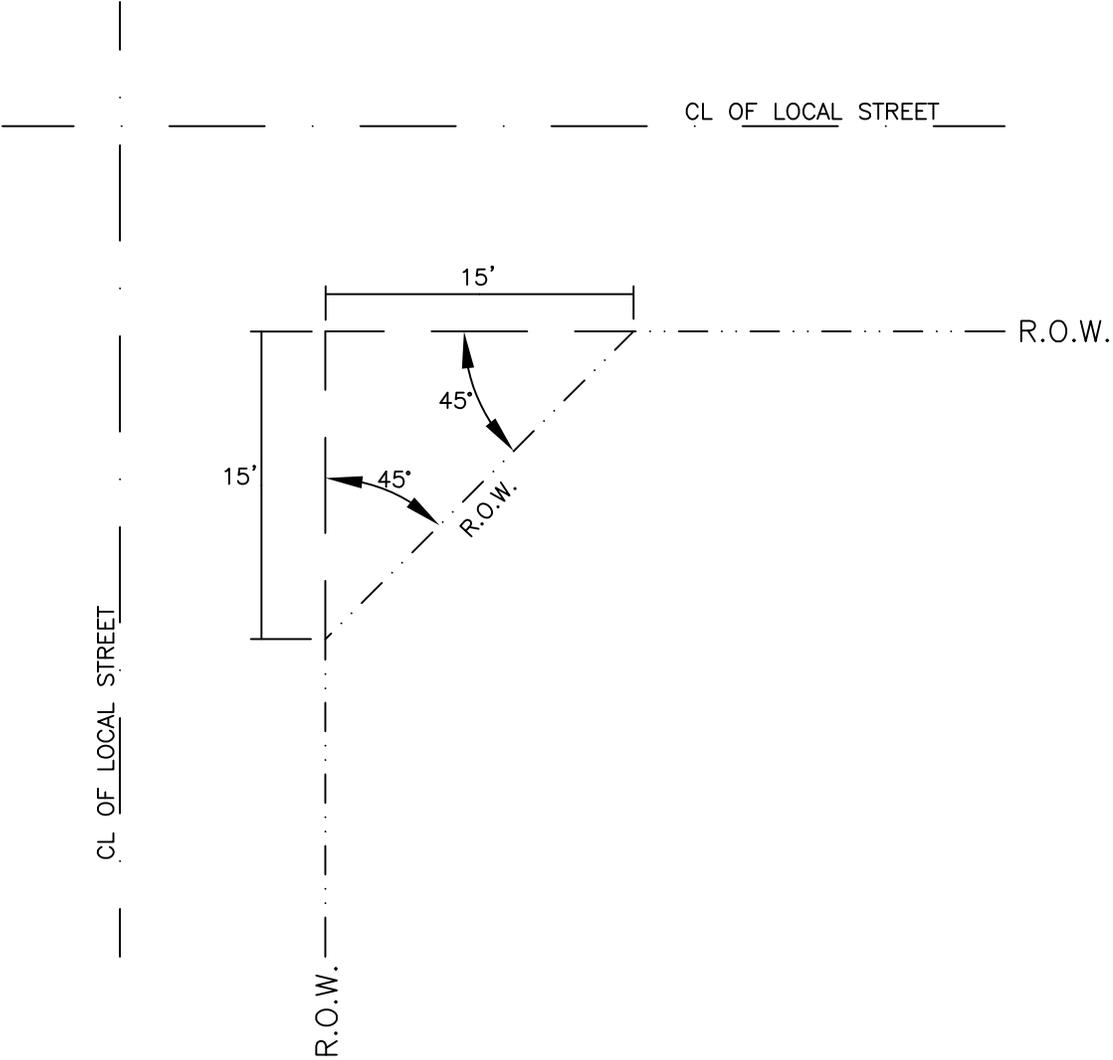


- NOTES:**
1. TRANSVERSE CONSTRUCTION JOINTS REQUIRED AT THE END OF EACH DAY'S POUR AND WHEN THE POUR HAS BEEN SUSPENDED FOR 30 MINUTES OR MORE.
  2. JOINT LAYOUT AND JOINT DETAILS FOR CONCRETE STREETS SHALL BE SUBMITTED TO THE TOWN ENGINEER FOR APPROVAL.

**COLD JOINT DETAILS**

NTS

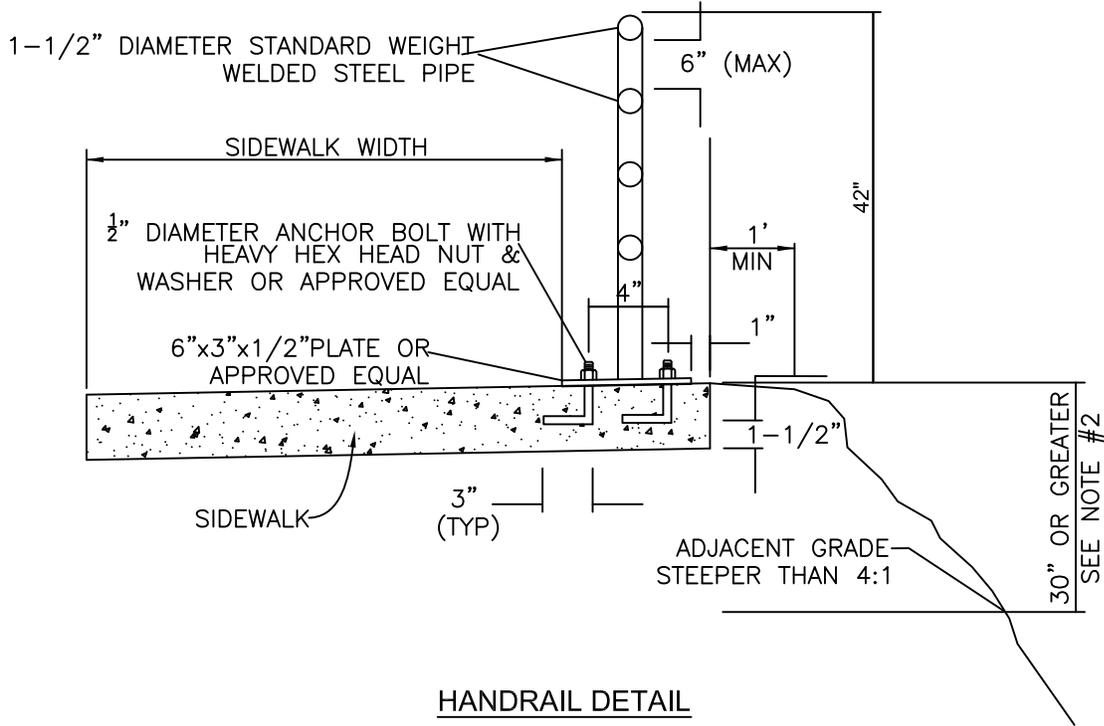




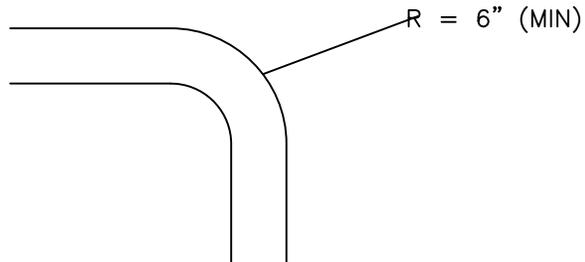
- NOTES:**
- 1. THIS DETAIL MAY BE USED FOR LOCAL ROADWAYS ONLY. FOR ALL OTHER ROADWAYS THE SITE TRIANGLE WILL DETERMINE THE RIGHT OF WAY AT INTERSECTIONS.
  - 2. RIGHT OF WAY AT ROUND-A-BOUNTS WILL BE DETERMINED ON A CASE BY CASE BASIS.

**LOCAL INTERSECTION RIGHT OF WAY**  
NTS





HANDRAIL DETAIL



TOP RAIL CORNER DETAIL

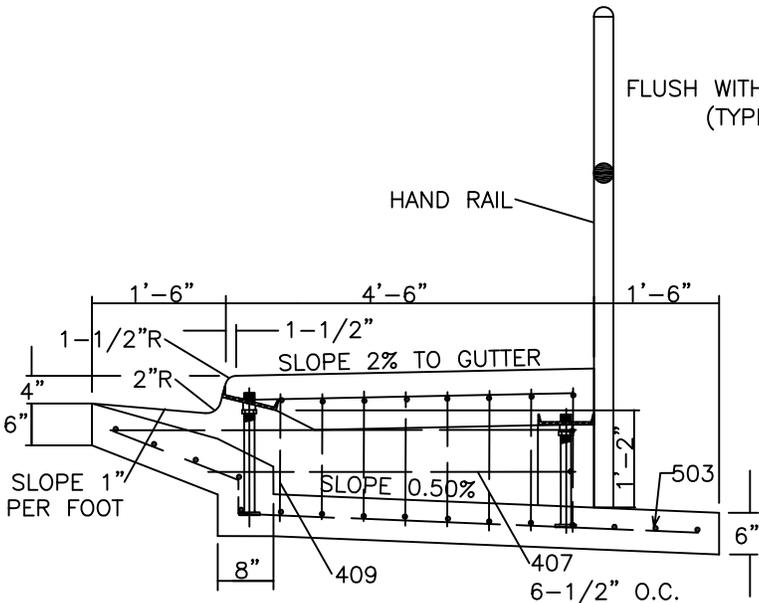
NOTES:

- 1. THE SIDEWALK WIDTH SHALL BE INCREASED BY A MINIMUM OF 6" WHEREVER A HANDRAIL IS USED.
- 2. IF A SIDEWALK IS MORE THAN 30" ABOVE THE ADJACENT GRADE A HANDRAIL MUST BE USED.
- 3. OPEN CLEARANCE BETWEEN INTERMEDIATE RAILS MUST BE 4" OR LESS.
- 4. FINISH SHALL BE EITHER GALVANIZED OR SEMI-GLOSS ENAMEL OVER A SHOP COAT OF METAL PRIMER.
- 5. WHEN THE SLOPE BEHIND THE SIDEWALK IS STEEPER THAN 4:1 A HANDRAIL MUST BE USED. WHEN THE SLOPE BEHIND THE SIDEWALK IS 6:1 OR FLATTER FOR A MINIMUM DISTANCE OF 10' A HANDRAIL IS NOT REQUIRED.

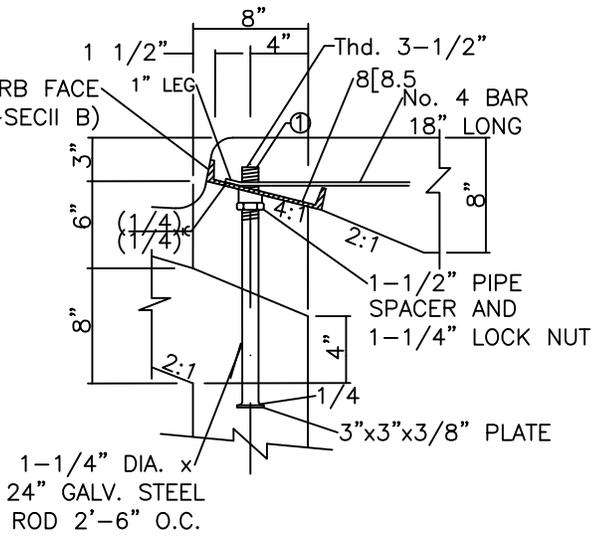
PEDESTRIAN HANDRAIL DETAIL

NTS

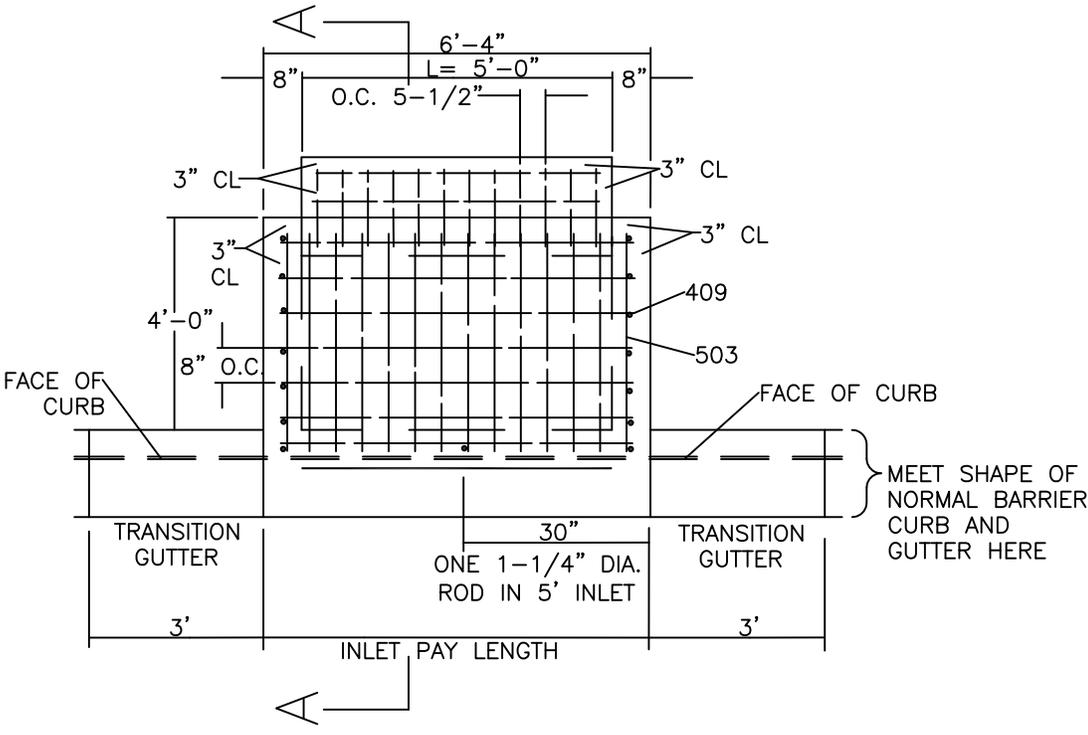




SEC. A - A



① CURB FACE ASSEMBLY  
PLACE ENTIRE ASSEMBLY BEFORE POURING CONCRETE

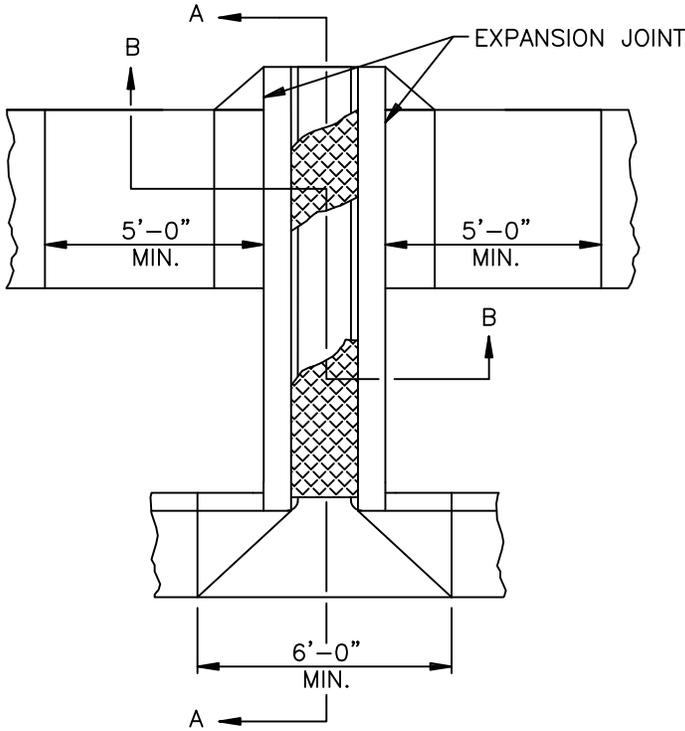
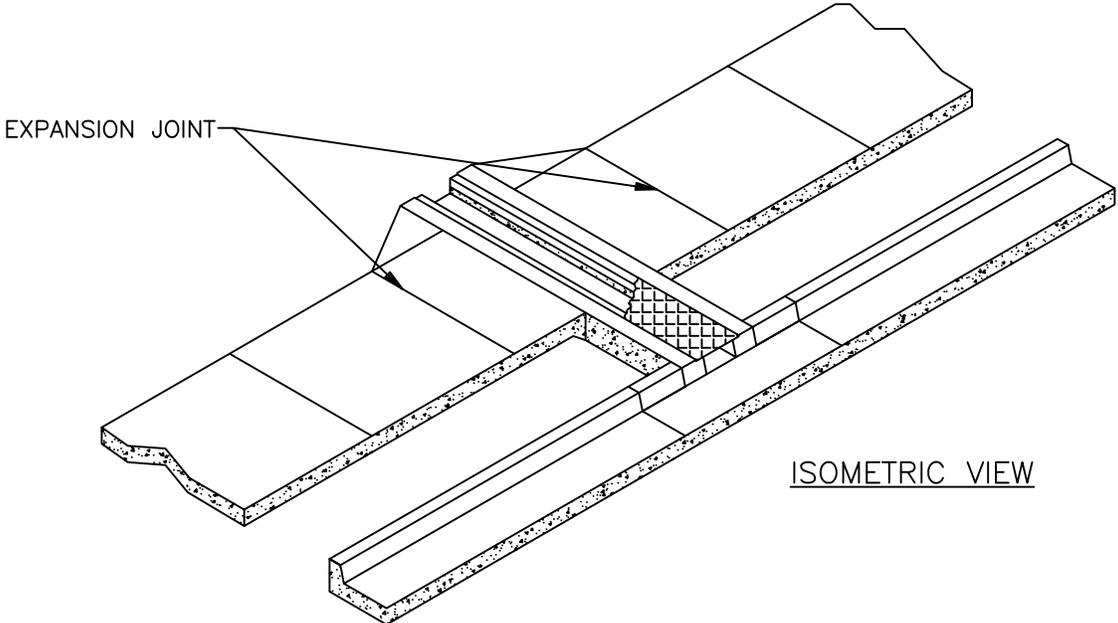


TYPICAL PLAN VIEW

NOTE:  
1. WRITTEN APPROVAL REQUIRED IF USED ON ANY OTHER ROADWAY CLASSIFICATION OTHER THAN LOCAL ROADWAYS.

**TYPE R MODIFIED CHASE**  
NTS

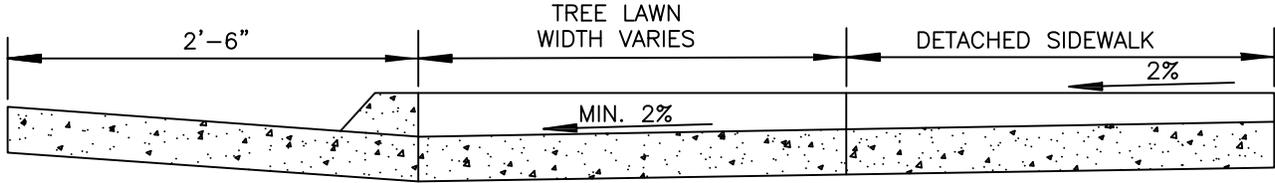




NOTE:  
1. CHASE DRAIN SHALL ONLY BE USED WITH TOWN ENGINEER APPROVAL.  
2. CHASE DRAINS SHALL NOT BE CONSTRUCTED WITH AN OPENING WIDTH OF GREATER THAN 2'. MULTIPLE CHASES MAY BE CONSTRUCTED WITH A MINIMUM 1' SEPARATION BETWEEN CHASE THROAT OPENINGS.

**CHASE DRAIN**  
NTS





SECTION A-A

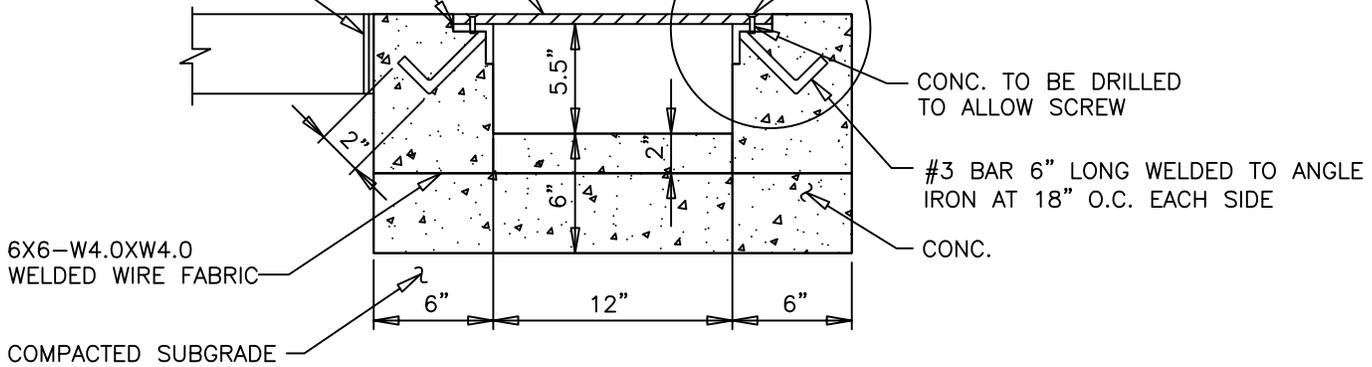
1/4" NON-SLIP RAISED PATTERN STEEL TREAD PLATE

2" X 2" X 1/4" ANGLE IRON TO BE DRILLED AND THREADED TO ALLOW SCREW

EXPANSION JOINT

SEE DETAIL A

1/2" X 1" FLATHEAD MACH. SCREW BRASS OR ELECTRO-GALVANIZED FINISH, 2' O.C.



SECTION B-B

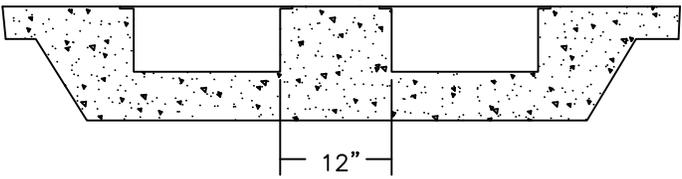
STEEL PLATE NON SLIP RAISED PATTERN

PLATE FLUSH WITH TOP OF WALK

1-1/2" X 1-1/2" X 1/4" ANGLE IRON DRILLED & TAPPED FOR 1/4" MACHINE SCREWS

1/2"

3/16" CLEARANCE



MULTIPLE CHASE DETAIL

1/4" X 3/4" F.H. MACHINE SCREWS @ 2'-4" O.C. COUNTER SUNK FLUSH W/PLATE

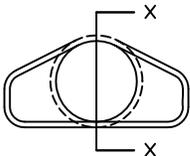
NO. 3 REBAR 6" LONG, WELD TO ANGLE, 18" O.C.

DETAIL A

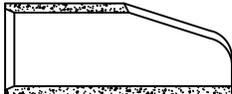
CHASE DRAIN DETAIL

NTS

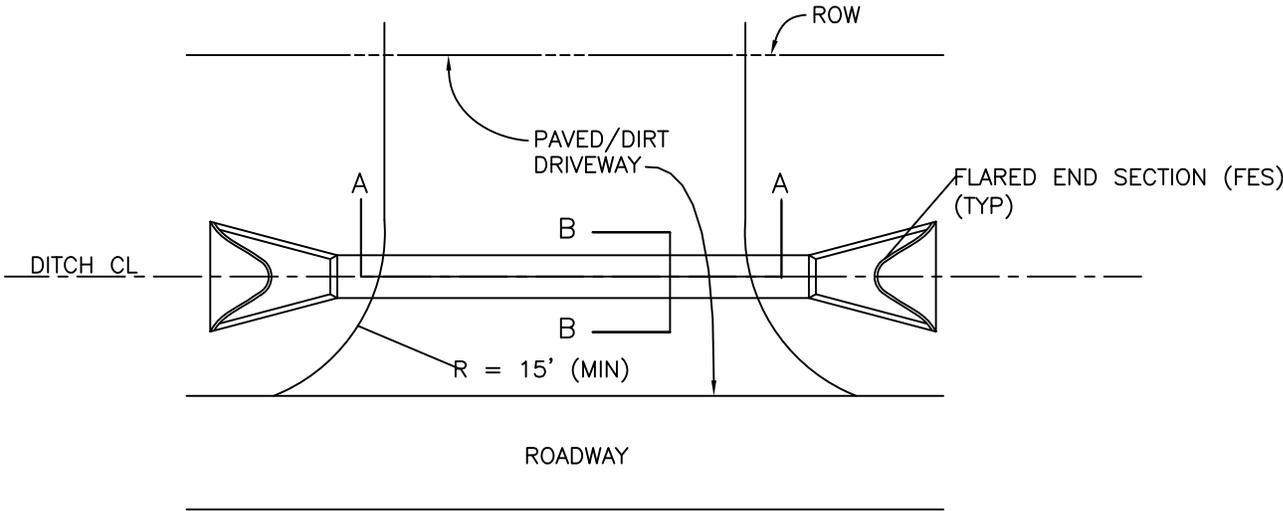




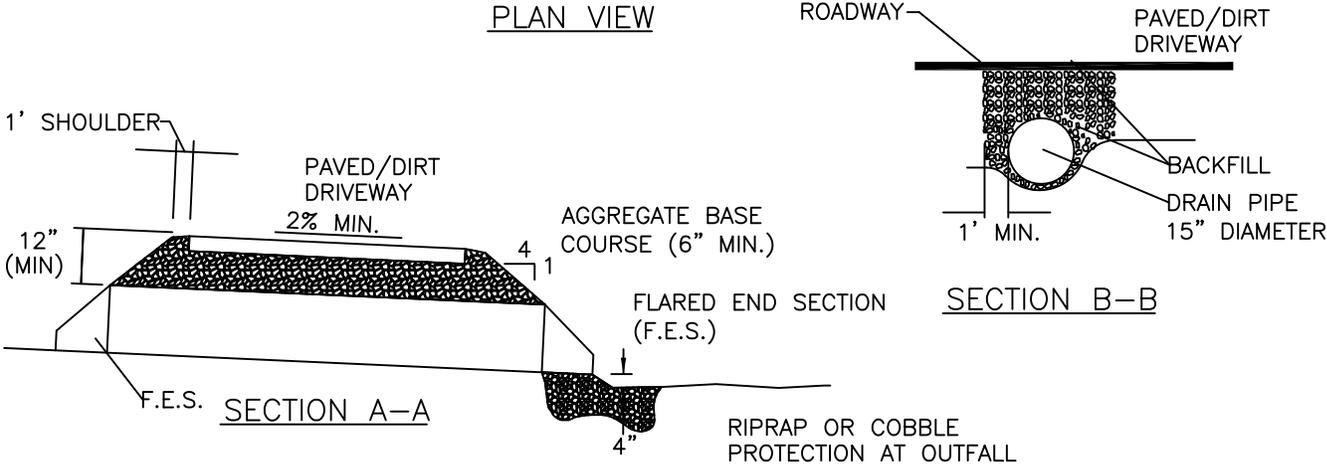
F.E.S. END VIEW



SECTION X-X



PLAN VIEW

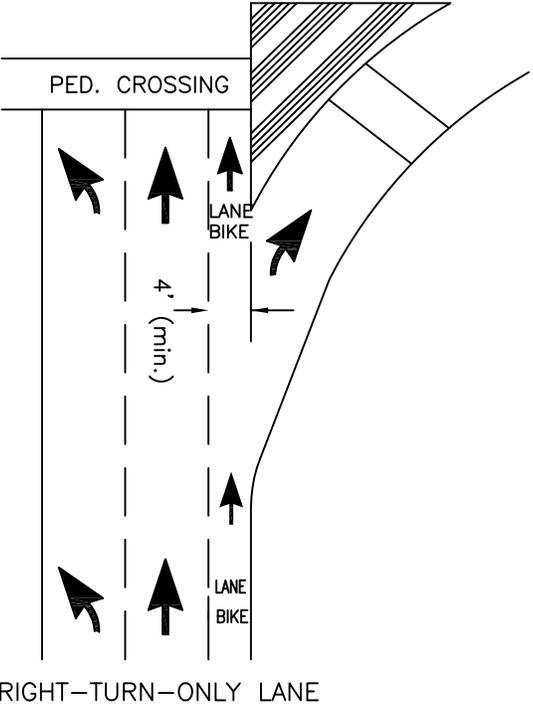
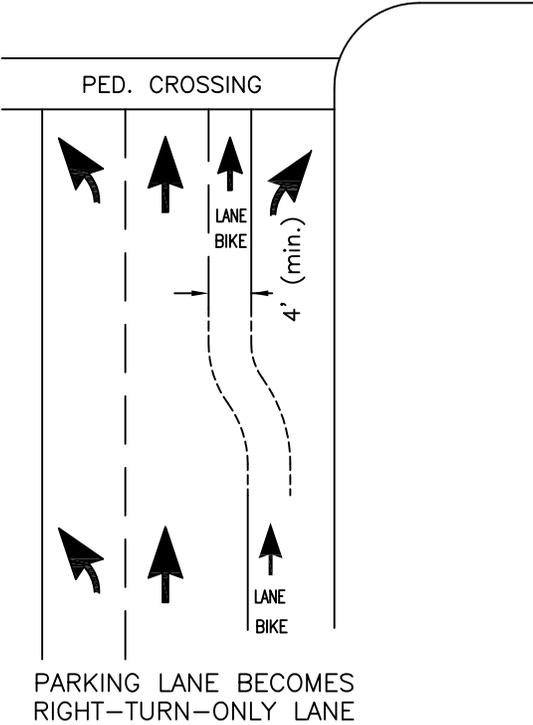


- NOTES:**
1. TOWN ENGINEER MAY REQUIRE DRIVEWAY TO BE ASPHALT OR CONCRETE.
  2. FLARED END SECTIONS ARE REQUIRED AT EACH END OF THE PIPE. ENGINEER SHALL VERIFY THE LOADING ON THE MATERIAL OF PIPE CHOSEN.
  3. MAXIMUM SIDE SLOPE OF DITCH IS 6:1.
  4. THE MINIMUM PIPE SIZE-15" DIAMETER RCP.
  5. THE PROPERTY OWNER SHALL BE RESPONSIBLE FOR MAINTENANCE OF ALL DRAINAGE DITCHES AND CROSSINGS UP TO THE EDGE OF ASPHALT.

**ACCESS ON RURAL ROADWAYS- W/O C&G**

NTS

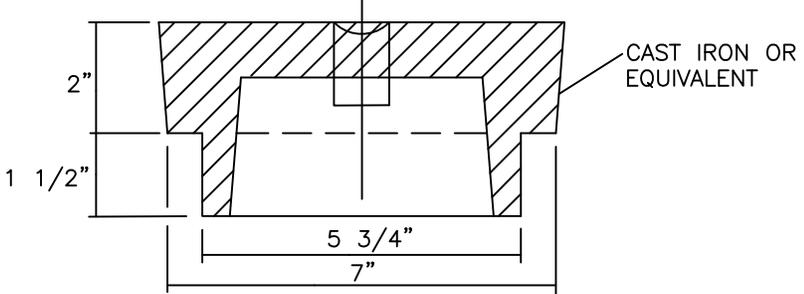
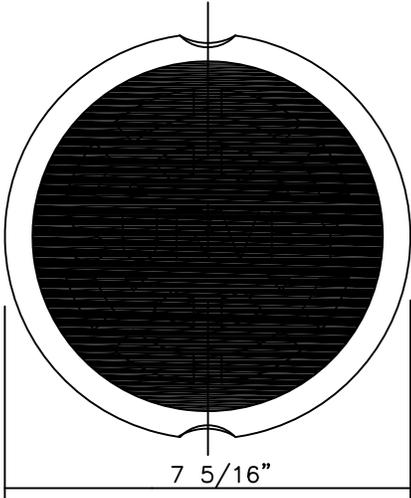




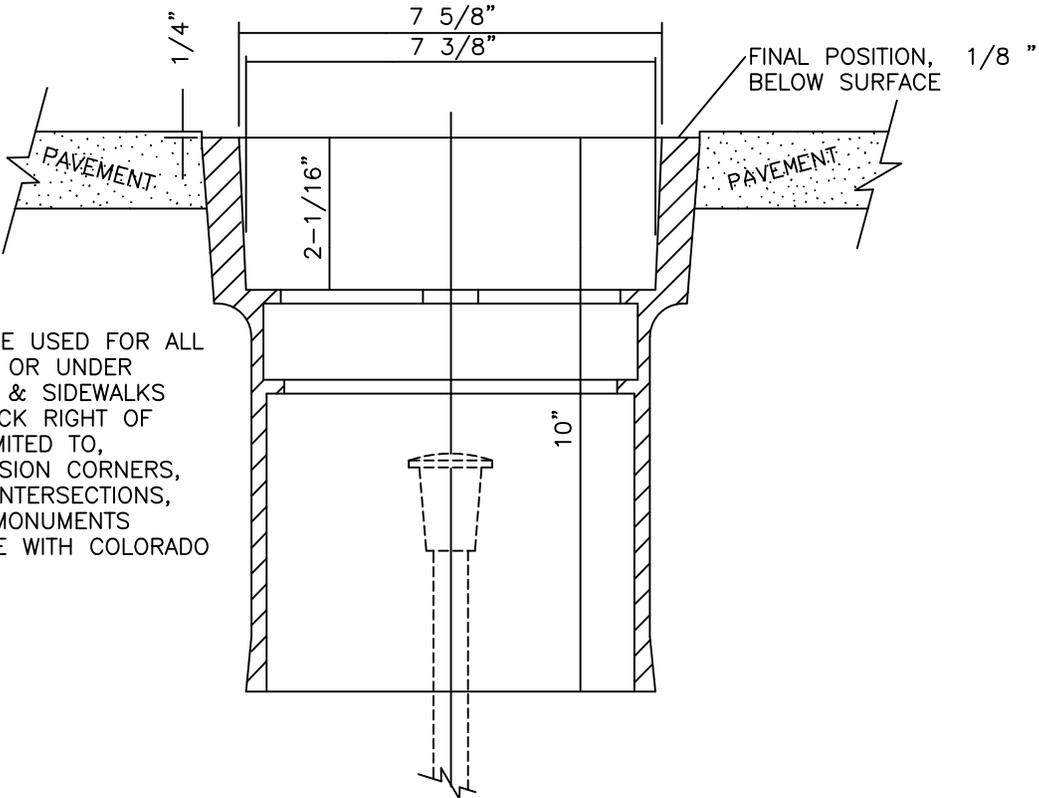
**BIKE LANE APPROACHING VEHICLE RIGHT TURN LANE**

NTS





MONUMENT LID

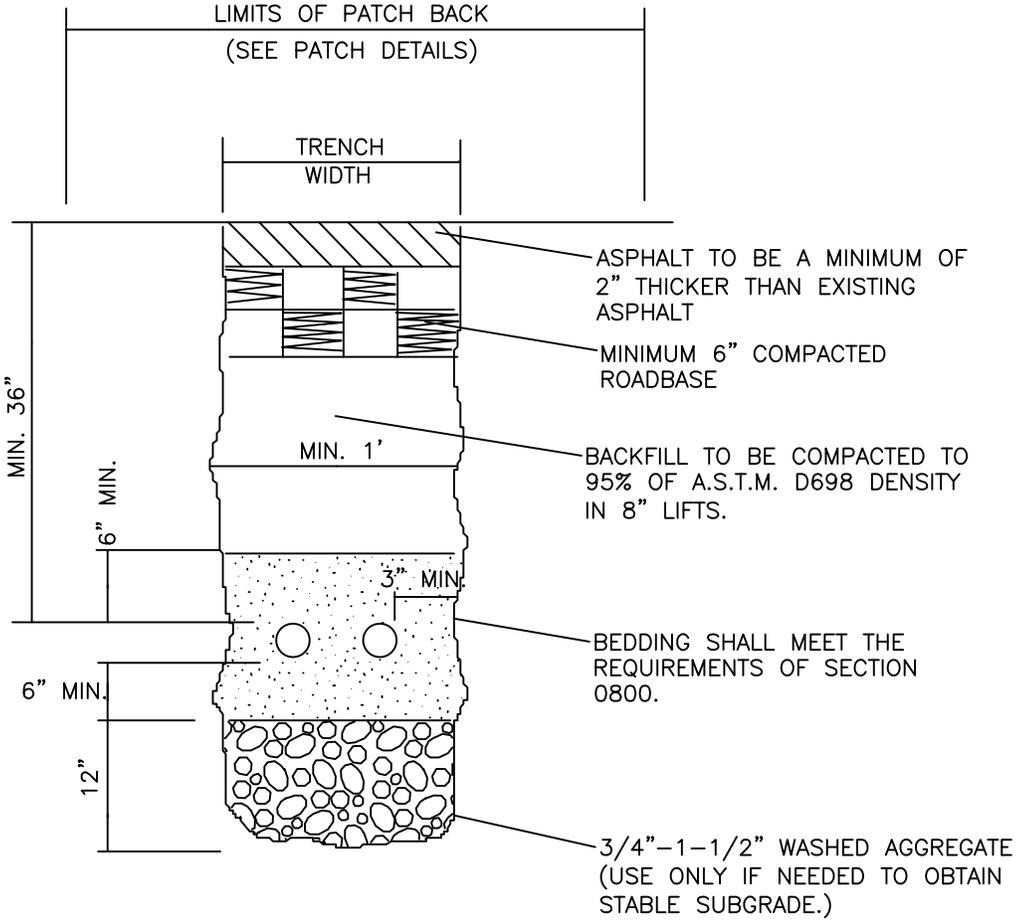


MONUMENT RISER

TYPICAL MONUMENT BOX TO BE USED FOR ALL SURVEY MONUMENTS LYING IN OR UNDER PAVED STREETS, BIKE PATHS & SIDEWALKS WITHIN THE TOWN OF FREDERICK RIGHT OF WAY, INCLUDING BUT NOT LIMITED TO, PROPERTY CORNERS, SUBDIVISION CORNERS, REFERENCE MARKS, STREET INTERSECTIONS, AND WITNESS CORNERS. ALL MONUMENTS SHALL BE SET IN ACCORDANCE WITH COLORADO STATE LAW.

**SURVEY MONUMENT BOX**  
NTS

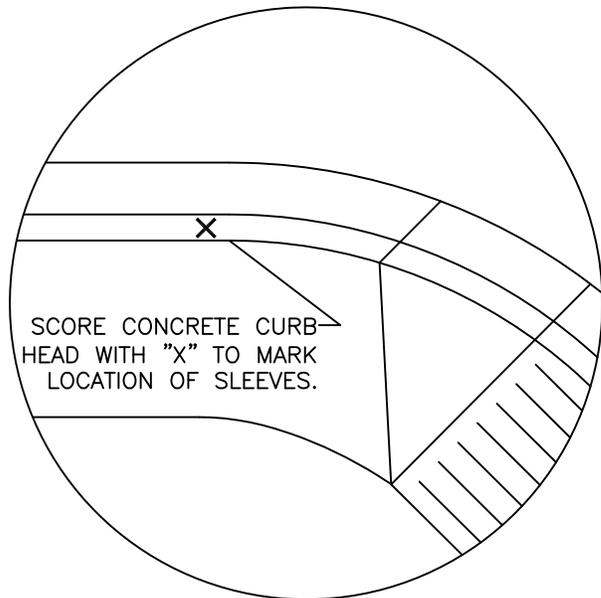
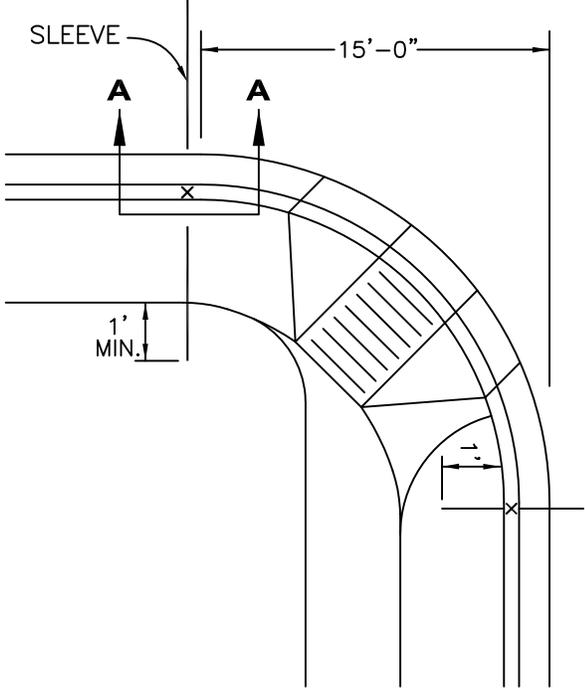




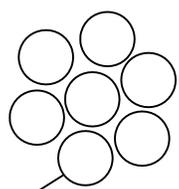
**NOTE:**  
THIS DETAIL SHALL BE USED UNLESS UTILITY SPECIFIC  
DETAIL IS APPROVED BY THE TOWN IN WRITING.

**CONDUIT TRENCH**  
NTS





DETAIL



BUNDLES OF SLEEVES PERMITTED

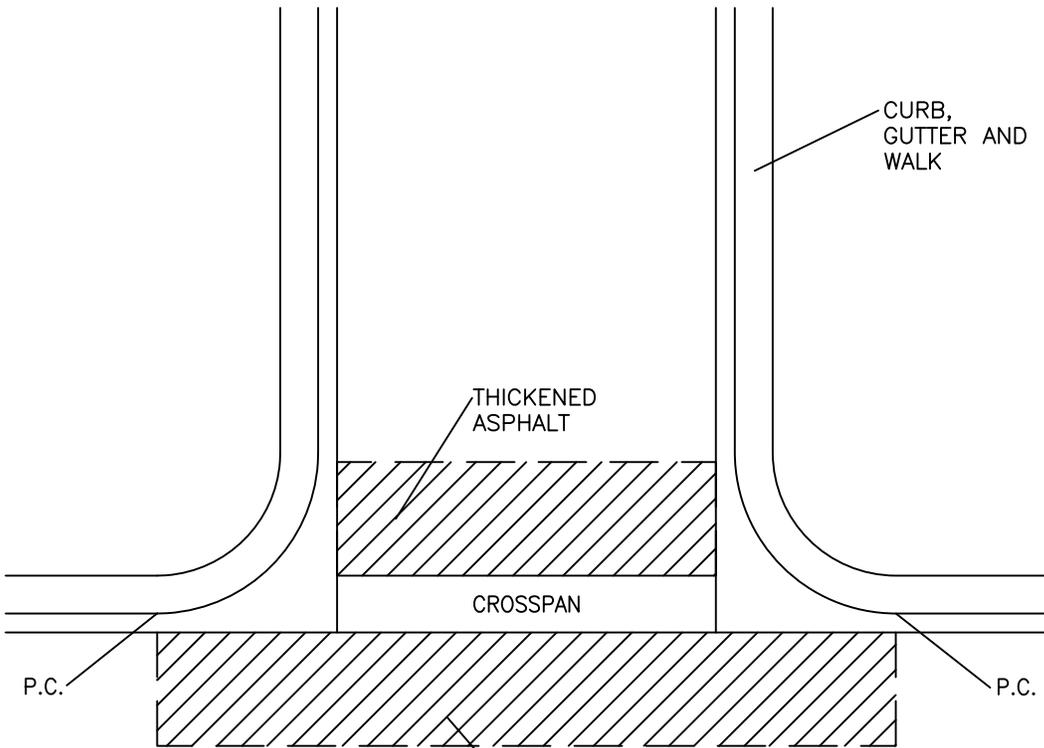
CROSS-SECTION A-A

- NOTES:**
1. MATCH LOCATION OF SLEEVES ON CURB HEAD.
  2. DEPTH OF SLEEVE SHALL BE NO LESS THAN 3' BELOW STREET GRADE.
  3. BUNDLES OF SLEEVES ARE PERMITTED.
  4. SLEEVES SHALL BE INSTALLED WITH "PULL WIRES".

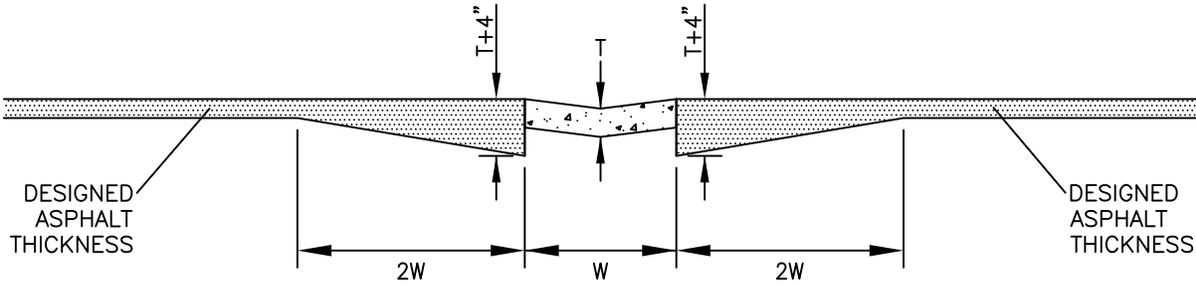
# CONDUIT LOCATIONS

NTS





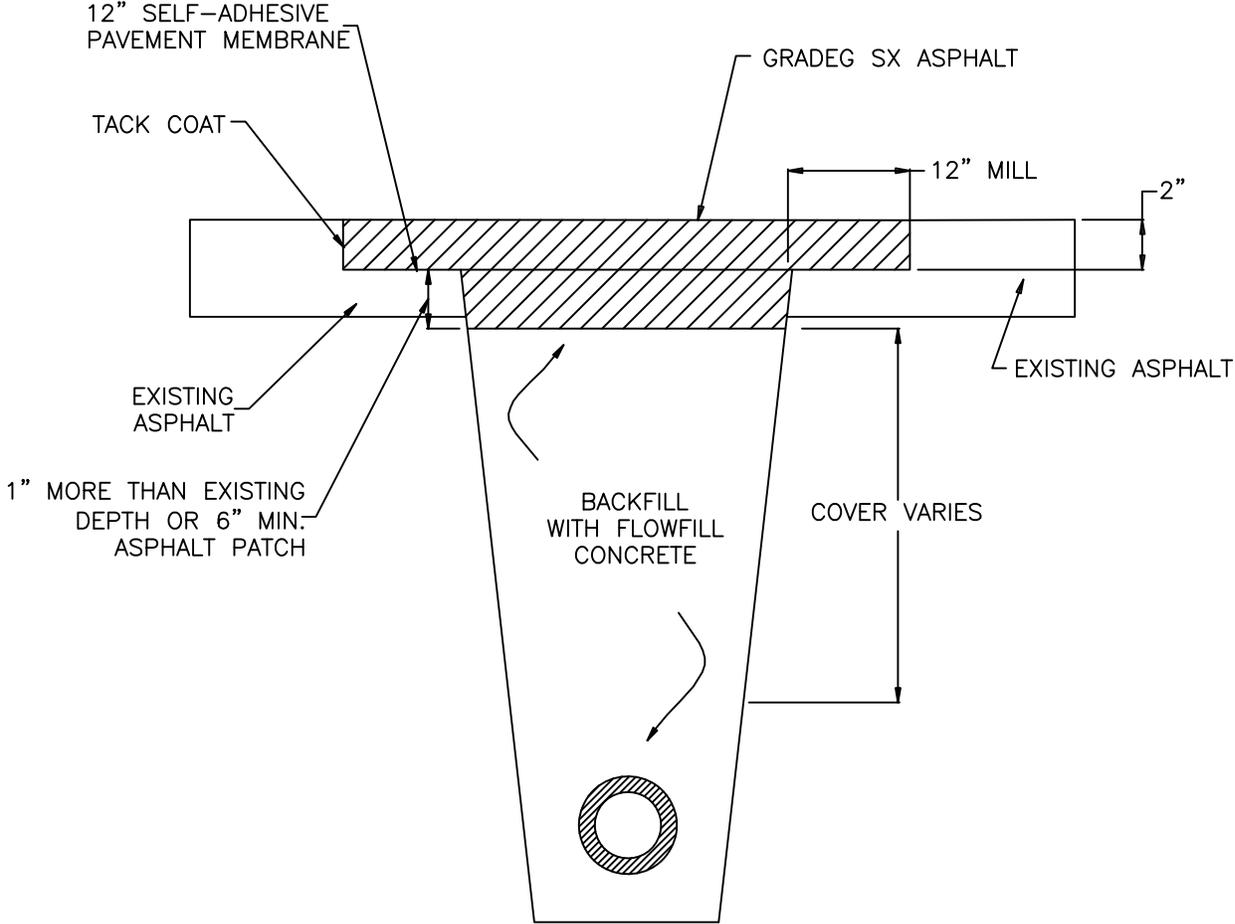
THICKENED ASPHALT  
 (IF A NEW ACCESS IS BEING ADDED TO AN EXISTING STREET, THERE MIGHT NOT BE A NEED FOR A THICKENED ASPHALT SECTION ON THE EXISTING STREET, TOWN ENGINEER TO DECIDE)



T = THICKNESS OF CROSSSPAN\*  
 W = WIDTH OF CROSSSPAN\*  
 \*REFER TO DETAIL 500-18

**ASPHALT PAVING AROUND CROSSPAN**  
 NTS



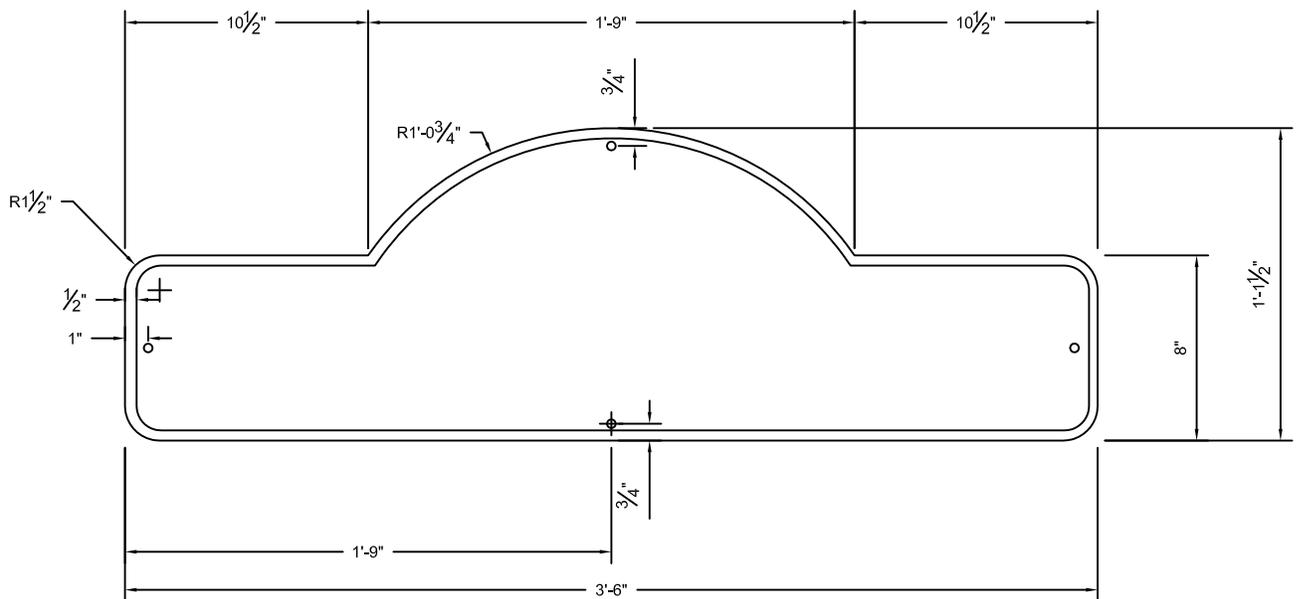
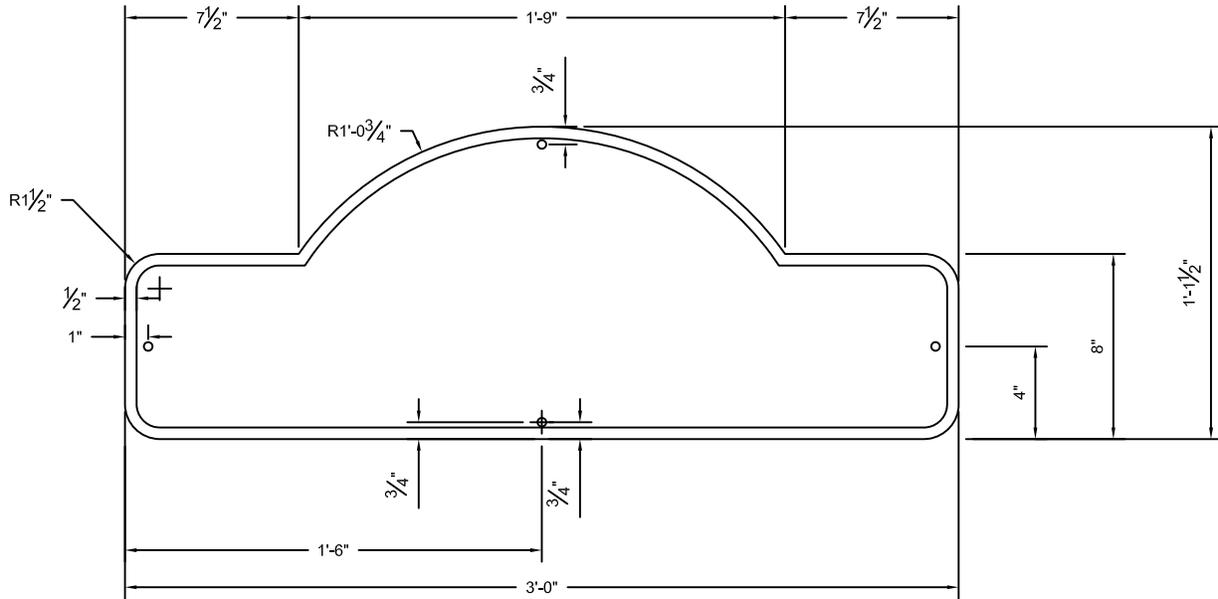


NOTE:  
IF A PAVEMENT CUT IS PERMITTED AFTER INSTALLATION OF THE TOP LIFT OF PAVEMENT,  
THE TOWN MAY REQUIRE HEATER SCARIFYING (INFRA-RED) OF PATCH JOINTS, OVERLAYING  
OF THE STREET, OR OTHER TECHNIQUES APPROVED BY THE TOWN TO AVOID ANY  
REDUCTION IN USEFUL LIFE OF THE PAVEMENT.

# UTILITY TRENCH PATCHING

NTS





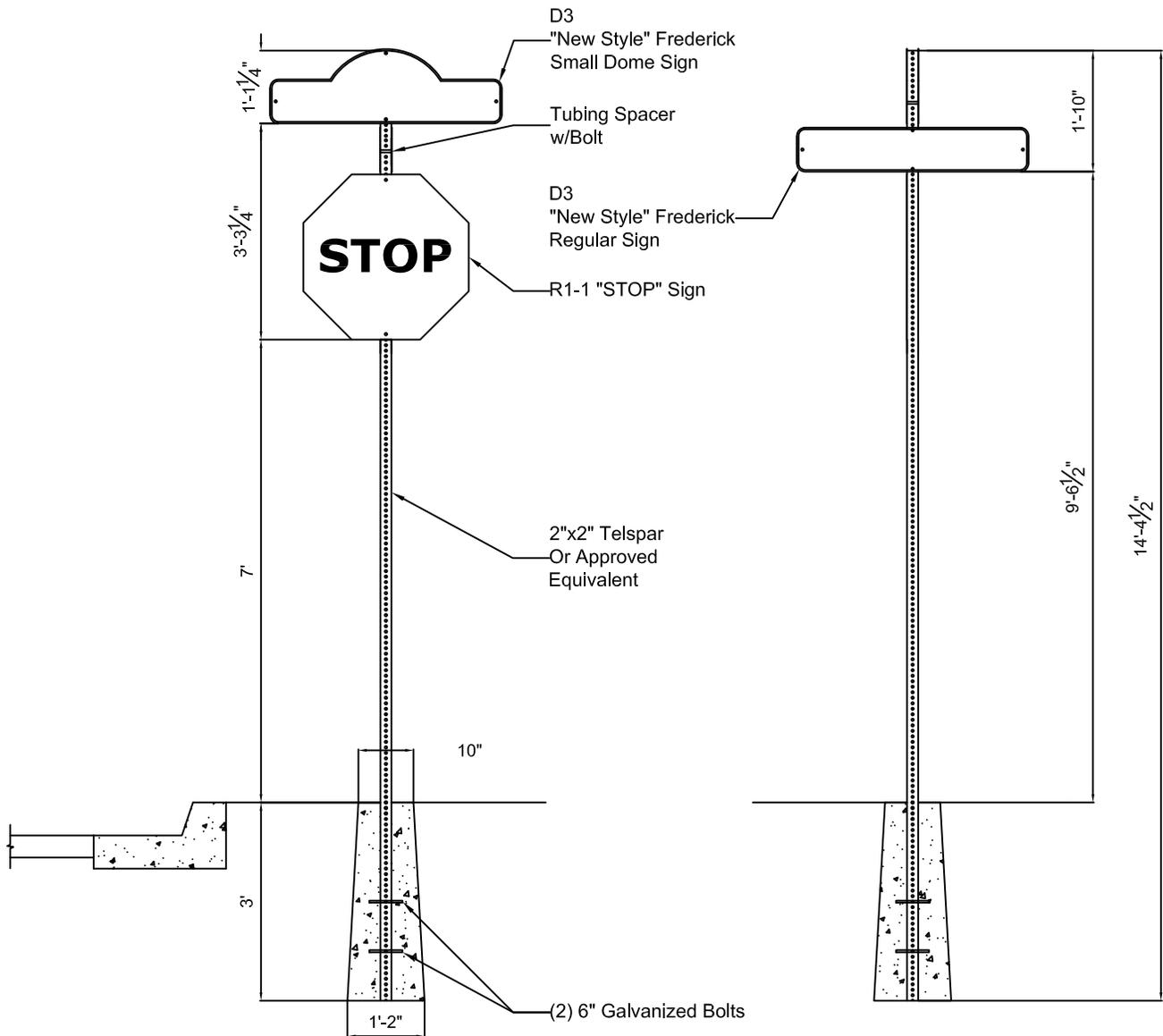
**NOTES**

1. SIGN BLANKS SHALL BE 6061 OR 5052-H38 ALUMINUM ALLOY .080" THICK
2. FACING SHALL BE GREEN HI-INTENSITY PRISMATIC SHEETING.
3. LETTERS AND NUMBERS SHALL BE WHITE HI-INTENSITY PRISMATIC SHEETING.
4. ALL STREET SIGNS SHALL BE INSTALLED BY THE CONTRACTOR
5. FHWA B SERIES LETTERING FOR STREET NAMES WITH MORE THAN 9 LETTERS.
6. 5" B SERIES LETTERING ON 36" OR 42" SIGNS TYPICAL.
7. STREET NAMES WITH 7 OR 8 LETTERS UTILIZE 5" C SERIES LETTERS.
8. STREET NAMES WITH 6 LETTERS OF LESS UTILIZE 5" D SERIES LETTERING.
9. 36" SIGNS TYPICAL FOR ALL STREET NAMES LESS THAN 9 LETTERS.

**SMALL DOME STREET SIGN DETAILS**  
**"NEW STYLE" FREDERICK STREET SIGN**

NTS

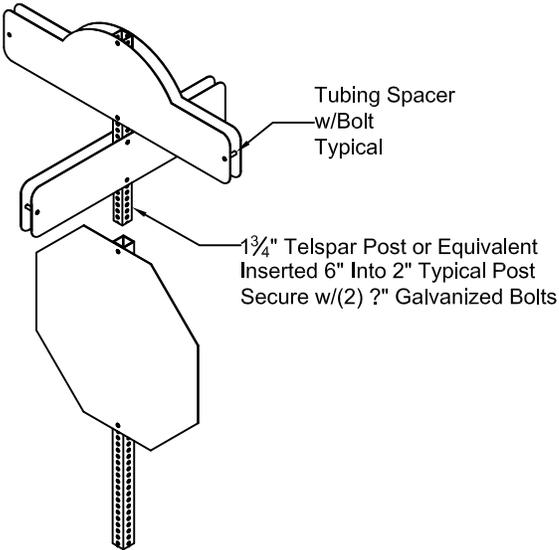
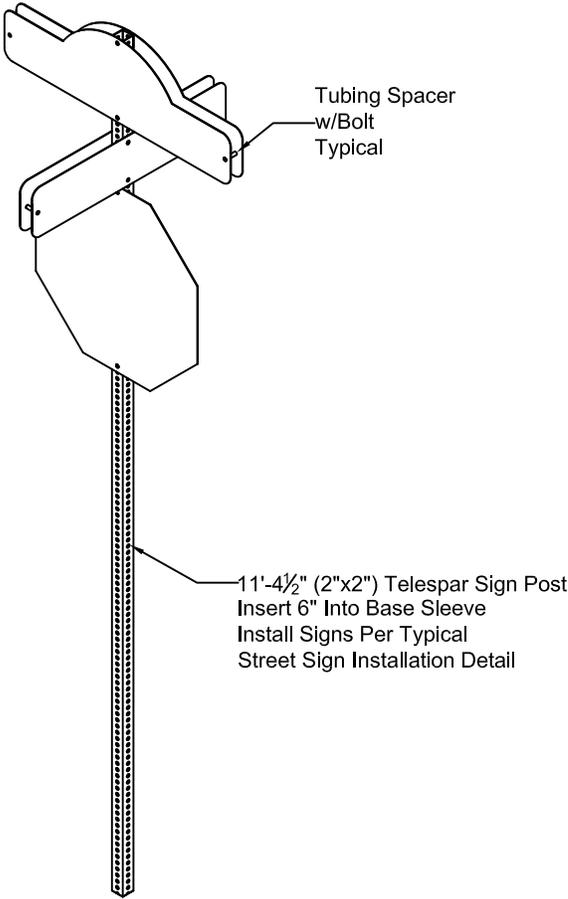




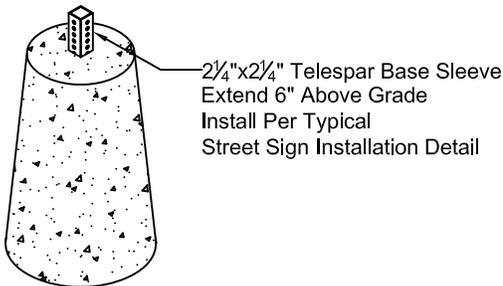
**"NEW STYLE" FREDERICK STREET SIGNS**  
**TYPICAL STREET SIGN INSTALLATION DETAIL**

NTS

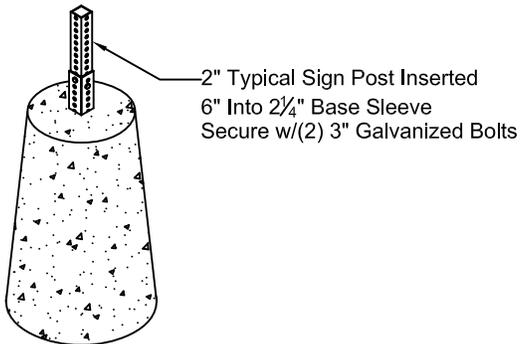




RETROFIT UPPER CONNECTION



ALTERNATE SLEEVE BASE CONNECTION



SIGN INSERTED IN BASE SLEEVE

ALTERNATIVE SLEEVE BASE & RETROFIT UPPER CONNECTION DETAILS

NTS



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**600 MINIMUM DESIGN CRITERIA**

**600.01 Genera**

Unless specified in this Section refer to Section 700 Potable Water Distribution for the requirements of the Standards and Specifications for non-potable water main and service line construction. Additional criteria shall be outlined during public improvement plan review as determined necessary by the Town Engineer or Town Representative. Under no circumstances shall the Non-Potable Water system be connected in any way to the Potable Water system.

**600.02 Design Guidelines**

<b>Table 600-01 - Design Guidelines</b>	
Max Main Pipe Velocity	8-fps
Max Service Line Velocity	8-fps
Minimum Static Pressure*	70-psi
Max Static Pressure	110-psi
Maximum System Pressure Fluctuation	20-psi

\*Pressure could be lower on certain Town Mains.  
(To be determined at time of system design)

**600.03 Pipe Sizes**

See Potable Water Distribution Section.

**600.04 Service Lines**

See Potable Water Distribution Section.

**600.05 Depth**

See Potable Water Distribution Section.

**600.06 Alignment**

All water lines shall be laid, when possible, generally 10-feet north or west of the center line of the street. If the curves exceed the Town’s maximum allowed deflections (half of the



manufacturers recommendation) then fittings shall be used. Potable and non-potable water lines shall be installed with a minimum 10-foot horizontal separation (edge to edge distance) unless otherwise authorized by the Town Engineer. All weather vehicular access shall be provided to manholes and valve boxes installed in areas outside of the public roadway. No potable or non-potable water mains shall be installed within 15-feet of any existing building, retaining wall, or structure, unless approved by the Town Engineer. No building, retaining wall, or structure shall be constructed within 15-feet from any potable or non-potable water main, unless approved by the Town Engineer.

**600.07 Grade**

See Potable Water Distribution Section.

**600.08 Future Connections**

See Potable Water Distribution Section.

**600.09 Valve Spacing**

In general, valves will be placed on lines of 12-inch or smaller diameter no more than 1,000-feet apart.

**600.10 Fire Hydrant Locations**

No fire hydrants shall be placed on the Town's non-potable water system without written approval of the Town Engineer.

**600.11 Fire Lines and Fire Hydrant Lines**

No fire hydrants shall be placed on the Town's non-potable water system without written approval of the Town Engineer.

**601 MATERIALS**

See the Approved Materials List in the Appendix. Accessible appurtenances not available from the manufacturer in the purple color (i.e. valve boxes, meter covers), shall be primed and painted with two (2) coats of an approved rust inhibitive purple paint.

**602 DUCTILE IRON PIPE**

Written approval of the Town Engineer is required to use this material.



**603 POLYVINYL CHLORIDE PIPE**

All Polyvinyl Chloride (P.V.C.) pipe shall be purple pipe and manufactured according to A.W.W.A. Standard C900, "Polyvinyl Chloride (P.V.C.) Pressure Pipe, 4-inch through 12-inch, for Water. No P.V.C. over 12-inches in diameter will be installed without approval of the Town Engineer. PVC pipe markings shall include the designation "CAUTION NONPOTABLE WATER" in addition to the standard factory labeling required by AWWA.

**604 ASBESTOS CEMENT PIPE**

See Potable Water Distribution Section.

**605 CAST AND DUCTILE IRON WATER WORKS FITTINGS**

See Potable Water Distribution Section.

**606 VALVES**

See Potable Water Distribution Section.

**607 VALVE BOXES**

See Potable Water Distribution Section.

**608 CURB STOP BOXES**

See Potable Water Distribution Section.

**609 FIRE HYDRANTS**

No fire hydrants shall be placed on the Town's non-potable water system without written approval of the Town Engineer.

**610 GENERAL INFORMATION**

There should be no connections between the potable and non-potable water systems.

**611 TAPPING**

See Potable Water Distribution Section.



**612 GENERAL PIPE INSTALLATION**

See Potable Water Distribution Section.

**613 RESTRAINT**

See Potable Water Distribution Section.

**614 SERVICE LINES**

Location of all service lines shall be marked with an "N" chiseled in the sidewalk or curb closest to the property line.

**615 SETTING OF VALVES AND FITTINGS**

See Potable Water Distribution Section.

**616 SETTING OF VALVE BOXES**

See Potable Water Distribution Section.

**617 SETTING HYDRANTS**

No fire hydrants shall be placed on the Town's non-potable water system without written approval of the Town Engineer.

**618 DISINFECTION AND FLUSHING**

Mains should be kept clean of all debris and should be thoroughly flushed if any debris or sediment is present.

**619 HYDROSTATIC TESTS**

See Potable Water Distribution Section.

**620 WATER METERS**

See Potable Water Distribution Section.



**621 BACKFLOW CONTROL**

Backflow prevention device requirements will be determined on a case by case basis at time of plan review.

**622 TEMPORARY WATER USE PERMIT REQUIRED**

See Potable Water Distribution Section.

**623 REFERENCES**

See Potable Water Distribution Section.



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## **700 MINIMUM DESIGN CRITERIA**

### **700.01 General**

1. Within the Town of Frederick's Town Limits there are three jurisdictions for public water supply. Left Hand water district generally supplies all public potable water demand on the west side of Interstate 25 (I-25). Central Weld Water District and the Town of Frederick supply potable water on the east side of I-25. Please contact the Town of Frederick to determine which jurisdiction a project is in. Each jurisdiction has their own design standards.
2. All water distribution systems will comply with the requirements of the Standards and Specifications for water main and service line construction and may include criteria established by the Engineer for the overall hydraulics of the water utility system. Additional criteria shall be outlined during public improvement plan review as determined necessary by the Town Engineer or Town Representative.
3. These Standards and Specifications apply to pipe sizes up to and including 12-inch diameter. Standards for pipe sizes larger than 12-inches shall be as determined by the Town Engineer on a project by project basis.
4. The maximum length of a dead-end line shall not be greater than 500-feet without the approval of the Town Engineer.

### **700.02 Water System Utility Study Requirements**

The Utility Study shall include the following information and shall be bound in an 8-1/2" x 11" folder:

1. Certification statement - shall be included at the beginning of the report and shall read as follows: "This Utility Report for the design of the \_\_\_\_\_ development was prepared by me or under my direct supervision in accordance with the Town of Frederick's Standards and Specifications and acceptable professional practices of the industry. We acknowledge that the Town of Frederick's review of this Utility Study is only for general conformance with submittal requirements, current design criteria and standard engineering principles and practices. We are also aware of the provisions of the Code of the Town of Frederick." The seal and signature of the professional engineer responsible for preparing the report shall follow this statement.
2. Report text for the water system design shall include at a minimum:
  - a. Project location and Description – a description of the boundary streets, project area and type of development proposed or anticipated use. Include a vicinity map.



- b. System layout – a description of the existing and proposed water infrastructure in conformance with the Town’s latest master plan shall be provided and reference shall be made to a figure in the back of the report illustrating these improvements. The description shall include the sizes and types of existing and proposed pipes and the influence of the improvements on the project and surrounding area.
- c. Design flow requirements – Complete design flow calculations and a discussion explaining the calculations and assumptions shall be provided. Items shall include types of facilities to be served, fire flow calculations based on building construction type and floor area, developed land area, number of units based on land use, and population densities. Calculations for Average Day, Max Day and Peak Hour demands shall be presented. Max Day plus Fire Flow and Peak Hour demand scenarios shall be evaluated for worst case and all include domestic demands, building sprinkler flows and domestic irrigation flows. Data shall be presented in table format, if possible, for ease of reading. The report shall acknowledge that the Public Works Department/Engineering Department/Fire Department has provided the required fire flows and that they approve of the proposed fire hydrant locations.
- d. Hydraulic Analysis – A detailed description of modeling assumptions and rationale shall be provided in the report text such that the analysis is clear and can be confirmed. Results of the analysis at a minimum shall include: minimum and maximum system pressures for the various scenarios modeled, corresponding node locations, distribution of fire flows among hydrants, and maximum pipe velocities. Data should be presented in table format. Reference shall be made to modeling data in the appendix and a figure of the pipe and node network provided.
- e. Conclusions – a description of the results and how they follow the Town criteria shall be provided. Any deviations from the Town criteria shall be described and applicable variances requested.
- f. Appendices - Printed data output from the modeling results shall be provided in the appendix and shall correspond with a figure of the pipe and node network. The appendix shall also include hydrant flow test results, hand calculations and any other pertinent data. A large size figure (24” x 36”) illustrating the existing and proposed utility improvements shall be provided and shall conform to the Town’s latest master plan. The drawing shall include pressure zone boundaries, building finished floor elevations, elevation contours and locations of proposed and existing utility easements and right-of-way.

**700.03 Design Guidelines**

**Table 700-01 - Design Guidelines**



	<b>SINGLE FAMILY</b>	<b>MULTIFAMILY</b>	<b>COMMERCIAL/INDUSTRIAL</b>
<b>MINIMUM FIRE FLOW (GPM)*</b>	1000	3500	3500
<b>MAX MAIN PIPE VELOCITY (ft/sec)</b>	8	8	8
<b>MAX SERVICE LINE VELOCITY (ft/sec)**</b>	8	8	8
<b>MINIMUM STATIC PRESSURE (psi)</b>	60	60	60
<b>MAX STATIC (psi)</b>	90	90	90
<b>PEAK DAY MIN (psi)***</b>	55	55	55
<b>PEAK HOUR MIN PRESSURE (psi)***</b>	40	40	40
<b>MAXIMUM SYSTEM PRESSURE FLUCTUATION (psi)</b>	40	40	40

\* In accordance with the current Frederick-Firestone Protection District standards, however, the required fire flow for some projects may be greater. Refer to the adopted IFC code for specific requirements. Minimum residual pressure during fire flow is 20-psi.

\*\* In accordance with the current IBC.

\*\*\* This pressure may not be possible for all situations. Quality of Life Benchmark.

#### **700.04 Pipe Sizes**

Minimum main line size shall be 8-inch, except for fire hydrant lines. Dead end water mains with less than the equivalent of ten 5/8-inch domestic taps on the line may be 6- inch diameter as long as fire flows are achieved per the Frederick-Firestone Fire Protection District. For pipe sizes larger than 12-inches, the Engineer will determine the Specifications.

#### **700.05 Service Lines**

Service lines shall be of a size which is adequate to supply the requirements of the property being served. The minimum size allowable for a service line shall be 3/4-inch. A 1-inch domestic tap may be installed in areas where a residential fire sprinkler system may be installed. The requirements of the property being served shall be defined as peak demand, as calculated in the IPC, latest edition.

#### **700.06 Depth**

All water lines shall have at least 5-feet of ground cover from the top of the pipe to the finished ground surface.



### **700.07 Location**

All water lines shall be laid, when possible, generally 10-feet north or west of the center line of the street. If the curves exceed the Town's maximum allowed deflections (half of the manufacturers recommendation) then fittings shall be used. All utilities shall be installed with a minimum ten feet (10') horizontal separation (edge to edge distance) and a minimum vertical separation of eighteen inches (18") unless otherwise authorized by the Town Engineer. All weather vehicular access shall be provided to manholes and valve boxes installed in areas outside of the public roadway. No water mains shall be installed within 15-feet of any existing building, retaining wall, or structure, unless approved by the Town Engineer. No building, retaining wall, or structure shall be constructed within 15-feet from any water main, unless approved by the Town Engineer.

### **700.08 Alignment**

The vertical alignment of water mains shall be designed such that unnecessary high points are avoided. If a high point in the main cannot be avoided, a controlled high point shall be located at a fire hydrant tee where trapped air in the system can be bled. For controlled high points in transmission mains (16-inch and larger), combination air valves shall be provided. High points at a water main lowering should be avoided by deflecting the main on both sides of the lowering such that positive pipe grades are maintained to controlled high points in the system. To maintain positive pipe grades to controlled high points, the maximum depth of cover to the main can increase to 8-feet, if approved in writing by the Town.

### **700.09 Waterline Crossings**

#### **1. Waterline Crossing Over a Sanitary Sewer Line**

When there is less than 18-inches of vertical clearance between the water main and the sanitary sewer, the sanitary sewer shall be encased in concrete a minimum of nine feet on each side of the centerline of the crossing or polyvinyl chloride pressure pipe in accordance with American Water Works Association C900, pressure class 305-psi may be used for the sanitary sewer.

#### **2. Sanitary Sewer Line Crossing Over a Waterline**

In all cases, regardless of vertical clearance, the sanitary sewer shall be encased in concrete a minimum of nine feet on each side of the centerline of the crossing or polyvinyl chloride pressure pipe in accordance with American Water Works Association C900, pressure class 305-psi may be used.

#### **3. Waterline Crossing Over a Storm Sewer Line**



When there is less than 18-inches of vertical clearance between the water main and the storm sewer, each joint of the storm sewer within nine feet of the centerline of the crossing shall be encased in concrete.

Freeze potential of a water main shall be evaluated when crossing storm sewers or other exposures to the elements. If a water main crosses a storm sewer with 3-feet or less of vertical clearance, a 12-inch thick layer of extruded polystyrene insulating foam, also referred to as "XPS" shall be provided all around the water main for a minimum of 5-feet on each side of the storm sewer. The sheets of "XPS" shall be thick enough to allow shaping of the material so it fits snugly around all sides of the pipe leaving a minimum 12-inch thickness around all sides of the pipe. The sheets of "XPS" shall be bonded together using "3M 78 Polystyrene Foam Insulation Spray Adhesive" or approved equal. Crossings of dead end water mains and storm sewer with less than 18-inches of vertical clearance shall be prohibited.

#### 4. Storm Sewer Line Crossing Over a Waterline

In all cases, regardless of vertical clearance, the joints of the storm sewer shall be encased in concrete a minimum of 9- feet on each side of the centerline of the crossing.

Freeze potential of a water main shall be evaluated when crossing storm sewers or other exposures to the elements. If a water main crosses a storm sewer with 3-feet or less of vertical clearance, a 12-inch thick layer of extruded polystyrene insulating foam, also referred to as "XPS" shall be provided all around the water main for a minimum of 5 feet on each side of the storm sewer. The sheets of "XPS" shall be thick enough to allow shaping of the material so it fits snugly around all sides of the pipe leaving a minimum 12-inch thickness around all sides of the pipe. The sheets of "XPS" shall be bonded together using "3M 78 Polystyrene Foam Insulation Spray Adhesive" or approved equal. Crossings of dead end water mains and storm sewer with less than 18-inches of vertical clearance shall be prohibited.

### 700.10 Grade

- 1 All pipe shall be installed to the lines, grades, and depths specified in the approved plans. Fittings, valves, and hydrants shall be installed at the specified locations with joints centered, and all valve and hydrant stems plumb. No deviation shall be made from the required line or grade except with the written consent of the Town Engineer.
2. Air and vacuum valves may be required at extreme high points on water lines 12-inches and larger. The Town Engineer may require installation on smaller lines as deemed necessary.

### 700.11 Future Connections

1. Water mains shall be designed such that they extend the entire frontage of the property to be served or as otherwise approved in writing by the Town.



2. When future main extensions are possible, the main which will be extended must be valved such that only one valve will have to be closed when the main is extended. The valve must be restrained so that when the one valve is closed and the line to be extended is exposed, the valve will remain safely in place. Restraint may be made by the use of a swivel or flange joint or the following minimum lengths of pipe installed on the extension side of the valve:

4-inch Pipe	--	29-feet
6-inch Pipe	--	41-feet
8-inch Pipe	--	53-feet
10-inch Pipe	--	64-feet
12-inch Pipe	--	76-feet

3. These are minimum lengths and the design engineer shall be responsible for determining if these are acceptable or if greater lengths are needed to develop sufficient friction.

#### **700.12 Valve Spacing**

1. Valves shall be placed at locations to minimize water outages in case of a line break or repair. In general, valves will be placed on lines of 12-inch or smaller diameter no more than 500-feet apart. Each fire hydrant shall have a hydrant valve. For lines larger than 12-inch the valve location and spacing will be determined by the Town Engineer.
2. The valving of the mainlines between hydrants must be accomplished to prevent more than one hydrant from being out of service in the event of a mainline break or shutdown, unless otherwise approved by the Town Engineer.
3. A minimum of two valves shall be installed at every tee and three valves installed at every cross, unless otherwise approved by the Town Engineer.

#### **700.13 Fire Hydrant Locations**

1. The Developer shall provide fire hydrants which conform to the requirements of these Specifications. Fire hydrant location and spacing shall be determined by the Frederick-Firestone Fire Protection District in accordance with the adopted International Fire Code. Generally, the number of fire hydrants, their location and spacing shall be as follows:
  - a. Residential Areas - 500-feet between hydrants starting at street intersections.
  - b. Multiple Dwellings - 500-feet between hydrants and not more than 200-feet from the end of required emergency access.



- c. Commercial, Industrial, Storage - 500-feet between hydrants and not more than 200-feet from the end of required emergency access.
  - d. No fire hydrant line shall be connected to less than an 8-inch water main or to a “dead end” water main unless the hydrant can deliver 1500-GPM with minimum of a 20-psi residual, or specifically approved by the Engineer.
2. Variances from the above requirements shall be coordinated with and approved by the Frederick-Firestone Fire Protection District.

#### **700.14 Fire Lines and Fire Hydrant Lines**

1. A fire hydrant line shall extend from the hydrant tee and valve on the water main to the fire hydrant.
2. A private fire service line for use on an internal fire suppression system shall require a valve at the mainline and a valve on the fire service line and the valves will be owned and maintained by the Town. The valves shall open left. The property owner shall own and maintain the fire service line from the fire service line valve to the building or structure.
3. Private fire service lines shall be six inch (6”) minimum diameter.
4. Domestic and irrigation taps shall not be allowed on the fire service line or fire hydrant line.
5. All fire sprinkler taps shall be installed with an approved backflow prevention device and a flow switch which will indicate when water has flowed through the line.
6. Plans for the installation of either of the above-mentioned fire service lines must be submitted to the Town for approval and must be stamped by a Professional Engineer.
7. Fire hydrant lines shall be ductile iron pipe with swivel tees. Any fittings used shall be class 250 (minimum) ductile iron.
8. Fire line valves shall have a flange connection and shall bolt directly to a mechanical joint anchoring tee (swivel tee) at the main.
9. The use of any private fire service line to supply more than one lot is not allowed.
10. Fire service lines shall be electrically insulated from the public mainline if the main line is cast or ductile pipe.
11. The property owner shall maintain the fire service line from the fire service valve to the building or structure.



**701 MATERIALS**

See the Approved Materials List in the Appendix.

**702 DUCTILE IRON PIPE**

**702.01 Description of Pipe**

1. Pipe class shall be in accordance with the table below with thickness designed in accordance with A.N.S.I. A21.50 (A.W.W.A. C150), and manufactured in accordance with A.N.S.I. A21.51 (A.W.W.A. C151). The pipe shall conform to pressure class 350. Alternate thickness designs, when appropriate, may be approved by the Town Engineer.
2. All buried joints for ductile iron pipe shall generally be mechanical joint or push-on conforming to A.N.S.I. A21.11 (A.W.W.A. C 111).

<b>Table - 700-02 - Class of Pipe</b>	
<b>TYPE OF PIPE</b>	<b>MINIMUM THICKNESS CLASS OF PIPE</b>
Fire hydrant lines	52
Fire service lines	52
4-inch	51
6-inch	50
8-inch	50
10-inch	50
12-inch	50

**702.02 Coating of Pipe**

Pipe and fittings shall be coated on the outside with a bituminous coating, in accordance with A.N.S.I. A21.51 (A.W.W.A. C 151).

**702.03 Cement Lining**

Pipe and fittings shall be cement lined in accordance with A.N.S.I. A21.4 (A.W.W.A. C 104).

**702.04 Tapping**

Taps larger than 2-inches in size shall be made only with approved tapping saddles or sleeves as determined by the Engineer. Refer to the Appendix for the Approved Material List.



## **702.05 Corrosion Protection**

1. Whenever the installation of metallic mainline pipe is proposed, a soil resistivity survey of the Construction area must be performed. The survey data and calculations shall be submitted to the Town. Joints of metallic pipe shall be bonded to provide electrical continuity and test stations installed at intervals approved by the Town Engineer. See Details at the end of this section.
2. Where soils adjacent to Construction areas are determined to have a resistivity of less than 1000 Ohm-Cm, or where stray current corrosion is, in the opinion of the Town, expected to be severe, an approved non-metallic or cathodic protection system shall be installed with the approval of the Town Engineer. Additional measures may be required to insure protection from corrosion.
3. All metallic pipe, fittings, valves, and other appurtenances shall be wrapped in polyethylene or an approved coating. The polyethylene encasement shall prevent contact between the pipe and surrounding material.
4. The polyethylene shall have a minimum wall thickness of 8-mils and be manufactured in accordance with A.W.W.A. Standard C105, "Polyethylene Encasement for Gray and Ductile Cast-Iron Piping for Water and Other Liquids".
5. All Ductile Iron pipe shall be wrapped in Polyethylene. A 2-inch wide 10-mil thickness polyethylene pressure-sensitive tape shall be used to close seams or hold overlaps.
6. Pipes of dissimilar metallic materials shall be insulated from each other using insulated flanges or fittings with test stations as approved by Engineer.

## **703 POLYVINYL CHLORIDE PIPE**

### **703.01 Description of Pipe**

All Polyvinyl Chloride (P.V.C.) pipe shall be manufactured according to A.W.W.A. Standard C 900, "Polyvinyl Chloride (P.V.C.) Pressure Pipe, 4-inch through 12-inch, for Water. No P.V.C. over 12-inches in diameter will be installed without approval of the Town Engineer. Following are additional requirements or exceptions.

### **703.02 Joint Type**

Pipe joints shall be made using an integral bell with an elastomeric gasket push-on type joint or using machined couplings of a sleeve type with rubber ring gaskets and machined pipe ends to form a push-on type joint. Solvent cement joints are strictly prohibited.



### **703.03 Class and Type**

All pipe up to and including 12-inches shall be Pressure Class 305 psi, dimension ratio 14 (DR 14) minimum. Larger pipe sizes must be designed by the Engineer.

### **703.04 Tapping**

1. Tapping of P.V.C. and ductile up to and including 2-inch shall be done only with approved tapping saddles.
2. Taps larger than 2-inches in size shall be made only with approved tapping saddles or sleeves as determined by the Town Engineer.
3. Tapping mains may require digging out bedding material and cutting or removing part of the corrosion protective wrapping. After the taps are made, the wrap shall be repaired or replaced by the contractor to protect both the service line and the main.
4. Service taps shall have a minimum separation of 24-inches and be no closer than 24-inches to a main line joint.
5. All taps into the water main shall be at an angle of not more than 45-degrees from the horizontal, and corporation stops shall be installed.
6. Taps to PVC mains shall be accomplished with the mainline valves either side of the tap in the closed position.
7. Taps to PVC mains shall only be made when the air temperature is 32-degrees Fahrenheit or higher.
8. All service taps shall be performed by the Contractor. All necessary materials for said taps, including corporations stops, copper line, meter pits, copper setters, curb stops, etc., shall be supplied by the Contractor. Said materials shall conform to these Standards and Specifications. The Town will inspect each tap prior to backfilling.

### **703.05 Tracing Wire**

1. All PVC pipe shall be installed with tracing wire taped securely to the top of the pipe and shall extend along the entire length of the pipe installed. The tracing wire shall be a minimum 12-AWG direct bury solid copper wire (see Detail 700-17). The tracing wire shall be tested prior to and as a condition of construction acceptance.
2. Tracing wire shall be brought to grade at all fire hydrants or test stations. The tracing wire shall be securely affixed to the barrel section of the fire hydrant and brought to grade as described in Section 712.04.



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## **704 ASBESTOS CEMENT PIPE**

### **704.01 Use**

The installation of Asbestos Cement Pipe is not permitted.

### **704.02 Tapping of Existing Lines**

Existing Asbestos Cement Pipe shall be tapped up to and including 2-inches with an approved stainless steel tapped repair clamp. The make and model of the clamp shall be approved by the Engineer. When taps are larger than two inches the Town Engineer may require that a full section of pipe be removed and replaced with a non-asbestos material.

## **705 CAST AND DUCTILE IRON WATER WORKS FITTINGS**

1. All cast iron fittings shall be manufactured in accordance with the following A.W.W.A. Standards: C104 "Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water", C110 "Ductile-Iron and Gray-Iron Fittings, 3-inch. – 48-inch (76-mm – 1,219-mm), for Water", C153 "Ductile-Iron Compact Fittings for Water Service", or C111 "Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings" with the following additional requirements or exceptions.
2. All fittings shall be furnished with mechanical joint ends conforming to referenced specifications, and in addition the tee-head bolts and hexagon nuts shall be fabricated from a high-strength, low alloy steel known in the industry as "Cor-Ten," "Usalloy" or equal. Accessories for the mechanical joint consisting of the gasket, gland and fasteners shall be furnished and packaged separately from the fittings. Each package shall be labeled in such a manner as to provide for proper identification and the number of units per package or bundle. All hydrant tees shall be mechanical by flanged joint or swivel tees.
3. All fittings shall be a minimum of 250-psi pressure rating and shall conform to the dimensions and weights shown in the tables of above referenced specifications. All fittings shall be made from gray-iron or ductile-iron.
4. All fittings shall be wrapped in polyethylene encasement.

## **706 VALVES**

### **706.01 General**

1. All valve operating wrench nuts shall be installed no deeper than 4-feet below finished grade. Stainless steel pins or a minimum of two (2) set screws may be used if any extension is necessary to meet this requirement.



2. Mainline valve placement shall be no greater than 24-inches from any fitting. In the event that a valve is located in a lowering, the location of the valve should be coordinated with the Town Engineer. In-line tee connections shall have no less than two (2) valves, in-line cross fittings shall have no less than three (3) valves. This does not apply to fire hydrant tees.
3. All valves larger than 12-inches shall be installed in a vault in accordance with the detail drawings at the end of this section. All valve vaults shall be capable of withstanding AASHTO H-20 highway loading. The vault shall also have lift hooks in the roof for valve removal inside the vault.
4. Vaults shall be made water proof after construction by use of sealants, epoxy or other approved methods. All vaults shall be designed with wall sleeves and link seal and be capable of handling thrusts caused by removing valves. All vent pipes for vaults shall be installed in conformance with the detail drawings at the end of this section.

#### **706.02 Gate Valves**

Gate valves shall be used on all lines up to and including 12-inch and shall be resilient seated gate valves with non-rising stem, compression seating, double "O" ring stem seals, with 2-inch square operating nut, conforming to AWWA C509. Valves shall be the same size as the line which they serve and shall open left (counterclockwise). Valve ends shall be mechanical-joint, except for hydrant valves, which shall have one flanged or swivel valve end.

#### **706.03 Butterfly Valves**

All valves having a nominal inside diameter of greater than 12-inches will be geared butterfly valves designed for direct burial and they shall conform to A.W.W.A. C504, Class 150B. Valves will be tight closing rubber seat type with the seats bonded to the body. No metal to metal surfaces will be permitted. All valves will open left (counterclockwise) with a 2-inch square nut conforming to A.W.W.A. C509. The Engineer may require Butterfly valves to be installed in a vault.

#### **706.04 Tapping Valves**

1. Tapping valves shall conform to the above standards and any additional requirements requested by the Town Engineer. Wet taps are allowed only with written approval of the Town Engineer.
2. Wet taps must be at least one nominal pipe size less than the diameter of the pipe being tapped. Same size taps will not be permitted.



### **706.05 Blow-Off Valve Assembly**

1. In all installations where the main will be permanently dead-ended, such as a cul-de-sac, a permanent blow-off assembly or fire hydrant shall be installed. Where the main will be temporarily dead-ended, for example the boundary of a subdivision filing, a temporary blow-off may be installed, unless a fire hydrant, which can serve additionally as a blow-off, is located at the main's temporary end. All plugs and caps unless otherwise specified, shall be provided with a concrete thrust block, or thrust shall be restrained by attaching suitable metal tie rods and clamps or joint restraints as specified (see Details 700-02, and 700-02A). The blow-off shall be installed at a right angle to the main.
2. Blow-off assembly sizing shall be dependant upon the size of line it is to be attached and will be sized to provide a flushing velocity in the main of at least 2-feet per second.
3. Temporary blow-offs shall be approved in writing by the Town Engineer.

### **706.06 Pressure Reducing Valves**

1. Pressure-reducing valve (PRV) installations are used to control pressure between distribution system pressure zones. When main extension plans are submitted for review, the need for a pressure-regulating valve installation shall be determined jointly by the developer's engineer and the Town. Plans shall be submitted as part of the utility study indicating size, type, and location of the PRV installation. All calculations shall be submitted to the Town for review.
2. For individual water services to buildings, water pressure regulators will be required if system pressures exceed 80-psi or at the discretion of the Building Division.

### **706.07 Manholes**

Manholes shall be installed on all pressure regulating valves, permanent blow-off installations, and air release valves in accordance with the detail drawing at the end of this section.

## **707 VALVE BOXES**

All valve box sections shall be cast iron, screw type with lid. Bases shall be suitable for the valves furnished and for the depth of cover specified. The box shall have a circular base for support around the valve (see Detail 700-01).



**708 CURB STOP BOXES**

1. The approved list of curb stop boxes is located in Appendix A APPROVED MATERIALS LIST.
2. Curb stops installed must conform to A.W.W.A. C800 up to 2-inches in size. Beyond 2-inches, a gate valve must be used.

**709 FIRE HYDRANTS**

**709.01 Approved Types**

See Detail 700-06 for the Standard Fire Hydrant Installation and Appendix for the manufacturer of approved Fire Hydrants.

**709.02 Requirements**

1. All fire hydrants used in the Town of Frederick Water System shall meet the following Specifications:
  - a. 5-inch minimum hydrant valve opening, 5-1/4-inch main valve opening.
  - b. Two (2) hose nozzles, 2-1/2-inch National Standard thread.
  - c. One (1) pumper nozzle, 4-1/2-inch National Standard thread.
  - d. Six (6) inch M.J. Shoe Connection inlet.
  - e. Operating nut, 1-1/4 inch points to flat National Standard pentagon.
  - f. Open left.
  - g. Color - red.
  - h. 5-foot bury depth.
  - i. Nozzles shall be a minimum of 18-inches above finished grade.
  - j. 200-psi. working pressure.
  - k. Hydrants shall have weep drain holes in the hydrant shoe and shall be surrounded with 1-1/2-inch washed rock. A sheet of 8-mil polyethylene shall be placed over the washed rock to prevent dirt from filling the rock.
  - l. Must comply with A.W.W.A. C502.



- m. The fire hydrant bottom flange shall be adjusted to not more than 8-inches or less than 2-inches above the approved finished grade.
  - n. All extension sections must be class 52 ductile or cast iron and installed per the manufacturers recommendations.
  - o. The lateral line, hydrant and fittings shall be wrapped in polyethylene
  - p. All hydrants shall be set on an 18-inch by 18-inch and 6-inch thick concrete foundation.
  - q. Each hydrant shall be blocked against the end of the trench with a concrete thrust block. If the trench is unstable then the hydrant shall be mechanically restrained from the tee at the main to the hydrant in addition to the thrust block.
  - r. All fire hydrants shall be of breakaway Construction.
  - s. All hydrants shall be NEW, unless an existing hydrant is in good operating condition and meets or exceeds the above standards. The use of an existing hydrant shall be approved by the Town Engineer.
2. Prior to installation the contractor must:
- a. Inspect the hydrant thoroughly for any defects or damage.
  - b. Toughly clean the hydrant interior.
  - c. Open and close as many times as necessary to determine that all parts are in proper working order, valves are seating properly and the drain valve is operating freely.
  - d. Align the hydrant so that the nozzles are rotated to face the accessible route by the Fire Department.
  - e. Verify the hydrant bury depth from the shoe to the finished grade and the appropriate hydrant installed. Extension kits will not be allowed on new hydrant installations without the prior written approval of the Public Works Director/Town Engineer.
3. Following installation, the contractor must ensure the following:
- a. The nozzle caps are removed, cleaned and greased with a food grade anti-seize compound such as those manufactured by Loctite, CRC, Assured Flow or USA Bluebook
  - b. Reservoir oil is checked and filled as required.
  - c. The operating nut is in new condition.



- d. The hydrant is re-painted in accordance with the requirements of these STANDARDS and SPECIFICATIONS.

## **710 GENERAL INFORMATION**

### **710.01 Operation of Valves**

When connecting to the existing water system, mainline valves on the existing system and connecting valves shall be operated by the Town of Frederick personnel ONLY. The Contractor shall notify the Engineer and Inspector at least 48- hours prior to needing any valve operated, except in the case of emergencies.

### **710.02 Connection to Existing System**

1. At locations where connections to existing water mains are to be installed, the Contractor shall locate the existing mains both vertically and horizontally and verify their exact size and material in advance of the time scheduled for making the connections.
2. Prior to connecting to existing water mains, the Contractor shall have all personnel, materials, and equipment ready to connect the fitting to the existing main, so as to keep the shutoff time to a minimum. As soon as possible after making the connections, the Contractor shall flush the connection so as to prevent contamination of the existing facilities. The Contractor shall take every precaution necessary to prevent dirt or debris from entering the main.
3. Connections to the existing water system shall be completed in a neat and workmanlike manner. The Inspector shall be notified at least 48- hours in advance and be present at all times during the Construction of the connection. The connection is subject to approval by the Engineer and the Inspector. Under NO circumstances shall a non-disinfected main, which cannot be isolated, be connected to an existing disinfected main.
4. The Town does not guarantee the water tightness of its valves on existing facilities. If existing valves leak, the Town shall assist in reducing the influx of water, but the Contractor must use methods at their own disposal to dewater the trench and complete any required testing or disinfection of the water line.
5. All connections shall be valved to separate new Construction from the existing system. Valves shall be kept closed until acceptance of the new system.

### **710.03 Abandonment of Existing Water Lines or "Stubs"**

All water and water service lines that were installed and will not be used (such as a replat or a change in building configurations) shall be abandoned at the main line. This shall include



excavating the main and removing any mainline valves on the line to be abandoned and replacing them with a plug. However, if the street was paved within the previous 3-years and no street asphalt overlay is planned for the next five years, then the developer shall place in cash escrow with the Town, sufficient funds for the Town to abandon the service line in the future.

## **711 TAPPING**

### **711.01 Tapping Authorization**

The Contractor is authorized to tap existing water mains within the Town of Frederick only when a Town Inspector is present. The Town should be notified 48-hours before the main is scheduled to be tapped. All appropriate fees shall be paid prior to any tapping.

## **712 GENERAL PIPE INSTALLATION**

### **712.01 General**

The Town shall be notified at least 48 hours in advance of any pipe installation. No pipes shall be backfilled until they have been inspected by the Town. Alignment and grade of the pipe and the location of fittings, valves, and hydrants shall be staked in accordance with the approved construction plans under the supervision of a professional surveyor registered in the State of Colorado.

### **712.02 Lowering of Pipe and Accessories into Trench**

Implements, tools and facilities satisfactory to the Engineer shall be provided and used by the Contractor for the safe and efficient execution of the work. All pipe, fittings, valves, hydrants and accessories shall be carefully lowered into the trench with suitable equipment in a manner that will prevent damage to pipe and fittings. Under no circumstances shall pipe or accessories be dropped or dumped into the trench. Pipe and accessories shall be inspected for defects prior to their being lowered into the trench. Any defective, damaged or unsound material shall be repaired or replaced as directed by the Town Engineer or Town Representative. All foreign matter or dirt shall be removed from the interior and machined ends of pipe and accessories before it is lowered into position in the trench. Pipe shall be kept clean by means approved by the Town Engineer during and after laying.

### **712.03 Drainage of Mains**

Mains shall be drained through drainage branches or blowoffs. Drainage branches, blowoffs, air vents, and appurtenances shall be provided with valves and shall be located and installed as shown on the plans. The Town may require dechlorination.



#### **712.04 Laying of Pipe**

1. Trenching, backfilling and compaction shall be done in accordance with Section 200 of these STANDARDS AND SPECIFICATIONS.
2. In the event unstable trench conditions are found at pipeline grade, a minimum of one and one-half inch uniformly graded, washed rock shall be used for trench stabilization. Depth of the stabilization shall be as approved in writing by the Town.
3. Granular bedding material shall meet the requirements of Section 200 of these STANDARDS AND SPECIFICATIONS. Bedding shall be placed to six inches below the bottom of the pipe and shall be placed around the sides of the pipe and to a minimum of 12-inches above the top of the pipe and in accordance with the detail drawing at the end of this section.
4. Every precaution shall be taken to prevent foreign material from entering the pipe while it is being placed in line. If that is not possible, the Town Engineer or Inspector may require that before lowering the pipe into the trench, a heavy, tightly woven canvas bag be placed over each end and left there until the connection is to be made. The end of the pipe will be plugged or capped with approved materials when work stops. Pipe shall be laid with bell ends facing in the direction of laying, unless directed otherwise by the Engineer. Where pipe is laid on a grade of 10% or greater, the laying shall start at the bottom and shall proceed upward with the bell ends of the pipe up-grade. No pipe shall be laid when, in the opinion of the Engineer or the Inspector, trench conditions are unsuitable.
5. A minimum 12 gage, direct bury, solid copper wire shall be buried directly above all pipe. The copper wire shall be attached to the top of the pipe and surface at each fire hydrant. The wire shall be taped to the front of the hydrant barrel and coiled around the barrel just below the top flange with an excess length of approximately 16-inches (see Detail 700-6). The tracing wire shall be installed in a continuous run between fire hydrants and the ends of the tracer wire shall be brought to the surface in a cathodic protection box next to the fire hydrant. If there is no fire hydrant where the tracing wire can be brought up, the wire may be brought up in a valve box as directed in the field.
6. For pipe outside the roadway there shall also be a warning tape installed 18-inches directly above the pipe in addition to the tracing wire described above.

#### **712.05 Cutting of Pipe**

The cutting of pipe for inserting valves, or fittings, 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. Pipe ends shall be smooth and beveled with a file or other tools according to the pipe manufacturer's recommendations. Flame cutting of ductile pipe shall not be allowed. Asbestos cement pipe shall not be cut, but the entire section of pipe shall be removed to the nearest joint and replaced with a non-asbestos type pipe.



### **712.06 Dissimilar Materials**

1. Cathodic protection and insulation shall be installed as required by the Town Engineer. Particular care shall be taken to insulate between dissimilar materials. Damage to the polyethylene wrap prior to or during backfilling shall be repaired by the Contractor. All damage to the polyethylene wrap caused by tapping the pipe shall also be repaired by Contractor.
2. Whenever it is necessary to join pipe of dissimilar metal, an approved insulated joint shall be installed. The Contractor with a Town inspector shall conduct a resistivity test across the joint. If the resistance test fails, the insulated joint shall be removed and repaired. The joint shall then be reinstalled and retested. This procedure shall continue until a successful test result is obtained. A test station shall then be installed near the joint for future testing of continuity.
3. Test stations for metallic mainlines shall be located in vehicular accessible areas no more than 500 feet apart or less as determined by the Town Engineer. Cathodic protection systems shall be designed by a qualified, licensed engineer, who regularly designs corrosion protection systems of this type.
4. Following backfill and compaction of the water mains, cathodic protection test stations, shall be tested for effectiveness by the contractor and the results of the continuity test shall be submitted to the Town. If cathodic protection of the pipe is determined not to meet industry standards, then corrections shall be made until it meets industry standards and is accepted by the Town.

### **712.07 Joining of Pipe**

1. Immediately before joining two lengths of pipe, the inside of the bell and the outside of the spigot end and the gasket shall be thoroughly cleaned. Caution shall be exercised to ensure that the correct type of gasket is used. A thin film of gasket lubricant shall be applied to the inside face of the gasket and the spigot end of the pipe. The spigot end of the pipe shall be placed in the bell with care to prevent the joint from contacting the ground. The joint shall be completed by pushing the pipe home with a slow steady pressure, without jerky or jolting movements. Pipe furnished without a depth mark shall be marked before assembly to ensure insertion to the full depth of the joint. The pipe shall then be properly set and brought to correct line and grade. After installation of the polyethylene protective wrap, if required, the pipe shall be secured in place by installation of bedding material and backfill, in accordance with Section 200 and the detailed drawings at the end of this section.
2. Push on joints shall be accomplished in accordance with A.W.W.A. C600 "Installation of Ductile-Iron Water Mains and Their Appurtenances", A.W.W.A. M23 "PVC Pipe - Design and Installation". Longitudinal bending of PVC is not allowed. All deflection shall be through fittings or allowable deflection at joints if allowed by manufacturer's written literature. Pipe shall not be deflected either vertically or horizontally more than one percent or one half of the limits recommended by the manufacturer, whichever is less.



3. Mechanical joints shall be accomplished in accordance with A.W.W.A. C600 "Installation of Ductile Iron Water Mains and Their Appurtenances".
4. Flanged (or swivel) joints shall be accomplished in accordance with A.W.W.A. C115 "Flanged Ductile Iron and Grey Iron Pipe with Threaded Flanges", and A.W.W.A. C110 "Ductile Iron and Grey Iron Fittings 3-inch Through 48-inch., For Water and Other Liquids".
5. All requirements for the joining of different types of pipe with an inside diameter greater than 8-inches shall be done with an approved sleeve or transition piece. Type and style to be determined by the Town Engineer on a case by case basis.

#### **712.08 Permissible Pipe Deflection**

Pipe shall not be deflected either vertically or horizontally more than one percent or one half of the limits recommended by the manufacturer, whichever is less.

#### **712.09 Backfilling**

During the backfilling of all PVC waterline trenches, a continuous 2-inch wide metallic-coated, detectable tape labeled "Waterline Buried Below" shall be placed in the trench backfill 2-feet above and directly over the pipe. Detectable tape shall be manufactured by Pro-Line, or Town approved equal.

### **713 RESTRAINT**

#### **713.01 Thrust Blocks**

All bends, tees, plugs, dead-ends, wet taps (in certain cases), hydrants, and blow-offs shall be designed and constructed with concrete thrust blocks. Concrete thrust blocks shall be designed for the internal pipe pressure, surge pressure and the soil bearing capacity. If the soil-bearing strength is unknown, the soil-bearing capacity used in design shall be 2,000-pounds per square foot. Refer to the detail drawings at the end of this section. Thrust blocks shall be placed between solid ground and the fitting to be anchored; the area of bearing on the pipe and on the ground in each instance shall be approved by the Engineer. The contractor shall excavate as required to ensure that the thrust blocks are placed against undisturbed soil and shall form the sides of the thrust block to provide the size and shape as required in the detail drawing at the end of this Section. When it is impossible, because of over excavation or other causes, to pour a thrust block against undisturbed earth, harness rods shall be used to anchor the fittings to the main in addition to the thrust block and as required by the Town. The thrust blocks shall be so placed that the pipe and fitting joints will be accessible for repair. All fittings and piping shall be protected with a suitable bond breaker prior to pouring a concrete thrust block (the concrete shall have a minimum 28-day compressive strength of 3000-psi). Refer to Details 700-04 and 700-05 for typical thrust block installations and sizing. Forms for thrust blocks may be required by the Town



Engineer. After the concrete has been placed and has set, the contractor shall remove all forming materials prior to backfilling around the thrust block. Backfill may be placed over the thrust blocks once the surface has set sufficiently to resist the weight of the backfill. However, no tamping or compacting shall be allowed above the thrust block for a minimum of 24-hours after placement. Concrete must set a minimum of 48-hours prior to the initial filling of the line.

### 713.02 Joint Restraint Devices

1. Joint restraint devices of adequate strength to prevent movement may be used instead of concrete blocking, as directed by the Engineer. Steel rods or clamps shall be coated and polywrapped, under no circumstance shall steel harness rods be allowed to be in contact with soils. Use of tie rods is only as approved by the Town Engineer in writing. Joint restraint devices shall be used on both sides of valves and fittings for pipe sizes 12-inches in diameter and smaller and in addition to thrust blocks. For transmission mains, 16-inches in diameter and larger, joint restraints shall be used for a specified distance as recommended using the latest edition of the pipe restraint calculator provided by EBAA Iron, or equivalent ([rcp.ebaa.com](http://rcp.ebaa.com)).
2. Kick blocks will be required to be used in addition to joint restraint devices on transmission mains. Vertical bends in all pipe sizes shall be restrained using joint restraint devices and shall be restrained for a specified distance as recommended using the latest edition of the pipe restraint calculator provided by EBAA Iron, or equivalent ([www.rcp.ebaa.com](http://www.rcp.ebaa.com)).
3. Harness rods, or “rodding”, are not an acceptable means for restraining pipe and fittings unless it is specified inside vaults as shown on the detail drawings at the end of this section.
4. Pipes shall be connected to valves and fittings by mechanical joints unless specified differently in the approved drawings. For approved slip-on joints, the joint shall be assembled with a ratchet jack or other approved method in a manner that does not cause any damage to the pipe. Both the spigot and bell must be thoroughly clean and free from tar or other coatings and rust.
5. For mechanical joint pipe, the last 8-inches of the outside of the spigot end of the pipe and the inside of the bell of all fittings and gate valves shall be thoroughly cleaned to remove oil, grit, tar (other than standard coating), and other foreign matter from the joint and then a thin film of gasket lubricant shall be applied. The cast iron gland shall then be slipped on the spigot end of the pipe with the lip extension of the gland toward the bell of the fitting. Gasket lubricant shall be applied to the rubber gasket and placed on the spigot end of the pipe with the thick edge towards the gland.
6. After the spigot end of the pipe is placed into the bell and fully inserted the gasket shall be pressed into place within the bell so it is even around the entire joint. After the gland is positioned behind the gasket, the contractor shall install all bolts and nuts and tighten them with a torque wrench in accordance with manufacturer’s



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

7. Jointing shall be done in accordance with AWWA Specification C-111-07, Rubber Gasket Joints for Ductile Iron Pressure Pipe and Fittings, for all mechanical joint fittings.

### **713.03 Restraint for Fire Hydrants**

The shoe of each hydrant shall be well braced against unexcavated earth at the end of the trench with concrete backing, and it shall be tied to the pipe with suitable metal tie rods or clamps, as directed by the Town Engineer.

## **714 SERVICE LINES**

### **714.01 General**

1. Each subdivided lot shall be served by a separate service line and meter except as provided for in the municipal code. Refer to detail 700-08 for a typical service line installation for more information.
2. The meter pit shall be located within 6-inches behind the back of an attached walk. Where no walks or detached walks are to be installed, the location of the meter pit shall be subject to the approval of the Town Engineer.
3. The owner of the premises shall maintain the curb stop box or meter pit so that it will always be conveniently accessible and in good working order, properly capped and clean of debris and other foreign matter.
4. All corporation stops shall have Corporation Cock (C.C.) threads.
5. All service lines supplying water from the Town's system shall conform to one of the following types of pipe:
  - a. Seamless copper tube, "Type K, soft", for service lines 3/4-inch through and including 2-inches.
  - b. Ductile Iron Pipe conforming to these Standards for service lines 3-inches or larger.
  - c. PVC pipe conforming to these Standards for service lines 4-inches and larger.
  - d. No other type of pipe shall be allowed without the written approval of the Town Engineer.



6. All service lines shall have a curb stop and meter box installed within the Town's right-of-way (ROW).
7. Service lines shall not be installed in trenches containing conduits which carry any substances other than potable water without written permission of the Town, service lines shall be separated laterally from conduits which contain a potential health hazard by a minimum of 10-feet.

Exception: If it is not possible to achieve a 10-foot separation of the water and sewer services due to the size, location or other physical restraints of the lot, the lines may be installed in the same trench with the approval of the Town Engineer and under the following conditions:

- a. The water service must be installed 18-inches above the sewer service on a separately excavated shelf of undisturbed soil in the common trench.
  - b. 4-1/2-feet of cover must be maintained as a minimum over the water service.
8. All service lines will be inspected by the Inspector. It is the responsibility of the Contractor or Developer to submit as-built drawings indicating the actual locations of all service stub-outs, prior to issuance of a final acceptance.
  9. See Detail 700-08 for a typical service line installation.
  10. The installation of pumps directly fed by the Town water system in service lines is prohibited.
  11. All taps shall be at least 18-inches from any joint, fitting, valve or other tap unless approved otherwise by Engineer.
  12. Location of all service lines shall be marked with a "W" chiseled in the sidewalk or curb closest to the property line.

#### **714.02 Ownership**

The Town shall maintain the water service line from the mainline to the curb stop, excluding the curb stop valve, box and stem, where a curb stop exists. In instances where no curb stop or outside meter exists, the Town will maintain the service line from the main to the right-of-way line. In instances where an outside meter exists without a separate curb stop, the Town will maintain the service line from the main to the meter, provided the meter is within fifteen feet of the right-of-way line. All remaining portions of the service line are to be maintained by the property owner, excluding the meter and backflow devices. Domestic water services shall not be tapped into fire service lines.



## **715 SETTING OF VALVES AND FITTINGS**

Valves, fittings, plugs, and caps shall be set and joined to pipe in the manner specified above in laying and joining of pipe. Valves in water mains shall be located as shown on the plans.

## **716 SETTING OF VALVE BOXES**

### **716.01 Valve Boxes**

1. Gear cases shall be tightened and the valve shall be inspected in opened and closed positions to ensure that all parts are in working condition prior to installation. The cases shall be supported by concrete blocks to prevent any shock or stress being transmitted to the valve.
2. A valve box shall be provided for every valve that has no gearing or operating mechanism, or in which the gearing or operating mechanism is fully protected with a cast-iron grease case. The valve box shall be centered and plumb over the operating nut of the valve, with the box cover at most 1/4-inch below the surface of the surrounding pavement or such other level as may be directed by the Town Engineer. Refer to Detail 700-01 for valve and valve box installation.
3. Extensions to within 4-feet of the finished grade shall be provided for valves installed with more than 5-feet of cover. All extensions shall be pinned to the valve operating nut. Earth fill shall be carefully tamped around each valve box to a minimum distance of 4-feet on all sides of the box, or to the undisturbed trench face if less than 4-feet.
4. Valves shall have the interiors cleaned of all foreign matter before and after installation.

## **717 SETTING HYDRANTS**

### **717.01 Location**

1. Hydrants shall be located at least 1-foot inside the right-of-way or water utility easement and 5-feet from the side lot line and shall conform to one of the following conditions.
2. When placed behind the curb, the hydrant barrel shall be set so that no portion of the pumper or hose nozzle cap will be less than 24-inches or more than 30-inches horizontal distance from the gutter face of the curb.
3. When set in the lawn space between the curb and the sidewalk, or between the sidewalk and the property line, the hydrant or nozzle cap shall be a minimum 6-



inches and a maximum of 18-inches off of the sidewalk. No portion of the hydrant or nozzle cap shall be over the sidewalk.

#### **717.02 Position**

All hydrants shall stand plumb and shall have their nozzles parallel with, or at right angles to, the appropriate curb, with the pumper nozzle facing the fire access. Hydrants shall be set to the established grade, with the safety flange approximately 4 to 6-inches, or as per the manufacturers recommendations, vertically above the ground.

#### **717.03 Connection to Main**

Each hydrant shall be connected to the main with a 6-inch swivel tee controlled by an independent 6-inch flanged by M.J. gate valve, unless otherwise specified. Dependent upon the soil conditions and the length of the hydrant run, the fittings and pipe lengths may require rodding as determined by the Engineer.

#### **717.04 Hydrant Drainage in High Permeability Soil**

Wherever a hydrant is set in soil that is pervious, drainage shall be provided at the base of the hydrant by placing 1-inch washed rock, from the bottom of the trench to at least 6-inches above the waste opening in the hydrant and to a distance of 1-foot around the elbow.

#### **717.05 Hydrant Drainage in Low Permeability Soil**

Wherever a hydrant is set in clay or other impervious soil, a drainage pit shall be excavated below each hydrant and filled with 1- inch washed rock and under and around the elbow of the hydrant and to a level of 6-inches above the waste opening. The drain pit shall be covered with polywrap prior to backfill.

#### **717.06 Usage and Operation of Hydrants**

Water usage from a fire hydrant is strictly prohibited unless a special use permit is issued by the Town of Frederick.

#### **717.07 Filling the Waterline**

The new pipeline shall be filled slowly, filling at a rate which will not cause surges or exceed the rate at which air can be released. All air in the line shall be purged. Where blow-offs or hydrants are not available or effective in purging air from the line, the Town Engineer shall require a tap to purge the line. The location and the size of the tap shall be at the Town Engineer's discretion. All costs related to make the tap shall be the Contractor/Developers responsibility. Tapping fees do not apply.



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## 718 DISINFECTION AND FLUSHING

1. The chlorination of finished water mains shall be done prior to the hydrostatic testing. Before filling the main with water, the main shall be clean and free from debris to the satisfaction of the Engineer.
2. Disinfection by chlorination of the main shall be performed prior to acceptance by the Town. The chlorinating agent and method of application shall be approved by the Engineer in accordance with A.W.W.A. C651.
3. If chlorine tablets are used for disinfection, the tablets shall be attached to the top of the pipe with A.W.W.A. and FDA approved adhesive specific for this purpose just prior to the installation of the pipe in the trench.
4. After the water main is filled with water and chlorine, the chlorinated water shall be held in contact with the main for 48-hours. At the end of the 48-hours, the water in the main shall be tested by the Town, to ensure a residual chlorine content of not less than 30-mg/l (ppm) and not more than 200-mg/l (ppm) under 2-mg/l (ppm) or equal to system level. The main shall then be thoroughly flushed to remove the heavily chlorinated water. Care shall be taken in flushing the main to prevent damage or danger to the public and the environment. The Town Engineer may require Contractor to dechlorinate the flushed water.
5. After final flushing and before the new water main is opened to the distribution system, two consecutive sets of acceptable samples, taken at every hydrant, shall be collected from the new main. The first set of samples shall be collected from every 1,200-feet of the new water main and all fire hydrants, plus one set from the end of the line and at least one set from each branch more than 100-feet long. The first set of samples shall be taken of water that has stood in the new main for at least 24-hours after final flushing. The second set of samples shall be taken after completion of the hydrostatic testing at the location(s) used for hydrostatic testing. All samples shall be collected and tested 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. Sampling and testing of residual chlorine and coli form organisms will be done by the Town.
6. If the initial disinfection fails to produce satisfactory bacteriological results or if tests indicate that other water quality parameters do not meet Town potable water standards, the new main may be re-flushed and shall be resampled. If check samples also fail to produce acceptable results, the main shall be re-chlorinated by the continuous-feed or slug method of chlorination in accordance with A.W.W.A. C651 until satisfactory results are obtained.

## 719 HYDROSTATIC TESTS

1. No hydrostatic tests shall be made on any portion of the pipeline until all field placed concrete has had adequate curing time. Sufficient backfill shall be placed between joints and fittings to stabilize the constructed pipeline, however joints, fittings, valves,



etc., may be required by the Inspector to remain uncovered so that visual inspection may be made at the time of testing. Tests shall include testing of service lines to and including the curb stop on new waterline installation.

2. All pipe shall be field tested to a minimum of 150-psi at all points in the line and 200-psi in private fire service mains.
3. The Town of Frederick shall be notified at least 24-hours in advance of any testing. All testing shall be done in the presence of the Town.
4. The Contractor shall furnish the necessary equipment to do the pressure test including a calibrated meter. The pipeline shall be in a state of readiness for testing, having been filled, flushed of high chlorine, and purged of air.
5. While the test pressure is maintained continuously for 2-hours, the allowable leakage from the pipe shall not exceed the formula listed below. An examination may be made of the pipeline in general during testing, and any leaks shall be repaired. Any pipe or fitting found to be cracked shall be removed and replaced. Cutting and replacing of pavement, excavating and backfilling are a necessary part of locating and repairing leaks discovered by pressure testing of pipe and the costs of these activities shall be borne by the Contractor.
6. No leakage is allowed through the bonnet of any valve. Any valve that leaks through the bonnet will be removed and replaced.

The hydrostatic pressure test shall be performed against each valve within the new piping system.

Allowable Leakage for PVC Pipe (per AWWA C605):

$$L = \frac{ND\sqrt{P}}{7,400}$$

Where:

- L = allowable leakage, in gallons per hour
- N = number of joints in the length of pipeline tested
- D = nominal diameter of the pipe, in inches
- P = average test pressure during the leakage test, in pounds per square inch (gauge)

Allowable leakage at various pressures is shown in the following table. The values in the table are calculated on the basis of the above equation.

Allowable leakage per 50 joints of PVC pipe\* (gph)

Avg. Test Pressure (psi)	Nominal Pipe Diameter (in)				
	4	6	8	10	12
200	0.38	0.57	0.76	0.96	1.15



175	0.36	0.54	0.72	0.89	1.07
150	0.33	0.50	0.66	0.83	0.99
125	0.30	0.45	0.60	0.76	0.91
100	0.27	0.41	0.54	0.68	0.81

\*If the pipeline under test contains sections of various diameters, the allowable leakage will be the sum of the computed leakage for each size.

Allowable Leakage for Ductile Iron Pipe (per AWWA C600):

$$L = \frac{SD\sqrt{P}}{133,200}$$

Where:

- L = allowable leakage, in gallons per hour
- S = length of pipe tested, in feet
- D = nominal diameter of the pipe, in inches
- P = average test pressure during the leakage test, in pounds per square inch (gauge)

Allowable leakage at various pressures is shown in the following table. The values in the table are calculated on the basis of the above equation.

Allowable Leakage per 1,000-feet of pipeline\* (gph)

Avg. Test Pressure (psi)	Nominal Pipe Diameter (in)					
	3	4	6	8	10	12
200	0.32	0.43	0.64	0.85	1.06	1.28
175	0.30	0.40	0.59	0.80	0.99	1.19
150	0.28	0.37	0.55	0.74	0.92	1.10
125	0.25	0.34	0.50	0.67	0.84	1.01
100	0.23	0.30	0.45	0.60	0.75	0.90

\*If the pipeline under test contains sections of various diameters, the testing allowance will be the sum of the testing allowance for each size.

## 7. Operational Inspection

At the completion of the project and in the presence of the Inspector, the Contractor shall operate all valves, hydrants, and water services to ascertain that the entire facility is in good working order; that all valve boxes are centered and valves are opened; that all hydrants operate and drain properly; that all curb boxes are plumb centered; and that water is available at all curb stops.



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## **720 WATER METERS**

### **720.01 General**

1. All work and materials must be acceptable to the Town Engineer or Town Representative.
2. All work and materials are subject to inspection by the Town of Frederick at all times.
3. There shall be only one Town water meter per service tap purchased. Multi-unit structures require tap fees to be paid for each unit.
4. The tap, water service line between the main and the meter, and water meter may all be the same nominal size. Where the meter size is smaller or larger than the service line size, the water service size shall be considered equal to the water meter size. There shall be installed upstream and downstream of said meter a pipe of the same diameter and 20 (twenty) times that diameter in length. Variation between service line and meter size must be approved by the Town Engineer in writing.
5. The Town reserves unto itself sole responsibility for testing and certifying the accuracy of Town water meters. No one shall in any way attempt to test, certify, or calibrate a Town owned water meter without the written approval of the Town.
6. Modification, alteration or relocation of metering equipment must be approved by the Town in writing.
7. Water meter and offsite reading equipment costs, fees, and repair costs shall be determined by the Town of Frederick.
8. The Town shall have the sole right to determine the rated size, kind, type, make, and component configuration of water meters and offsite reading equipment.

### **720.02 Ownership**

1. Water meters and off-site reading equipment shall be obtained from the Town of Frederick, upon payment of fees, and shall remain in the Town's ownership.
2. Town ownership of water meters includes the entire meter. All water meters connected to the Town of Frederick's utility system shall be the property of the Town. Under no circumstances shall anyone other than Town personnel remove a water meter once the pit or vault has been inspected and approved. No connections shall be made in the meter pit, for irrigation or otherwise, by anyone other than authorized Town personnel. Irrigation system connections shall be made downstream from the meter and a minimum of five feet from the meter pit or vault.
3. Water meters installed at a premise shall remain with that premise and are not transferable.



### **720.03 Materials**

1. Setter, pit, dome, meter and AMI; 5/8-inch to 1-inch shall be obtained from the Town of Frederick.
2. The user/customer has the sole responsibility to determine the potential loads a meter pit and meter vault will require and shall provide the structural strength required. The Town may require AASHTO HS-20 loading at its option.
3. No solder containing lead shall be used. All soldering fluxes, plumbing pastes, pipe dopes, sealants, coatings, gaskets, and similar material which may come into contact with potable water must be non-toxic and approved for general plumbing use.

### **720.04 Installation**

1. Whenever possible, the installation of water meter vaults in streets, roadways, driveways, alleys, or parking lots will not be allowed. Meters for residences shall be placed in a pit (for 5/8-inch or 1-inch services) outside of the structure as indicated in the detail drawings. Meters for commercial/industrial buildings may be placed inside the building as approved by the Town Engineer. Meters for larger services (greater than 1-inch) may be placed in minimum 4-foot diameter vault. The vault must be within 300-feet of the structure. Meters for all Parks & Forestry maintained areas (parks, arterial streets and primary greenways) must be placed in a minimum 72-inch diameter vault for service lines 3-inches and less.
2. The water meter shall be situated such that it is protected from freezing and frost damage.
3. The meter pit shall be installed within the right-of-way or public Utility Easements. Water meter pit locations and installations must be acceptable and meet the approval of the Town Engineer. The meter pit shall be located within 6-inches behind the back of an attached walk, within the tree lawn but no closer than 18-inches from the front edge of the walk to the edge of the meter lid of a detached sidewalk, and no more than 6-feet behind the back of curb if there is no sidewalk. See Detail 700-08. Water meter pits shall not be installed with the construction of the water service line until such time as the electric service lines, or other adjacent utilities, have been installed unless otherwise approved by the Town Engineer. For installation outside the Town limit, the meter pit shall be installed immediately adjacent to right-of-way (ROW).
4. All meter settings must be inspected before backfilling.
5. If the street or ground is not to final grade at the time of installation of the meter, the owner must raise or lower the meter vault when the final grade is established. Top of pit lid must be a minimum of 2-inches above dirt level if no sod or other landscape covering is in place at the time of final inspection.
6. Galvanized piping is not allowed.



7. The service line through and on both sides of the meter pit must be of the same material.
8. No branch connections shall be made in the meter pit. Connections must be made more than 5-feet from the meter pit on the downstream side.
9. Valves 4-inch diameter and larger shall be supported by adjustable steel supports, and 1-1/2-inch diameter and larger meters shall be supported by concrete blocks with steel shims if needed.
10. Manhole rings and covers shall be in conformance with the wastewater section of these Standards, except "WATER" shall be cast in the cover.
11. Meter manholes for meters 1-1/2-inch and larger shall use a 24-inch aluminum ring and cover and the outside of the aluminum ring shall have 8-mils of tar applied. A 24-inch by 36-inch aluminum cover adaptor and ring shall be used to enlarge the access opening if required. Once the tar is set then a 12-inch wide by 6-inch thick concrete collar shall be placed around the manhole ring. The manhole cover shall have a 2-inch diameter hole in the center of the cover for the transponder and the cover shall have the lettering "Water Meter" cast into the lid. Meter manholes in traffic areas are only allowed at the discretion of the Town. If allowed, the manhole shall use a 24-inch cast iron ring and cover and shall be designed to accommodate and protect the transponder. Approval by the Town of this design will be on a project specific basis.
12. Settings of meters other than shown and detailed herein shall be considered as non-standard and shall require prior approval of proposed piping layout, meter setting and structural design of vault for each separate installation.
13. Backflow prevention devices will be required in accordance with the Municipal Code.
14. Customers/users and contractors shall be responsible for obtaining all locates for underground utilities and services prior to excavation.
15. The following apply to 2-feet in diameter water meter pit installation (meters  $\leq$  1-inch).
  - a. The pit shall rest upon brick supports or concrete block.
  - b. The installed pit shall have its top locking lid at the same elevations as the grade of the adjacent landscaping. Care shall be taken that drainage of surface waters be directed away from the pit lid and do not puddle over the pit.
  - c. Both the inner frost lid and the top locking lid shall be installed on the pit. The locking mechanism shall be fully functional.
  - d. When installed, the water meter shall not be touching or resting against the pit barrel or pit cone assembly. The water meter shall lie horizontal and be essentially level.



- e. Water meter pits shall not contain any plumbing fixture, fitting, valve, or pipe not directly a part of the pit assembly, the water meter set, or the water meter itself. Lawn irrigation tees, valves, and winterizing fittings shall not be allowed inside a water meter pit.
  - f. The meter must be within 18-inches below the top lid.
16. The following apply to 4-foot and larger water meter vault installation (meters >1-inch).
- a. Water meter vaults proposed for water meters larger than 2- inches, manifold water meter sets, fire line rated water meters, or specifically constructed water meter sets shall have site and design plans approved by the Town Engineer prior to the start of Construction.
  - b. Vaults are to be of water tight construction with a sump pit.
  - c. To the extent possible, the top of the water meter register head shall be visible from the opened access lid.
  - d. Bypasses for 1-1/2-inch and larger meters are required for commercial, industrial and multi-family users (see Details). Bypass sizes are to be determined by the Town.
  - e. A list of approved meter setters can be found in the Appendix.
17. The following apply to inside installations.
- a. Bypasses for 1-1/2-inch and larger meters are required for commercial, industrial and multi-family users. Bypass sizes are to be determined by the Town.
18. The Property Owner is required to bear the costs of relocating a meter and/or remote when their actions limit existing free and easy access for the meter readers or introduces a safety hazard. This would include remodeling, additions, fences, new landscaping, etc.
19. When installing 1-1/2-inch and larger water meters/backflow devices inside commercial buildings and inside of a locked room, a lock box, locked with an approved lock with a key to the room, must be provided for access by the Town and installed just outside of the locked door.

#### **720.05 Access - Water Meters**

- 1. Free, easy, and ready access for the purposes of testing, certification, repair, maintenance, or replacement shall be provided to water meters at any reasonable hour.



2. All water meters have to be periodically tested and certified. The customer/user shall take whatever measures are necessary for providing this periodic access.
3. There shall be a clear line of access to the water meter. This access line shall be free of any impediment, including safety hazards, to the movement of personnel and necessary tools, equipment, or material.
4. Lines of access and openings governing access to the water meter set shall be large enough to accommodate the passage of the water meter without the water meter having to be dismantled in any way. It is the responsibility of the customer/ user to move belongings, material, or property to insure reasonable conditions of access.
5. There shall be no obstruction of any sort which would necessitate the reaching around, through, behind, under, or over in order to perform usual and necessary work. Nor shall there be any obstruction which would impair the clear viewing of the water meter. The area around the water meter shall be fully sufficient for a person to place their body squarely before and in close proximity to the water meter, have a clear view of the meter, and have room to operate customary tools without hindrance.
6. Whenever security considerations necessitate that access to a water meter be controlled through the use of a lock, alarm, or other such device, the customer/user shall make known to the Town the procedures to be followed for ready access through such locks, alarms, or other security arrangements.

## **721 BACKFLOW CONTROL**

### **721.01 General**

1. All work and materials must be acceptable to the Town Engineer.
2. All work and materials are subject to inspection by the Town of Frederick at all times.
3. Modification, alteration or relocation in backflow device equipment must be approved by the Town.
4. All work necessary to achieve installation of a backflow prevention device or assembly shall be inspected. Inspections will be required as follows:
  - a. Any work on a water service line, including all piping and valve work, and underground vaults shall be approved by a Town Inspector prior to any backfilling.
  - b. Backflow prevention device sets, device installation, and discharge piping where appropriate, shall be approved by Town of Frederick prior to device installation.



- c. For commercial and multi-family properties, no Certificate of Occupancy will be issued without an approved inspection and device test result submitted to the Town of Frederick.
5. Backflow prevention devices shall be required on the domestic line for commercial, industrial, and multi-family units where 4 (four) or more units are connected by a common meter and tap.
6. The specific make, model, and manufacturer shall be found in the most recent listing published by The Foundation for Cross-Connection Control and Hydraulic Research of the University of Southern California's (FCCC&HR) "List of Approved Backflow Prevention Assemblies." In the cases of single family residences, the assemblies shall bear the approval of the American Society of Sanitary Engineers (ASSE).

#### **721.02 Backflow Prevention Devices**

1. An approved backflow prevention device or assembly used for protection by containment is required on any water service line whenever there is an actual or potential situation when backflow due to backpressure and/or backsiphonage can occur.
2. The Town of Frederick staff shall make an inventory of water use in any facility or location which is supplied potable water from the Town's water distribution system to determine the degree of hazard which might exist.
3. On remodels or retrofit situations, subsequent to the hazard inspection, the Town staff will notify the customer of the type of backflow prevention device required.
4. Where hazards are largely unknown or hazard inspections cannot be conducted for whatever reason the highest degree of protection may be required.

#### **721.03 Ownership**

1. Backflow prevention devices shall be privately owned and maintained by the property owner.
2. Backflow prevention devices used for protection by containment remain with a premise and are not transferable to another premise, property, area, or street address.
3. Only properly trained and certified cross-connection control personnel are permitted to install, repair, replace, relocate, maintain, test, certify, modify, or otherwise affect the internal workings of a backflow prevention device.



## 721.04 Design Requirements

### 1. Definitions

**AIR GAP:** The unobstructed vertical distance through the free atmosphere between the lowest opening from any pipe or faucet supplying water to a tank, plumbing fixture, pool, or other device and the flood level rim of said vessel or container. An approved air-gap shall be at least double the diameter of the supply pipe, measured vertically, above the flood level rim of the vessel or container; and, in no case less than 1-inch.

### 2. Location requirements

- a. Backflow prevention devices or assemblies used for protection by containment shall be located on the building side of Town owned water meters.
- b. A reduced pressure zone backflow prevention device shall be used for all non-residential irrigation services. This shall be required for both domestic and reclaimed water sources. The assembly shall be located a minimum of five feet downstream of the water meter and installed per Colorado Department of Public Health and Environment guidelines and Town of Frederick Municipal Code to allow for proper operation and easy access for annual testing and maintenance.
- c. Backflow prevention devices or assemblies used for protection by containment shall be located such that all water entering the premise or property through the water service line shall pass through the device or assembly prior to any use by the customer/user. There shall be no fitting, fixture, or other means capable of diverting water from the service line before the device. The exceptions are as follows:
  - d. There may be closed loop bypass around the backflow prevention device or assembly, provided the bypass itself has in it a similar type approved backflow prevention device or assembly. The purpose shall only be to insure continuous water delivery while one device or assembly is undergoing testing, maintenance, repair, or replacement.
  - e. Landscape irrigation systems may be tested before the backflow prevention device used for containment, provided such systems are themselves properly equipped with an approved backflow prevention device or assembly.
  - f. The Town may authorize more than one approved backflow prevention device or assembly when physical conditions in a retro-fit situation pose unusual problems to the installation of a single device or assembly.

### 3. Underground vaults

- a. The user/customer has the sole responsibility to determine the potential loads an underground vault will require and shall provide the structural strength required.



- b. Site plans and Construction details for proposed installation of underground vaults which will be subjected to the loads of motor vehicles shall be submitted to and receive the approval of the Town Engineer prior to the commencement of Construction. Whenever possible, the siting of underground vaults in streets, roadways, driveways, alleys, or parking lots will not be allowed. The location of underground vaults on any premise where there is any routine handling of petroleum products, chemicals, hazardous, or toxic materials shall be such that spillage, flow, or runoff of those materials will be away from the underground vault. Care shall be taken that ground slope, landscaping, and other provisions for runoff will not cause any accumulation of such materials inside, over, or adjacent to the vault.
4. Pressure Increases
  - a. Most backflow prevention devices and assemblies, by the very nature of their design, do not allow any release of pressure which may build up on the customer/user's side of the piping or plumbing system to escape back to the Town's water distribution system. Customer/users must insure that there is adequate protection from increases in water pressure on the downstream or user's side of a backflow prevention device or assembly.

THE TOWN DOES NOT ACCEPT NOR TAKE ANY RESPONSIBILITY OR LIABILITY FOR DAMAGES OF WHATEVER KIND WHICH MAY BE OCCASIONED BY OR RELATED TO AN INCREASE OR DECREASE IN PRESSURE IN THE PIPING OR PLUMBING SYSTEM DUE TO THE INSTALLATION OR OPERATION OF AN APPROVED BACKFLOW PREVENTION DEVICE OR ASSEMBLY.

- b. The customer/user shall maintain in good working order pressure relief valves on their hot water tanks, boilers, and hot water heating systems. Further, the customer/ user shall install and maintain whatever additional pressure relief valves, water hammer arrests, pressure expansion tanks, or other means deemed prudent and wise.
5. Shutoff valves
  - a. The customer/user shall install and shall maintain in good operating order a curb stop and at least one (1) other valve in the service line before the backflow prevention device or assembly used for protection by containment. Both the curb stop and additional valve shall be capable of fully stopping all water flows into the device or assembly. The curb stop is required on the service line between the back of curb and the edge of meter lid. The isolating valves on the backflow prevention devices or assemblies are not to be considered in lieu of these valves. The isolating valves are to be used only for testing and certifying the device, not for the control of water flow through any piping or plumbing system.
6. Drainage
  - a. Certain types of approved backflow prevention devices and assemblies are specifically designed to dump or vent water to the atmosphere as an expected



part of their operation. The customer/user shall be responsible for providing whatever drainage work may be needed to control and carry away water which may be dumped or vented by such devices or assemblies.

- b. The Town accepts no responsibility nor liability for damages or injury caused or related to the dumping or venting of water, or water mixed with other materials.
  - c. Reduced pressure principle devices (RP devices) may dump or vent large quantities of water under pressure. These devices or assemblies are equipped with an air gap funnel to catch the dumped or vented water. The customer/user shall provide whatever piping is necessary from the outlet side of the air gap funnel to effectively and safely carry away and dispose of any dumped or vented water or water mixed with other substances.
7. Stop and Waste Valves
- a. Stop and waste valves on the upstream side of a backflow control device will be allowed only if the valves can vent to daylight. No upstream stop and waste valve may be buried nor be situated such that it is, or potential can be, submerged by the water it vents or dumps, any other water, or any other liquids.

#### **721.05 Materials**

No solder containing lead shall be used. All soldering fluxes, plumbing pastes, pipe dopes, sealants, coatings, gaskets, and similar materials which may come into contact with potable water must be non-toxic and approved for general plumbing use.

#### **721.06 Access - Backflow Prevention**

1. Free, easy, and ready access for the purposes of testing, certification, repair, maintenance, or replacement shall be provided to backflow prevention devices or assemblies used for protection by containment at any reasonable hour.
2. All backflow prevention devices have to be periodically tested and certified, most of them annually. The customer/user shall take whatever measures are necessary for providing this periodic access to the device or assembly for the purposes of testing and certification.
3. There shall be a clear line of access to the backflow prevention device or assembly. This access line shall be free of any impediment, including safety hazards, to the movement of personnel and necessary tools, equipment, or material.
4. Lines of access and openings governing access to the device set shall be large enough to accommodate the passage of the backflow prevention device or assembly without the device or assembly having to be dismantled in any way. It is the responsibility of the customer/ user to move belongings, material, or property to insure reasonable conditions of access.



5. There shall be no obstruction of any sort which would necessitate the reaching around, through, behind, under, or over in order to perform usual and necessary work. Nor shall there be any obstruction which would impair the clear vision of the device set. The area around the device set shall be fully sufficient for a person to place their body squarely before and in close proximity to the device set, have a clear view of the set, and have room to operate customary tools without hindrance.
6. Whenever security considerations necessitate that access to a backflow prevention device or assembly be controlled through the use of a lock, alarm, or other such device, the customer/user shall make known to the Town the procedures to be followed for ready access through such locks, alarms, or other security arrangements.

#### **721.07 Space and Location Requirements**

1. The following requirements shall apply to backflow prevention device or assembly sets in all newly constructed structures or facilities and, where reasonable, in all retro-fit situations:
  - a. A minimum vertical distance of 12-inches shall exist between the ground or floor and the lowest point on the device or assembly, including the air gap funnel on reduced pressure principle (RP) devices.
  - b. The lowest point on the device or assembly shall not exceed 30-inches above the floor, ground, or a firm, permanent footing surface.
  - c. The closest side of the device or assembly sized 2-inch and smaller shall not be less than 2- inches from any wall or obstruction and shall be at least 4-inches from any surface which is subjected to freezing temperatures on its other side. Larger devices or assemblies which require companion flanges for installation shall have a minimum clearance of 12-inches from the closest wall or obstruction.
  - d. At least one side of the device or assembly shall be open to ready and easy access.
  - e. The piping side of all unions and companion flanges shall allow sufficient room to introduce bolts, nuts, and use usual tools. In no case shall the piping side of a union or companion flange be closer than 4-inches to a wall, floor, or other obstruction.
  - f. There shall be at least 12-inches of clearance between the test cocks and any adjacent wall, fixture, or ceiling.
  - g. No device or assembly set shall be installed in or above a ceiling.
  - h. No device or assembly shall be located such that any vented or dumped water cannot be safely carried away without damaging property.



- i. No device or assembly, including any air gap funnel, shall be located such that it is likely to be submerged in the water it vents or dumps, in ground water, or in other water or liquids which may be present.
- j. No device or assembly shall be located either above or below a hazardous location, such as a chemical mixing tank, electrical apparatus, electronic equipment, or a storage site for chemicals or other hazardous materials.
- k. All devices or assemblies shall be located such that they are protected against vandalism, mischief, and deterioration due to atmospheric conditions. Customers/users who are retro-fitting the backflow prevention device set may request a variance to the above requirements when they deem them to be unduly burdensome. Such request should be directed to the Town which will make an investigation and render a decision.

#### **721.08 Installation Requirements for Air Gaps**

1. Properly constructed and located air gaps are approved for protection by containment for all degrees of hazard. Air gaps used for protection by containment are most commonly used for applications on tank loading stations, pools used for swimming, wading, or therapy, chemical processing tanks, and sumps or tanks which provide water for pumping. Air gaps shall conform to the following:
  - a. They shall be located downstream of the Town water meter.
  - b. They shall be constructed such that no hose, piping arrangement, or other fixture may be attached to defeat the air gap separation. This includes any solid funnel arrangement installed to prevent splashing.
  - c. They shall be constructed such that the potable water supply line is at a vertical distance of not less than two inside pipe diameters (of the potable supply line) above the flood level of the receiving vessel, and in no case shall the air gap between the potable line and the receiving vessel be less than 1-inch.
  - d. When the potable supply line discharge is within two (2) inside pipe diameters of any wall or protrusion, the required vertical air gap between the potable supply discharge and receiving vessel shall be extended to a minimum of three (3) inside pipe diameters of the potable supply line, or 2-inches, whichever is greater.
  - e. There shall be adequate drainage arrangements to handle full volume overflows of the receiving vessel.
  - f. The water supply or service line shall be protected from freezing.
  - g. Stop and waste type valves are not allowed.
  - h. Air gaps used for protection by containment shall be considered approved backflow prevention devices and shall be inspected at least annually.



**721.09 Installation Requirements for Reduced Pressure Principle (RP) or Reduced Pressure Detector Check (RPDC) Devices or Assemblies**

1. A reduced pressure principle (RP/RPDC) device or assembly shall be installed for protection by containment whenever the degree of hazard is high and there is a potential risk of contamination to the Town's water distribution system. RP/RPDC devices or assemblies shall be installed at any premises or location where toxic or hazardous materials are routinely handled or present. RP/RPDC devices or assemblies shall meet the following:
  - a. When installed horizontally, they shall be in an upright position, essentially plumb, and with the relief valve pointed down. RP/RPDC devices or assemblies larger than 2-inches in size must be installed horizontally.
  - b. RP devices 2-inches and smaller may be installed in a vertical position provided the water flow will be in an upward direction through the device or assembly. Such installations require the addition of a vent elbow such that the outlet of the air gap funnel will be pointing down.
  - c. RP devices 2-inches and smaller shall be equipped with full port/quarter turn ball isolating valves.
  - d. RP/RPDC devices sized 2-1/2-inch and larger are normally provided with resilient seat butterfly type isolating valves. OS & Y type gate valves can be substituted for the butterfly valves when the device or assembly is to be used in a fire suppression water line.
  - e. RP/RPDC devices shall be protected against frost and freeze damage.
  - f. RP/RPDC devices shall not be installed in underground vaults unless such vaults have a drain to daylight which is capable of carrying the maximum possible discharge from the device. The drain shall be provided with a 24-inch mesh non-corrodible screen at the discharge to prevent any material from entering the waste line and creating a plug. A sump pump shall not be utilized in lieu of a drain to daylight.
  - g. Installation of an RP/RPDC device above ground in a small enclosure is acceptable provided that the enclosure has non-corrodible screened opening(s) which will provide the necessary drainage without the air gap funnel being submerged in the vented or dumped water.
  - h. RP/RPDC devices installed inside structures may have a drainage line through an exterior wall to daylight provided any dumped or vented water exiting the drain line will not pose a hazard to the public. Such drain line shall be equipped with a non-corrodible screen at the discharge opening.
  - i. The Town may elect to remove the operators or handles from the isolating valves or to chain them together to prevent unauthorized operation of the isolating valves.



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**721.10 Installation Requirements for Double Check Valve (DCV) Devices or Assemblies**

1. A double check valve (DCV) device or assembly shall be installed if the degree of hazard is low, with little or no risk of bodily harm should the device or assembly fail. Customers/users or contractors have the option of substituting a reduced pressure principle device or air gap for a DCV. DCV devices shall conform to the following:
  - a. When installed horizontally, DCV devices or assemblies shall be in an upright position and essentially plumb.
  - b. DCV devices may be installed vertically, provided, the water flow is in an upward direction through the device.
  - c. DCV devices 2-inches and smaller shall be equipped with full port/quarter turn ball isolating valves.
  - d. DCV devices sized 2-1/2-inches and larger are normally provided with resilient seat butterfly type isolating valves. OS & Y type gate valves can be substituted for the butterfly valves when the device or assembly is to be used in a fire suppression water line.
  - e. DCV devices shall be protected against frost and freeze damage.
  - f. DCV devices may be installed in underground vaults, either alone or in conjunction with water meters. The following provisions shall be met:
    - i. Vaults must be a minimum of 4-feet in diameter for DCV devices sized 2-inches and smaller.
    - ii. Vaults for larger DCV devices shall conform to the minimum space requirements on the appropriate Engineer's approved detail drawing.
    - iii. Standard water meter pits cannot be used for DCV installations.
    - iv. Vaults containing both water meters and DCV devices must provide sufficient working room to perform usual maintenance, repair, or replacement of both the water meter and the DCV device.
    - v. Vaults must satisfy all access and siting requirements.
    - vi. Vaults must provide that the DCV not be submerged due to high water tables, infiltration of ground waters, or infiltration by surface runoff. Properly screened drains to daylight, sump pumps, or water proof construction may be required to ensure the DCV is not subjected to submersion.



- g. Installation of a DCV device above ground in a small enclosure is acceptable, provided that the enclosure provides the necessary frost protection and conditions of access.
- h. The Town may elect to remove the operators or handles from the isolating valves or to chain them together to prevent unauthorized operation of the isolating valve.

**721.11 Installation Requirements for Pressure Vacuum Breaker (PVB) Devices or Assemblies**

- 1. Pressure vacuum breaker (PVB) devices or assemblies shall only be used for protection by containment for water service lines supplying landscaping irrigation systems. PVB devices cannot be used in lieu of reduced pressure principle or double check valve devices or assemblies. PVB devices shall conform to the following:
  - a. PVB devices shall be installed in an upright position and essentially plumb.
  - b. PVB devices shall be installed with the critical level mark, or bottom of the device if it has no critical level mark, a minimum of 12-inches above the highest point of downstream usage.
  - c. PVB devices shall not be installed where they are, or where they will be subjected to backpressure. However, they can be subjected to continuous line pressure, provided it is not greater than the water pressure on the supply side of the device.
  - d. PVB devices used for protection by containment of a landscaping irrigation system shall be equipped with full port/quarter turn isolating ball valves.
  - e. PVB devices can have valves, including "stop and waste" type, on their downstream side.
  - f. PVB devices shall be protected against frost and freeze damage. Air ports for winterizing the device by means of blowing out water are acceptable upstream of the PVB device provided the air port is not, nor is likely to be, submerged.
  - g. Installation of a PVB device above ground in a small enclosure is acceptable provided that the enclosure provides the necessary conditions of access and adequate drainage.

**721.12 Installation Requirements for Atmospheric Vacuum Breaker (AVB) Devices or Assemblies**

- 1. Atmospheric vacuum breaker (AVB) devices or assemblies shall only be used for protection by containment for water service lines supplying landscaping irrigation systems. AVB devices cannot be used in lieu of pressure vacuum breaker, reduced



pressure principle, or double check valve devices or assemblies. AVB devices shall conform to the following:

- a. AVB devices shall be installed in an upright position and essentially plumb.
- b. AVB devices shall be installed with the critical level mark, or the bottom of the device if it has no critical level mark, a minimum of 6-inches above the highest point of downstream usage.
- c. AVB devices shall not be installed where they are, or where they will be, subjected to backpressure from any cause. There cannot be any valves of any type downstream of the AVB device, nor can AVB devices be used in situations where the floating check disk or poppit will be in a closed position for more than 12-hours continuously.
- e. AVB devices used for protection by containment of a landscaping irrigation system shall be installed in each zone of the irrigation system, downstream of all solenoid or zone control valves, such that when the water supply to each zone is shut-off, the float check disk, or poppit, will immediately drop.
- f. AVB devices shall be protected against frost and freeze damage. Air ports for winterizing the device by means of blowing out water are acceptable upstream of the AVB device provided the air port is not, nor is likely to be, submerged.

### **721.13 Installation Requirements for In-Line Dual Check (IDC) Devices or Assemblies**

1. In-line dual check (IDC) devices or assemblies are approved for residential and commercial locations where potable water use is limited to drinking, family cooking, bathing, and washing. The IDC device or assembly can only be installed when the lowest degree of backflow hazard exists. The IDC device or assembly shall not be subjected to any backpressure condition. IDC devices or assemblies shall conform to the following:
  - a. IDC devices or assemblies shall be considered for protection by containment only when they are configured with a water meter setter or resetter. By themselves, dual in-line checks are not approved for containment unless the application has been specifically authorized by the Superintendent.
  - b. IDC devices or assemblies offer the least amount of protection against backflow. The Town reserves the right to require all IDC devices or assemblies to be upgraded to devices or assemblies offering higher degrees of protection at any time it is considered wise or prudent. Customers/users are strongly urged to treat IDC devices or assemblies as a temporary compliance of having a backflow prevention device installed.
  - c. IDC devices or assemblies shall not be considered in lieu of any other required backflow prevention device or assembly.



- d. The Town reserves the right to require that previously installed IDC devices or assemblies not so equipped to be retro-fitted with venting or pressure relief ports, testing ports, and/or other means which would increase their effectiveness as a backflow preventer.
- e. All IDC devices shall meet the appropriate standard of the ASSE.

#### **721.14 Backflow Prevention Device Sets**

- 1. The backflow prevention device set and connected piping or plumbing shall be firmly supported so that there is no centerline misalignment in the device set when the device or assembly is not in place. The backflow prevention device or assembly is not to be used to support nor bear the weight of other components in plumbing or piping system.
- 2. No part or component of the device set is to be used for any purpose other than holding and securing the backflow prevention device or assembly in place.
- 3. In no case shall the backflow prevention device set allow the device or assembly to rest directly upon a lower weight bearing surface. Removable blocking or approved jacks shall be used between the device or assembly and the bearing surface to provide needed support to the device or its set. Such blocking shall be of cement block, brick, or similar non-biodegradable materials.
- 4. Only bottom support as provided by movable blocking or approved jacks shall be in contact with the backflow prevention device or assembly. No strapping, pipe hangers, or similar supporting devices shall be attached or connected to the device or assembly itself.
- 5. All backflow prevention device sets shall be thoroughly flushed to remove all Construction debris and foreign matter from them and the service line or plumbing system piping prior to device installation.

#### **721.15 Testing and Certification of Backflow Control Devices or Assemblies**

- 1. Testing of Backflow Control Devices is the responsibility of the property owner. Devices must be tested by a Certified Cross-Connection Control Technician prior to the issuance of a Certificate of Occupancy. The successful test results must be provided to the Town before a Certificate of Occupancy will be issued.
- 2. Each year after the first test, the property owner will be notified in writing by the Town of the need to recertify the Backflow Control Devices at each property. The property owner will have 60-days to have all Backflow Control Devices on the referenced property tested by a Certified Cross-Connection Control Technician. If the testing is not completed in the 60-days, the Town may terminate water service to the property.



3. The inspections, tests, and replacement of Backflow Control Devices shall be the expense of the property owner.
4. Testable backflow assemblies for lawn sprinkler system of single family residences where there is no injection or mixing of fertilizer or any other foreign substances shall be tested by the owner on a schedule determined by the Town.
5. Repair Parts
  - a. Only replacement parts produced by or specifically recommended by the Backflow Control Device manufacturer shall be used in the repair of the Backflow Control Devices.
  - b. The reuse of parts from check valves by reversing the part will not be allowed.
6. All testing gauges used by Certified Cross-Connection Control Technicians shall be checked for accuracy at least yearly, and proof of testing shall be provided to the Town upon request.

#### **721.16 Records and Reports**

1. Within 10-days of the completion of inspections, tests, or maintenance, a completed form must be submitted to the Town and to the property owner.
2. A Certified Cross-Connection Control Technician shall attach a tag to the backflow preventer or other tested devices.

#### **721.17 Backflow Prevention Devices on Irrigation Systems**

1. Per the requirements of the International Plumbing Code, all landscaping irrigation systems which use potable water shall be equipped with a proper backflow prevention device. The Town will inspect all backflow preventers upon installation. Testing of all devices will be done by a Certified Cross-Connection Control Technician, or properly trained personnel.
2. Water service lines which are dedicated solely to supplying irrigation water shall conform to all appropriate procedures and conditions based upon a hazard inspection and a determination of the necessary type of device and its installation as required for protection by containment.
3. Landscaping irrigation systems which are supplied with potable water by means of a tee in a water service line which also supplies water for other uses shall conform to the following:
  - a. Air gap separations and reduced pressure principle (RP) devices or assemblies shall be acceptable in all situations.



- b. All irrigation systems which have pumps, or other means of producing backpressure, chemical injection of any kind or type, or are capable of using water from another source, shall be equipped with air gap separation or reduced pressure principle (RP) devices or assemblies.
- c. All irrigation systems which do not produce any backpressure and utilize only potable water from the Town's distribution system may be equipped with a reduced pressure principle valve (RP), pressure vacuum breaker (PVB), or atmospheric vacuum breaker (AVB) devices or assemblies, provided, each type of device is installed in conformance with its appropriate installation requirements.
- d. Each and every pipe, water line, or other means used to provide potable water to an irrigation system shall have an approved backflow prevention device or assembly installed in it.

#### **721.18 Backflow Prevention Devices on Fire Suppression Lines**

- 1. Unless otherwise required by ordinance, all newly constructed or modified fire suppression systems using potable water from the Town's water distribution system shall be required to have an approved backflow prevention device or assembly installed. Modified shall mean any expansion, piping alteration or realignment, rebuilding, or piping replacement in an existing system. Such fire suppression systems shall conform to the following:
  - a. Reduced pressure principle (RP) devices or assemblies shall be installed whenever any chemical additive, pump, injection, or other means of producing backpressure, except for a "Siamese" type connection, is present. RP devices or assemblies shall also be installed in any situation where a second source of water is utilized, or may be utilized. All other fire suppression lines shall be protected with a double check backflow prevention device.
  - b. All backflow prevention devices or assemblies shall conform to their appropriate installation requirements.

#### **722 TEMPORARY WATER USE PERMIT REQUIRED**

Temporary use of potable water from the Town's water distribution system by means of a temporary water tap, a temporary service line, a fire hydrant, or other devices shall require a permit from the Town, subject to availability. Said permit shall include provisions for payment of water used, installation of a meter, installation of an appropriate backflow prevention device, deposit and daily rental charge. The Town will require a minimum of two (2) working days advance notice prior to the issuance of any temporary water use permit. The Contractor may use their own meter after paying a deposit to the Town for the fire hydrant. At its sole discretion, the Town may suspend temporary water use permits at any time.



**723 REFERENCES**

<b>Standards Referenced in Section 700:</b>	
<b>Number</b>	<b>Title</b>
AWWA C104	Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water
AWWA C105	Standard for Polyethylene Encasement for Ductile-Iron Pipe Systems
AWWA C110	Ductile-Iron and Gray-Iron Fittings, 3-inch through 48-inch, for Water and Other Liquids
AWWA C111	Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings
AWWA C115	Flanged Ductile-Iron Pipe with Ductile-Iron or Gray-Iron Threaded Flanges
AWWA C150	Thickness Design of Ductile-Iron Pipe
AWWA C153	Ductile-Iron Compact Fittings for Water Service
AWWA C502	Dry-Barrel Fire Hydrants
AWWA C504	Rubber-Sealed Butterfly Valves
AWWA C509	Resilient-Seated Gate Valves for Water-Supply Service
AWWA C605	Underground Installation of Polyvinyl Chloride (PVC) Pressure Pipe and Fittings for Water
AWWA C651	Disinfecting Water Mains
AWWA C800	Underground Service Line Valves and Fittings
AWWA M23	PVC Pipe - Design and Installation

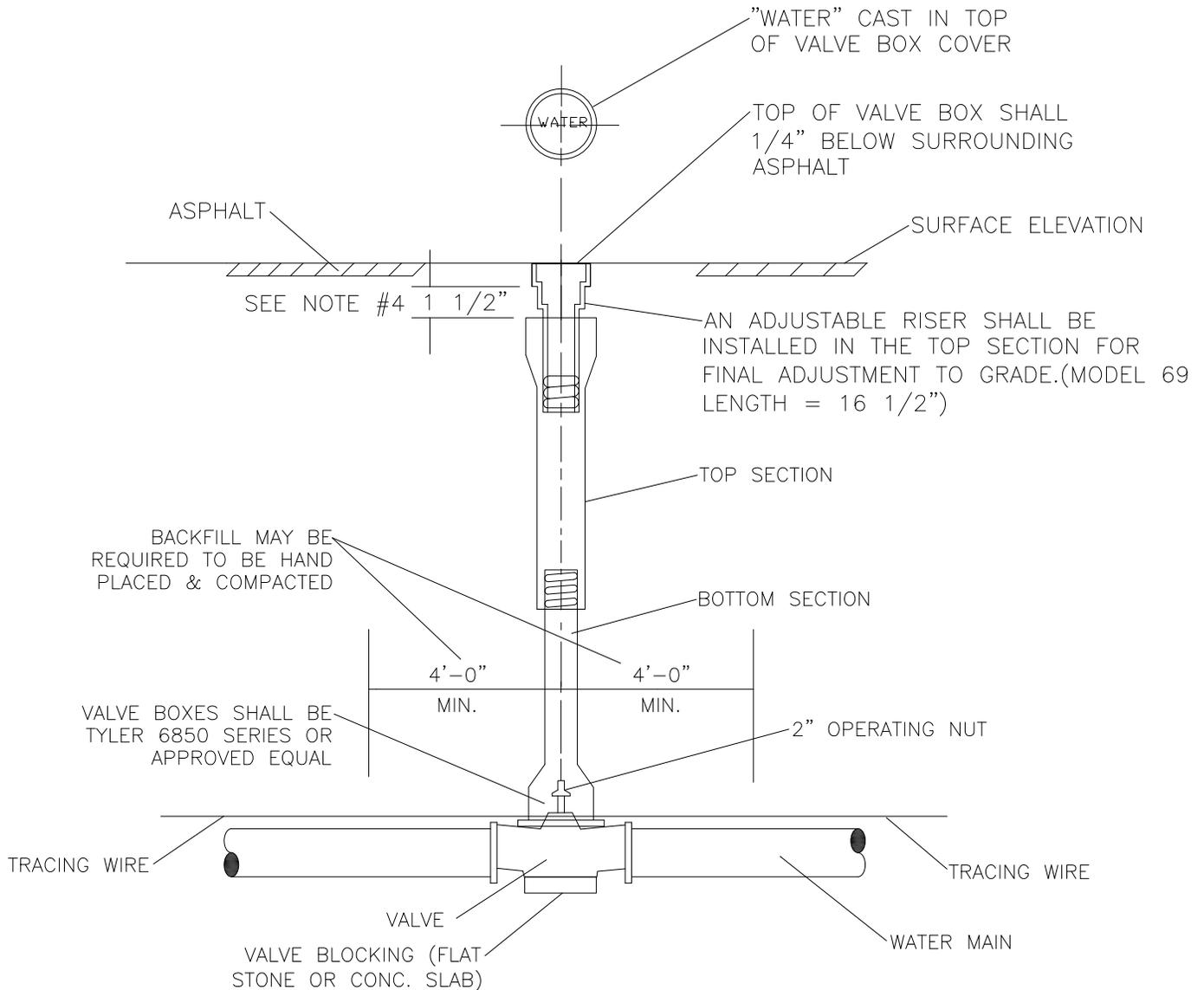


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**SECTION 700 – POTABLE WATER DISTRIBUTION**

700-01	STANDARD VALVE AND BOX DETAIL
700-02	STD. BLOW-OFF INSTALLATION FOR 12" & SMALLER PIPE
700-02A	TEMPORARY 2" BLOW-OFF INSTALLATION FOR 12" AND SMALLER PIPE
700-03	WATER SERVICE LINE RECONNECTS
700-04	UPPER VERTICAL THRUST BLOCK DETAIL
700-05	HORIZONTAL THRUST BLOCK DETAIL
700-06	STANDARD FIRE HYDRANT INSTALLATION PROFILE
700-07	12" OR SMALLER WATERLINE LOWERING DETAIL FOR UTILITY CROSSINGS
700-08	WATER SERVICE AND OUTSIDE METER INSTALLATION (DETACHED SIDEWALK SHOWN)
700-09	IRRIGATION METER AND BACKFLOW PERVENTER (2" OR LESS)
700-10	DITCH OR PIPE CROSSING
700-11	EXOTHERMIC WELD CAP INSTALLATION
700-12	JOINT BOND INSTALLATION
700-13	CATHODIC TEST STATION – TYPE 1
700-14	CATHODIC TEST STATION – TYPE 2
700-15	CATHODIC TEST STATION – TYPE 3
700-16	MARKER POST
700-17	WATERLINE TRENCH DETAIL
700-18	PRV VALUT PLAN
700-19	PRV VAULT SECTION





NOTES:

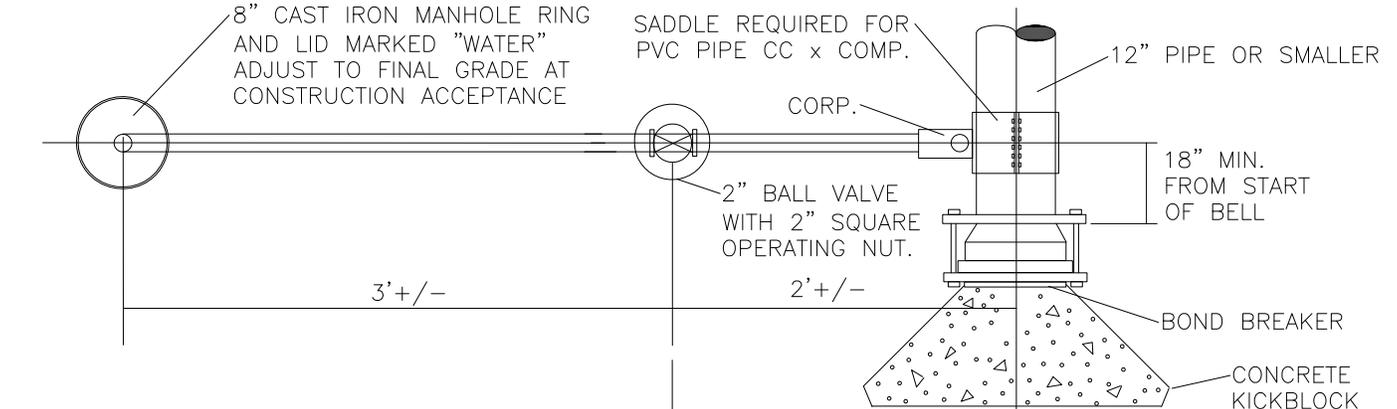
- 1) VALVE BOX SHALL NOT BE SUPPORTED BY THE WATER LINE.
- 2) VALVE BOX TO BE PLUMB AND CENTERED OVER NUT.
- 3) VALVE BOX DETAIL SHALL APPLY TO BOTH NEW INSTALLATION & ADJUSTMENT OF EXISTING VALVES.
- 4) THE MAXIMUM DISTANCE THAT THE SCREW-IN RISER MAY EXTEND ABOVE THE TOP SECTION, WHEN INITIALLY INSTALLED, SHALL BE 1 1/2 INCHES.
- 5) WHEN ADJUSTING EXISTING VALVE BOXES, RECONNECT EXISTING TRACING WIRE IF PRESENT.

**STANDARD VALVE AND BOX DETAIL**  
NTS

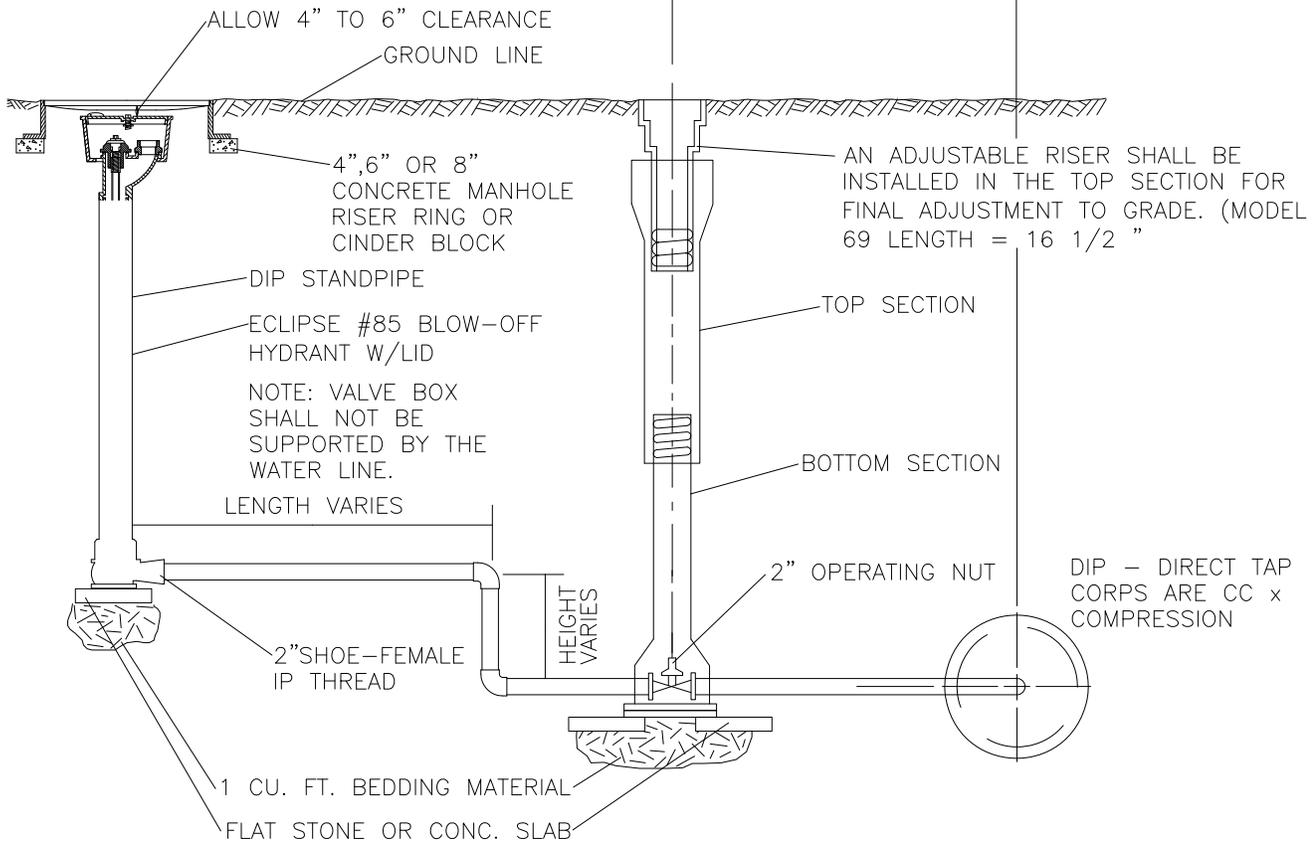


NOTES:

- 1) PLUG SHALL BE MECHANICALLY RESTRAINED.
- 2) 2" BLOW OFF PIPING MAY BE BRASS WITH THREADED BRASS FITTINGS OR TYPE K SOFT COPPER WITH BRONZE THREADED x COMPRESSION FITTINGS.



PLAN

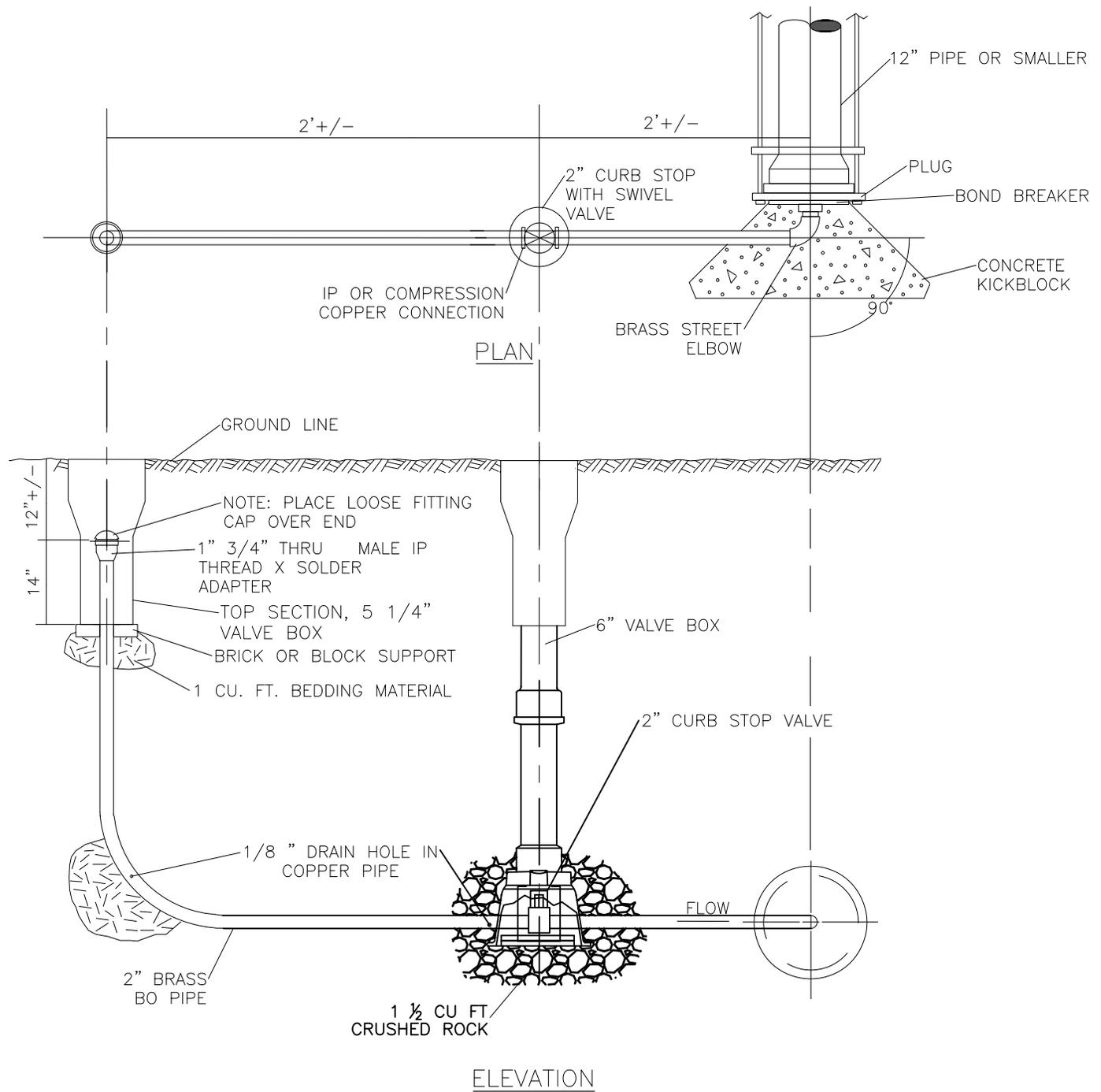


ELEVATION

**STD. BLOW-OFF INSTALLATION  
FOR 12" & SMALLER PIPE**

NTS

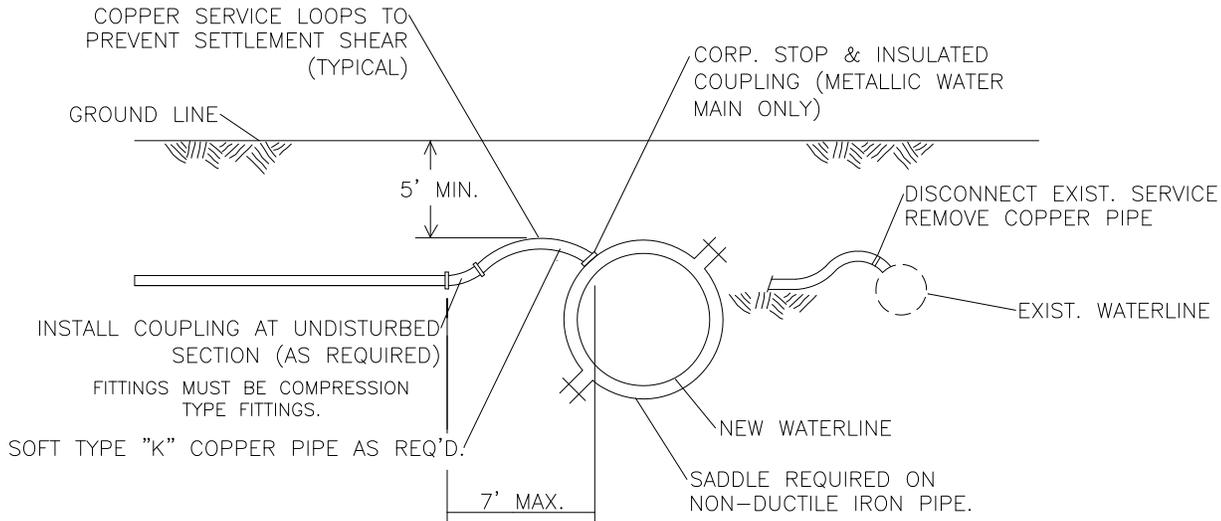




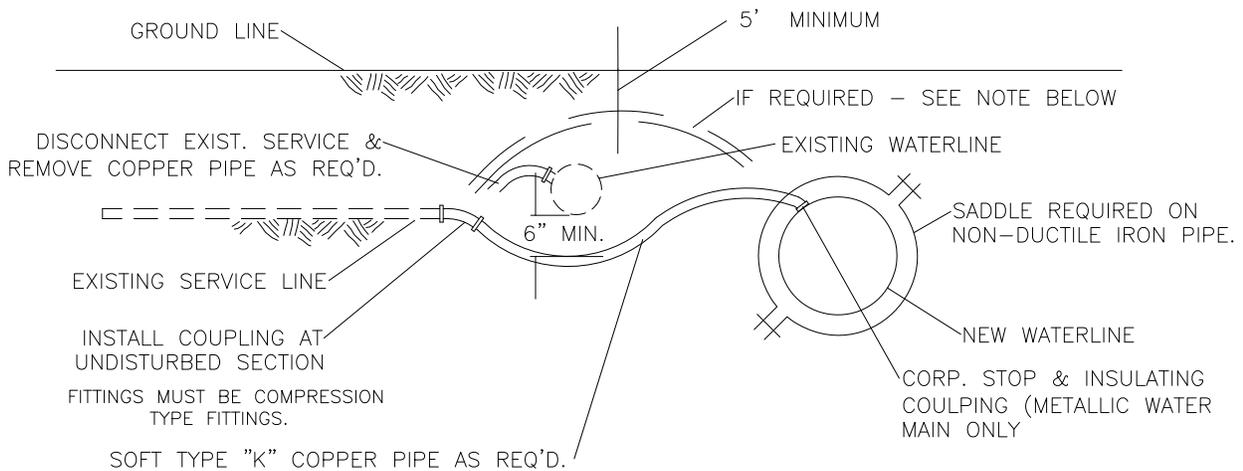
**TEMPORARY 2" BLOW-OFF INSTALLATION  
FOR 12" AND SMALLER PIPES**

NTS





SERVICE RECONNECT (SHORT)



SERVICE RECONNECT (LONG)

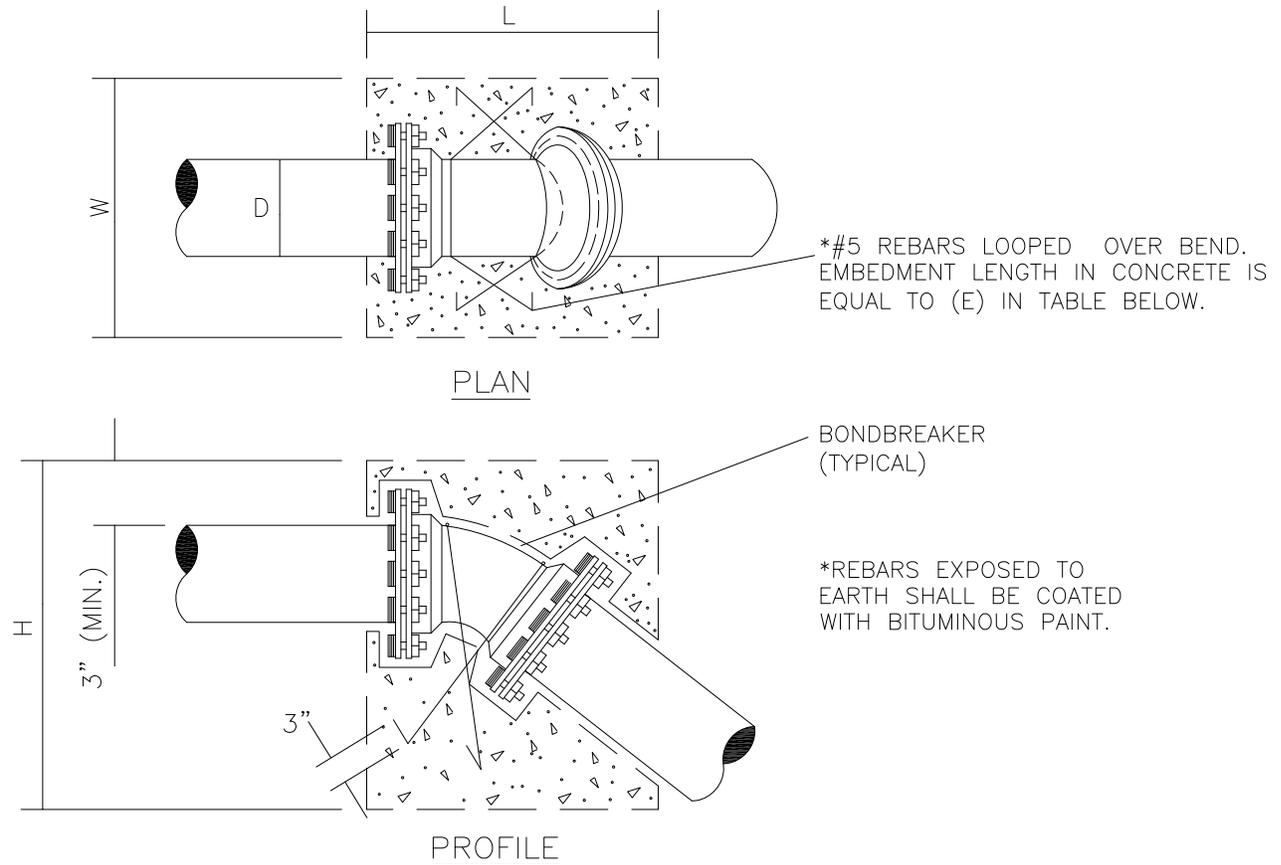
NOTE:

IF THE EXISTING WATERLINE IS AT SUCH A DEPTH THAT THE NEW LONG SERVICE CAN BE INSTALLED OVER THE EXISTING WATERLINE AND STILL MAINTAIN 5 FEET MINIMUM GROUND COVER, THE SERVICE MAY BE CONNECTED AS SHOWN IN THE ABOVE DETAIL. THE CONTRACTOR SHALL OBTAIN APPROVAL FROM THE TOWN ENGINEER PRIOR TO CONSTRUCTING THE SERVICE CONNECTION IN THIS MANNER.

**WATER SERVICE LINE RECONNECTS**

NTS





SIZE OF PIPE (D)	11 1/4 DEGREE					22 1/2 DEGREE					45 DEGREE				
	L"	W"	H"	E"	VOL	L"	W"	H"	E"	VOL	L"	W"	H"	E"	VOL
4"	12	24	24	12	4	12	34	34	12	8	22	37	32	22	15
6"	18	32	27	18	9	15	52	40	15	18	28	64	32	28	33
8"	21	40	33	21	16	22	61	40	22	31	35	64	45	35	58
10"	24	50	36	24	25	30	59	48	30	49	42	72	52	42	90
12"	31	56	36	31	36	36	70	48	36	70	45	80	62	45	129

NOTES:

- 1) VOLUME IS IN CUBIC FEET.
- 2) ALL CONCRETE TO BE 3,000 P.S.I. MIN.
- 3) BLOCKS TO BE CENTERED HORIZONTALLY ON THE BEND.
- 4) DESIGN BASED ON A TEST PRESSURE OF 150 P.S.I. AND SAFETY FACTOR ( $S_f$ ) OF 1.5

THE DESIGN ENGINEER IS RESPONSIBLE FOR VERIFYING THE ACTUAL SITE CONDITIONS WITH RESPECT TO THE ASSUMPTIONS LISTED ABOVE.

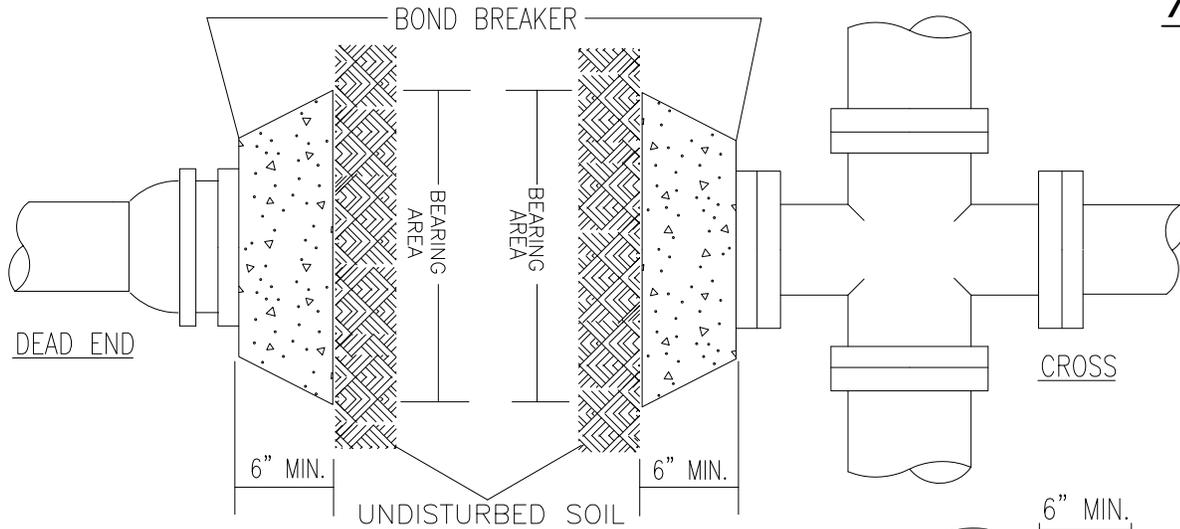
$$5) V_g = \frac{S_f PA \sin \theta}{W_m}$$

$$6) W_m = 140 \# / FT^3$$

**UPPER VERTICAL THRUST BLOCK DETAIL**

NTS





**NOTES:**

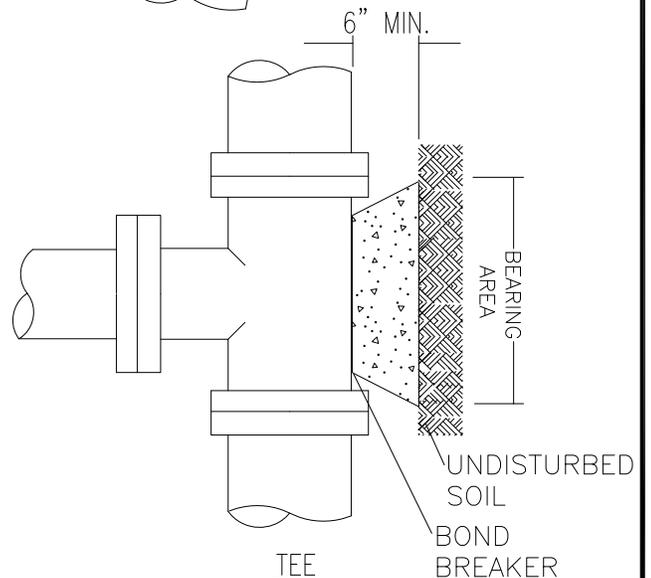
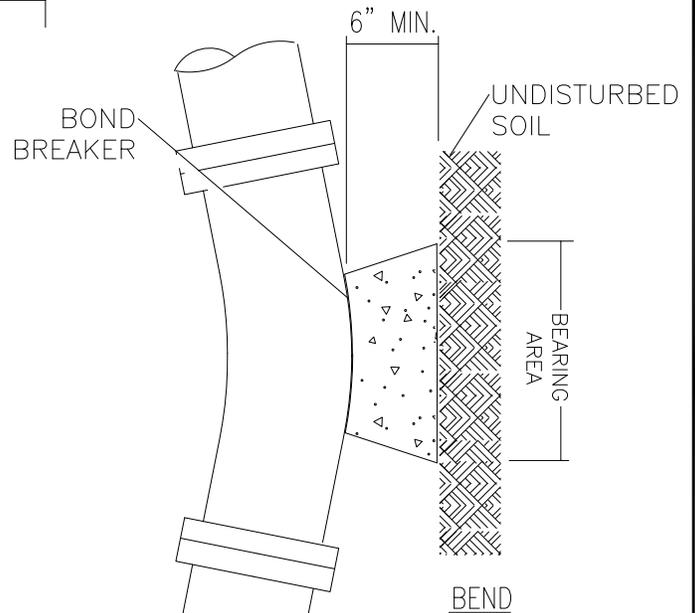
1. BEARING SURFACES SHOWN IN CHART ARE MINIMUM
2. THE CHART IS BASED ON 150 PSI POTENTIAL PIPE PRESSURE PLUS A 1.5 SAFETY FACTOR
3. SOIL BEARING CAPACITY = 1,500 LB/SQ. FT. (ASSUMED)
4. THRUST IS EQUAL TO  $[S_f (2)PA \sin \theta/2]$  FOR A BEND
5. THRUST IS EQUAL TO  $[PA S_f]$  FOR A TEE OR DEAD END
6. BEARING AREA IS THRUST DIVIDED BY SOIL BEARING CAPACITY
7. THE DESIGN ENGINEER IS RESPONSIBLE FOR VERIFYING THE ACTUAL SITE CONDITIONS WITH RESPECT TO THE ASSUMPTIONS LISTED ABOVE.

MINIMUM BEARING SURFACE AREA  
(IN SQUARE FEET)

SIZE OF PIPE	BENDS				TEE OR DEAD END
	11 1/4 DEG	22 1/2 DEG	45 DEG	90 DEG	
4"	1	1	2	3	2
6"	1	2	4	6	5
8"	2	3	6	11	8
10"	3	5	10	17	12
12"	4	7	13	24	17

**NOTES:**

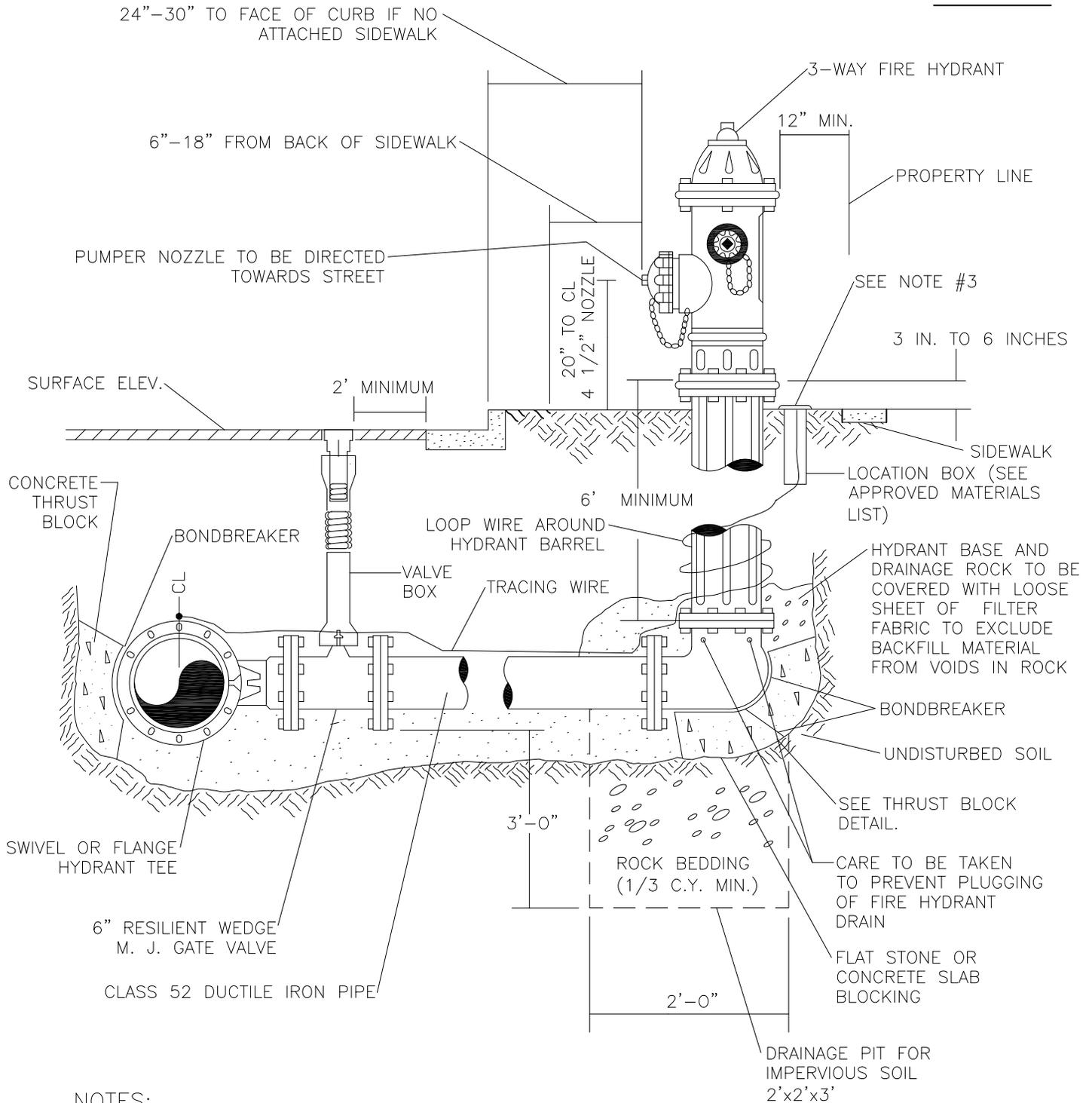
1. THESE NUMBERS ARE ROUNDED UP TO THE NEXT WHOLE NUMBER.
2. BLOCK HEIGHT SHOULD BE EQUAL TO OR LESS THAN 1/2 THE TOTAL DEPTH TO THE BOTTOM OF THE BLOCKS, BUT NO LESS THAN THE PIPE DIAMETER. ALSO THE WIDTH MUST BE BETWEEN ONE AND TWO TIMES THE HEIGHT.



**HORIZONTAL THRUST BLOCK DETAIL**

NTS





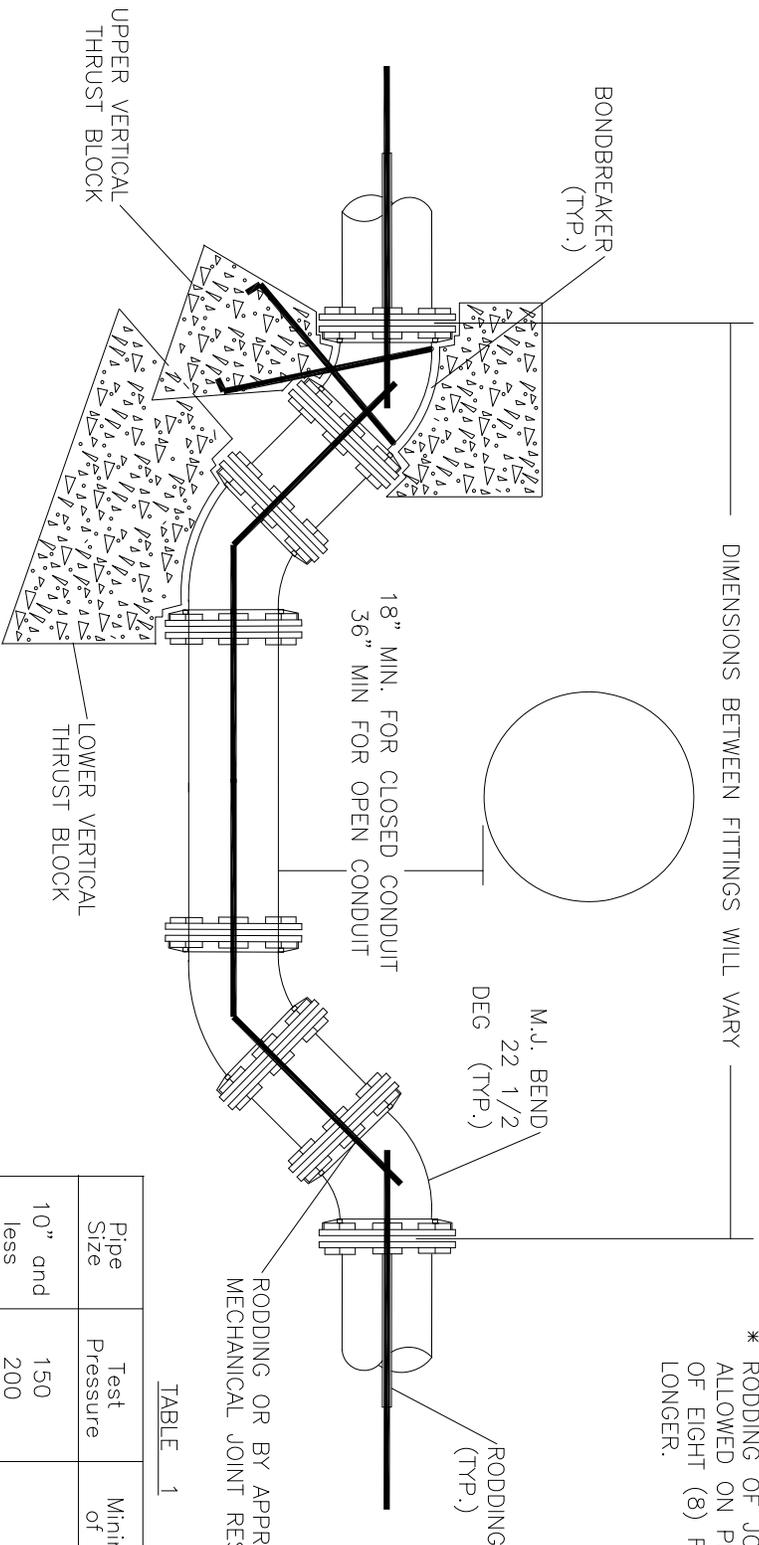
**NOTES:**

- 1) IF MORE THAN ONE BARREL EXTENSION IS USED TO RAISE A FIRE HYDRANT TO GRADE, ONLY ONE STEM EXTENSION OF THE PROPER LENGTH WILL BE ALLOWED. MULTIPLE STEM EXTENSIONS ARE NOT ACCEPTABLE.
- 2) ALL METALLIC PIPE MUST BE WRAPPED IN POLYETHYLENE INCLUDING HYDRANT BARREL.
- 3) A MINIMUM OF 12 INCHES OF SLACK SHALL BE INSTALLED FOR EACH WIRE IN THE LOCATION BOX
- 4) ADDITIONAL TRACING WIRE STATIONS MAY BE NECESSARY IF FIRE HYDRANT SPACING IS TOO GREAT TO ADEQUATELY TRACE THE PIPELINE.
- 5) FIRE HYDRANT LOCATIONS SHALL CONFORM TO THE INTERNATIONAL FIRE CODE.

**STANDARD FIRE HYDRANT  
INSTALLATION PROFILE**

NTS





\* RODDING OF JOINTS IS NOT ALLOWED ON PIPE SECTIONS OF EIGHT (8) FEET OR LONGER.

TABLE 1

Pipe Size	Test Pressure	Minimum number of Tie Rods
10" and less	150 200	2 2
12"	150 200	2 4

- NOTES:
- 1) LOWERING OF THIS TYPE MAY BE RESTRAINED BY MEANS OF THRUST BLOCKING OR BY RODDING OF THE JOINTS OR BY APPROVED MECHANICAL JOINT RESTRAINTS.
  - 2) FOR SIZING INFORMATION OF THRUST BLOCKS REFER TO THRUST BLOCK DETAILS.
  - 3) WHEN RESTRAINING PIPE BY MEANS OF RODDING JOINTS, 3/4" TIE RODS, NUTS, AND WASHERS WILL BE USED AND ARE TO BE MADE OF "COR-TEN" STEEL GRADE #2 AS PER A.S.T.M. A242.

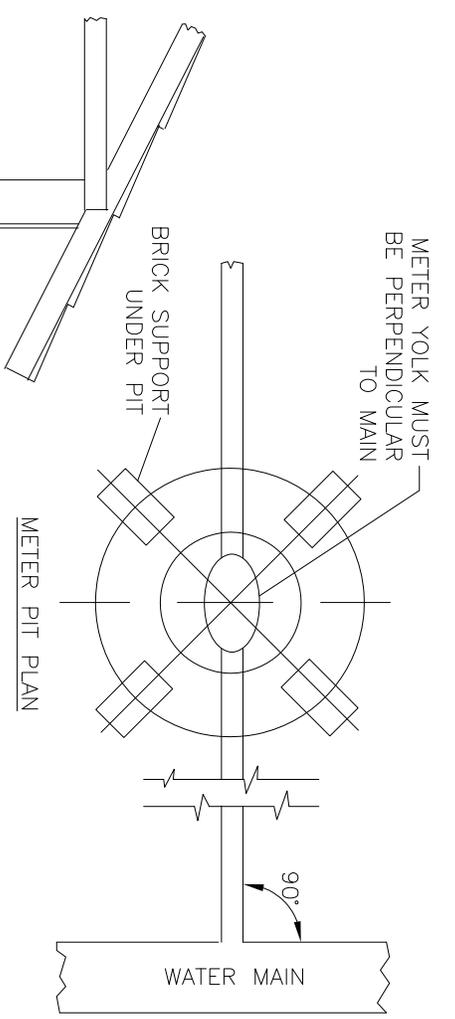
- 4) FOR FURTHER INFORMATION ON RODDING OF JOINTS REFER TO TABLE 1.
- 5) ALL METALLIC PIPE, FITTINGS, AND APPURTENANCES WILL BE WRAPPED IN POLYETHYLENE.
- 6) REQUIREMENTS FOR LARGER THAN 12" DIAMETER PIPE WILL BE DETERMINED ON A CASE BY CASE BASIS.
- 7) IF CONTINUOUS LINE PRESSURE IS GREATER THAN 100 PSI, A COMBINATION OF RODDING/RESTRAINING GLANDS AND THRUST BLOCKS WILL BE REQUIRED.

# 12" OR SMALLER WATERLINE LOWERING DETAIL FOR UTILITY CROSSINGS

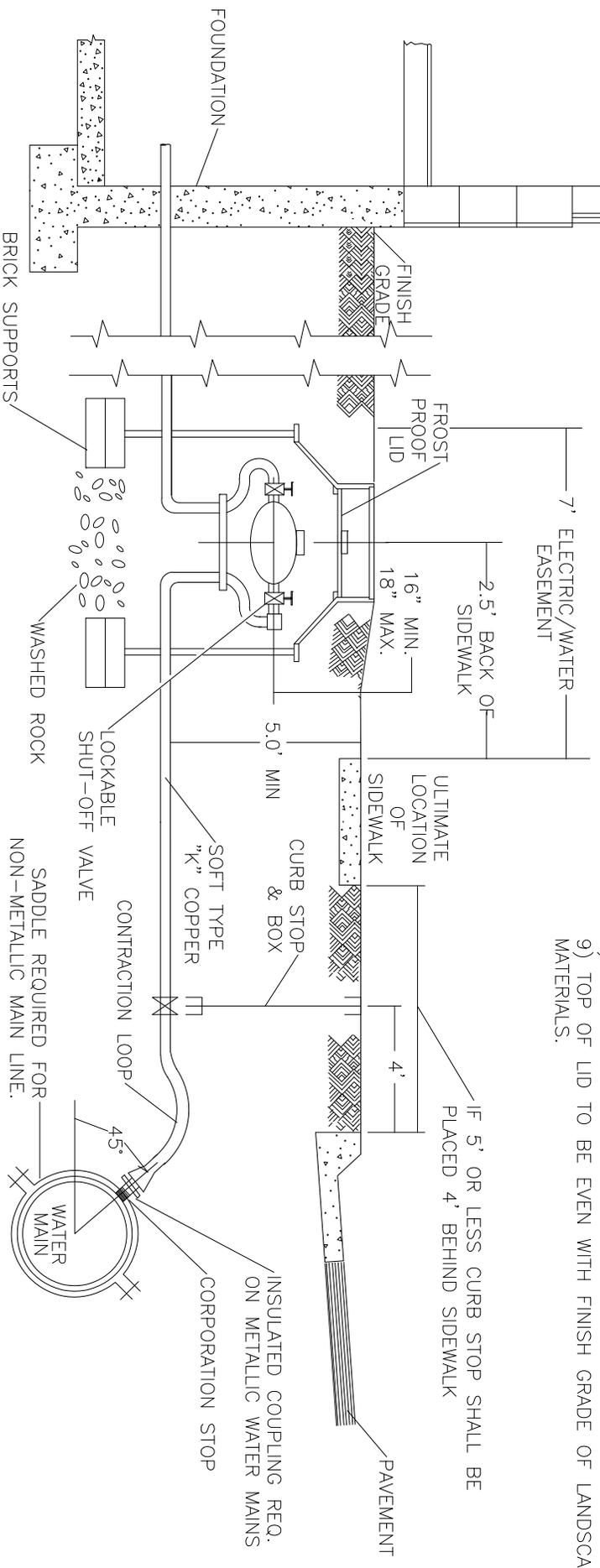
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TOWN OF FREDERICK  
STANDARDS & SPECIFICATIONS



- NOTES:
- 1) TOWN APPROVED METERS & YOKES ONLY.
  - 2) FITTINGS OUTSIDE THE STRUCTURE MUST BE COMPRESSION TYPE FITTINGS.
  - 3) METER PITS SHALL BE LOCATED 5' OFF SIDE LOT LINES AND OUT OF DRIVEWAYS.
  - 4) CONTRACTOR SHALL MARK THE LOCATION OF THE CURB STOP & BOX WITH A METAL T-POST EXTENDING A MINIMUM OF 4 FT. ABOVE THE GROUND.
  - 5) IF INSTALLATION OF SERVICE LINE IS CONSTRUCTED BY "PUNCHING" UNDER AN EXISTING SIDEWALK/CURB & GUTTER, THEN CONTRACTOR MUST INSTALL A PVC SLEEVE UNDER SIDEWALK/CURB & GUTTER. DIAMETER OF PVC SLEEVE MUST BE WITHIN 1/4" OF "PUNCHED" HOLE.
  - 6) ANY VARIATION OF LOCATION OF METER PITS AND ASSOCIATED APPURTENANCES MUST BE APPROVED BY THE ENGINEER.
  - 7) METER PIT SHALL NOT BE INSTALLED AT THE TIME OF SERVICE LINE INSTALLATION.
  - 8) REFER TO SEC. 700.06 FOR RIGHT OF WAY LOCATION.
  - 9) TOP OF LID TO BE EVEN WITH FINISH GRADE OF LANDSCAPING MATERIALS.



# WATER SERVICE AND OUTSIDE METER INSTALLATION DETACHED SIDEWALK

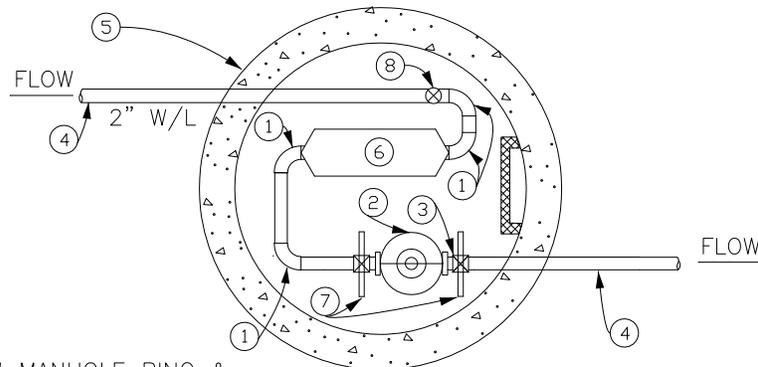
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DATE MODIFIED : FEBRUARY 26, 2019



TOWN OF FREDERICK  
STANDARDS & SPECIFICATIONS

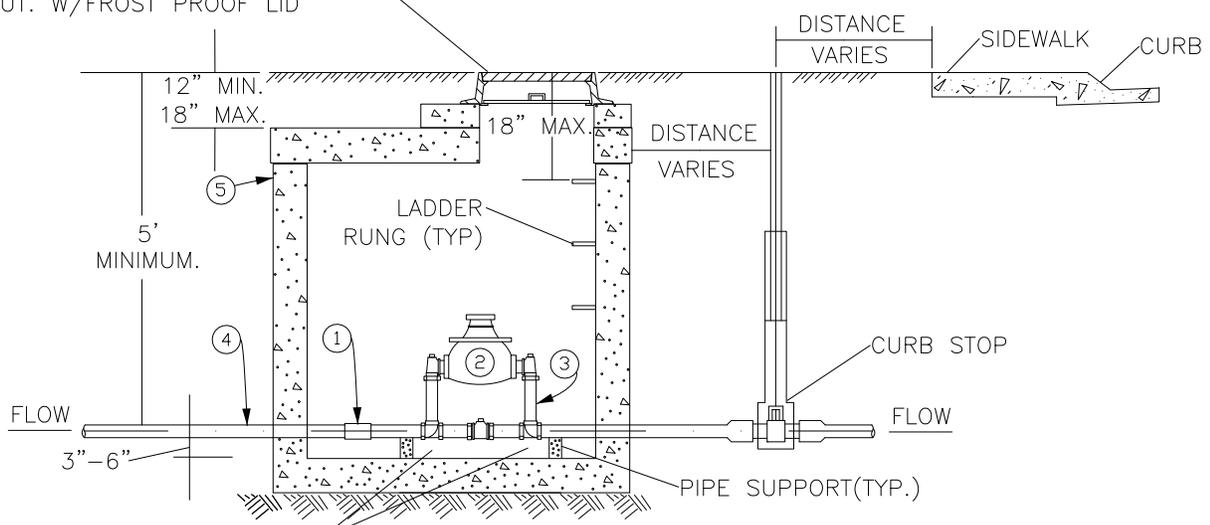
700-08



- ① - 90 DEG. ELBOW
- ② - METER UNIT
- ③ - APPROVED COPPERSETTER WITH BYPASS.
- ④ - TYPE K 'SOFT' COPPER TUBING
- ⑤ - 60" DIA. CONCRETE VAULT
- ⑥ - DOUBLE CHECK VALVE
- ⑦ - BRACE PIPE
- ⑧ - BALL VALVE

ALUMINUM MANHOLE RING & LID W/ STAINLESS STEEL PENTAGON HEAD BOLT, WASHER & NUT. W/FROST PROOF LID

PLAN



BRACE PIPE EYELETS ARE FOR STABLE SET.

ELEVATION

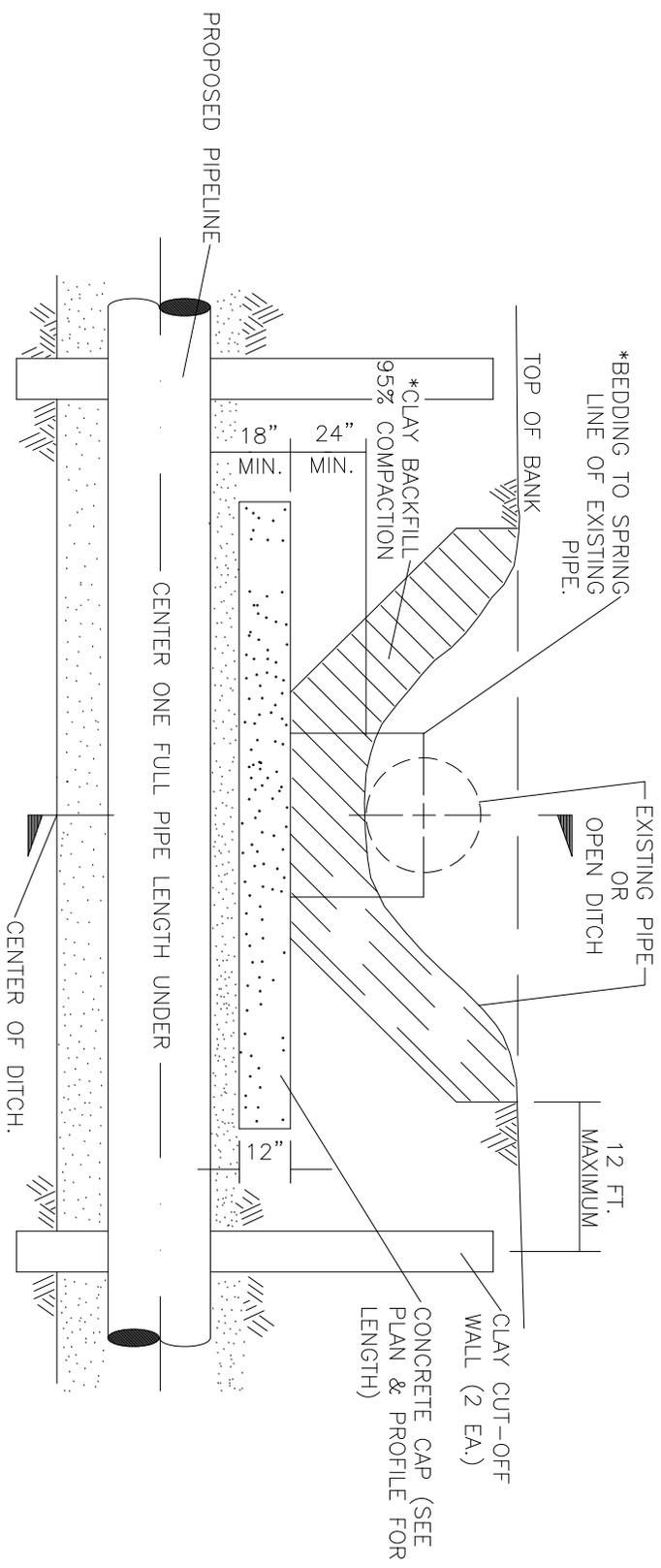
**NOTES:**

- 1-BASE AND BOTTOM BARREL SECTION SHALL BE PRECAST AS A SINGLE UNIT. THE VAULT SHALL BE WATERTIGHT. USE APPROVED GASKET MATERIALS TO SEAL PIPE PENETRATIONS.
- 2-A 60" DIA. VAULT WILL ACCOMMODATE A 2" METER. LARGER METERS WILL REQUIRE A SPECIAL DESIGN.
- 3-JOINTS INSIDE METER VAULT SHALL BE EITHER THREAD, COMPRESSION, SILVER SOLDERED OR 95-5 TINANTIMONY SOLDER.
- 4-THE PROPOSED WATER METER AND BACKFLOW DEVICE SHALL BE PURCHASED FROM TOWN OF FREDERICK AND PUBLIC WORKS. COORDINATE WITH THE TOWN FOR TYPES OF METERS, JUMPER BARS & METER CONNECTORS
- 5-METER SETTER SHALL BE AS INDICATED IN TOWN STANDARDS.
- 6-NO CONNECTIONS OR CHANGES IN PIPE DIAMETER SHALL BE MADE IN THE METER OR IN THE DISTANCE OF FIVE FEET ON EITHER SIDE OF METER VAULT.
- 7-LADDER RUNGS SHALL BE SITUATED SO THAT METER PIPING IS NOT DIRECTLY UNDER STEPS.
- 8-1 1/2" AND LARGER METER SETS MUST HAVE 1/2" OR LARGER CONDUIT FROM THE PIT TO THE CLOSEST BUILDING AT THIS POINT NEED A 110V PLUG IN AND A "POTS" PHONE LINE WITHIN 20' OF CONDUIT.
- 9-METERS FOR ALL PARK AND FORESTRY MAINTAINED AREAS SHALL BE PLACED WITHIN VAULT.

**IRRIGATION METER AND BACKFLOW PREVENTER (2" OR LESS)**

NTS





\*USE CLAY BACKFILL ONLY WHEN CROSSING OPEN DITCH. USE BEDDING MATERIAL TO SPRING LINE OF EXISTING PIPE WHEN CROSSING PIPE.

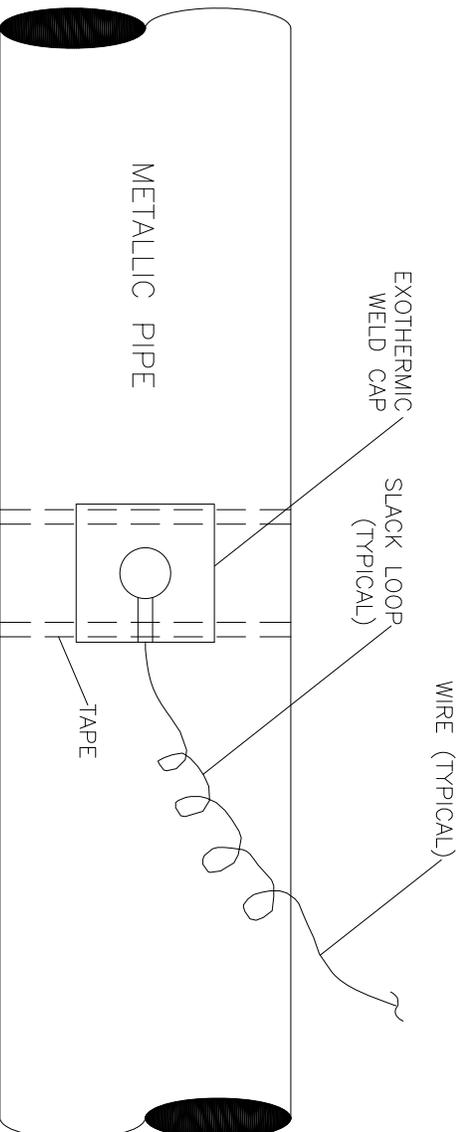
**DITCH OR PIPE CROSSING**

NTS



TOWN OF FREDERICK  
STANDARDS & SPECIFICATIONS

700-10



- NOTES:
1. THE EXOTHERMIC WELD CAP SHALL COMPLETELY COVER THE WIRE CONNECTION.
  2. TAPE SHALL BE USED TO SECURE THE WELD CAP TO THE PIPE.
  3. THE WELD CAP SHALL BE ORIENTED SO THAT THE WIRE SHALL BE RUN IN THE LONGITUDINAL DIRECTION OF THE PIPE.

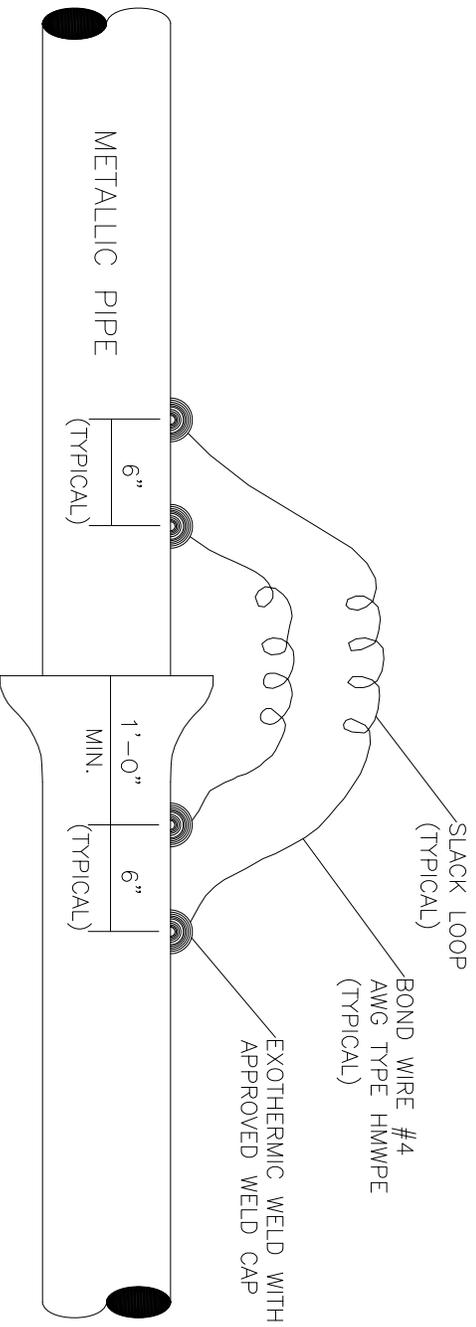
## EXOTHERMIC WELD CAP INSTALLATION

NTS



TOWN OF FREDERICK  
STANDARDS & SPECIFICATIONS

700-11

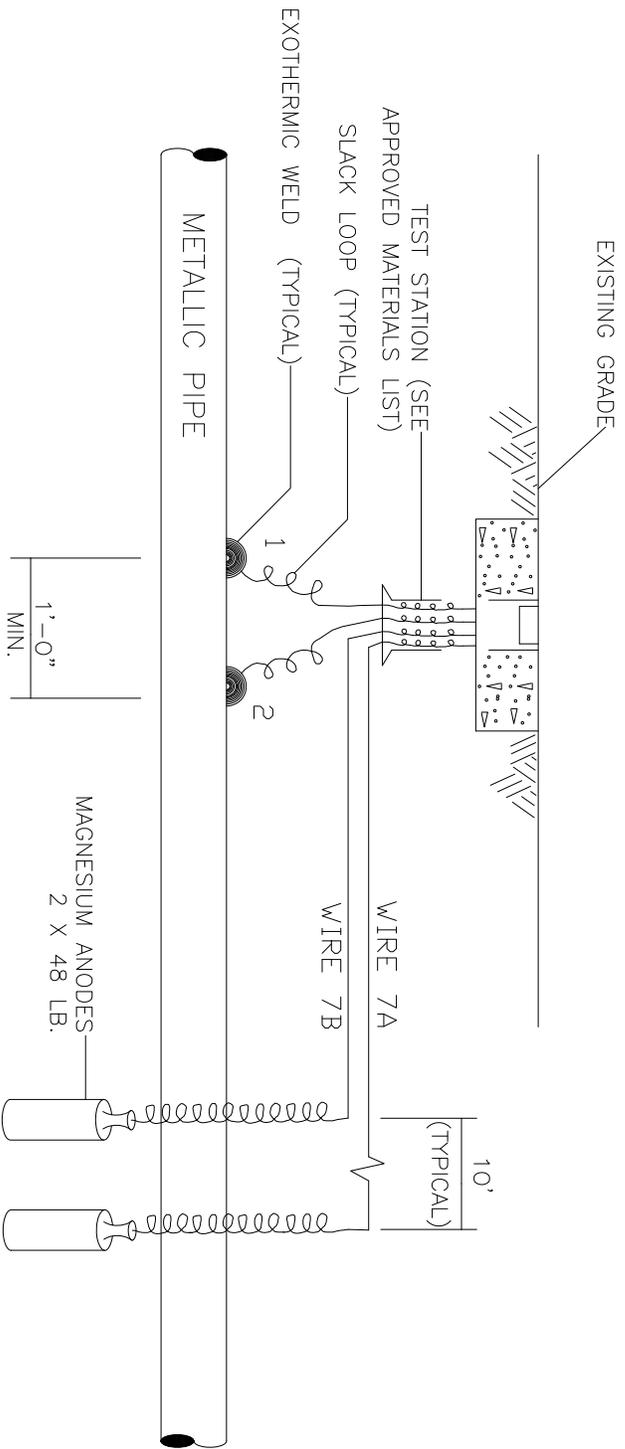


NOTE:  
 1. BOND WIRES SHALL BE ATTACHED TO THE PIPE, VALVE OR FITTING TOP CENTERLINE.

## JOINT BOND INSTALLATION

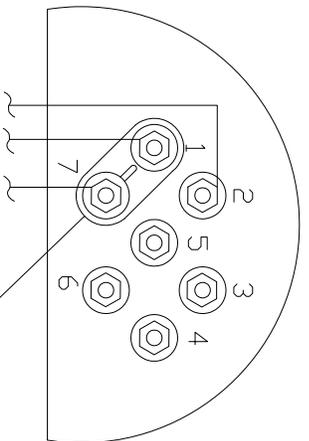
NTS





- NOTES:
- 1: ALL WIRES SHALL BE STRANDED COPPER TYPE RHW-2/RHH/USE-2.
  - 2: A MINIMUM OF 24 INCHES OF SLACK SHALL BE INSTALLED IN EACH WIRE IN THE TEST STATION BOX.
  - 3: ALL WIRES SHALL BE ATTACHED TO TOP OF PIPE.
  - 4: ANODES ARE TO BE PLACED AT PIPE DEPTH OR BELOW AND 5 FEET AWAY FROM THE PIPE. INSTALL ON ALTERNATE SIDES OF THE PIPE.

TEST STATION  
TERMINAL BOARD  
WIRING DETAIL.



0.01 OHM--8 AMPERE  
SHUNT COLOR CODE--  
YELLOW COTT MANUF.

TERMINAL AND WIRE #	SIZE	COLOR
1	12 AWG	RED
2	12 AWG	RED
7 (A&B)	12 AWG	BLACK

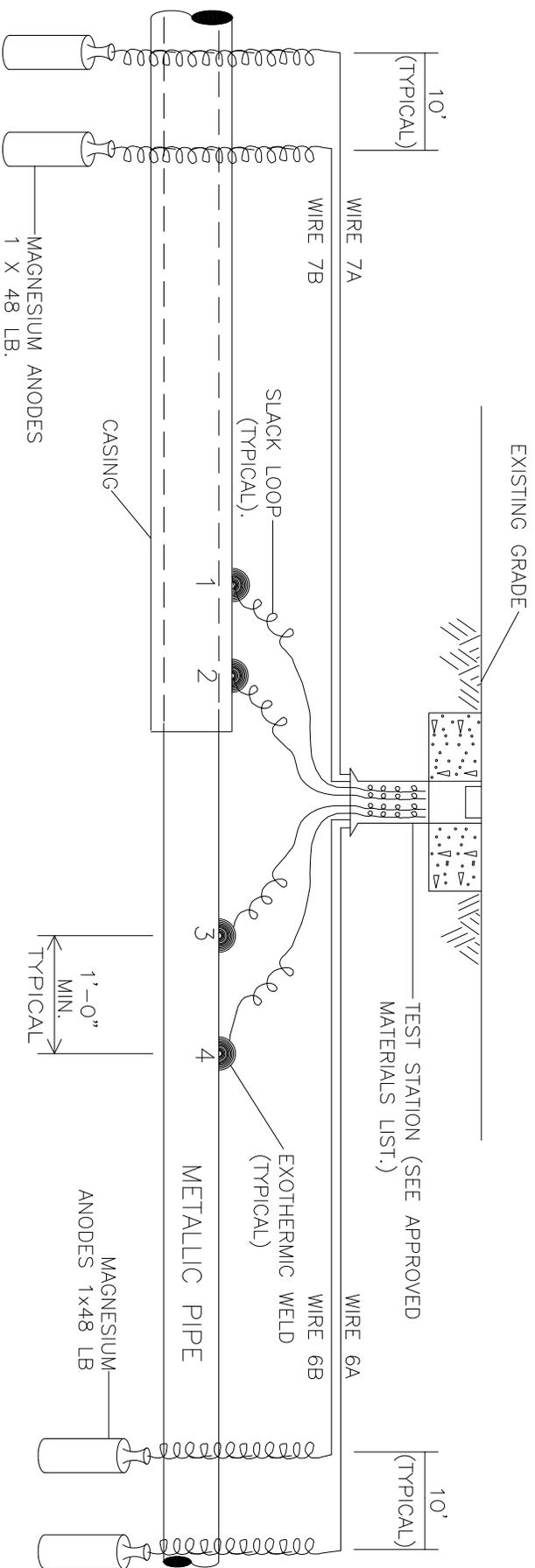
# CATHODIC TEST STATION - TYPE 1

NTS



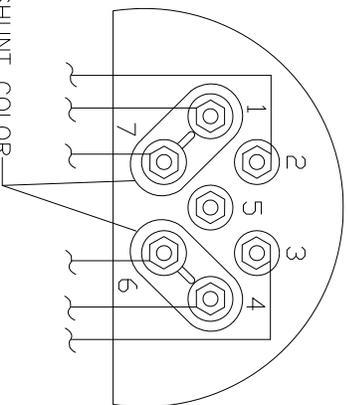
TOWN OF FREDERICK  
STANDARDS & SPECIFICATIONS

700-13



- NOTES:
- 1: A MINIMUM OF 24 INCHES OF SLACK WIRE SHALL BE INSTALLED FOR EACH WIRE IN THE TEST STATION BOX.
  - 2: ALL WIRES SHALL BE STRANDED COPPER TYPE RHW-2/RHH/USE-2.
  - 3: ALL WIRES SHALL BE ATTACHED TO THE PIPE TOP CENTERLINE.
  - 4: ANODES ARE TO BE PLACED AT PIPE DEPTH OR BELOW AND 5 FEET AWAY FROM THE PIPE.

TEST STATION  
TERMINAL BOARD  
WIRING DETAIL.



0.01 OHM-8 AMPERE SHUNT COLOR  
CODE - YELLOW COTT MANUF.

TERMINAL AND WIRE #	SIZE	COLOR
1	12 AWG	GREEN
2	12 AWG	GREEN
3	12 AWG	RED
4	12 AWG	RED
5	—	—
6 (A&B)	12 AWG	BLACK/RED
7 (A&B)	12 AWG	BLACK/GREEN

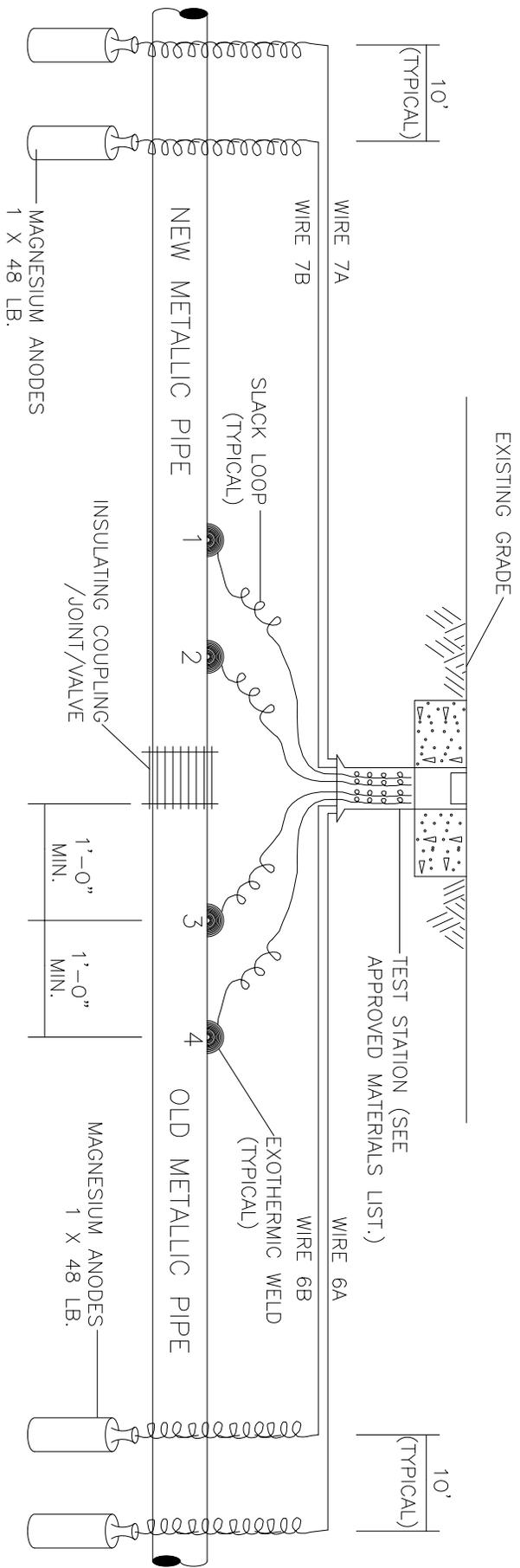
## CATHODIC TEST STATION - TYPE 2

NTS



TOWN OF FREDERICK  
STANDARDS & SPECIFICATIONS

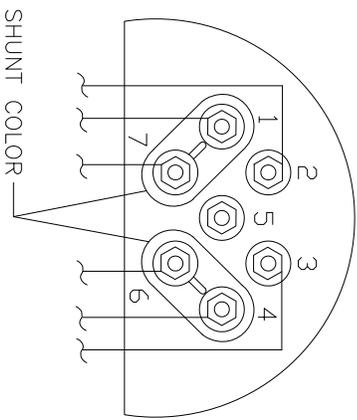
700-14



- NOTES:
- 1: A MINIMUM OF 24 INCHES OF SLACK WIRE SHALL BE INSTALLED FOR EACH WIRE IN THE TEST STATION BOX.
  - 2: ALL WIRES SHALL BE STRANDED COPPER TYPE RHW-2/RHH/USE-2.
  - 3: ALL WIRES SHALL BE ATTACHED TO THE PIPE TOP CENTERLINE.
  - 4: ANODES ARE TO BE PLACED AT PIPE DEPTH OR BELOW AND 5 FEET AWAY FROM THE PIPE.

TEST STATION  
TERMINAL BOARD  
WIRING DETAIL.

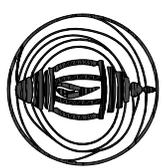
0.01 OHM-8 AMPERE SHUNT COLOR  
CODE- YELLOW COTT MANUF.

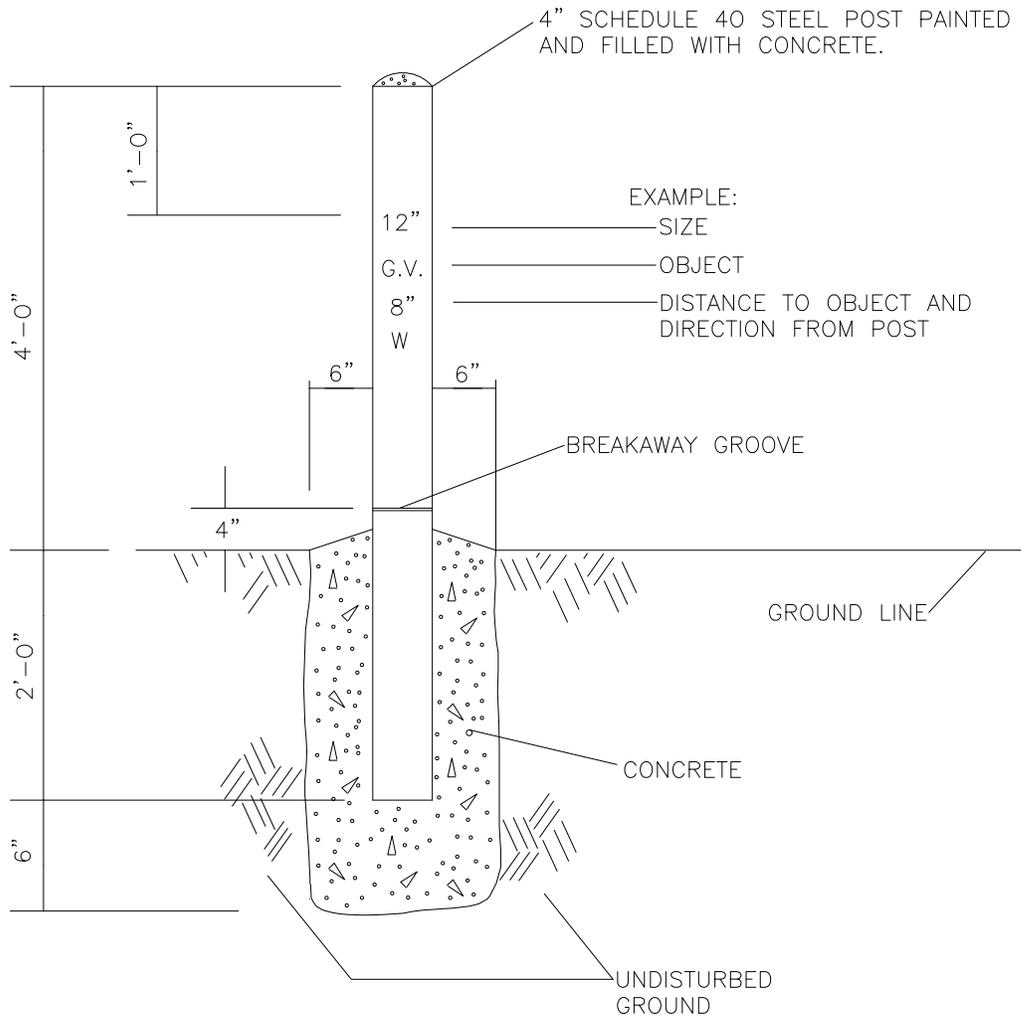


TERMINAL AND WIRE #	AWG SIZE	COLOR
1	12 AWG	RED
2	12 AWG	RED
3	12 AWG	BLUE
4	12 AWG	BLUE
5	—	—
6 (A&B)	12 AWG	BLACK/BLUE
7 (A&B)	12 AWG	BLACK/RED

# CATHODIC TEST STATION - TYPE 3

NTS





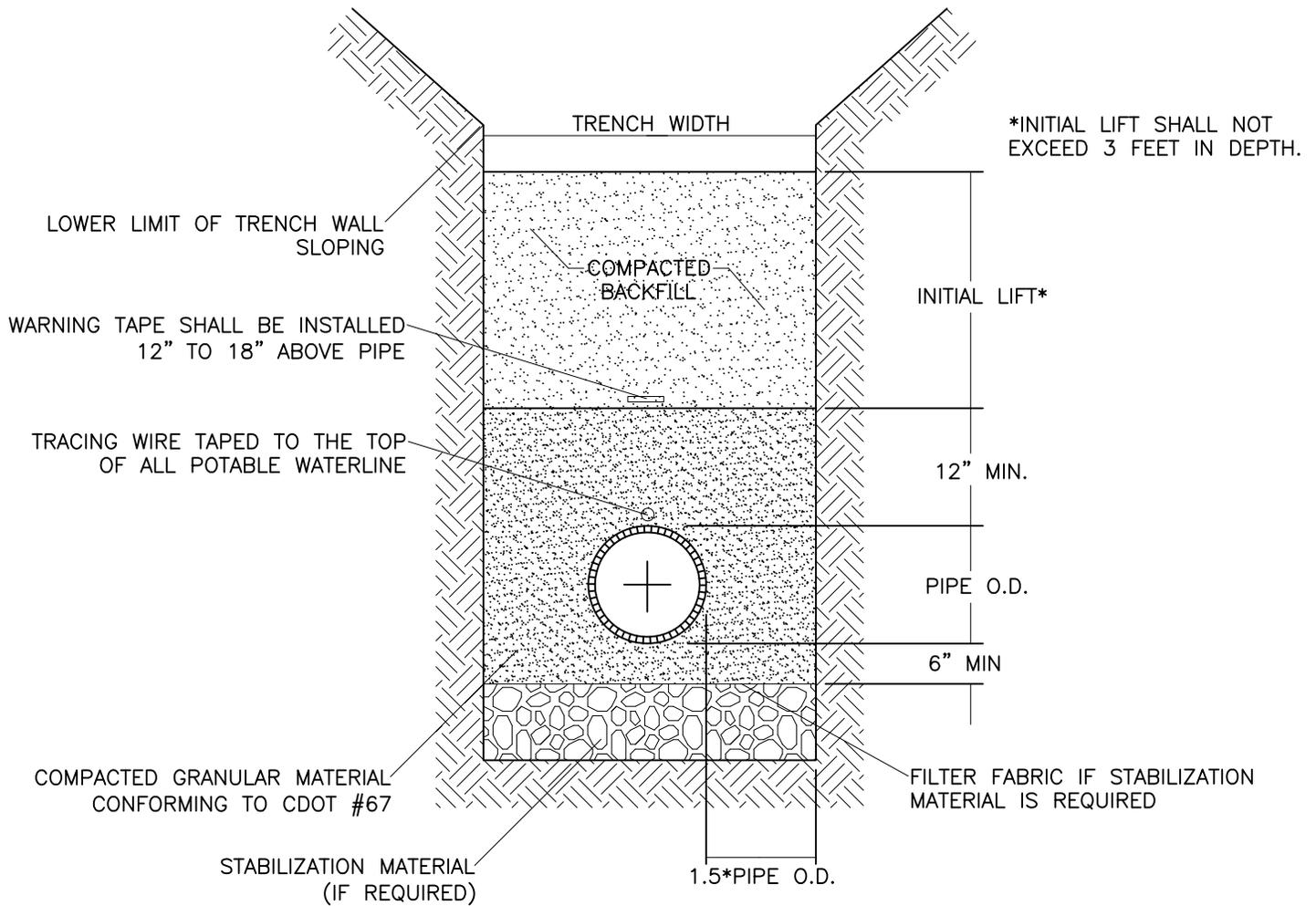
PAINT SCHEDULE

- SAFETY YELLOW – CATHODIC PROTECTION
- WHITE – POTABLE WATER PIPE, FITTINGS, VALVES
- GREEN – SANITARY SEWER

NOTE:  
 MARKER POSTS SHALL BE INSTALLED AT ALL FITTINGS, VALVES AND  
 MANHOLES AS SHOWN ON THE PLAN.

**MARKER POST**  
 NTS





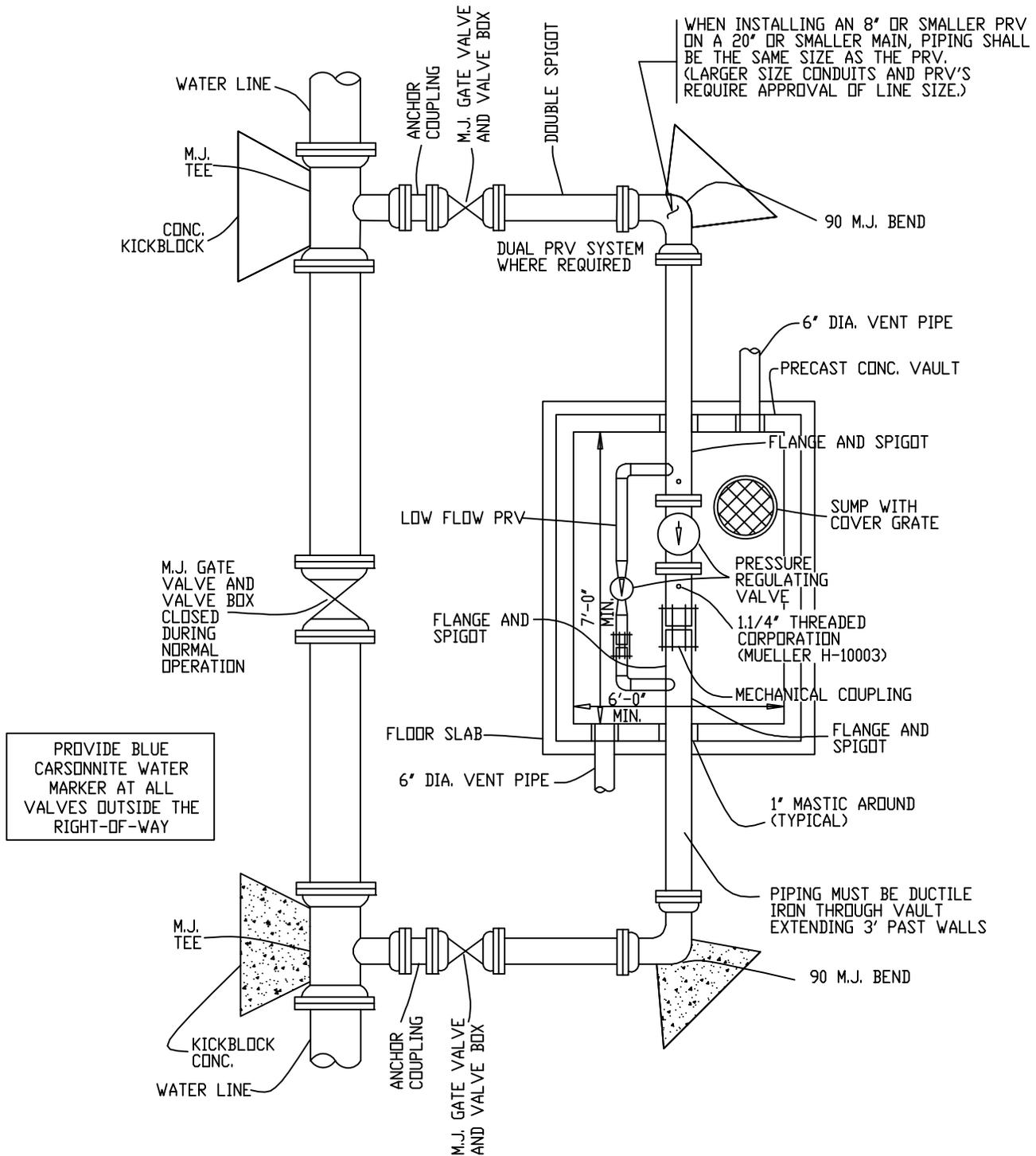
NOTES:

1. ALL WATERLINE SHALL HAVE A MINIMUM OF 5 FEET OF COVER.
2. BACKFILL SHALL BE COMPACTED TO 95% ASTM D698 RELATIVE DENSITY.
3. 14 AWG. SOLID COPPER WIRE SHALL BE INSTALLED AS TRACING WIRE ABOVE ALL POTABLE WATER PIPES. THE WIRE SHALL BE CONNECTED AND COME TO THE SURFACE BEHIND THE FIRE HYDRANTS IN A TEST BOX.
4. FILTER FABRIC IS REQUIRED ONLY IF STABILIZATION MATERIAL IS NEEDED. TRENCH SHALL BE BRACED OR SHEETED AS NECESSARY FOR THE SAFETY OF THE WORKMEN AND PROTECTION OF OTHER UTILITIES IN ACCORDANCE WITH APPLICABLE LOCAL, STATE AND FEDERAL SAFETY REGULATIONS.
5. PIPE SHALL BE BEDDED FROM 6-INCHES BELOW THE BOTTOM OF THE PIPE TO 12-INCHES ABOVE THE PIPE.
6. COMPACTION SHALL BE AS FOLLOWS: PIPE ZONE BEDDING 6-INCHES UNDER AND 12-INCHES OVER THE PIPE REQUIRES 90% STANDARD PROCTOR DENSITY. TRENCH ZONE ABOVE BEDDING MATERIALS REQUIRE 95% STANDARD PROCTOR DENSITY.

**WATERLINE TRENCH DETAIL**

NTS



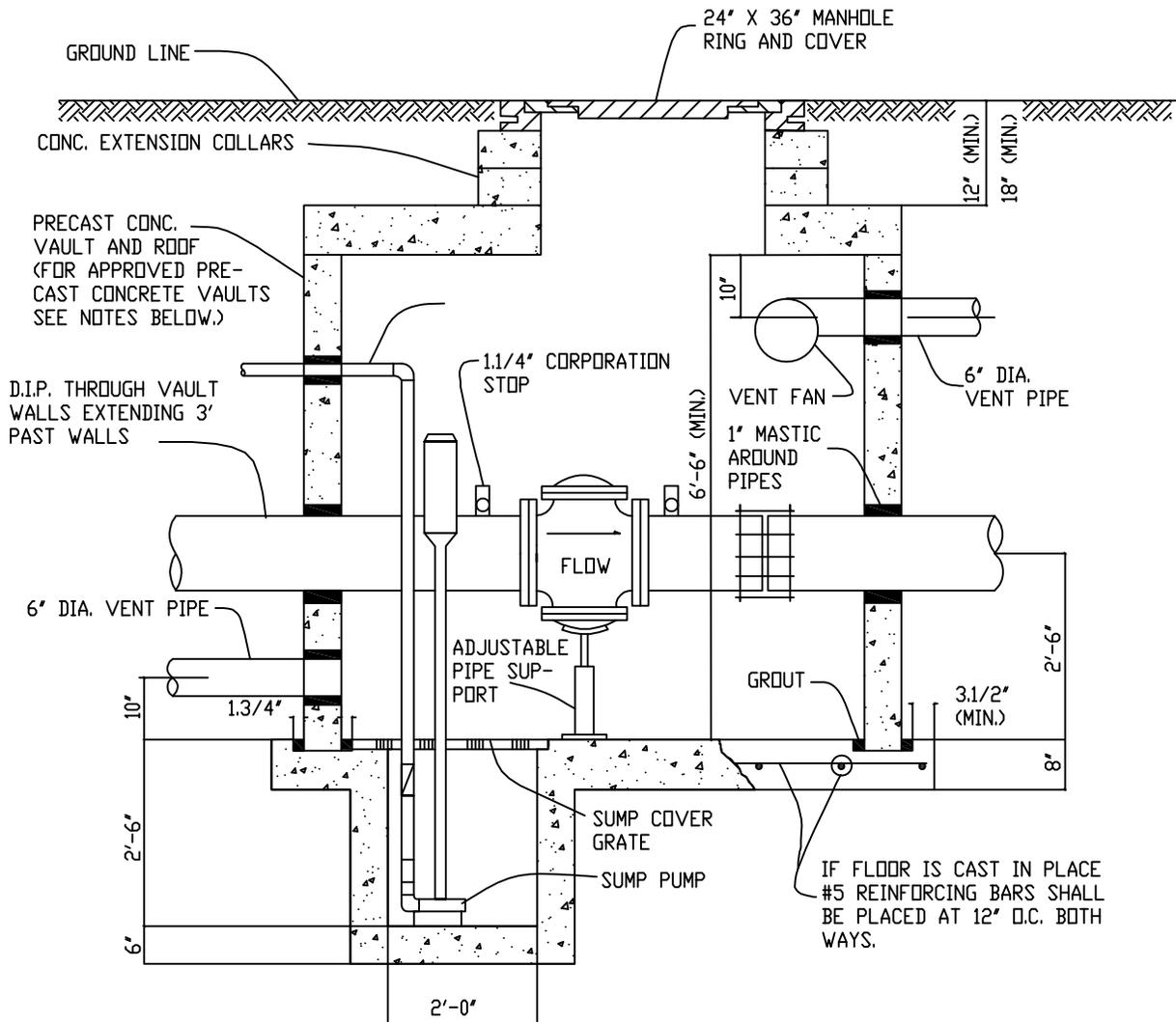


PROVIDE BLUE CARSONNITE WATER MARKER AT ALL VALVES OUTSIDE THE RIGHT-OF-WAY

NOTE:  
SEE DRAWING 700-19 FOR ADDITIONAL NOTES.

**PRV VAULT PLAN**  
NTS





NOTE:

1. SHOP DRAWINGS SHALL BE SUBMITTED FOR APPROVAL.
2. SEE DRAWINGS 700-18 FOR PLAN VIEW.
3. NOT ALL FITTINGS AND VALVES SHOWN FOR CLARIFICATION
4. A RECTANGULAR VAULT IS REQUIRED WHERE TELEMETRY OR ELECTRICAL EQUIPMENT INSIDE THE VAULT IS ANTICIPATED.
5. ACCESS STAIRS WITH DOOR OUTSIDE OF PAVEMENT MAY BE REQUIRED ON STREETS WITH HEAVY TRAFFIC.
6. SUMP PUMP AND VENT FAN REQUIRED IN VAULTS WITH ELECTRICAL OR TELEMETRY EQUIPMENT.
7. THIS MANHOLE IS SUITABLE FOR CHECK VALVE INSTALLATIONS.
8. THREADED FITTINGS ON LOW FLOW.
9. COUPLING ON LOW FLOW.
10. SADDLE FOR TAP FOR LOW FLOW
11. ALL PIPING 4" DIAMETER OR GREATER IS D.I.P.
12. NO PVC ALLOWED.

**PRV VAULT SECTION**

NTS



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**800 GENERAL**

1. This section of the specifications covers the furnishing and installing of all storm drainage improvements, storm sewers, storm water inlets, manholes, headwalls, other appurtenances and all related work necessary to complete the storm drainage improvements.
2. All piping and material shall be of the type and materials specified herein. The use of materials other than those specified herein, require written approval from the Town Engineer. All materials shall be new and unused. All pipe sizes and references to pipe diameter on the drawings or in the Specifications are intended to be the nominal inside diameter, and shall be interpreted as such.
3. The work covered by this section will not be accepted until the backfill connected with the work has been completed satisfactorily. Any section of storm sewer line that is found defective in tests, material, alignment, grade, or joints shall be corrected.
4. The Contractor shall provide a copy of the manufacturer's installation recommendations for each type of pipe to each foreman and inspector prior to construction. These installation recommendations shall be followed except where the approved Construction Plans call out different material or installation methods.
5. The Design Engineer or the Town reserves the right to require the testing of pipe and materials after delivery and to reject all pipe or materials represented by the sample which fail to comply with the specified requirements.

**801 PIPE DESIGN**

1. Storm piping may not be curved or deflected.
2. Pipe inside diameter shall be a minimum of 15-inches for public and private storm sewers, except direct connections to down spout roof gutters or trench drains, see Section 811.
3. For changes in pipe size, the crowns of the pipes shall be at the same elevation, or the incoming flow shall be 0.2-feet above the outgoing flow, whichever is the greater drop across the manhole invert.
4. All pipes shall be laid to provide a minimum velocity in the pipe of 3-feet per second.

**802 REINFORCED CONCRETE PIPE (RCP)**

1. Circular reinforced concrete pipe shall meet the requirements of ASTM C76. Pipe laying lengths shall be a minimum of 7-feet 6-inches. The class of pipe shall be as indicated on the approved plans. The pipe strength shall be a minimum of Class III. Bedding for concrete pipe shall be 6-inches minimum below the pipe and for 24-



- inches and smaller pipes the bedding shall extend to 1-foot above the top of pipe. For 30-inches and larger pipes the bedding shall extend to the spring line of the pipe. See Detail 800-01 at the end of this section.
2. Arch Culvert reinforced concrete pipe shall meet the requirements of ASTM C506 and the requirements contained herein.
  3. Elliptical reinforced concrete pipe shall meet the requirements of ASTM C507 and the requirements contained herein.
  4. All (RCP) shall be constructed with Type II modified cement. The absorption of the concrete pipe shall not exceed 5.5%.
  5. Gaskets shall be rubber O-ring type per ASTM C361 or rubber neoprene gaskets per ASTM C443. Gaskets will be used in a bell and spigot joint. Other gaskets may be allowed after review of submitted documentation, and approval by the Town Engineer.
  6. Each pipe joint shall conform to ASTM C361, Section 8, with the gaskets confined in a groove cast in the pipe spigot. Pipe with collars in lieu of integral cast bells will not be accepted. The pipe joints shall be designed to withstand, without cracking, the gasket compression plus a differential load across the joint equal to 4,000-pounds per foot of inside diameter.
  7. Each piece of reinforced concrete storm drain pipe shall be plainly and permanently marked showing the pipe class, date of manufacture, and the manufacturer's name or mark. These markings shall be made on the outside of the pipe before curing or shall be painted on the pipe using waterproof paint.
  8. The Town Engineer may require the submittal of reports covering joint leakage, joint shear, cement mill reports, and three edge bearings on each size and class of pipe for review before any pipe is installed in the field. The tests for joint leakage, joint shear, and three-edge bearing are for proof of design only. Reports covering tests made on other pipe of the same size, class, and design as specified herein, and manufactured from materials of equivalent type and quality are generally acceptable.
  9. The Town Engineer may require the submittal of drawings, specifications, and other data showing complete details of the design, fabrication, and construction of the reinforced concrete pipe for review. These submittals shall include data on all materials proposed to be used in the pipe, the size and location of each cage of the reinforcement, joint details including reinforcement, gasket details, and test results on materials, joints, and pipe.

### **803 REINFORCED CONCRETE BOX CULVERTS**

1. Reinforced Concrete Box Culverts may be used on storm sewer projects within the Town of Frederick.



2. Reinforced concrete box culverts shall conform to the requirements of The Colorado Department of Transportation, Standard Plans List, M & S Standards, Latest Edition and ASTM C1433.

**804 TRENCHING**

1. Trenching is to be performed in accordance with all applicable safety standards, including construction fence, shoring, stepped back trenches, material stockpiles, trench access, etc.
2. The excavation or trench shall be kept free from water until the structure or pipe is completely installed. All efforts should be made to keep the structure free from hydrostatic pressure and flotation.
3. The Contractor shall provide a firm and stable subgrade. Wherever unstable material is encountered in the bottom of the trench said material shall be over-excavated to a depth suitable for construction of a stable subgrade as determined by the Design Engineer and approved by the Town Engineer. A sample design is contained in this section's Details but must be verified as adequate by the Design Engineer if included in Construction Plan details.
4. The contractor shall have no more than 200-linear feet of trench open and waiting for utility line installation. Contractor is to only open as much linear trench as they expect to bed, install pipe, cover with squeegee and select fill, and backfill to surrounding grade in that day. Where excavation is a hazard to automotive or pedestrian traffic, the amount of open trench and the duration of that opening is to be minimized.

**805 BEDDING AND SELECT FILL MATERIAL**

1. All pipe bedding and cover material shall be "squeegee" or other select material meeting the specifications below. Pipe bedding material shall be crushed or non crushed durable rock well graded between the No. 4 sieve size and the No. 100 sieve size with less than 5% passing the No. 200 sieve. See Table below.

<b>Table 800-1 - Pipe Bedding Gradation</b>	
<b>Sieve Size</b>	<b>Percent Passing (%)</b>
3/8-inch	100
No. 4	40-90
No. 16	10-30
No. 200	0-5



2. Pipe bedding is to be poured into place and hand tamped around installed pipe using shovel handle or a similar tool. To prevent lateral displacement, squeegee shall be deposited uniformly and simultaneously on each side of the pipe.
3. Select backfill, generally excavated on site material, is to be placed on top of the pipe bedding to a compacted depth of 1-foot above top of pipe bell. Select backfill material is to be free from clods and rock greater than 1.5-inches in any dimension. This material to be moistened and thoroughly mixed as needed before placement.

**806 BACKFILL AND COMPACTION**

1. All pipe will have a minimum of 2-feet of cover from the top of the finished grade to the top of the pipe bell, and shall be capable of withstanding AASHTO HS-20 highway traffic loadings.
2. Backfilling should be timed to minimize the length of open trenches during the day and particularly overnight. Trenches shall not be left open overnight. In the event where this can not be avoided the Contractor shall fence the trench and put up warning signs for safety. The Town is not responsible for the safety of open trenches.
3. Any soil used for trench backfill shall be free from frozen matter, stumps, roots, brush, other organic matter, cinders or other corrosive material, hazardous material, and debris. Water shall be added to the material and the material shall be harrowed, disked, bladed, or otherwise worked to insure uniform moisture content, as specified.

If imported soil is used for trench backfill it shall meet CDOT specifications for Class I structural backfill as defined below:

<b>Table 800-2 - Structure Backfill Class 1</b>	
<b>Size</b>	<b>Percent Passing (%)</b>
2-inch	100
No. 4	30-100
No. 50	10-60
No. 200	5-20

In addition this material shall have a liquid limit not exceeding 35 and a plasticity index of not over six when determined in conformity with AASHTO T89 and T90 respectively.

4. Trenches shall be backfilled promptly after the utility has been installed and inspected. Backfill around manholes and inlets shall be compacted with hand-operated equipment. Backfill material shall be deposited in uniform horizontal layers which may not exceed 8-inches loose. All compacted backfill shall be within the Geotechnical Engineer's Specification of moisture, density, and soil type.



5. Field Compaction tests will be conducted to determine compliance of compaction methods with specified density in accordance with ASTM D2922, Test Methods for Density of Soil and Soil-Aggregate in Place by Nuclear Methods.
6. Compaction tests shall be performed at a depth of 1.5-feet above the top of the pipe and in 1-foot vertical increments up to the finish grade. Compaction tests shall be performed at least once per every 100-linear feet as measured along the length of the pipe. If the Town Engineer determines in writing that reliable and uniform results are produced by the Contractor's construction techniques, the frequency of testing may be changed to one every 200-linear feet. Compaction shall be to the following minimum densities unless specified to a different percent by the approved Construction Plans.

<b>Table 800-3 - Minimum Densities</b>	
<b>Type</b>	<b>Minimum Density</b>
Pipe Bedding	90% of Maximum Standard Density
Trench Backfill:	
Under paved roadways, sidewalks, and other paved areas	95% of Maximum Standard Density
Under gravel roadways	95% of Maximum Standard Density
Under footing, foundations, or structures	98% of Maximum Standard Density
Fields and open areas	90% of Maximum Standard Density

7. At the Contractor's option, flowable fill meeting the applicable requirement of Section 300, Concrete, may be used in lieu of trench backfill.
8. The Contractor shall maintain and repair all trench settlement and make necessary repairs to pavement, sidewalks, or other structures which may be damaged as a result of backfill settlement. Contractor shall warrant work for a period of 2-years after conditional acceptance by the Town.

**807 INLETS AND INLET GRATES**

1. Structures, detention outlets, and inlets shall be reinforced as per the approved plans. All structures shall have steel rebar reinforcement. Inlets may be cast-in-place or precast.
2. Inlets allowed in the Town of Frederick are Type C (Surface inlet), Type D (Surface Inlet), Type R (Curb Inlet), Type 13 (Combination Inlet), and Type 13 (Valley Inlet) as



detailed in CDOT M & S Standards, Latest Edition. Details covering each inlet to be included in Construction Plan details. Type 13 inlet grates may have a smaller 17.75-inch by 36-inch grate with a minimum 1.8-square foot opening only if the smaller grate is considered in the hydraulic calculations. Use of Type R inlets are encouraged due to no grate hazard and low blockage potential.

3. Access covers and steps shall be provided for all inlets. Access covers shall have the words "Storm Sewer, Confined Space, Entry Permit Required" cast on the cover. Access covers will be sized for 24-inch diameter openings, 1-inch thick, designed for heavy traffic loading (H-20 Loading). Inlets over 10-feet in length are to have two access covers installed on the opposite ends of the inlet.
4. Storm sewer penetrations are to be at downstream end of box. No pipes shall enter into the corner of the inlet.
5. Inlet grates in streets, alleys, and areas with pedestrians shall be of a design that is safe for bicycles and pedestrians.
6. New holes for pipeline connections to existing inlets must be cored, not broken open with sledge hammers. Connections and methods to existing inlets must be approved by the Town Engineer.

## **808 MANHOLES**

1. The Contractor shall locate manholes at all changes in grade, alignment, pipe materials, and pipe sizes.
2. Manholes shall be located at street intersections whenever possible.
3. Drop manholes are allowed for storm drainage improvements. No outside drops are allowed on manholes and the Town Engineer may restrict the difference in height between the incoming pipe invert and the outgoing pipe invert.
4. No manholes may be located in sidewalks, pans, gutters, areas of ponding, storm detention basins, or in the crown of the road. If all other manhole locations have been exhausted the Town Engineer may approve in writing a manhole that is located in an area which will experience surface runoff ponding or is in a flow channel. These manholes must have a solid manhole cover, having an integral O-ring type gasket, that can be bolted closed and the manhole ring shall be bolted to the manhole cone.
5. Manholes must be spaced no farther apart than 400-feet for pipes with inside pipe diameters of 15-inches to 36-inches, and 500-feet apart for pipes with inside diameters of 42-inches and larger.
6. Manholes shall be at least 48-inch diameter for pipes between 15-inches to 36-inches diameter. Manholes shall be at least 60-inch diameter for pipes between 42-inches to 48-inches diameter. Manholes shall be at least 72-inch diameter for pipes



between 54-inches to 60-inches diameter. Minimum manhole diameter shall be based on largest diameter pipe entering manhole. Manholes shall have a box base or precast tee for pipes larger than 60-inches diameter. When multiple pipes penetrate a manhole the minimum distance along the inside radius of the manhole shall be 1.5-feet between pipes.

7. Manhole covers shall have the words "Storm Sewer, Confined Space, Entry Permit Required" cast on the cover.
8. Manholes shall be located in areas which allow direct access via all-weather drives by maintenance vehicles.
9. All manholes located outside the dedicated street right-of-way shall be designed and constructed with a watertight, bolted type cover and the manhole ring shall be bolted to the manhole cone.

#### **809 END SECTION AND OUTFALL MATERIAL**

1. All storm sewers end sections and outfalls shall have a cast-in-place reinforced concrete headwall or a pre-manufactured flared end section. Pre-cast headwalls are not acceptable. All headwalls, and accompanying wingwalls, shall conform to the CDOT Standard Plans, M & S Standards, Latest Edition and full details shall be included in the construction plans. Pre-manufactured flared end sections shall be made of the same materials as the pipe to which they are connected and shall meet the minimum material specifications applying to the pipe. Refer to Details 800-05 to 800-06B for flared end sections and trash racks.
2. All storm sewer openings that are larger than 15-inches or subject to unauthorized entrance or trash accumulation shall have a designed trash rack with a galvanized coating.
3. Riprap protection shall be per UDFCD Requirements, Chapter 9, Section 3.2.3 *Riprap Size for Riprap Apron and Low Tailwater Basin* in the Urban Storm Drainage Criteria Manual, Volume 2.

#### **810 CONNECTION OF GUTTERS/DRAINS TO STORM DRAINS**

1. Roof gutters and trench drains may be direct connected to a storm sewer manhole using plastic pipe. The down spout location, drain connection, and manhole placement should minimize the length of the plastic pipe. The pipe size should be a minimum 2-inch diameter over the designed carrying capacity diameter of the pipe (minimum pipe diameter + 2-inch). Pipe size, slope, specific pipe type, and any special connections are to be called out on plans. Elbows or deflection are not allowed in the pipe run.
2. The Town recommends cleanouts be installed at appropriate intervals. Design Engineer must provide full details of cleanout from wye to surface



treatment/protection of cleanout lid. The Town Engineer may require cleanouts at any location they deem necessary within the Right-of-Way or publicly owned land.

3. The Town does not assume ownership or maintenance responsibility for roof drains or roof drain connections to storm systems unless specifically stated otherwise in the Town Board approved documents.

### **811 EXISTING EXTENSIONS-FUTURE STUB OUTS**

1. The extensions of storm drainage pipe shall be of the same material as the existing culvert as far as the next manhole/inlet. The physical connection to the existing storm drain system shall be plugged at the first downstream manhole until the storm system has been completed to the satisfaction of the Town.
2. When a storm drain line is anticipated to be extended at a future date, the Contractor shall install a manhole at the end of the line and shall install plugged stub out(s) in the direction(s) of the extension. The length of these stub outs will be directed by the Town Engineer.

### **812 INSTALLATION OF PIPE AND APPURTENANCES**

1. All pipe, fittings, and accessories shall be carefully lowered into the trench with suitable equipment in a manner that will prevent damage to the pipe. Under no circumstances shall pipe or accessories be dropped or dumped into the trench. Pipe and accessories shall be inspected for defects prior to being lowered into the trench. The Town Engineer or a Town representative shall have the authority to reject any pipe, gaskets or any accessories deemed to be below these standards. All foreign matter or dirt shall be removed from the interior of the pipe and the accessories before lowering into the trench. The pipe shall be kept clean by means approved by the Town Engineer during and after installation.
2. Pipe shall be laid to a true line and at uniform rates of grade as shown on the approved plans. Fine grading of the trench shall proceed ahead of pipe laying.
3. Pipe laying should proceed upgrade with the spigot ends of the pipe pointed in the direction of flow. The Contractor shall make all pipe connections to the manholes. When connecting to existing storm drains, the Contractor shall take every precaution necessary to prevent dirt or debris from entering the existing storm drainage system.

### **813 CONSTRUCTION OF MANHOLES**

1. In shallow manholes, less than 3-feet from invert to lid, manhole covers shall be lined up over the pipeline outlet to allow maintenance jetting equipment access to the pipelines. In manholes greater than 3-feet in height, the manhole rim is to be lined up to access rungs (see Details 800-03 and 800-04).



2. Flat top manholes shall only be used due to height constraints and with written approval of the Town Engineer. All flat tops are to be pre-cast and H20 traffic rated, regardless of location. Design Engineer shall submit a specific detail for construction of a flat top manhole.
3. New holes for pipeline connections to existing manholes must be cored, not broken open with sledge hammers. Connections and methods to existing inlets must be approved by engineer.

#### **814 CONSTRUCTION OF STORM WATER INLETS AND STRUCTURES**

1. All concrete and steel reinforcing work shall be in accordance with the Colorado Department of Transportation Sections 601 and 602, except as modified by these Standards and Specifications. Additives for concrete, other than those specified in the mix design, shall not be used without prior approval of the Design Engineer and accepted by the Town Engineer in writing. When approved for use, chemical admixtures or additives shall comply with applicable ASTM or AASHTO standards. Calcium chloride or admixtures containing chloride shall not be allowed in reinforced concrete.
2. All casting used shall sit flush with the surrounding concrete.
3. The bottom of all inlet structures shall be formed to drain to the outlet pipe as per the inlet details.

#### **815 TESTING AND FLUSHING PIPE**

1. Prior to final acceptance of each section of the storm sewer line, the storm drains shall be cleaned by appropriate methods approved by the Town Engineer. All dirt and debris shall be prevented from entering the existing storm drain system by means of watertight plugs or other suitable methods. The Town Engineer may require the storm sewer line be air pressure tested prior to final acceptance. When an air pressure test is required the contractor shall adhere to the test procedure called out by the Town Engineer. A water test for manholes may also be required by the Town Engineer. This test will be subject to less than a 1-inch per hour rise or fall to pass.
2. Any visible infiltration which the Town Engineer considers to be detrimental to the system shall be repaired in a manner approved by the Town Engineer before the work will be accepted. No manhole will be accepted that has any visible infiltration.
3. Upon completion of the construction, the Town Engineer will carefully inspect all storm drains and appurtenances. Any unsatisfactory work shall be removed and replaced in a proper manner. The invert of the storm drain and manholes shall be left smooth, clean, and free from obstructions throughout the entire length. Manhole rings and covers must be raised to finished grade before acceptance of the storm drain.



4. The storm sewer pipelines may be inspected by camera instead of air tested if approved by the Town Engineer.
5. All inlet structures shall be flushed with water after completion of construction. The inlets are not acceptable if water, dirt or debris remains in the invert of the structure.

**816 REFERENCES**

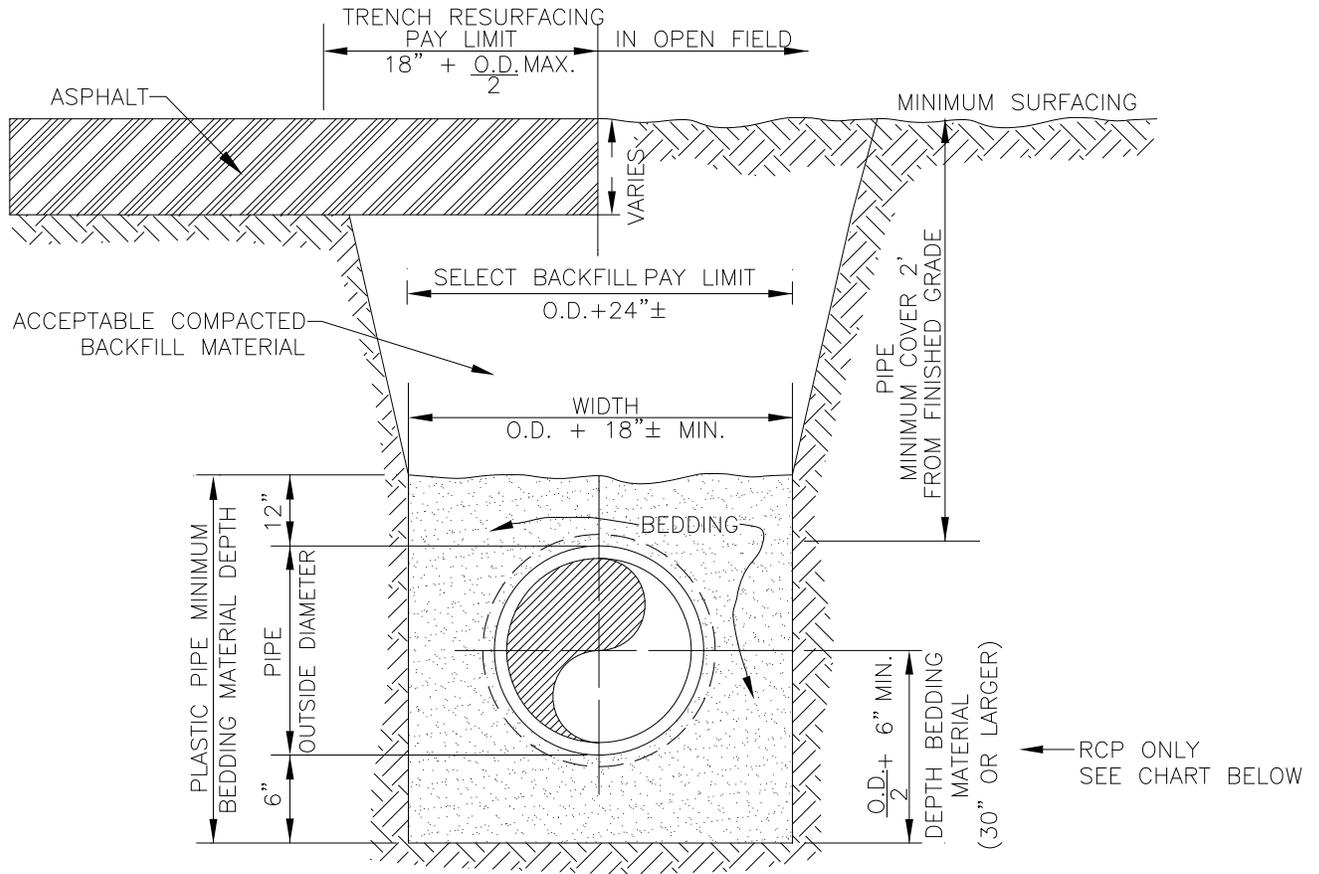
<b>Standards Referenced in Section 800:</b>	
<b>Number</b>	<b>Title</b>
ASTM C76	Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe
ASTM C361	Reinforced Concrete Low-Head Pressure Pipe
ASTM C443	Joints for Concrete Pipe and Manholes, Using Rubber Gaskets
ASTM C506	Reinforced Concrete Arch Culvert, Storm Drain, and Sewer Pipe
ASTM C507	Reinforced Concrete Elliptical Culvert, Storm Drain, and Sewer Pipe
ASTM C1433	Precast Reinforced Concrete Box Sections for Culverts, Storm Drains, and Sewers
ASTM D2922	Standard Test Methods for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth)



**SECTION 800 – STORM SEWER IMPROVEMENTS**

800-01	PIPE BEDDING AND BACKFILL LIMITS
800-02	UNSTABLE SUBGRADE AND UNDERDRAIN BEDDING
800-03	STANDARD MANHOLE
800-04	STANDARD MANHOLE COVER
800-05	STANDARD FLARED END SECTION TRASH RACK
800-05A	STANDARD FLARED END SECTION TRASH RACK MOUNTING DETAIL
800-06	ELLIPTICAL FLARED END SECTION TRASH RACK
800-06A	ELLIPTICAL FLARED END SECTION TRASH RACK MOUNTING DETAIL





TYPICAL TRENCH

RCP PIPE ONLY

RCP DIAMETER	24" AND SMALLER	30" AND LARGER
HEIGHT OF BEDDING	1' ABOVE TOP OF PIPE	SPRINGLINE

MINIMUM COMPACTION DENSITY

PIPE BEDDING	90% OF MAXIMUM STANDARD DENSITY
TRENCH BACKFILL:	
UNDER PAVED ROADWAYS, SIDEWALKS AND OTHER PAVED AREAS	95% OF MAXIMUM STANDARD DENSITY
UNDER GRAVEL ROADWAYS	95% OF MAXIMUM STANDARD DENSITY
UNDER FOOTING, FOUNDATIONS OR STRUCTURES	98% OF MAXIMUM STANDARD DENSITY
FIELD AND OPEN AREAS	90% OF MAXIMUM STANDARD DENSITY

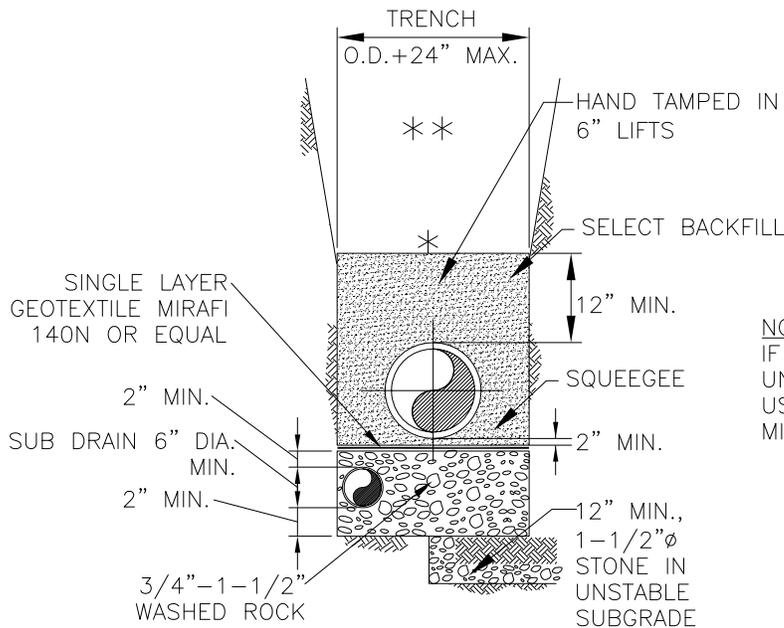
NOTE:

1. MINIMUM BEDDING BELOW PIPE SHALL BE 6" FOR PLASTIC AND RCP.
2. BEDDING SHALL BE APPROVED MATERIAL. SEE TABLE 800-1 IN SECTION 800 OF THESE STANDARDS.
3. REPLACE ALL PAVEMENT MARKINGS, STRIPING, SYMBOLS, AND PAVEMENT MARKERS IN KIND IN PAVED AREA.
4. PLASTIC PIPE MATERIAL WITHIN RIGHT OF WAY AT MINIMUM DEPTH OF COVER SHALL EITHER BE ENCASED IN CONCRETE OR FLASH-FILL IN LIEU OF BEDDING.

PIPE BEDDING AND BACKFILL LIMITS

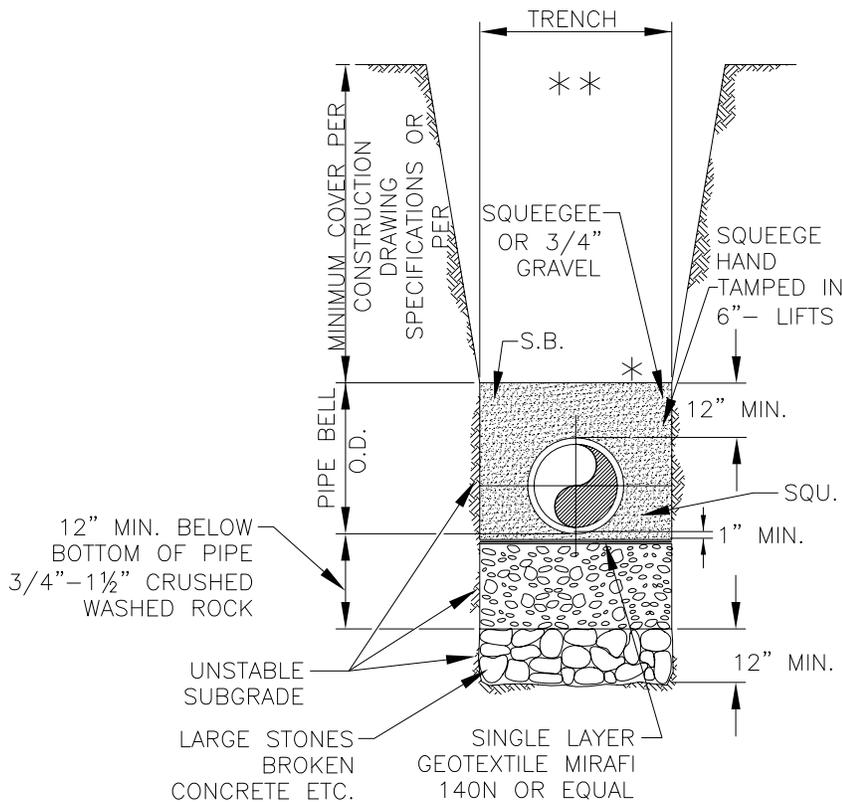
NTS





PIPED UNDERDRAIN

NOTE:  
IF A GEOTEXTILE SOCK IS USED ON THE UNDERDRAIN PIPE, SQUEEGEE MAY BE USED TO BED THE UNDERDRAIN AND MIRAFI WILL NOT BE REQUIRED.



UNSTABLE SUBGRADE

NOTE:  
THIS DETAIL SHOULD BE USED AS A GUIDE FOR UNSTABLE SUBGRADE. IT IS THE RESPONSIBILITY OF THE DESIGN ENGINEER TO DETERMINE IF THIS DETAIL IS SUFFICIENT FOR THE SPECIFIC UNSTABLE SUBGRADE ENCOUNTERED ON THE PROJECT.

LEGEND:

\*  
LIMIT OF SLOPING OR BENCHING OF TRENCH WALLS.

\* \*  
MACHINE COMPACTED TRENCH BACKFILL

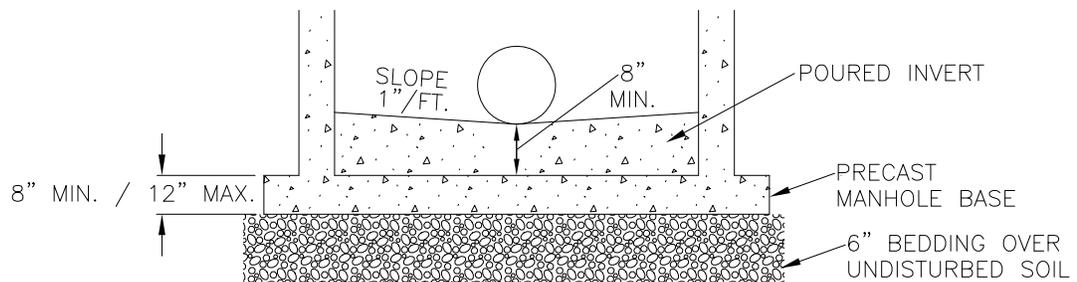
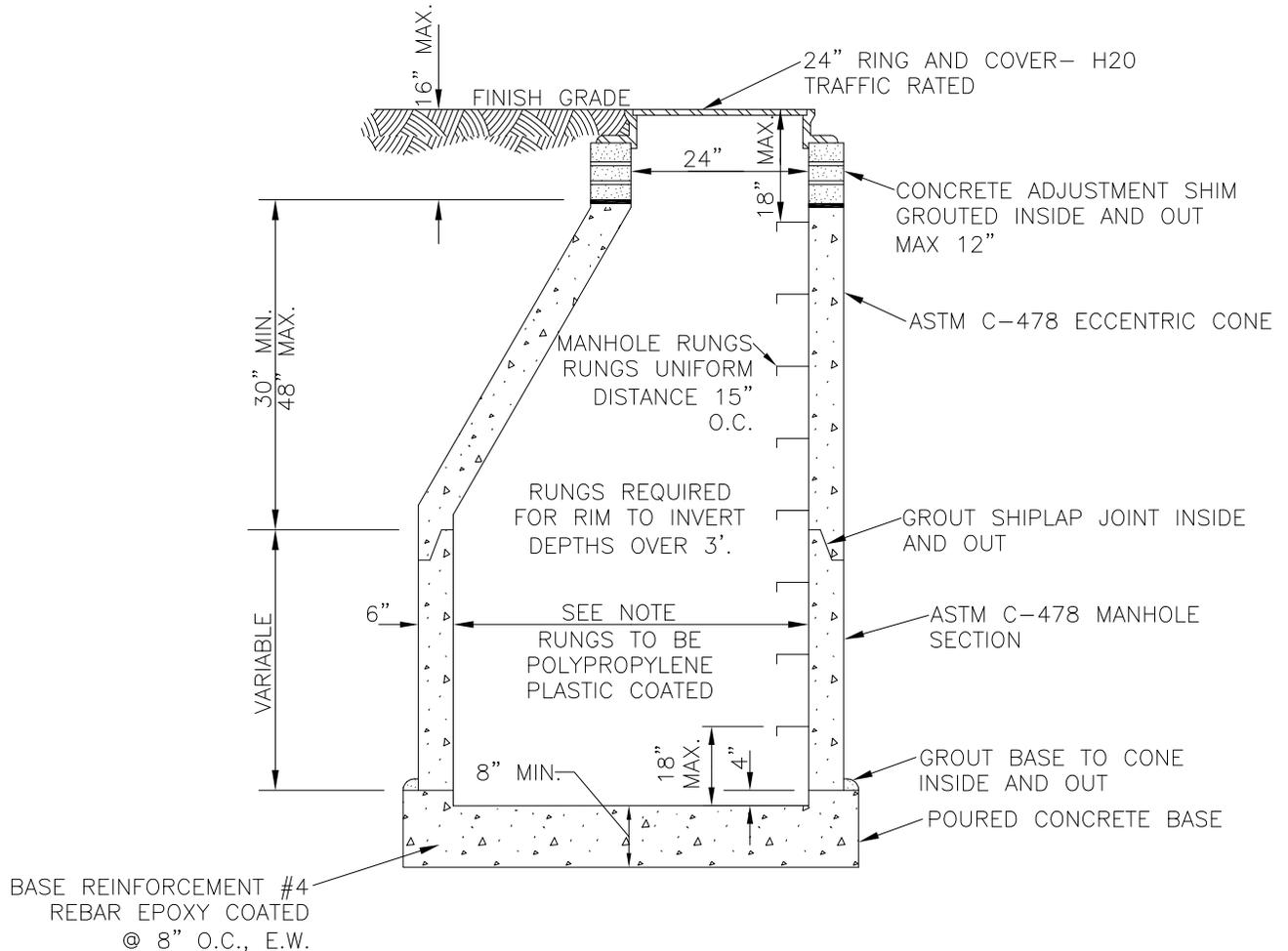
UNDISTURBED GROUND

UNSTABLE SUBGRADE AND UNDERDRAIN BEDDING

NTS



FLAT TOP MANHOLES SHALL ONLY BE USED DUE TO HEIGHT CONSTRAINTS WITH WRITTEN APPROVAL OF TOWN ENGINEER. ALL FLAT TOPS ARE TO BE PRE-CAST AND H20 TRAFFIC RATED REGARDLESS OF LOCATION. SEPARATED DESIGN DETAIL REQUIRED.



ALTERNATE BASE

NOTE:  
MINIMUM INSIDE DIAMETER OF MANHOLE SHALL BE AS FOLLOWS.

PIPE SIZE	MIN. MH DIAMETER
15" TO 36"	48"
42" TO 48"	60"
54" TO 60"	72"

MANHOLE SPACING

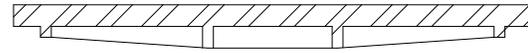
MAX. 400' APART FOR 15" TO 36" LINES  
MAX. 500' APART FOR 36" > LINES. \*

\*ELLIPTICAL PIPE IS BASED ON SMALLER DIMENSION

**STANDARD MANHOLE**

NTS

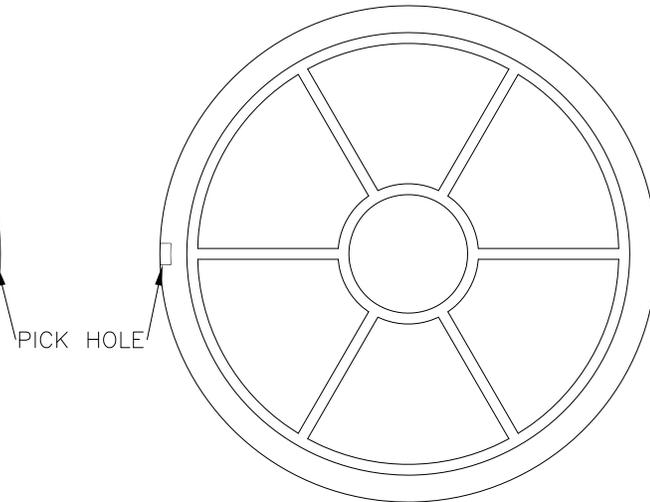




PROFILE



TOP VIEW



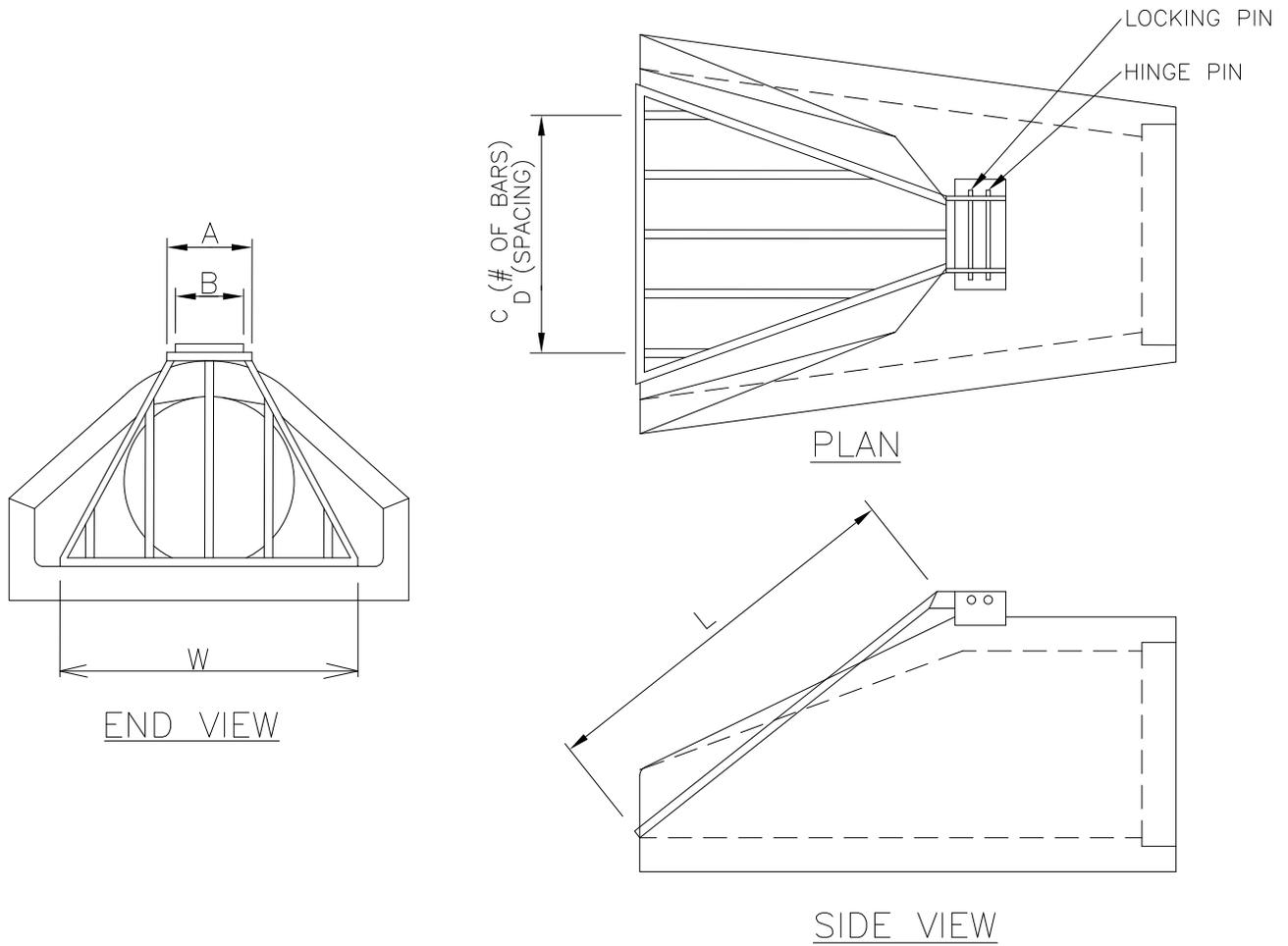
BOTTOM VIEW

NOTES:

1. RIM & LID TO BE H2O TRAFFIC RATED
2. 4"-8" SET RINGS ALLOWED
3. FOR PAVEMENT PERCENTAGES EXCEEDING 4%, CROWN AND ROAD GRADE COMBINED REQUIRE SHIMMING. PLASTIC INJECTION MOLDED ADJUSTING RINGS ALLOWED WITH UP TO 1.2" DIFFERENTIAL ACROSS RING.

**STANDARD MANHOLE COVER**  
NTS

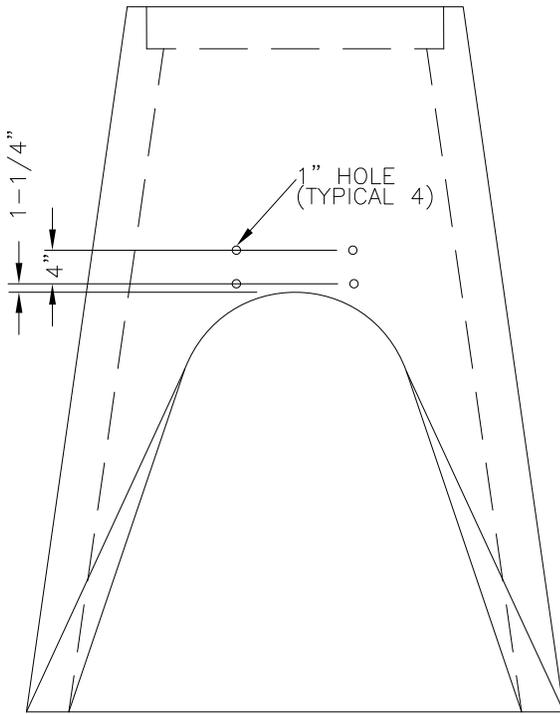




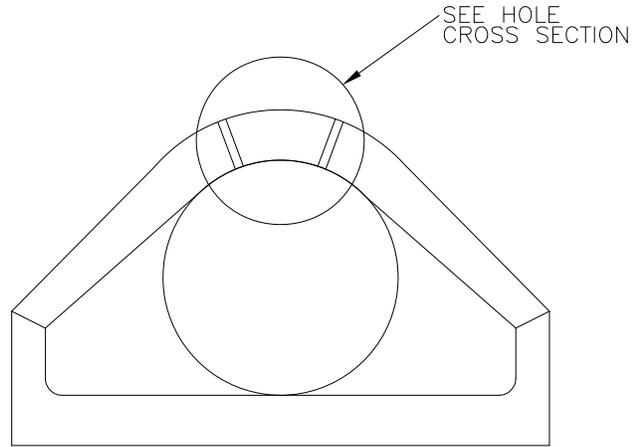
PIPE DIAMETER	A	B	C	D	W	L
12"	11"	7.5"	3	6"	21"	30"
15"	9"	5.5"	3	6.5"	27"	28"
18"	10"	6.5"	3	8"	28"	31"
24"	12"	9.5"	5	8"	40"	47.5"
30"	15"	12.5"	5	9"	52"	
36"	18"	15.5"	7	8.5"	58"	71.25"
42"	21"	18.5"	7	9"	64"	75"
48"	24"	21.5"	9	8"	70"	82.75"
54"	24"	21"	14	6"	84"	84"
60"	24"	21"	22	6"	132"	108"
72"	24"	21"	22	6"	132"	108"

**STANDARD FLARED END SECTION TRASH RACK**  
 NTS

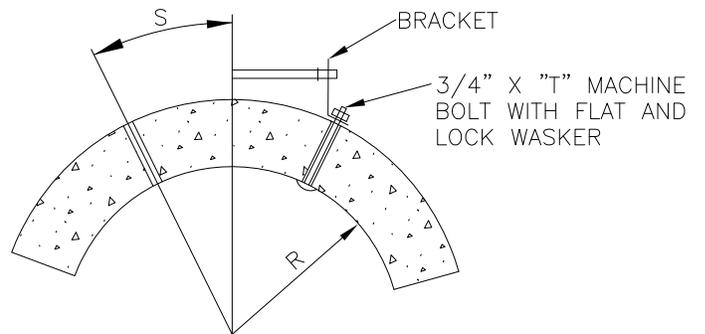




PLAN



END VIEW



HOLE CROSS SECTION

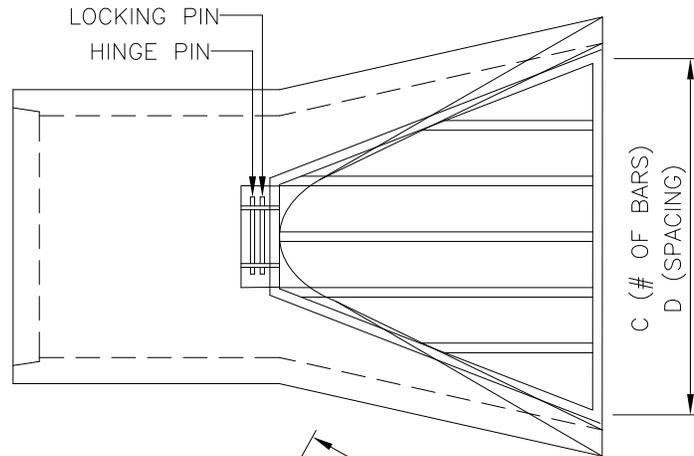
PIPE DIAMETER	R	S	T
12"	8"	5.25"	4.5"
15"	9.75"	3.5"	4.75"
18"	11.5"	5"	5"
24"	15"	6.5"	5.5"
30"	18.5"	8"	6"
36"	22"	9.5"	6.5"
42"	25.5"	11"	7"
48"	29"	12.75"	7.5"
54"	33.25"	14.5"	8.5"
60"	36.75"	16.25"	9"
72"	43.75"	19.75"	11"

**STANDARD FLARED END SECTION TRASH RACK MOUNTING DETAIL**

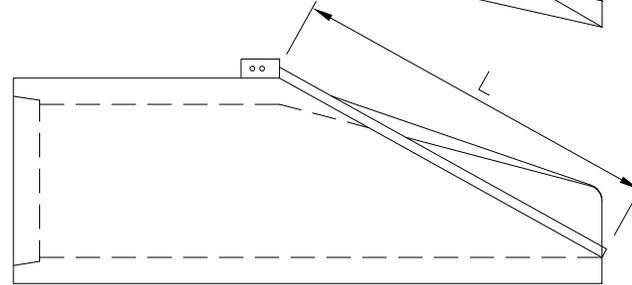
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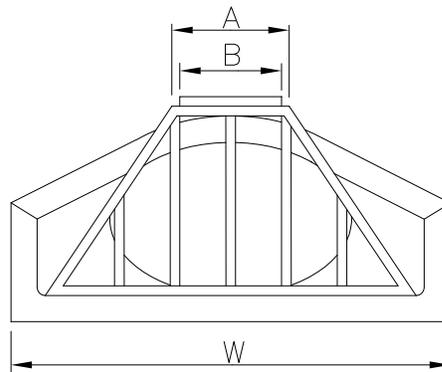
PLAN VIEW



SIDE VIEW



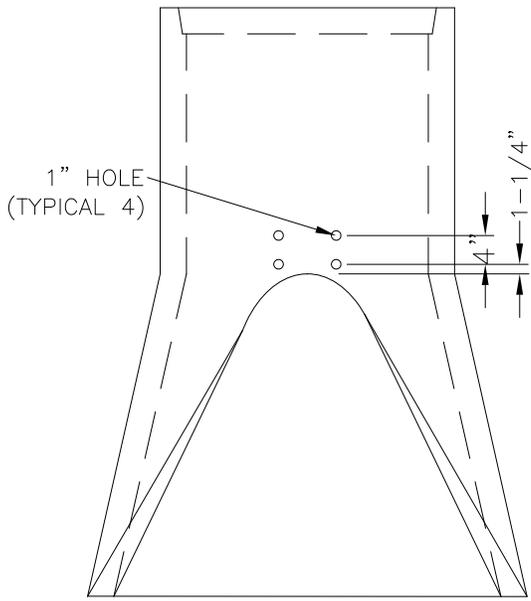
END VIEW



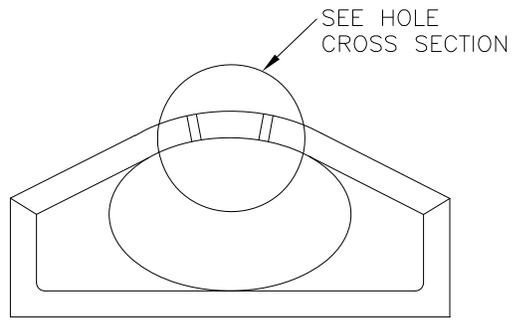
EQUIVALENT CIRCULAR PIPE DIAMETER	SPAN	RISE	A	B	C	D	W	L
18"	23"	14"	15"	12"	4	9.5"	38"	30"
24"	30"	19"	20"	17"	4	8.5"	40"	39.5"
30"	38"	24"	25"	21.75"	5	9"	52"	55"
36"	45"	29"	30"	26.75"	6	9.5"	64"	62.75"
42"	53"	34"	35"	31.5"	6	9.5"	64"	65"
48"	60"	38"	39"	36.38"	7	9"	70"	67"
54"	68"	43"	45"	42"	10	10"	80"	69"
60"	76"	48"	50"	47"	10	10"	90"	71"

**ELLIPTICAL FLARED END SECTION TRASH RACK**  
 NTS

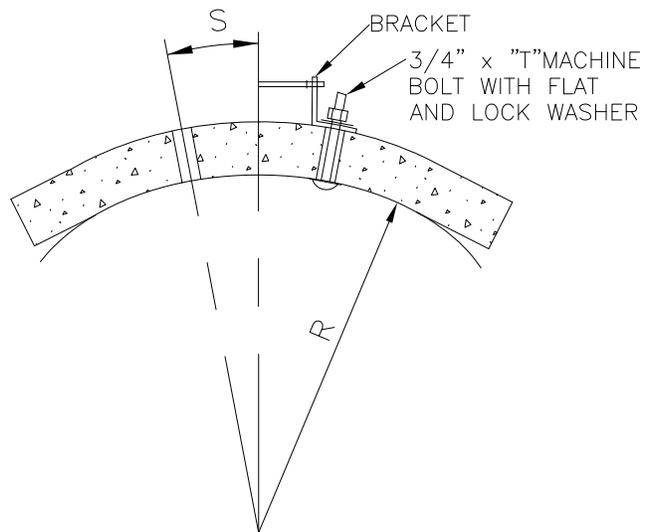




PLAN VIEW



END VIEW



HOLE CROSS SECTION

EQUIVALENT CIRCULAR PIPE DIAMETER	SPAN	RISE	R	S	T
18"	23"	14"	23"	7.75"	4.25"
24"	30"	19"	29"	10.25"	5.75"
30"	38"	24"	36.25"	12.75"	6.25"
36"	45"	29"	43.5"	15.25"	7"
42"	53"	34"	50.5"	17.75"	7.5"
48"	60"	38"	57.63"	20"	8"
54"	68"	43"	63"	23"	8.5"
60"	76"	48"	70"	26"	9"

**ELLIPTICAL FLARED END SECTION TRASH RACK  
MOUNTING DETAIL**



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**900 DESCRIPTION**

1. Storm drainage improvements design and reporting requirements shall be completed in accordance with these. The Town of Frederick has adopted the *Urban Storm Drainage Criteria Manuals (Volumes 1-3)* and the *South Weld I-25 Corridor Master Drainage Plan*. Urban Drainage manuals are available on-line and the South Weld study is available through Weld County. The Town of Frederick may adopt additional drainage studies. It is the Developers responsibility to contact the Town.
2. In accordance with Section 116 of these specifications, a complete set of record drawings shall be stamped and signed by a Professional Engineer registered in the state of Colorado and submitted to the Town Engineer at the completion of construction. Also, a *Certification Letter* shall be submitted prior to issuance of any building permits describing any deviations from the approved plan set and/or drainage report with As-built survey information and submitted for consideration by the Town Engineer. This Certification Letter shall also have as-built survey information for all detention facilities with actual storage and design storage volumes included.

**901 GENERAL DESIGN CRITERIA**

**901.01 Design Storms**

Minor Storm (Design excluding detention) = 5-year Return Frequency Storm

Minor Storm (Detention only) = 10-year Return Frequency Storm

Major Storm (Design and Detention) = 100-year Return Frequency Storm

Notes:

- a. If the property is within the Tri-Town Basin as identified in the South Weld I-25 Corridor Master Drainage Plan the release from on-site detention facilities shall be limited to the 2-year existing condition peak discharge during the 100-year storm event.

**901.02 Storm Sewer and Inlets**

The storm sewer and inlets shall have a minimum design capacity equal to the minor storm peak flows. Storm sewer must be RCP. The minimum storm sewer size is 15-inch diameter.

**901.03 Street Capacities**

1. Gravel Road



**Major Storm Event** – The 100-year runoff tributary to the borrow ditches shall be contained entirely within the ditches. Additional ROW may be required to increase the capacity of the ditches if the 100-year runoff exceeds the capacity of the ditches.

2. Local Road

**Minor Storm Event** – No curb overtopping.

**Major Storm Event** – The maximum depth at the centerline of the roadway may not exceed 0.10-feet.

3. Collector Road

**Minor Storm Event** – No curb overtopping.

**Major Storm Event** – The spread must be contained in the ROW. The depth at the flowline must not exceed 18-inches and also maintain one 12-foot travel lane open.

4. Arterial Road

**Minor Storm Event** – The spread must be contained in the ROW. The spread must also maintain at least one 12-foot travel land free of water in each direction.

**Major Storm Event** – The spread must be contained in the ROW. The spread must also maintain at least one 12-foot travel lane free of water in each direction.

**901.04 General**

The report shall demonstrate safe passage of 100-year flows (off-site and on-site) through the project site and into the downstream receiving body or structure.

**901.05 Water Quality**

Water quality detention shall have a minimum holding time of 24-hours and a maximum holding time of 40-hours. Design of water quality features including Best Management Practices (BMPs) shall be per UDFCD Criteria Manual Volume 3 requirements and subject to final approval by the Town.

**901.06 Detention**

All stormwater detention facilities shall be designed per UDFCD Criteria. Emergency spillways are required on all ponds set at the 100-year water surface elevation so that in the event the pond outlet is blocked the runoff will be conveyed over the spillway and continue in a safe manner on the original drainage path. Emergency spillways shall not be utilized to convey the 100-year storm runoff under normal conditions, they are for emergencies only.



Retention and Percolation ponds with pumping facilities are allowed in the Town of Frederick only with written approval from the Town Engineer.

## **902 DRAINAGE PLAN SUBMITTAL REQUIREMENTS**

### **902.01 Review Process**

All new developments within the jurisdiction of the Town of Frederick shall submit drainage reports in accordance with the requirements of this section. Further, the Town of Frederick has adopted the Urban Drainage and Flood Control District standards and therefore, all requirements therein shall be in effect in conjunction with these requirements. Preliminary and Final Drainage Reports shall be submitted in hard copy (2) and electronically including: 1) spreadsheet summary tables; 2) runoff and routing model inputs and outputs; and 3) AutoCAD drawings.

### **902.02 Conceptual Drainage Report**

1. The purpose of the Conceptual Drainage Report is to identify and define conceptual solutions to problems, which may occur on-site and off-site as a result of the development. In addition, those problems that exist on-site prior to development must be addressed during the conceptual phase. All reports shall be typed on 8-1/2" x 11" paper and bound. The drawings shall be bound within the report or included within a pocket attached inside the back cover of the report. The report needs to stand-alone and therefore all important reference material should be copied and included within the report appendix. The report shall include a cover letter presenting the conceptual design for review and shall be prepared by or supervised by a professional engineer licensed in Colorado. The report shall contain a certification sheet as follows:

"I hereby certify that this report for the conceptual drainage design of (Name of Development) was prepared by me (or under my direct supervision) in accordance with the provisions of the Urban Drainage and Flood Control District Storm Drainage Criteria and supplemental Town of Frederick requirements for the owners thereof."

Registered Professional Engineer State of  
Colorado No. \_\_\_\_\_  
(Affix Seal)

2. Report Contents

The Conceptual Drainage Report shall be prepared in accordance with the following outline and contain the applicable information listed:

- a. General Location and Description

- i. Location



1. Township, range, section,  $\frac{1}{4}$  section.
  2. Local streets within and adjacent to the development.
  3. Major open channels and facilities.
  4. Names of surrounding developments.
- ii. Description of Property
1. Area in acres.
  2. Ground cover
  3. Major open channels.
  4. General project description.
  5. Irrigation facilities.
- b. Drainage Basins and Sub-Basins
- i. Major Basin Description
1. Reference to I-25 Corridor Master Drainage Plan (Anderson, 2000) or other plans accepted by the Town.
  2. Major basin drainage characteristics
  3. Identification of all nearby irrigation facilities within 100 feet of the property boundary.
- ii. Sub-Basin Description
1. Historic drainage patterns on the subject property.
  2. Off-site drainage flow patterns and impact on the subject property.
- c. Drainage Facility Design
- i. General Concept
1. Drainage problems encountered and solutions at specific locations.
  2. Maintenance access and aspects of the design.



3. Drawing Contents

A General Location Map shall be provided at a scale of 1" = 2000' or larger in sufficient detail to identify upstream off-site drainage areas flowing into the development and general drainage patterns. A vicinity map should be included on an .5" x 11" sheet.

A Drainage Plan of the proposed development shall be provided at a scale from 1" = 100' to 1" = 200' on a 24" x 36" drawing. The plan shall show the following information:

- a. Existing contours at 2-foot maximum intervals.
- b. Property lines, lot lines, and easements.
- c. Streets with names.
- d. Existing drainage facilities, structures, irrigation facilities, and sizes.
- e. Overall drainage area boundary and sub-area boundaries.
- f. Proposed flow directions using arrows.
- g. Conceptual location of storm sewers, swales, open channels, culverts, detention ponds, and other appurtenances.
- h. Location of all defined 100-year floodplains affecting the property.
- i. Any other items so noted within the Drainage Report

**902.03 Preliminary Drainage Report**

1. The purpose of the Preliminary Drainage Report is to identify and define preliminary solutions to problems, which may occur on-site and off-site as a result of the development. In addition, those problems that exist on-site prior to development must be addressed during the preliminary phase. All reports shall be typed on 8.5" x 11" paper and bound. The drawings shall be bound within the report or included within a pocket attached inside the back cover of the report. The report needs to stand-alone and therefore all important reference material should be copied and included within the report appendix. The report shall include a cover letter presenting the preliminary design for review and shall be prepared by or supervised by a professional engineer licensed in Colorado. The report shall contain a certification sheet as follows:

"I hereby certify that this report for the preliminary drainage design of (Name of Development) was prepared by me (or under my direct supervision) in accordance



with the provisions of the Urban Drainage and Flood Control District Storm Drainage Criteria and supplemental Town of Frederick requirements for the owners thereof."

Registered Professional Engineer State of  
Colorado No. \_\_\_\_\_  
(Affix Seal)

2. Report Contents

The Preliminary Drainage Report shall be in accordance with the following outline and contain the applicable information listed:

a. General Location and Description

1. Location

- a. Township, range, section, 1/4 section.
- b. Local streets within and adjacent to the development.
- c. Major open channels and facilities.
- d. Names of surrounding developments.

2. Description of Property

- a. Area in acres.
- b. Ground cover.
- c. Major open channels.
- d. General project description.
- e. Irrigation facilities.

b. Drainage Basins and Sub-Basins

1. Major Basin Description

- a. Reference to I-25 Corridor Master Drainage Plan (Anderson, 2000) or other plans accepted by the Town.
- b. Major basin drainage characteristics
- c. Identification of all nearby irrigation facilities within 100-feet of the property boundary.



2. Sub-Basin Description
  - a. Historic drainage patterns on the subject property.
  - b. Off-site drainage flow patterns and impacts on the subject development.
  
3. Summary Table that includes the following information for each sub-basin:
  - a. Basin Name
  - b. Area (acres)
  - c. Initial flow length (ft)
  - d. Travel flow length (ft)
  - e. Average basin slope (ft/ft)
  - f. Impervious area (acres and percent)
  - g. Runoff Coefficients (5-year; 10-year and 100-year)
  - h. Time of Concentration (with input parameters)
  - i. Peak Runoff Rate (5-year; 10-year and 100-year)  
Refer to the example table.
  
- c. Drainage Design Criteria
  1. Regulations: Discussion of the optional criteria selected or the deviation from the Town or UDFCD criteria if any.
  2. Development Criteria Reference and Constraints
    - a. Discussion of previous drainage studies (i.e., project master plans) for the subject property that influence or are influenced by the drainage design and how the plan will affect drainage design for the site.
    - b. Discussion of the drainage impact of site constraints such as street, utilities, existing structures, and development or site plan.
  3. Hydrological Criteria
    - a. Identify design rainfall.



- b. Identify runoff calculation method.
  - b. Identify detention discharge and storage calculation method.
  - c. Identify design storm recurrence intervals.
  - d. Discussion and justification of other criteria or calculation methods used that are not presented in or referenced by the Town or UDFCD criteria.
4. Hydraulic Criteria
- a. Identify various capacity references.
  - b. Identify detention outlet type.
  - c. Identify check/drop structure criteria used.
  - e. Discussion of other drainage facility design criteria used.
- d. Drainage Facility Design
1. General Concept
- a. Discussion of concept and typical drainage patterns.
  - b. Discussion of compliance with off-site runoff considerations.
  - d. Discussion of the content of tables, charts, figures, or drawings presented in the report.
  - e. Discussion of anticipated and proposed drainage patterns.
2. Specific Details
- a. Discussion of drainage problems encountered and solutions at specific design points.
  - b. Discussion of detention storage and outlet design
  - c. Discussion of maintenance access and aspects of the design.
3. Summary Table(s)
- a. Discharge at Design Points
    - ii. Design points should include at a minimum: all culverts, inlets, pipes or channel sections where a



- change of flowrate occurs or a design component proposed.
      - iii. All Design Points should have peak 5-year and 100-year flows summarized in this table.
      - iv. Location/Description of Design Component
      - v. Minimum facility size
- 4. Detention Pond Table(s)
  - a. Each detention pond should have a table that summarizes the *Area-Stage-Storage-Discharge relationship* for each detention facility.
  - b. The outlet invert elevation and 100-year maximum water surface elevation should be specified on this table.Refer to the example tables.
- e. Conclusions
  - 1. Compliance with the Town and UDFCD criteria.
  - 2. Drainage Concept
    - a. Effectiveness of drainage design to control damage from storm runoff.
    - b. Influence of proposed development on the Local Master Drainage Plan recommendations.
    - c. Approval of affected irrigation company or other property owner to be obtained.
- f. References: Reference all criteria and technical information used.
- g. Appendices
  - 1. Hydrology Computations
    - a. Land use assumptions regarding adjacent properties.
    - b. Initial and major storm runoff computations at specific design points.
    - c. Historic and fully developed runoff computations at specific design points.
  - 2. Hydraulic Computations
    - a. Culvert sizing.



- b. Storm sewer sizing (15-inch RCP minimum).
- c. Street capacity evaluation.
- d. Storm inlet sizing.
- e. Swale sizing.
- f. Open channel sizing.
- g. Check and/or drop structure sizing.
- h. Detention pond area/volume capacity and outlet sizing.

3. Drawing Contents

A General Location Map shall be provided at a scale of 1" = 2000' or larger in sufficient detail to identify upstream off-site drainage areas flowing into the development and general drainage patterns.

A Drainage Plan of the proposed development shall be provided at a scale from 1" = 100' to 1" = 200' on a 24" x 36" drawing. The plan shall show the following information:

- a. Existing and proposed contours at 2-foot maximum intervals,
- b. Property lines, lot lines, and easements.
- c. Streets with names.
- d. Existing drainage facilities, structures, irrigation facilities, and sizes.
- e. Overall drainage area boundary and sub-area boundaries.
- f. Proposed flow directions using arrows.
- g. Proposed storm sewers, swales, open channels, culverts, cross-pans, and other appurtenances, including cross-sections of swales and open channels.
- h. Proposed outfall point for runoff from the development area and facilities to convey flows to the final outfall point without damage to downstream properties.
- i. Routing and accumulation of flows at various critical points for the minor storm runoff.
- j. Routing and accumulation of flows at various critical points for the major storm runoff.



- k. Detention storage facilities and outlet works, including proposed 100-year water surface elevations.
- l. Location and elevations of all defined 100-year floodplains affecting the property.
- m. Location of all existing and proposed utilities.
- n. Routing of off-site drainage flows through the development.
- o. Minimum lowest opening elevations of residential and commercial buildings above the 100-year water surface in streets, open channels, ditches, swales, or other drainage facilities, as illustrated by the preliminary grading plans.
- p. Proposed on-site private and public drainage easements.
- q. Proposed off-site private and public drainage easements.

#### **902.04 Final Drainage Report**

1. The purpose of the Final Drainage Report is to update the preliminary design concepts, and to present the design details for the drainage facilities discussed in the Preliminary Drainage Report. Also, any change to the preliminary concept shall be presented.
2. All reports shall be typed on 8.5" x 11" paper and bound. The drawings shall be bound within the report or included within a pocket attached inside the back cover of the report. The report needs to stand-alone and therefore all important reference material should be copied and included within the report appendix. The report shall include a cover letter presenting the final design for review and shall be prepared by or supervised by a professional engineer licensed in Colorado. A certification sheet similar to the Preliminary Drainage Report shall be included indicating Final Drainage Report.

#### **903 DRAINAGE IMPROVEMENTS ON PRIVATE PROPERTY**

1. Drainage improvements on private property that do not receive storm runoff from other parcels, do not serve public area and are not within Town drainage easements or right of way, will not be reviewed or maintained by the Town. However, private sewers shall still meet typical levels of service including not flooding vehicles in parking lots and adequate freeboard on finished floor elevations. The Town Engineer may make exceptions in writing.
2. All groundwater drainage facilities shall remain private and require an encroachment permit from the Town to be constructed and operated in a public right of way or on public land. Groundwater discharge is subject to Town approval and water quality standards that might be imposed by the Town.



**904 TERM OF PLAN APPROVAL**

Drainage plans shall be valid for two years after approval of the Final Drainage Report unless the Town Engineer estimates that off-site or on-site changes may have significant effect on the proposed plan.

**905 RECORD DRAWINGS**

1. A Pond Certification Letter with As-Built Survey prepared by a registered engineer is required to be submitted for review and acceptance by the Town Engineer prior to issuance of a certificate of occupancy for a commercial or industrial lot, public facility, or conditional acceptance of Public Improvements within a subdivision.
2. The As-Built Survey shall identify the designed and constructed contours of the pond and embankment as well as elevations the outlet structure.
3. The Pond Certification Letter shall describe the difference between the proposed and constructed pond grade, capacity, outlet structure, etc. and verify that the pond will function as designed and meets the requirements of the UDFCD Criteria Manual and these Standards and Specifications.



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## **1000 DESCRIPTION**

This item shall govern the general construction requirements for utilities that are not owned by the Town of Frederick but are within the Town of Frederick.

## **1001 DESIGN CRITERIA**

1. The design of utility transmission lines shall be in accordance with applicable Federal, State, and industry standards.
2. Utility transmission lines shall be placed entirely within the Town ROW or easements dedicated to that purpose. Easements shall be at least 20-feet in width for a single utility line. Easements for multiple utilities shall be 25-feet or wider as dictated by utility spacing plus 10-feet of easement outside of the most exterior utility lines.
  - a. Each utility must be installed with a minimum of 12-inches of vertical clearance from parallel or crossing utility lines and must maintain a minimum of 3-feet of horizontal clearance from parallel utility lines. These clearances may be greater depending on the types of utilities and should be verified with each utility provider.
  - b. Each utility line must be installed with at least 12-inches of clearance from any other underground structure not associated with the utility line. If this clearance cannot be attained, the utility line must be protected from damage that might result from the proximity of the other structure.

## **1002 CONSTRUCTION REQUIREMENTS**

1. Utility installation within any existing or known proposed ROW must be backfilled with material free of organics or overly saturated material. Backfilling under existing or known proposed roads shall be accomplished to the backfilling density, moisture, and material specification of that approved or anticipated road subgrade design.
2. Backfill with appropriate bedding material per individual utility specifications.
3. All utility lines shall have metal detectable underground warning tape installed 6 to 12-inches below finished grade, regardless of location. Warning tape shall be APWA Detectable Underground Warning Tape – 5-mil, as manufactured by Presco Products, or approved equivalent. The following must be written legibly on a background of sharply contrasting color on each line marker: “Warning”, “Caution” or “Danger” followed by the type of utility, i.e. gas, raw water, fiber optic, etc., in letters at least 1-inch with 1/4-inch stroke and the name of the utility operator and the telephone number where the operator can be reached at all times.



### **1003 RECORD DRAWINGS**

All utility work completed shall be recorded on "Record Drawings". These submittals shall be shown on copies of the construction drawings and to scale. Use text as necessary to provide further explanation if necessary. These drawings are part of the Conditional Acceptance requirements starting the 2-year warranty period.



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## **1100 DESIGN CRITERIA**

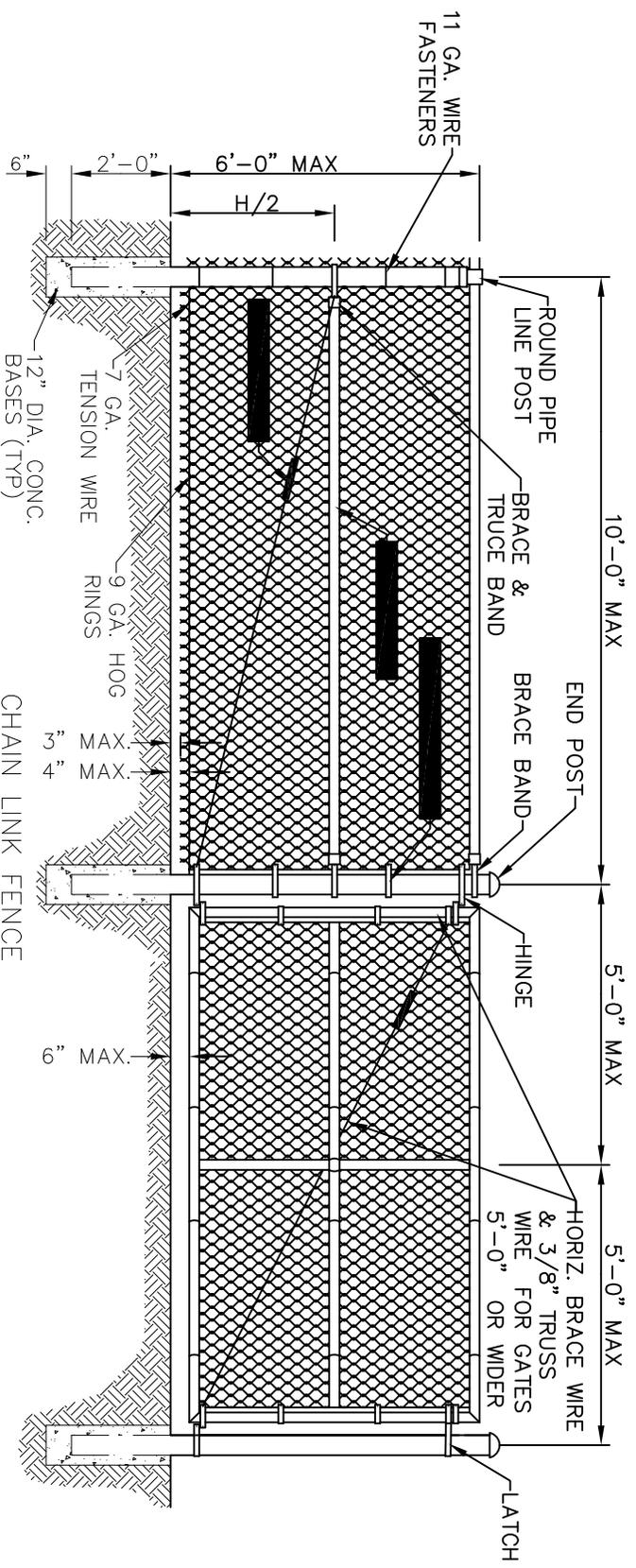
Fences shall conform to the Town of Frederick Land Use Code, Section 2.16, Fences and Walls, and shall be designed to meet the wind design criteria of the currently adopted Building Code.



**SECTION 1100 – FENCES**

1100-01	CHAIN LINK FENCE DETAIL
1100-02	3-RAIL TYPICAL FENCE DETAIL
1100-03	WOOD FENCE
1100-04	GREENBELT FENCE





- NOTES:
1. ATTACH FABRIC TO ALL FENCE & GATE STRUCTURES AT 12" INTERVALS VERTICALLY AND AT 20" HORIZONTALLY.
  2. BRACE RAIL WILL NOT BE REQUIRED FOR 36", 42", OR 48" FABRIC HEIGHTS. BRACE RAIL FOR FENCE WITH ROLL-FORM STEEL ELEMENTS IS 12" BELOW THE TOP RAIL.
  3. CHAIN LINK SHALL CONFORM TO THE REQUIREMENTS OF AASHTO M 181.
  4. STEEL POSTS, RAILS, AND GATE FRAMES SHALL CONFORM AASHTO M 181 TYPE 1, GRADE 1 OR GRADE 2.
  5. TENSION WIRE SHALL BE CONTINUOUS BETWEEN END OR CORNER POST AND LINE BRACE POST. A TURNBUCKLE SHALL BE USED FOR EACH CONTINUOUS SPAN OF TENSION WIRE. WIRE SHALL BE AS SPECIFIED IN AASHTO M 181.
  6. CONCRETE FOOTINGS SHALL HAVE TOPS CROWNED AT GROUND LEVEL AND SHALL BE CLASS 1, AX, OR B. CONCRETE WITH LIGHTWEIGHT AGGREGATE CONFORMING TO AASHTO M 195, WILL BE PERMITTED.
  7. CHAIN LINK FABRIC UP TO 5'-0" HIGH SHALL BE KNUCKLED AT THE TOP AND BOTTOM SELVAGES. FABRIC OVER 5'-0" HIGH SHALL BE TWISTED AND BARBED ON THE TOP SELVAGE AND KNUCKLED ON THE BOTTOM SELVAGE.
  8. FENCE SHALL BE CONSTRUCTED WITH EITHER ROUND PIPE OR ROLL-FORMED STEEL COMPONENTS. THE CONTRACTOR SHALL STATE THE TYPE OF CONSTRUCTION AND TYPE OF LINE POST TO BE USED THROUGHOUT THE PROJECT ON THE CONSTRUCTION PLANS.

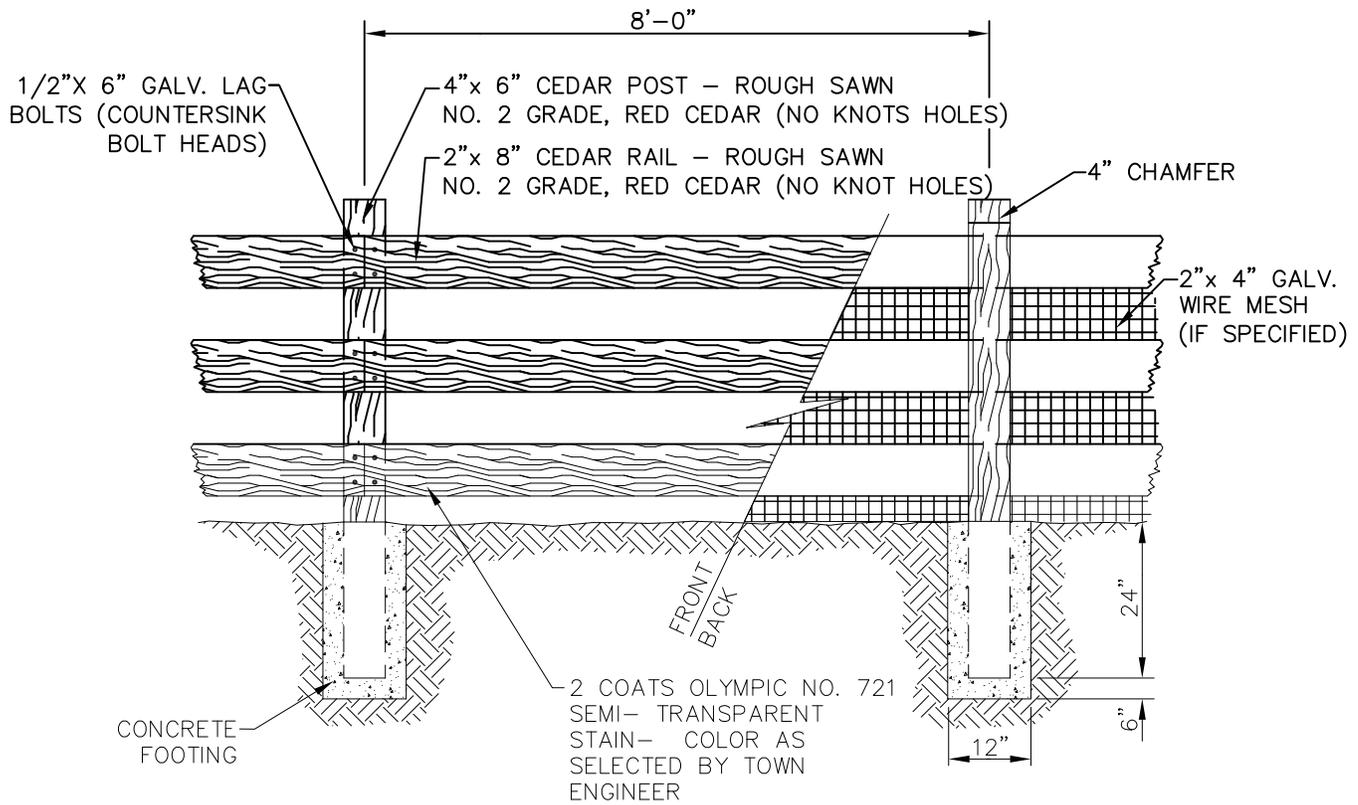
# CHAIN LINK FENCE DETAIL

NTS

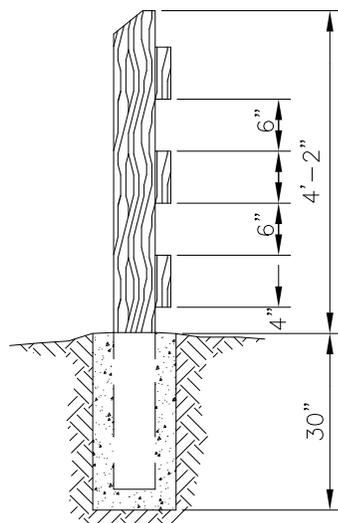


TOWN OF FREDERICK  
STANDARDS & SPECIFICATIONS

1100-01



FRONT VIEW

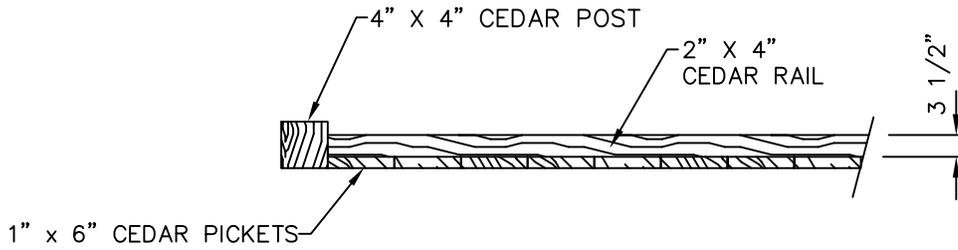


SIDE VIEW

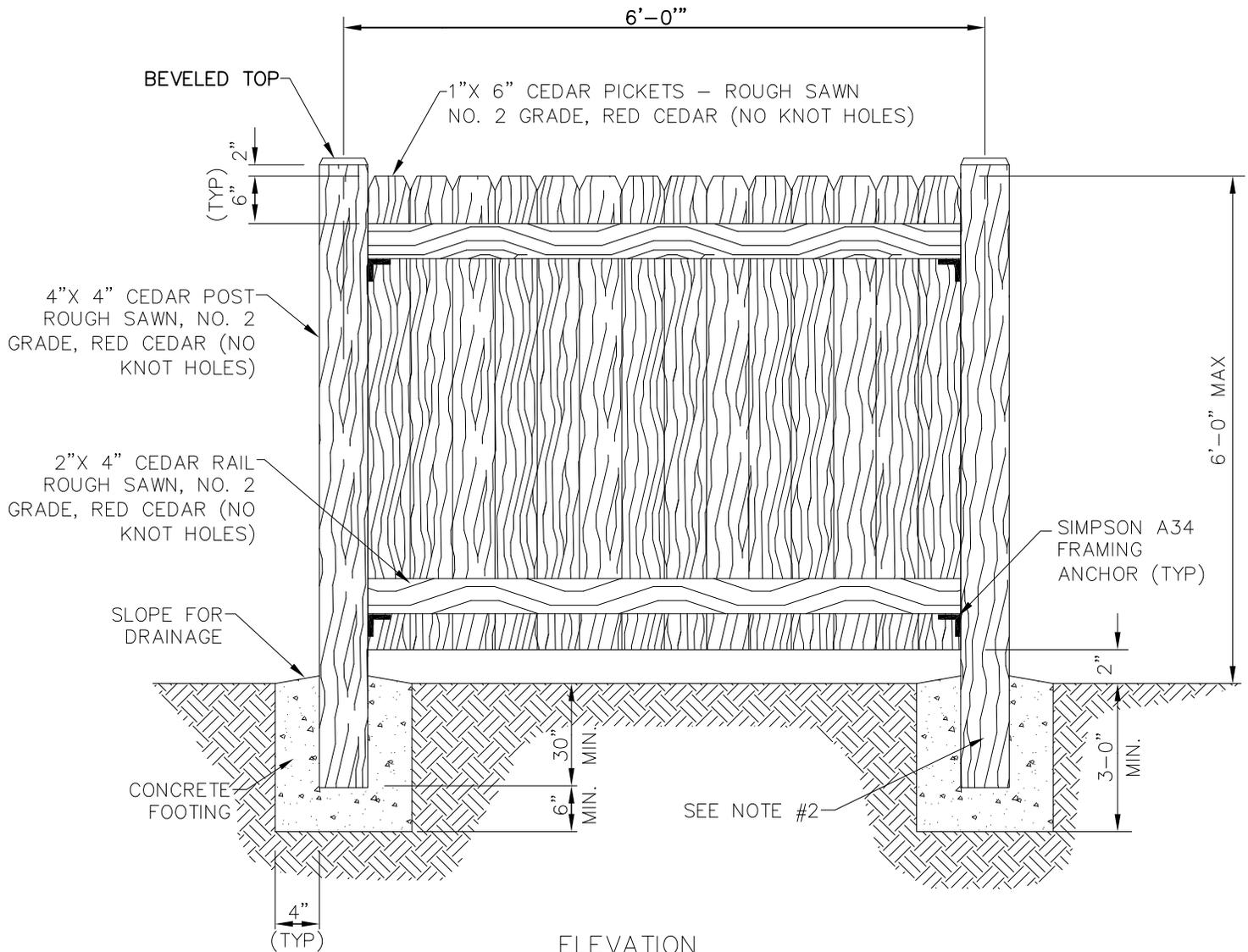
3-RAIL TYPICAL FENCE DETAIL

NTS





PLAN



ELEVATION

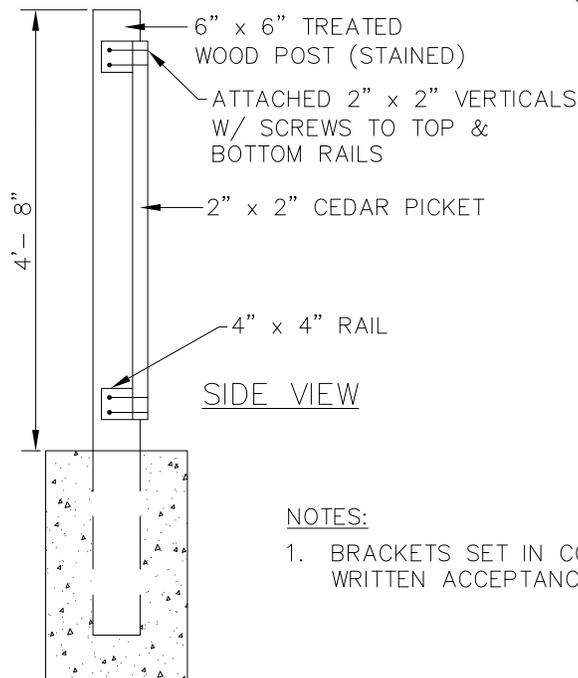
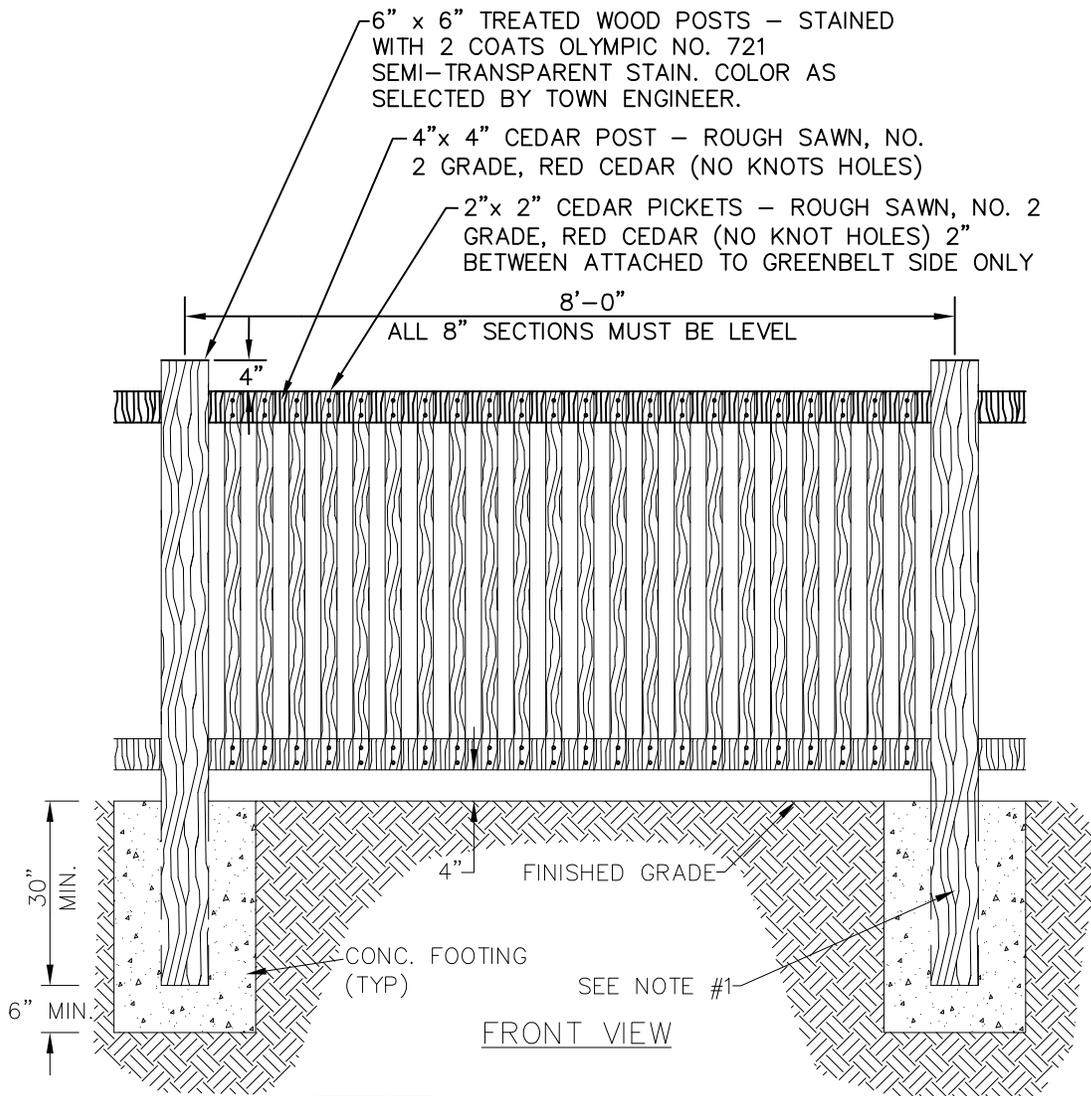
NOTES:

1. ALL HARDWARE SHALL BE GALVANIZED.
2. BRACKETS SET IN CONCRETE CAN BE USED WITH WRITTEN ACCEPTANCE OF TOWN ENGINEER.

**WOOD FENCE**

NTS





**GREENBELT FENCE**  
NTS



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## **1200 DESCRIPTION**

Sediment is the number one water quality pollutant originating from construction sites and is a major pollutant in the water of this country today. To reduce this pollution, the Town requires that temporary erosion and sediment control measures be used and comply with all State and Federal Regulations. Storm water regulations governed by the U.S. Environmental Protection Agency (EPA) requires that all local, state and federal storm water regulations be followed including the local municipality and county regulations. The Town does not accept any liability for the Contractor obtaining or following the requirements of Storm Water Management Plans or any other permits.

## **1201 GENERAL PROVISIONS**

The Storm Water Management Plan shall meet CDPHE and EPA requirements.

1. A Storm Water Management Plan (SWMP) shall be prepared in accordance with the most recent SWMP guidance document prepared by the CDPHE. The SWMP shall include an erosion and sediment control plan.
2. All BMP's located in or negatively affecting Town Right-of-Ways (ROW) or Town Easements shall be properly maintained and inspected.
3. Inspections shall be performed as required by the CDPHE and the EPA requirements.
4. The contractor shall minimize vehicle tracking of sediment or soil off site at locations where vehicles exit the construction site onto paved surfaces
5. Tracked sediment shall be removed from paved surfaces within 24 hours (maximum) of discovery.

### **1201.01 Limitations**

No person shall clear or grade land without implementing soil erosion and sediment controls in accordance with the requirements of these STANDARDS AND SPECIFICATIONS, and the Town of Frederick's Municipal Code.

### **1201.02 Exemptions**

1. Agricultural land management practices and construction of agricultural structures;
2. Clearing or grading activities that disturb less than 2-acres of land area and disturb less than 200 cubic yards of earth, provided the existing grades are less than 8% and the effected property does not abut public lands.
3. Clearing or grading activities that are subject exclusively to State approval and enforcement under State law and regulations.



## **1202 EROSION AND SEDIMENT CONTROL PLANS**

### **1202.01 Design Criteria**

All BMP's installed and/or designed should meet the CDPHE requirements and EPA requirements:

1. [www.cdphe.state.co.us](http://www.cdphe.state.co.us) & [www.cdphe.state.co.us/wq/](http://www.cdphe.state.co.us/wq/)
2. [www.epa.gov](http://www.epa.gov) & [www.epa.gov/waterscience/guide/stormwater/monitor.htm](http://www.epa.gov/waterscience/guide/stormwater/monitor.htm)

### **1202.02 Review and Approval**

1. A person may not clear or grade land without first preparing an erosion and sediment control plan which has been approved by the Town.
2. The applicant shall submit an erosion and sediment control plan and any supporting computations to the Town for review and approval. The erosion and sediment control plan shall contain sufficient information, drawings, and notes to describe how soil erosion and off site sedimentation will be minimized. The City shall review the plan to determine compliance with these STANDARDS AND SPECIFICATIONS, and the Town of Frederick's Municipal Code prior to approval. The plan shall serve as a basis for all subsequent grading and stabilization.
3. In approving the plan, the Town may impose such conditions thereto as may be deemed necessary to ensure compliance with the provisions of these STANDARDS AND SPECIFICATIONS, and the Town of Frederick's Municipal Code for the preservation of public health and safety.
4. The erosion and sediment control plan shall not be considered approved without the inclusion of the signature and date of signature of the Town Engineer.
5. Approved plans may remain valid for one year from the date of approval unless renewed by the Town.
6. Approved plans will become an exhibit to the Town's Grading Permit. In addition, the developer/contractor will be required to execute an improvements agreement and provide surety in a form outlined by Town Code prior to beginning earthwork operations.

### **1202.03 Modifications to Approved Erosion and Sediment Control Plans**

1. When inspection of the site indicates the approved erosion and sediment control plan needs modification, the modification shall be made in compliance with the erosion and sediment control criteria contained in these STANDARDS AND SPECIFICATIONS, and the Town of Frederick's Municipal Code.



2. The permittee shall submit requests for major modifications to approved erosion and sediment control plans, such as the addition or deletion of a sediment basin, to the Town to be processed appropriately. This processing includes modifications due to plan inadequacies at controlling erosion and sediment as revealed through inspection.
3. The Town may approve minor modifications to approved erosion and sediment control plans in the field if conditions so merit.

#### **1202.04 Grading and Erosion Control Notes**

The following minimum grading and erosion control notes shall be stated on, as well as incorporated into the overlot grading and erosion control plan:

##### GRADING AND EROSION CONTROL NOTES

1. All site grading (excavation, embankment, and compaction) shall conform to the recommendations of the latest soils investigation for this property and shall further be in conformance with the Town of Frederick's "STANDARDS AND SPECIFICATIONS FOR THE DESIGN AND CONSTRUCTION OF PUBLIC IMPROVEMENTS," latest edition.
2. Natural vegetation shall be retained and protected wherever possible. Exposure of soil to erosion by removal or disturbance of vegetation shall be limited to the area required for immediate construction operation and for the shortest practical period of time.
3. Topsoil shall be stockpiled to the extent practicable on the site for use on areas to be revegetated. Any and all stockpiles shall be located and protected from erosive elements.
4. Temporary vegetation shall be installed on all disturbed areas where permanent surface improvements are not scheduled for installation within three months. Vegetation shall be a vigorous, drought tolerant, native species mix. (Refer to Section 1500 of these STANDARDS AND SPECIFICATIONS for seeding mix.) Project scheduling should take advantage of spring or fall planting seasons for natural germination, but seeded areas shall be irrigated, if conditions so merit.
5. At all times, the property shall be maintained and/or watered to prevent wind caused erosion. Earthwork operations shall be discontinued when fugitive dust significantly impacts adjacent property. If earthwork is complete or discontinued and dust from the site continues to create problems, the owner/developer shall immediately institute mitigative measures and shall correct damage to adjacent property.
6. Temporary cut/fill slopes shall not exceed a steepness of 2:1 (2H:1V). Permanent slopes shall not exceed 3:1 (3H:1V) in areas to be seeded or sodded.



7. Utility construction is not approved under this plan.
8. The owner/developer shall provide any additional dust abatement and erosion control measures deemed necessary by the Town, should conditions merit them.
9. Temporary fences shall be installed along all boundaries of the construction limits or property lines as shown on the approved erosion control plan, to prevent grading on property not owned by the developer. In addition, the Town may require additional temporary fences if field conditions so merit them.

#### **1202.05 Standard Erosion Control Details**

Details within the UDFCD Criterial Manual are the standard erosion control details which are acceptable to the Town of Frederick.



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## **1300 DESCRIPTION**

Traffic control devices shall be maintained in a safe operating condition at all times. The contractor shall provide for approval by the Town Engineer, a traffic control plan, and shall comply with these Standards and Specifications. If the Town Engineer finds the construction area to be inadequately barricaded, he/she has the authority to stop work and direct that corrective measures be taken prior to proceeding with work.

## **1301 GENERAL PROVISIONS**

The Contractor shall contact the Town Engineer at least 48 hours before starting work on any arterial street, or within 400-feet. of a traffic signal, to secure locations of any underground facilities. The Contractor shall be responsible for the cost of repair to any facilities damaged by construction. The Contractor shall not interfere with traffic between the hours of 7:00 a.m. to 8:30 a.m. and 3:30 p.m. to 6:00 p.m. on weekdays or at any time on weekends or holidays without written permission from the Town Engineer.

## **1302 DESIGN CRITERIA**

The Manual on Uniform Traffic Control Devices shall be the basis upon which the construction traffic control plan is designed in concern with proper, prudent, and safe engineering practice. All necessary signing, striping, coning, barricading, flagging, etc. shall be shown on the plan.

## **1303 MATERIALS**

Unless otherwise directed by the Town Engineer, materials used in the construction of traffic signs and sign structures, including traffic signals and systems, shall conform to the requirements of CDOT Standard Specifications for Road and Bridge Construction Section.

## **1304 TRAFFIC CONTROL REQUIREMENTS**

### **1304.01 General Requirements**

1. The Contractor shall not allow construction equipment, personal vehicles, or construction materials to remain on or near the traveled lanes, or at any location that may interfere with the safe movement of traffic.
2. The Contractor shall provide access, acceptable to the property owners, to existing driveways of business and homes in the project area.
3. The Contractor shall remove all construction mud and debris from the travel lanes daily. Construction traffic control signs or devices not in use shall be removed or laid down.



4. Every precaution shall be taken to ensure that construction work does not interfere with the movement of pedestrian traffic, which shall be maintained on the sidewalk at all times. A traffic control person shall be provided for guidance as necessary.

#### **1304.02 Vehicular Traffic**

1. Construction work zone traffic shall be controlled by signs, barricades, detours, etc., which are designed and installed in accordance with the Manual on Uniform Traffic Control Devices, most recent edition, and applicable Town of Frederick Standards. A traffic control plan shall be submitted and approved by the Town Engineer, or designee, prior to start of any construction.
2. During construction of new facilities, traffic control should strive to keep the motorist from entering the facility. The primary means to accomplish this is by use of temporary barricades, located in advance of the point where new construction joins existing, and by appropriate signage. New construction shall not be opened to traffic and, thus, the construction traffic control removed without the approval of the Town Engineer.
3. Directional access on roadways may be restricted (minimum travel lane width in construction area is 10-feet, but proper controls including flagging must be indicated. Removal of on-street parking should be considered and noted where applicable.

#### **1304.03 Traffic Control Person**

1. The Contractor shall provide a traffic control person, other than the Project Superintendent, when called for in the plans or in the special conditions, or when determined necessary by the Town Engineer. The Traffic Control Person shall:
  - a. Have traffic control as their primary duty.
  - b. Carry a valid Traffic Control Supervisor certificate and a valid Flagging certificate (recognized by the Colorado Department of Transportation)
  - c. Be on the job site at all times during working hours.
  - d. Verify that all traffic control devices are in accordance with the Manual on Uniform Traffic Control Devices, including the Colorado Supplement, and that all traffic control devices are properly positioned and operating according to the approved traffic control plans.
  - e. Maintain two-way traffic on existing pavement unless otherwise specified in the approved traffic control plans.



#### **1304.04 Signage and Pavement Markings**

1. Installation and removal of temporary signing and striping shall be the responsibility of the Contractor.
2. Unless otherwise shown on the plans, the Contractor shall be responsible for final lane marking and signing that is to be in place prior to opening the project area to traffic. Coordinate with the Town's Engineering department to order and install all signage.
3. When a construction project includes the relocation of any traffic signal equipment or construction of a new signalized intersection, the work will be done by a qualified signal contractor.

#### **1304.05 Barricades**

Whenever roadways terminate due to project phasing, subdivision boundaries, etc., barricades are required. Design and construction shall comply with the requirements of the Manual of Uniform Traffic Control Devices, most recent edition. Details shall be shown on the construction drawings, and installation shall be provided by the Developer.

#### **1305 INSPECTION**

The Contractor shall take appropriate measures to assure that all traffic control devices are installed correctly and functioning properly. The Contractor shall inspect all traffic control devices before the start of construction each day to verify all devices are in place and functioning. Where lighted barricades are used, the Contractor shall perform a light check at least once every two days.



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## **1400 DESCRIPTION**

This section is for all Town of Frederick construction projects. All landscaping irrigation for development projects and development review should refer to the Town of Frederick Land Use Code. Furnish all work, materials, appliances, tools, equipment, facilities, transportation, and services necessary for new and modification work incidental to performing all operations in connection with the installation of "landscape irrigation" complete, as shown on drawings and/or specified herein.

## **1401 GENERAL PROVISIONS**

The Contractor shall not willfully install the irrigation system as shown on the drawings when it is obvious in the field that obstructions, grade differences or discrepancies in area dimensions exist that might not have been known in design. Such obstructions or differences should be brought to the attention of the Town. In the event this notification is not performed, the Contractor shall assume full responsibility for any revisions necessary.

### **1401.01 Experience**

1. All work shall be installed by skilled persons, proficient in the trades required, in a neat, orderly and responsible manner with recognized standards of workmanship. Project foreman shall be certified through the Certified Landscape Technician (CLT) program for irrigation as sponsored by the Associated Landscape Contractors of Colorado.
2. The Contractor shall have considerable experience and demonstrated ability in the installation of sprinkler irrigation systems of this type. To demonstrate ability and experience necessary for this project, the Contractor shall submit, prior to contract award, if requested by Town, the following:

List of 3 projects completed in the last 2-years of similar complexity to this project. Description of projects shall include:

- a. Name of project
- b. Location
- c. Brief description of work and project budget

## **1402 SUBMITTALS**

All submittals shall be accepted by the Town Engineer in writing before any irrigation installation commences.



**1402.01 Material List**

1. Prior to installation of any work, prepare a detailed list of all material proposed for use in the project and submit to the Town Engineer for approval.

2. Certificates

Submit manufacturer's certification that plastic pipe and fittings comply with the specification requirements as directed by Town Engineer.

3. Prior Approval

Equipment or materials installed or furnished without prior approval of the Town may be rejected and the Contractor required to remove such materials from the site at his own expense.

**1402.02 Record Drawings (As-Built)**

1. The Contractor shall supply the Town with a mylar as-built drawing of modifications approved by system designer, before final acceptance of the irrigation system.

2. The Contractor shall dimension from two (2) permanent points of reference, i.e., building corners, sidewalk, road intersections or any permanent structures, the location of the following items:

- a. Connection to existing water lines
- b. Routing of sprinkler pressure lines (dimension maximum 100-feet along routing)
- c. Sprinkler control valves
- d. Quick coupling valves
- e. Drain valves
- f. All gate valves
- g. Other related equipment as directed by the Town
- h. Sleeves
- i. Control wire routing outside mainline trench



### **1402.03 Controller Charts**

1. Provide two (2) controller charts for each automatic controller. Do not prepare charts until record drawings have been approved by the Town Engineer. Charts must be completed and approved prior to final review of irrigation system.
2. Chart shall be a reproduction of the record drawing, if the scale permits, fitting the controller door. If photo reduction prints are required, keep reduction to maximum size possible to retain full legibility.
3. Chart shall be a reproduction of the actual "as-built" system, showing the area covered by that controller with the area of coverage of each remote control valve, using a distinctly different pastel color, drawn over the entire area of coverage.
4. Following approval of charts by Town Engineer, they shall be hermetically sealed between two layers of 10-mil. thick plastic sheet.

### **1402.04 Operations and Maintenance Submittals**

1. Deliver the following items to the Town when work is completed and prior to final acceptance of work:
  - a. One (1) wrench for disassembly and adjustment of each type of sprinkler head supplied.
  - b. One (1) 30-inch sprinkler key for operation of manual drain valves.
  - c. Two (2) keys for each automatic controller.
  - d. Two (2) quick coupler keys and two (2) matching hose swivels for each type of quick coupling valve installed.
  - e. Two (2) keys for opening valve boxes.
  - f. Two (2) sprinkler heads of each size and type installed.
  - g. One (1) 72-inch steel tee wrench for operating gate valves with square nut.

## **1403 MATERIALS**

### **1403.01 Delivery**

Deliver, unload, store, handle materials, packaging, bundling, products in dry, weatherproof, waterproof condition in manner to prevent damage, breakage, deterioration, intrusion, ignition, and vandalism. Deliver in original unopened packaging containers prominently displaying manufacturer name, proprietary, volume, quantity, contents, instruction,



conformance to local, state, and federal law. Remove and replace cracked, broken, contaminated items or corrosive elements prematurely exposed to moisture, inclement weather, snow, ice, temperature extremes, fire, and job site damage.

#### **1403.02 Handling of PVC Pipe**

The Contractor is cautioned to exercise care in handling, loading, and storing of PVC pipe. All PVC pipe shall be transported in a vehicle which allows the length of pipe to lie flat so as not to subject it to undue bending or concentrated external load at any point. Any section of pipe that has been dented or damaged will be discarded and, if installed, shall be replaced with new piping. Pipe should not be stored/exposed to prolonged sunlight exposure (6 months plus).

#### **1403.03 Storage of Materials**

All materials shall be carefully stacked or stored at an area designated by the Town Engineer, if available. Contractor must make prior arrangements with the Town Engineer before moving any materials on site for storage. Contractor is responsible for care and security of all stored materials.

#### **1403.04 Products**

1. Irrigation Mains:
  - a. Purple PVC Pipe: Pipe shall be suitable for use at maximum hydrostatic working pressure of 200-psi. Pipe shall be made from clean, virgin, NSF approved, type 1, and grade 1 PVC conforming to Astin Resin specification D1784-60 and project standard D2241 for PVC SDR21. Gasketed pipe shall be of the type prescribed by manufacturer. No insert gaskets or insert gasket fittings shall be accepted. Install thrust blocks in accordance with pipe manufacturer's recommendations.
  - b. Fittings: PVC gasketed fittings shall conform to ASTM D-3139-98. Gaskets shall conform to ASTM F-477-99.
2. General Piping:
  - a. Pressure Supply Line: From point of connection through backflow prevention unit: Type K copper.
  - b. Downstream Lines: Pressure supply lines downstream of backflow prevention units: CL-200 PVC.
  - c. Non-pressure lines: CL-200 PVC.
  - d. Sleeves: CL 160 PVC.



3. Brass Pipe and Fittings:
  - a. Brass Pipe: Brass pipe shall be 85% red brass, American National Standard Institute (ANSI), Schedule 40 screwed pipe.
  - b. Fittings: Fittings shall be medium brass, screwed 125-pound class.
4. Copper Pipe and Fittings:
  - a. Copper Pipe: Copper pipe shall be type K, hard tempered, ASTM 13-88.
  - b. Fittings: Fittings shall be wrought copper, solder joint type.
  - c. Joints: Joints shall be soldered with silver solder, 45% silver, 15% copper, 16% zinc, 24% cadmium and solidus at 1125-degrees Fahrenheit and liquids at 1145-degrees Fahrenheit.
  - d. Use a dielectric union whenever a copper-based metal (copper, brass, bronze) is joined to an iron-based metal (iron, galvanized steel, stainless steel).
5. Plastic Pipe and Fittings:
  - a. Identify all pipe with the following indelible markings:
    - i. Manufacturer's name
    - ii. Nominal pipe size
    - iii. Schedule of class
    - iv. Pressure rating in psi
    - v. NSF (National Sanitation Foundation) seal of approval
    - vi. Date of extrusion
  - b. Pipe (Solvent Weld Type): Manufactured from virgin polyvinyl chloride compound in accord with ASTM D 2241 and ASTM D 1784, cell classification 12454-B, Type 1, Grade 1 with the following:
    - i. Fittings: Standard weight, Schedule 40, injection molded PVC. Comply with ASTM D 1784 and D 2466, cell classification 12454-B
    - ii. Threads: Injection molded type
    - iii. Tees and ells: Side gated



- iv. Threaded nipples: ASTM D 2464, Schedule 80 with molded threads
  - v. Joint cement and primer: Type as recommended by manufacturer of pipe fittings
  - c. Sleeves: Class 160 BE PVC, minimum diameter two (2) sizes larger than pipe; 2-inches minimum diameter for wire.
  - d. Marking Tape: Standard, Type 1, non-detectable, 6-mil linear low density polyethylene.
  - e. Color blue to match APWA standards.
  - f. Printed surface, black ink with protective coating, "BW" (blue water).
6. Backflow Preventer:
- Size and type as shown on plans, without protective cage. "Febco" 825Y.
7. Isolation Valves:
- Isolation valves shall be resilient wedge gate valves, 2-inch and smaller shall be Nibco T-22 series, and 2-1/2-inch and larger shall be Nibco P-619-RW 200 psi push on gate valve with locking gasket or approved equal.
8. Quick Coupling Valves:
- "Rain Bird" 44NP two-piece type brass body, 150-pound class, with female threads opening at the base. Valve design to permit operation with a special connection device (coupler) designed for this purpose:
- a. Coupler threads: Lug type.
  - b. Hinge cover: Provide with "non-potable" rubber-like vinyl cover.
9. Remote Control Valves:
- a. Valve Type: "Rain Bird" PESB Series spring-loaded, packless diaphragm activated, normally closed type with plastic body, equipped with flow control and pressure regulator. Equipped with bleeder valve to permit operation in the field without power at the controller.
  - b. Valve Solenoid: 24-volt AC, 4.5-watt maximum, 500-milliamp maximum surge, corrosion proof, stainless steel construction, epoxy encapsulated to form a single integral unit.
10. Valve Boxes:
- a. Pressure Reducing Valves: For pressure reducing valves, use Ametek or Carson 12-inch Standard Box.



- b. Control Valves: For control valves 3/4-inch through 2-inches, use Ametek or Carson 12-inch Standard Box or Jumbo as needed with extensions as required.
  - c. Control Wiring Splices: Carson #910-12, Brooks #1100 box or approved equal.
  - d. Valve manifolds (2 or more valves): Carson #1730-12B, Brooks #2436-18, or approved equal.
11. Electrical Control Wiring:
- a. High Voltage:
    - i. Town will provide the necessary 110-volt electrical supply to point of hookup for irrigation controller. Contractor is responsible to connect line power to all system equipment. Enclose wiring in conduit.
    - ii. Meet all local codes and ordinances.
  - b. Low Voltage:
    - i. The electrical control wire shall be No. 14 direct burial copper wire AWG U.F.U.L. approved or larger, if required to operate system as designed.
    - ii. All control wires shall be red. All common wires shall be white. All spare wires to be different color from control wires.
    - iii. If multiple controllers are being utilized, and wire paths of different controller cross each other, both common and control wires from each controller to be of different colors.
    - iv. Control wire connections and splices shall be made with "Rain Bird" Pentite connectors, or similar dry splice method.
    - v. Control wire not installed in mainline trench to be installed in PVC Schedule 40 electrical conduit.
12. Automatic Controller:
- Size and type as shown on approved plans. Mounted on exterior of existing pump house with protective case.
13. Sprinkler Heads:
- a. General Requirements: All sprinkler heads shall be as shown on plans or as approved.
    - i. Riser units shall be fabricated in accordance with any details or approvals.
    - ii. Riser nipples for all sprinkler heads shall be the same size as the riser opening in the sprinkler body.
  - b. Gear Driven Turf Rotor: "Rain Bird" 5000 Series.
    - i. Body and nozzle: Plastic material.



- ii. Body threads: Female, 1-inch IPS.
- c. Pop-up Turf Heads: "Rain Bird" 1800 SAM-PRS.
  - i. Plastic body and nozzle.
  - ii. Pop-up height 12-inches.
  - iii. Pre-set arc coverage.
  - iv. Standard trajectory.

## **1404 CONSTRUCTION STANDARDS**

### **1404.01 Protection of Property**

1. The Contractor shall be responsible for the preservation and protection of all trees, plants, monuments, structures, and paved areas from damage due to this work. In the event damage does occur, all damage to inanimate items shall be completely repaired or replaced to the satisfaction of the Town Engineer, and all injury to living plants shall be repaired by the Contractor or such persons as it may employ to accomplish this work. All the costs of such work shall be charged to and paid by the Contractor.
2. Buildings, walks, walls, and other property shall be protected from damage. Open ditches left exposed shall be flared and barricaded by the Contractor. Damage caused by the Contractor to asphalt, concrete, or other building material surfaces shall be repaired or replaced at the Contractor's expense. Contractor shall restore disturbed areas to original condition.

### **1404.02 Existing Trees and Shrubs**

1. All trenching or other work near existing evergreens or low branching deciduous material shall be done by appropriate methods so that no limbs, branches or root structure are adversely damaged in any way.
2. Excavation, in areas where root damage could occur, shall be done by an approved method including hand trenching which will insure the least possible damage. Roots one inch or larger in diameter, except directly in the path of pipe or conduit, shall be tunneled under and shall be protected to prevent scarring or excessive drying. Where a trenching machine is operated close to trees when small roots are cut, the wall of the trench adjacent to the tree shall be hand trimmed making clean cuts through roots. Trenches adjacent to trees should be closed within the same day.
3. Protection and Repair of Underground Lines



The Contractor shall be responsible for requesting the proper utility company to stake the exact location of any underground electric, gas, cable, water, or telephone lines. The Contractor shall take whatever precautions are necessary to protect these underground lines from damage, and, in the event damage does occur, all damage shall be repaired by the Contractor. All costs of such work shall be paid by the Contractor unless other arrangements have been made. The Contractor shall, at his expense, locate any private utilities (i.e. electrical service to outside lighting) before proceeding with any excavation. If, after such request and necessary staking, private utilities which were not staked are encountered and damaged by Contractor, they shall be repaired by the Contractor.

4. Replacement of Paving and Curbs

Where trenches and lines cross existing roadways, paths, curbing, etc., damage to these shall be kept to a minimum and shall be restored to original condition. Saw cutting of pavements may be required. Sections will be removed to nearest joint when directed by Town Engineer or shown on plans. No paving shall be removed without prior written approval of the Town. Pavement will be replaced in accordance with Section 520 of these specifications.

**1404.03 Staking and Layout**

1. The Contractor shall provide all materials necessary for the staking of the irrigation system. Staking shall occur as follows:
  - a. Contractor shall mark the routing of pressure supply line and flag heads for all zones.
  - b. All piping and equipment shown diagrammatically on drawing, any irrigation equipment shown outside of planting areas shall be installed inside planting areas whenever possible.
  - c. Lay out sprinkler heads and make any minor adjustments required due to differences between actual site conditions and the drawings. Minor adjustments shall be maintained within the original design intent.
  - d. Lay out each system using staking method as approved by Town Engineer. Maintain and protect approved staking layout.

**1404.04 Excavation, Trenching and Backfilling**

1. Layout: Trench excavation shall follow, as much as possible, shortest layout possible at approved layout to required depths.
2. Pipe Support: Dig trenches straight and support pipe continuously on even grade continuously for full run of trench. Trench bottom shall be clean and smooth with all rock and organic debris removed.



3. Trench Width: For all piping smaller than three inches, trenches shall have a minimum width of seven inches, or as adequate to permit work space for installing connections and fittings.
4. Vibratory Plow: Not permitted.
5. Pipe and Wire Depth:
  - a. Main Line Piping – 24-inches from top of pipe, maximum 3-feet.
  - b. Non-pressure Piping (rotor) – 18-inches from top of pipe.
  - c. Non-pressure Piping (pop-up) – 12-inches from top of pipe.
  - d. Control Wiring – side of pressure main. Sleeved and at 18-inch depth when not in main line trench.

#### **1404.05 Line Clearances**

1. Provide not less than 4-inch clearance between each line and not less than 6-inch clearance between lines of other trades.
2. Do not install parallel lines directly over any other line.

#### **1404.06 Installation**

1. Solvent Weld PVC: All plastic to plastic joints shall be made and pipe laid following manufacturer's recommendations for same including cold weather protection.
2. Threaded fittings: Assemble using Teflon tape applied to male threads only. Tighten with strap-type friction wrench.
3. Tape all open ends to pipe during installation to prevent entry of any foreign matter into the system.
4. Pipe shall be snaked as much as possible to allow for expansion and contraction.
5. Cure for 30-minutes before handling, 24-hours before water carry.

#### **1404.07 Wiring**

1. Low Voltage:
  - a. Controller will be required. Control wiring between existing controller(s) and electric valves shall be buried in main line trenches; or in a separate trench in



PVC sleeve from controller to main line. Use a continuous wire unless otherwise approved for a splice.

- b. All 24-volt wires shall be bundled at 25-foot intervals and laid with pressure supply line pipe to one side below mainline in the trench.
  - c. An expansion loop shall be provided at every pressure pipe angle fitting and every 500-feet. Expansion loop shall be formed by wrapping wire at least eight (8) times around a 3/4-inch pipe and withdrawing pipe.
  - d. All splices and ECV connections shall be made using "Rain Bird" Pentite connectors, or similar dry splice method. Provide 24-inch loop of excess wire at each splice and connection to allow for future maintenance.
  - e. All control wire splices not occurring at control valves shall be installed in a separate splice valve box.
  - f. Install one (1) control wire for each control valve.
  - g. Run two (2) spare #14-1 wires from controller pedestal or terminal along entirety of pressure supply line to last electric control valve on each and every leg of main-line.
  - h. Label spare wires at controller and wire stub box.
  - i. Provide for four (4) additional valves to modify existing manual system.
2. High Voltage Wiring for Automatic Controller:
- a. 110/120-volt power connection to the automatic controller shall be provided by the Contractor. Live power to point of controller by Town as per local codes.
  - b. All electrical work shall conform to local codes, ordinances and union authorities having jurisdiction. All high voltage electrical work to be performed by licensed electrician.

#### **1404.08 Automatic Controller**

1. Existing as shown on plan. Verify location with Town in coordination with power.
2. Contractor to connect any new remote control valves to Town's controller in numerical sequence.
3. Contractor to install all valve wires to controller.

#### **1404.09 Electric Control Valves**

1. General: Install where shown on plans and as per details.



2. Grouping: When grouped together, allow at least 24-inches between valves.
3. Separate Boxes: Install each remote control valve in a separate valve box.
4. Low Points: Do not install at low points.

#### **1404.10 Quick Coupling Valves**

Install quick coupling valves per plans and details. All quick couplers shall be installed on double swing-joint risers of Schedule 40 PVC. Angled nipple relative to pressure supply line shall be no more than 45-degrees and not less than 10-degrees.

#### **1404.11 Valve Boxes**

1. Installation Details: Install one valve box for each type of valve installed as per details.
2. Gravel Sump: Gravel sump shall be installed after compaction of all trenches. Final portion of gravel shall be placed inside valve box after installation of valve.
3. Branding: Controller letter and station number are to be branded on the lid of each valve box. Letter and number size to be no smaller than 1-inch and no greater in size than 1-1/2 inch, depth of branding to be no more than 1/4-inch into valve box lid.

#### **1404.12 Isolation Valves**

Install main line isolation valve where shown on plans and as per detail.

#### **1404.13 Sprinkler Heads**

Install the sprinkler heads where designated or where staked as per plan details. Spacing of heads shall not exceed the maximum recommended by the manufacturer.

#### **1404.14 Adjustment and System Coverage**

1. Coverage and Performance:

The Contractor shall install and adjust all sprinkler heads for optimum performance and to prevent over-spray onto walks, roadways, and buildings as much as possible. If it is determined that adjustments in the irrigation equipment will provide proper and more adequate coverage, the Contractor shall make such adjustments prior to final acceptance at direction of Town at no additional expense. Adjustments may also include changes in nozzle sizes, degrees of arc and control valve throttling as required.



2. Valves:

Adjust flow controls and pressure reducing valves to attain the required pressure (as shown on sprinkler head legend) at the sprinkler head.

3. Grade Set:

All sprinkler heads shall be set perpendicular to finished grade unless otherwise designated.

4. Corrections:

Any areas which do not conform to designed operation requirements due to unauthorized changes or poor installation practices shall be immediately corrected at the Contractor's expense.

#### **1404.15 Training**

Train the Town's maintenance personnel in proper operation of all major equipment, including recommended winterization procedures. Provide this training at the Town's convenience and submit written evidence that training has been successfully completed.

#### **1404.16 Maintenance**

After final acceptance, the Town will immediately assume maintenance responsibility.

#### **1404.17 Clean-up**

Clean-up shall be a continuous operation throughout the duration of the work. Contractor shall be responsible for disposing of, off site, at no additional expense, any trash or debris generated by the installation of the work. Upon completion of work, restore ground surfaces to required elevation and remove excess materials, debris and equipment from the site to satisfaction of the Town Engineer.

### **1405 TESTING AND INSPECTION**

#### **1405.01 Flushing**

1. Flush all lines as follows:
  - a. All pressure supply lines shall be flushed from dead end fittings for a minimum of 5-minutes under a full head of pressure.
  - b. Before sprinkler heads are set, non-pressure lines shall be thoroughly flushed to clean all foreign matter in the lines.



**1405.02 Pressure Supply Line Testing**

1. The Contractor shall arrange for the presence of the Town 48-hours in advance of testing. Contractor must supply compressor and all other test equipment.
2. Testing Pressure:  
  
After backfilling, fill pressure supply line with water pressure 40-psi over the designated static pressure or 150-psi, whichever is greater, for a period of 2-hours.
3. Repairs:  
  
Any leaks which occur during the test period will be repaired immediately following the test. The pressure supply line will then be retested until accepted by the Town.
4. Testing Period:  
  
Before final acceptance, the pressure supply line must remain under pressure for a period of 48-hours.

**1405.03 Manual Valves**

1. Test all drain, isolation, quick coupler valves completely to insure proper operation and incorporation into system.
2. Operation Prior to Turf Installation: Do not seed or lay sod until all required zones are completely operational and fully tested for 2-minutes minimum.

**1405.04 Preliminary Walk Through**

1. Notification:  
  
The Contractor shall arrange for presence of Town Engineer 48-hours in advance of walk through.
2. Installation and Operation:  
  
Entire system shall be completely installed and operational prior to scheduling of walk through. Test shall be accomplished before any ground cover or turf is planted.
3. Zone Operation:  
  
The Contractor shall operate each zone in its entirety for the Town Engineer at time of walk through and will additionally open all valve boxes, if directed by the Town Engineer.
4. Punch List:



Town or his Engineer shall generate a punch list indicating all items to be corrected prior to final walk through. Final walk through to be within 7-days of generated punch list.

5. Corrections:

Furnish all materials and perform all work required to correct any inadequacies of coverage due to deviations from plans, or where the system has been willfully installed as indicated on the drawings when it is obviously inadequate or inappropriate, without bringing to the attention of the Town.

**1405.05 Final Acceptance and Walk Through**

1. Notification:

The Contractor shall arrange for presence of the Town Engineer 48-hours in advance of final walk through.

2. Submittal Evidence:

The Contractor shall show evidence that the Town has received all accessories, charts, record drawings and equipment as required before final acceptance will be scheduled.

3. Operation:

The Contractor shall operate each zone in its entirety for the Town Engineer at time of walk through to insure correction of all items on the punch list. Any items deemed not acceptable by the Town Engineer shall be reworked to the complete satisfaction of the Town Engineer.

**1406 REFERENCES**

Standards Referenced in Section 1400:	
Standard	Title
ASTM D 2241	Standard Specification for Poly(Vinyl Chloride) (PVC) Pressure-Rated Pipe (SDR Series)
ASTM D 1784	Standard Specification for Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds
ASTM D 2464	Standard Specification for Threaded Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80



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**1500 DESCRIPTION**

1. This section is for all Town of Frederick construction projects. All landscaping for development projects and development review should refer to the Town of Frederick Land Use Code.
2. Order and furnish all labor, materials, supplies, tools and transportation and perform all operations in connection with and reasonably incidental to complete the installation of the landscaping and guarantee as shown on the drawings. The work shall include but not necessarily be limited to the following:
  - a. Soil preparation
  - b. Fine grading of all planting areas
  - c. Protection of existing landscaped areas
  - d. Seeding
  - e. Sodding
  - f. Planting, staking and guying
  - g. Mulching
  - h. Pre-inspection maintenance of installed work
  - i. Clean-up, inspection and approval
  - j. Guarantee of all work

**1501 GENERAL PROVISIONS**

Only qualified, well trained personnel shall be used to complete work and operate equipment. Where licenses or certifications are required, i.e. herbicide application, only those approved and licensed personnel shall be employed. The landscape crews shall be supervised by an on-site superintendent or foreman holding a Certified Landscape Technician (CLT) certificate as provide by the Associated Landscape Contractors of Colorado (ALCC).

**1502 SUBMITTALS**

All submittals shall be accepted by the Town Engineer in writing before any planting commences.



**1502.01 Materials List**

Submit a list of all materials to be used in the planting operations, together with the source of those materials. The list shall include plant materials, mulches, soil amendments, edgers, tree stakes and guys, etc.

**1502.02 Descriptive Data**

Submit catalog cuts, brochures, analyses of any manufactured items.

**1502.03 Analytical Tests**

Submit results of any analytical tests, performed by a certified soils laboratory, or suppliers certified analysis of materials with certified specification requirements. Analysis must be current, up-to-date and reliable as determined by the Town Engineer.

**1502.04 Soil Test**

1. Submit soil test analysis report for each sample of topsoil and planting mix from a soil testing laboratory approved by the Town Engineer.
2. Provide a particle size analysis, including the following gradient of mineral content:

Table - 1500-01 - Class of Pipe
USDA Designation
Gravel
Very Coarse Sand
Coarse Sand
Medium Sand
Fine Sand
Very Fine Sand
Silt
Clay

3. Provide a chemical analysis, including the following:
  - a. pH and buffer pH
  - b. Percentage of organic content by oven-dried weight.
  - c. Nutrient levels by parts per million, including phosphorus, potassium magnesium, manganese, iron, zinc, and calcium. Nutrient test shall include the testing laboratory recommendations for supplemental additions to the soil based on the requirements of horticultural plants.



- d. Soluble salt by electrical conductivity of a 1:2, soil: water, sample measured in millimho per cm.
- e. Cation exchange capacity (CEC).

**1502.05 Soil Amendment Humus Test**

Submit the manufacturer's particle size analysis, salt analysis and the pH analysis and provide a description and source location for the content material of all soil amendment humus materials.

**1503 MATERIALS**

**1503.01 Sod**

1. All sod for sod areas shall be a blended mixture of four (4) improved bluegrass varieties:
  - a. 25% SR2100
  - b. 25% Freedom 2
  - c. 25% New Glade
  - d. 25% Award
2. Sod available from Green Hills Sod Farm, 1283 Weld County Road 38, Berthoud, Colorado 80513, 970-535-4317. Similar sod acceptable if source and mixture blend is made known and approved prior to laying. The Contractor will furnish written proof by certificate of sod variety to Town Engineer. Sod must be tested by the Colorado State Laboratory or a certified laboratory at the Contractor's expense, if requested by the Town Engineer.
3. Sod shall be healthy, field grown, free of weeds and insects, and without undesirable debris such as stones, twigs, excess grass clippings, etc.
4. Cut root zone at a uniform thickness of 3/4-inch to 1-inch. Town Engineer has the option of inspecting and approving sod at growing source.
5. Immediately prior to cutting and lifting, all sod shall have been mowed to a height of 2 to 2-1/2-inches. During growth and culture, sod shall have been mowed, watered, fertilized, sprayed for weeds, and otherwise regularly maintained to produce a healthy, vigorous turf, free of undesirable weeds or grasses.
6. Deliver to the site within 24-hours of cutting in trucks with protective coverings to prevent drying and exposure. Limit daily deliveries of sod which can be laid within 48-hours of delivery time. Care will be exercised at all times to retain the native soil



on the sod roots during transportation, handling and planting. Dumping sod from vehicles will not be permitted.

7. During delivery and while in stacks, all sod will be kept moist and protected from exposure to the wind, sun and freezing. All damaged or dry sod will be rejected.

### **1503.02 Top Soil**

1. Imported Topsoil:

Top soil shall be loamy, friable soil, containing a minimum of 1.5% by dry weight organic matter; free from: subsoil, refuse, roots, heavy or stiff clay, stones larger than 1-inch, noxious seeds, sticks, brush, litter, and other deleterious substances including soluble natural salts. It shall be suitable for the germination of seeds and the support of vegetative growth. The pH value shall be between 6.5 and 8.0.

Provide a minimum of one soil sample with the accompanying soil test report per 250-cubic yards of material required from samples obtained randomly throughout the source field location or stockpile.

2. Existing Topsoil:

Existing topsoil may be used if it meets the requirements for imported topsoil or if approved by Town Engineer. Provide a minimum of one soil sample with accompanying soil test report for each topsoil type found at the site. Following the completion of the soil testing, the Contractor and Town Engineer shall meet at the site prior to beginning of topsoil stripping and establish the limitations of areas where existing topsoil may be used and the depth of topsoil stripping permitted.

*(NOTE: The Town Engineer may test the existing soil prior to bidding any projects and include the areas and depths of topsoil availability in the bid documents along with the soil test results.)*

### **1503.03 Soil Amendments**

Soil amendment humus shall be Aspen Rich Compost as supplied by Jensen Sales Company, Littleton, Colorado or A-1 Compost, Eaton, Colorado or BOSS Compost, Denver, Colorado. Submit analysis as required by Section 1503.5, Soil Amendment Humus Test.

### **1503.04 Fertilizer**

1. Soil Preparation Fertilizer:

Diammonium phosphate, soluble mixture in granular form of treated minerals with 18% nitrogen and 46% minimum available phosphoric acid (18-46-0).



2. Sod/Seed Fertilizer:

Inorganic base (20-10-5) analysis with 2% iron and 8% sulfur. Submit manufacturer's guaranteed analysis as required in Section 1603, Submittals.

**1503.05 Mulches**

1. Wood Cellulose Mulch:

Wood fiber mulch for seeded areas dyed green for visual metering, 12% maximum water content, 1-1/2 to 2-pounds weight per cubic foot, pH 4.5 to 7.0, Conwed "HydroMulch 2000 Fiber" with tacifier, straw, or approved equal.

2. Shredded Wood Mulch (Aspen Coarse):

Natural tree mulch, shredded and mixed to create a blend of coarse, fibrous material that will intertwine and mat when placed. Equal to 'Aspen Coarse' mulch supplied by Jensen Sales Company.

**1503.06 Decorative Cobble and Gravel**

1. Cobble:

Native stream cobble, 4 to 8-inch diameter, round oval shape, tan/gray shades, less than 15% fractured or not entire.

2. Washed River Gravel:

Native river gravel, 1-1/2-inch diameter, generally rounded-oval with no more than 20% fracture. Supply from one source only.

**1503.07 Grass Seed Mix**

1. Seed for grass shall be fresh, clean, new crop seed composed of the varieties as specified, testing weeds as specified, and applied at the rate shown. Provide premixed and bagged with required contents tags. Seed shall have been tested for purity, germination and freedom from weeds within 6-months of the date of the contract. All seed shall be free of *Poa annua*, noxious weeds and shall not exceed 0.1% crop seed. Unless otherwise directed by Town Engineer, seed germination shall equal or exceed 90% and a purity of 85%. Poundage rates are given in bulk pounds. Obtain from Arkansas Valley Seed, Inc. or Pawnee Butes Seed Company.

2. All seed to be mixed by the wholesale dealer. The seed shall be mixed in the proportions necessary to obtain the application rate specified. The Contractor shall furnish the dealer's guaranteed statement of composition of mixture, percentage of



- purity, germination and maximum weeds for each seed mix to Town Engineer upon delivery of the seed mixture to the site and prior to application.
3. Light – Medium Use:
    - a. Wear-n-Tear #450564.50
    - b. 40% Bonanza II Tall Fescue
    - c. 40% Crewcut Tall Fescue
    - d. 10% Blue Chip Kentucky Blue
    - e. 10% Omni Perennial Rye
    - f. Seed rate: 220-260 bulk pounds/acre by volume (5.5 to 6-pounds per 1000-square feet). If hand broadcast, seeding rate is doubled.
  4. Medium – Heavy Use:
    - a. ProSports Turf #450495.50
    - b. 25% SR2100 Kentucky Bluegrass
    - c. 25% Arcadia
    - d. 25% SR4200 Perennial Rye Grass
    - e. 25% Manhattan III Perennial Rye Grass
    - f. Seed rate: 175 bulk pounds/acre by volume (4-pounds per 1000-square feet).  
If hand broadcast, seeding rate is doubled.
  5. Colorado Native (Non-Irrigated):
    - a. 30% Western Wheat Grass
    - b. 25% Slender Wheat Grass
    - c. 15% Blue Gramma
    - d. 10% Buffalo Grass
    - e. 10% Arizona Fescue
    - f. 5% Canada Wild Rye Grass
    - g. 5% Canby Blue Grass



- h. Seed rate: 15 bulk pounds per acre by volume (1/3-pound per 1000 square feet).  
If hand broadcast seeding: 40 bulk pounds per acre by volume (1-pound per 1,000-square feet)
6. Special Situation Seeding by permission of the Town Engineer only.

### **1503.08 Water**

Contractor is responsible for coordination of his needs for water with Town Engineer. Contractor must arrange any pay for water. If fire hydrant is to be used, Contractor may be required to use a temporary meter. There may be a charge for this use. Contractor may be required to use his own portable water truck if Town Engineer's water source is not seasonably available. Water is expected to be supplied free of cost to the Town.

### **1503.09 Landscape Fabric**

Spunbond type landscape fabric/weed barrier similar and equal to Landmaster, Duon, Mirafi 140, Typar, or Stablenka T-80. Woven mesh or black polyethylene film materials are *not* acceptable.

### **1503.10 Steel Edging**

Preformed steel edging with provided stakes, 1/8" x 4" "Prosteel" or "Ryerson," painted green with overlapping joint configuration.

### **1503.11 Material for Staking and Guying**

1. Post Stakes:  
T-type metal fence posts with bottom anchor plate intact, eight foot (8-foot height, painted green.
2. Staking Wire:  
Annealed, galvanized iron or steel, 14-gauge wire. Provide 15-inch length of 1/2-inch diameter white PVC sleeve over all guying and staking wire.
3. Tree Collar:  
Non-stretch fabric with brass grommets, Model #PS-1 as manufactured by Foresight Industries, Cheyenne, Wyoming or "Neptco" arbor tape, white, 900-pound strength guying tape. Use collar size compatible with tree size and expected wind stress.

In lieu of Tree Collar and Staking Wire, use Tree Hugger as manufactured/distributed by SK Tree Products, LLC; 542 West Confluence Avenue; Salt Lake City, UT 84123; 801-891-4658; [www.treehugger.com](http://www.treehugger.com).



4. Tree Wrap:

Use 4-inch wide layered horticultural tree wrap with interior layer of asphaltic material. Material shall be specifically manufactured as horticultural tree wrap.

5. Tree Mulch Mats:

“Permascape” #10101 30-inch diameter manufactured fibrous, circular tree mulch mat from recycled rubber by Aquapore Moisture Systems, Inc.

6. Erosion Control Fabric:

Jute mesh of open, uniform weave, single jute yarn, not to vary in thickness by more than one-half normal diameter. Weight per lineal yard 1.22-pounds (+/- 5%). Smolder resistant. 48-inches wide (+/-1-inch). Complete with #11-gauge steel wire staples formed into ‘u’ shape, 6-inch long. Conforming to CDOT standard specifications.

**1504 METHODS**

**1504.01 Planting Time and Completion**

1. All balled and burlapped trees are to be dug during an appropriate time of year for optimum transplanting and survival.
2. Do not lay sod during periods of prolonged cold or heat as directed.
3. Plants shall be planted and turf seeded only when weather and soil conditions ideally permit and in accordance with locally accepted practice, as accepted by the Town Engineer, and within the requirements of the schedule.
4. Contractor assumes all responsibility for plant protection and planting at the proper time and conditions including unexpected influences from weather, i.e., winter kill, freeze damage, wind.
5. All required site preparation shall be completed prior to bringing plants, seed, sod, etc., to the site for installation. No storage of live material permitted on-site overnight unless given prior written approval by Town Engineer.
6. Do not seed when soil is less than ideal for seedbed preparation or wind displacement would occur during seeding operations.
7. Topsoil shall not be stripped, transported, or graded if moisture content exceeds field capacity or if the soil is frozen.
8. Topsoil stockpiles shall be protected from erosion and contamination.



9. Amendments required to be added, as indicated on the soil test report, shall be added by the Contractor at the time of soil preparation for sodding, seeding or planting.

#### **1504.02 Site Preparation**

1. General:

All ground areas within the limits of planting shall be sodded, seeded, planted with trees or mulched with bark or gravel as indicated on the drawings and/or as specified herein.

2. Weed Control:

If the area to be developed is undisturbed or infested with bindweed, Canadian thistle, undesirable, noxious weeds or plants, the vegetation will be destroyed by a chemical application of Round-Up or equivalent at a rate recommended on the chemical's label for controlling all existing vegetation.

3. Excess Excavation:

Excess excavation may be wasted on-site, off-site, or in the planting area as directed by the Town Engineer at no cost. Excess excavation for off-site disposal is not expected.

4. Clearing:

Prior to any soil preparation, all existing vegetation which might interfere with the specified soil preparation shall be mowed, grubbed, raked, and the debris removed from the site. Prior to or during grading or tillage operations, the ground surface shall be cleaned of materials that might hinder final operations.

5. Addition of Soil Amendments:

If soil amendments are required as per soil test recommendations, they shall be tilled a minimum of 6 inches deep forming a homogenous uniform mix. Any sticks, stones or other debris brought to the surface during tilling that are 2-inches or more in any dimension shall be removed.

#### **1504.03 Topsoil Spreading**

1. Spread topsoil from on-site stripped pile or imported source over prepared grades free of ruts, holes, debris or other undesirable condition.
2. Spread topsoil to a depth of 6-inches over all areas to be seeded, sodded or otherwise planted. Grade to smooth surface ready for soil preparation.



#### **1504.04 Soil Preparation**

Soil preparation for all groundcover, sodded or seeded areas:

1. Rototill existing soil at required grades to a depth of 6-inches minimum in one direction using an approved rototiller. Areas adjacent to walks, structures, curbs, etc. where the use of large mechanical equipment is difficult shall be worked with smaller equipment or by hand.
2. Remove all rubble, stones, and extraneous material over 2-inches in diameter from the surface after each pass.
3. If soil amendments are required, spread fertilizer and soil amendment humus in quantities as dictated by the soils test, over the entire area to receive sod or seed and incorporate into the top 6-inches of soil by discing or rototilling thoroughly until a uniform mixture is obtained with no pockets of soil amendments remaining. Perform multiple passes at cross angles.
4. Fine grade to restore smooth, even finish grades and to insure positive surface drainage. Top of finish grade (sod or seed) shall be established as per Section 1504.5, Finish Grading. No planting or seeding shall take place until soil preparation and grade is accepted by the Town Engineer.

#### **1504.05 Finish Grading**

1. Finish grading shall be accomplished to within 1-inch of proposed elevations on any area of disturbed or fill soil. A smooth, compatible transition shall be produced between areas of undisturbed soil and the areas being finish graded. Debris shall be removed after final pass.
2. Blading, dragging, and soil cultivation techniques shall be used to produce a soil condition acceptable for sodding, seeding, ground cover beds, shrub areas, or mulched areas as shown on the plans. In sodding areas, the finish grade shall be held 1-1/2-inch below existing or proposed levels of sidewalks, curbs, sprinkler heads, etc. Seeded areas shall be held 1-inch below such elements, and mulched areas shall be held 1-inch greater than specified depth of the mulch.
3. Drainage swales, drain pipes, or other open sheet drainage areas requiring particularly accurate grades shall be staked by use of an instrument before construction to insure proper drainage.
4. Grassed swales shall be contained between 1-1/2 and 4% grades unless otherwise specified. Drainageways shall not contain any water holding depressions and shall have erosion control fabric as shown on the approved plans.
5. Mounds, terraces, or other earthforms shall be constructed to plans and/or instructions of the Town Engineer and shall be inspected and approved prior to finish



landscape treatment. Contractor shall use appropriate grading equipment to ensure detail undulation of earth forms as shown on plans or directed by the Town Engineer.

6. The Contractor shall prepare the site in an orderly condition free of all debris so that seeding, sodding, planting, and other construction operations may proceed immediately. All areas outside the contract limits that have been disturbed shall be restored to their original condition in accordance with procedures as described herein at Contractor's expense.

#### **1504.06 Sodding**

1. Lay sod on finish graded surface with tight joints and no overlap. Where applicable during hot weather conditions, lay according to complete irrigation zones in order to apply water as soon as possible. Lay perpendicular to slopes. Smooth any disturbed final grading and remove debris that may prohibit a smooth sod surface. Remove tree-watering berms as part of grading operation in irrigated turf area.
2. On slopes greater than 3:1 grade, provide staples, pins or cedar shingle stakes in all sodded areas in diamond pattern at three feet on center. Drive staking material flush to soil line of sod. On long slopes less than 3:1 grade, the Town Engineer may require staking.
3. Immediately upon laying sod and before watering, gently tamp or roll the sod to tighten joints and level any minor unevenness. Use a light weight roller that will not displace sod or cause depressions. Do not roll soil if underlying surface is wet enough to depress or displace sod. Hand tamp in areas inaccessible to motorized, large equipment.
4. Water immediately after fertilizing to produce a soggy condition to all sodded areas. As a guide to sufficient watering, sod should depress 2-inches from foot traffic. Prohibit all traffic after watering. Coordinate irrigation system controller and/or other requirements for optimum continual watering which prevents sod from showing signs of stress.
5. Where directed by Town Engineer, provide traffic control barriers sufficient to prohibit foot traffic during establishment period.

#### **1504.07 Seeding**

1. Seed shall be spread at the rate specified in Section 1503.7, Grass Seed Mix, for the type of seed used when winds are calm, using a Brillion seeder or approved equivalent. If hydroseeding is used for seeding, seed shall be applied separately, not mixed in the mulch.
2. Do not use wet seed that is moldy or otherwise damaged in transit or storage.



3. Sow lawn grass seed using mechanical drill type (Brillion) seeding machine for slopes 4:1 and flatter and for slopes steeper than 4:1, sow seed with hydroseeder. Distribute seed evenly over entire area by sowing equal quantity in 2 directions at right angles to each other.
4. Sow native grass seed areas using hydraulic seeding equipment suited to conditions and capable of uniform sowing of seed and coverage of mulch.
5. For areas inaccessible to seeding machine or if its use is not required, rake seed lightly into top 1/4-inch of soil, roll lightly, and water with a fine spray. Cover with approximately 1/2-inch layer of peat mulch.

#### **1504.08 Mulching Seeded Areas**

1. Mulching of seed areas shall be accomplished immediately after seeding using an approved hydro-mulcher to apply wood cellulose fiber and mulch binder at rate of 2,000-pounds per acre or 46-pounds per 100-square feet.
2. Mulching shall not be done in the presence of free surface water resulting from rains, melting snow or other causes.
3. Areas not properly mulched, or damaged due to the Contractor's negligence, shall be repaired and the area remulched in an acceptable manner at the Contractor's expense. Mulch removed by wind prior to acceptance, shall be reestablished by the Contractor at his own expense.
4. Apply erosion control netting immediately after seeding and mulching. Do not complete seeding and mulching when erosion control operations cannot immediately follow.

#### **1504.09 Erosion Control**

1. Area to be Netted:

Apply jute netting and/or mulch binder to areas which are vulnerable to soil erosion. Areas include 6-feet on both side of swales, and slope areas in excess of 2-1/2 :1. In addition, see plans for specifically indicated areas. If the Contractor fails to net such areas and soil erosion subsequently occurs, Contractor shall re-establish the finish grade, soil preparation, seed bed, and apply jute netting at his own expense.

2. Jute Netting:

- a. Roll out in place after seeding and mulching. Apply material loosely and smoothly to soil surface without stretching. Avoid walking directly on the seed bed either before or after the jute is applied.



- b. Bury the up-channel end of each piece of jute netting in a narrow trench, 6-inches deep. After the jute is buried, tamp the trench firmly closed.
- c. In cases where one roll of netting ends and a second roll is needed, overlap up-channel piece over the second roll by at least 18-inches. When two or more widths of netting are applied side by side, make an overlap of at least 6 inches.
- d. Outside edges of Netting: Level to grade of seeded area at edges to allow for smooth entry of water.
- e. Stapling: Staple overlaps which run parallel to the direction of the flow in channel bottoms on 2-foot intervals. Staple outside edges, centers and overlaps on banks on 2-foot intervals.
- f. Each Width of Cloth: Install row of staples down the center as well as along each side.
- g. Staple check slots and junctions of new rolls across the channel on 6-inch intervals.
- h. On soft or sandy soil, or areas subject to wind blowout, apply staples in alternate diagonal position and space at fourteen inch (14-inch to eighteen inch (18-inch intervals.

#### **1504.10 Transportation and Storage of Plant Material**

1. Branches shall be tied with rope or twine only, and in such a manner that no damage will occur to the bark or branches.
2. During transportation of plant material, the Contractor shall exercise care to prevent injury and drying out of the trees. Should the roots be dried out, large branches broken, balls of earth broken or loosened, or areas of bark torn, the Town Engineer may reject the injured tree(s) and order them replaced at no additional cost to the Town. All loads of plants shall be covered at all times with tarpaulin or canvas. Loads that are not protected will be rejected.
3. Plants must be protected at all times from sun or drying winds. Those that cannot be planted immediately on delivery shall be kept in the shade, well protected with soil, wet mulch, or other acceptable material, and kept well-watered. Plants shall not remain unplanted any longer than 3-days after delivery. Plants shall not be bound with wire or rope at any time so as to damage the bark or break branches. Plants shall be lifted and handled with suitable support of the soil ball to avoid damage.

#### **1504.11 Mechanized Tree Spade Requirements**

Trees may be moved and planted with an approved mechanical tree spade. The tree spade shall move trees limited to the maximum size allowed for a similar B&B root-ball diameter



according to the *American Standard for Nursery Stock* and/or Colorado Nursery Act, or the manufacturer's maximum size recommendation for the tree spade being used, whichever is smaller. The machine shall be approved by the Town Engineer prior to use. Trees shall be planted at the designated locations in the manner shown in the plans and in accordance with applicable sections of the specifications.

#### **1504.12 Tree and Shrub Planting**

1. Establish Location:

Stake or set out trees in locations shown on the plans for approval by Town Engineer. Locate and mark all subsurface utility lines. Approval of the Town Engineer is required before excavation begins.

2. Planting Pits:

- a. Tree, shrub, and groundcover beds are to be excavated to the depth and widths indicated on the drawings. If the planting area under any tree is initially dug too deep, the soil added to bring it up to the correct level should be thoroughly tamped.
- b. The bottom of all beds shall slope parallel to the proposed grades or toward any subsurface drain lines within the planting bed. The bottom of the planting bed directly under any tree shall be horizontal such that the tree sits plumb.
- c. Maintain all required angles of repose of the adjacent materials as shown on the drawings. Do not excavate compacted subgrades of adjacent pavement or structures.
- d. Subgrade soils shall be separated from the topsoil, removed from the area, and not used as backfill in any planted or lawn area. Excavations shall not be left uncovered or unprotected overnight.
- e. For trees and shrubs planted in individual holes in areas of good soil that is to remain in place and/or to receive amendment in the 6-inch layer, excavate the hole to the depth of the root ball and to widths shown on the drawing.
- f. The sides of the holes shall be roughened to remove any compacting or "glazing" caused by the digging operation. The bottom of the hole shall be loosened to the minimum depth of 6-inches. Mix loosened soil to blend soil types and compact prior to planting to prevent settling after planting.
- g. If areas of soil with poor internal drainage are encountered as determined by Town Engineer's representative, over-excavate hole's perimeter ring by 50% to allow full pit water drainage within a 24-hour period. Notify Town Engineer's representative and receive acceptance before over-excavating.





4. If the root flare is less than 2-inch below the soil level of the root ball, plant the tree at the appropriate level above the grade to set the flare even with the grade. If the flare is more than 2-inch at the center of the root ball the tree shall be rejected.
5. Lift plants only from the bottom of the root balls or with belts or lifting harnesses of sufficient width not to damage the root balls. Do not lift trees by their trunk or use the trunk as a lever in positioning or moving the tree in the planting area.
6. Remove plastic, paper, or fiber pots from containerized plant material. No plant shall be planted in any partial or complete container. Pull roots out of the root mat, and cut circling roots with a sharp knife. Loosen the potting medium and shake away from the root mat. Immediately after removing the container, install the plant such that the roots do not dry out. Pack planting mix around the exposed roots while planting.
7. Cut ropes or strings from the top of shrub root balls and trees after plant has been set. Remove burlap or cloth wrapping from around top half of balls. Do not turn under and bury portions of burlap at top of ball. Completely remove any waterproof or water-repellant strings or wrappings from the root ball and trunk before backfilling.
8. Remove all wire baskets. Remove the bottom of the basket first and set the plant in the plant pit. Once plant is adjusted properly in plant pit, remove sides of wire basket.
9. Set balled and burlapped trees in the hole with the north marker facing north unless otherwise approved by the Town Engineer. Containerized material may not have a north orientation due to movement during the production process.
10. Place native soil, topsoil, or planting mix into the area around the tree, tamping lightly to reduce settlement.
11. For plants planted in individual holes in existing soil, add any required soil amendments to the soils, as the material is being backfilled around the plant. Ensure that the amendments are thoroughly mixed into the backfill.
12. For plants planted in large beds of prepared soil, add soil amendments during the soil installation process.
13. Ensure that the backfill immediately around the base of the root ball is tamped with foot pressure sufficient to prevent the root ball from shifting or leaning.
14. Thoroughly water all plants immediately after planting. Apply water by hose directly to the root ball and the adjacent soil.
15. Remove all tags, labels, strings, etc. from all plants.
16. Remove any excess soil, debris, and planting material from the job site at the end of each workday.



17. Form watering saucers 4-inch high immediately outside the area of the root ball of each tree as indicated on the drawings.

#### **1504.14 Mulching Trees and Shrubs**

1. Install specified mulch in all shrub beds, ground cover areas and around trees. Install mulch over smooth soil surface and up to base of plants and to containment paving and/or edging, 4-inch depth for mulch in shrub beds, 3-inch depth for organic mulch in ground cover areas. Use no underlayer of landscape fabric in ground cover areas or for individual trees in turf areas.
2. Keep mulch applications even; with smooth, level surface without voids. Place under shrub branches to trunk area. Do not cover runners of ground covers.
3. Provide mulched saucer for water retention in dryland areas. In irrigated turf area, mulch using steel edging for containment or concrete mulch containment curb or use mulch mat as specified.

4. Mulch Mat:

Install even with turf grades over smooth soil surface. Pin down with 12-inch steel edging staples four (4) per edge, two (2) per radius out. Cut out for trunk diameter as needed.

5. Edging Installation:

Install at grade to lines as shown on plans. Provide stakes for every preformed slot, anchor securely. Lower bed grade to bottom of edging and slope back for 2-feet to accommodate level of mulch.

#### **1504.15 Staking**

Stake trees in a true vertical position per the appropriate construction detail. Drive stakes plumb to equal elevations. Stakes and guys shall be installed immediately upon approval of planting, and shall be removed at the beginning of the second growing season.

#### **1504.16 Wrapping**

Wrapping material shall be applied from the base of the tree to the first branch. All wrapping material shall be applied only in the fall and removed no later than May 15<sup>th</sup> or as specified by the Town Engineer.

#### **1504.17 Pruning**

1. Plants shall not be heavily pruned at the time of planting. Pruning is required at planting time to correct defects in the tree structure, including removal of injured branches, double leaders, waterspouts, suckers, and interfering branches. Healthy



- lower branches and interior small twigs should not be removed except as necessary to clear walks and roads. In no case should more than one-quarter of the branching structure be removed. Retain the normal or natural shape of the plant.
2. All pruning shall be completed using clean, sharp tools. All cuts shall be clean and smooth, with the bark intact with no rough edges or tears.
  3. Except in circumstances dictated by the needs of specific pruning practices, tree paint shall not be used. The use of tree paint shall be only upon approval of the Town Engineer. Tree paint, when required, shall be paint specifically formulated and manufacturing for horticultural use.
  4. Pruning of large trees shall be done from a hydraulic man-lift such that it is not necessary to climb the tree.

#### **1504.18 Cleanup**

Clean the entire site of any construction debris, pruned material, excess material, weeds, etc., as a last operation. Broom clean is acceptable procedure, unless directed by the Town Engineer.

### **1505 MAINTENANCE**

#### **1505.01 Seeded/Sodded Area Maintenance**

Contractor is required to maintain all sodded/seeded areas until Initial Acceptance. Prior to Initial Acceptance all irrigated seeded areas shall be maintained with at least the following operations: water and adjust irrigation system for ideal seedbed moisture where seedbed is irrigated. Repair any erosion damage including seeding and mulching. Control weeds by mechanical or herbicide application methods. Remove debris. Maintain access barriers. Correct any site condition which may adversely impact the seeded area. Reseed and mulch all areas greater than 1-square foot which show no sign of germinating seedlings 3-weeks after sowing. Maintain any specified temporary irrigation systems.

#### **1505.02 Maintenance of Trees, Shrubs and Groundcovers**

1. Maintenance shall begin immediately after each plant is planted and continue until its acceptance has been confirmed by the Town Engineer.
2. Maintenance shall consist of pruning, watering, cultivating, weeding, mulching, mulch adjustment and refurbishing, tightening and repairing guys and stakes, resetting plants to proper grades or upright position, restoring of the planting saucer, and furnishing and applying such sprays or other materials as necessary to keep plantings free of insects and diseases and in vigorous condition.
3. Planting areas and plants shall be protected at all times against trespassing and damage of all kinds for the duration of the maintenance period. If a plant becomes



damaged or injured, it shall be treated or replaced as directed by the Town Planning Department at no additional cost.

**1505.03 Watering**

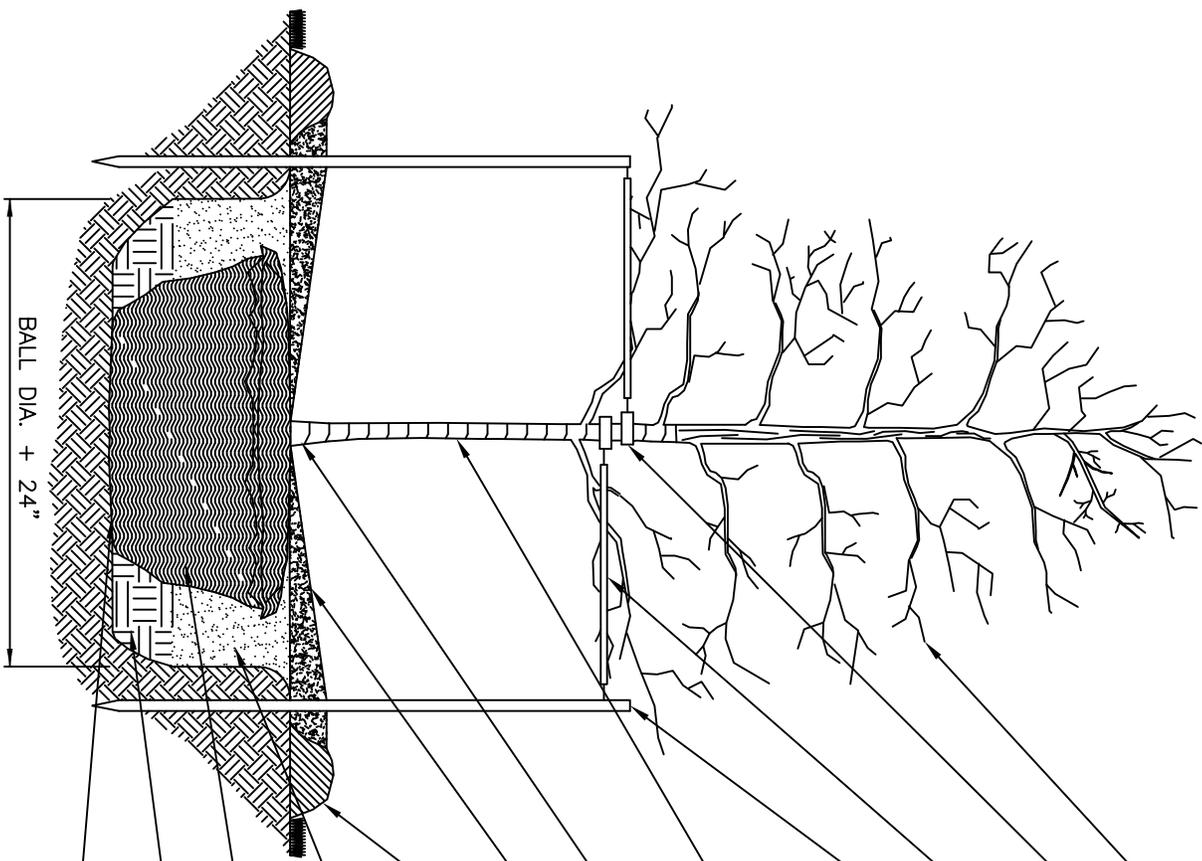
1. Contractor shall irrigate as required to maintain vigorous and healthy tree growth. Overwatering or flooding shall not be allowed. The Contractor shall monitor, adjust, and use existing irrigation facilities, if available, and furnish any additional material, equipment, or water to ensure adequate irrigation. Root balls of all trees and large shrubs shall be spot watered using handheld hoses during the first four months after planting, as required to ensure adequate water within the root ball. Winter watering is the responsibility of the Contractor for all guaranteed planting.
2. During periods of restricted water usage, all governmental regulations (permanent and temporary) shall be followed. The Contractor may have to transport water from ponds or other sources, at no additional expense to the owner when irrigation systems are unavailable.



**SECTION 1500 – LANDSCAPING**

1500-01	DECIDUOUS TREE PLANTING
1500-02	DECIDUOUS TREE PLANTING ON SLOPE
1500-03	MULTI-TRUNK TREE PLANTING
1500-04	EVERGREEN TREE PLANTING
1500-05	EVERGREEN TREE PLANTING
1500-06	SHRUB PLANTING
1500-07	GROUND COVER/PERENNIAL PLANTING
1500-08	TREE STAKING AND GUYING





DO NOT CUT OR DAMAGE LEADER, PRUNE DAMAGED OR DEAD BRANCHES AFTER PLANTING AND STAKING. KEEP CROWN SHAPE TYPICAL OF SPECIES.

SPECIFIED TREE STRAP COLLAR, DO NOT TWIST. STAKES TO BE SECURED TO TREE ABOVE THE FIRST LATERAL BRANCHES BUT NO HIGHER THAN HALF OF THE TREE HEIGHT.

14 GAUGE GALV. WIRE WITH 1/2" DIA. X 18" WHITE PVC PIPE ON EACH WIRE.

(3) SPECIFIED POSTS, 2" DIA., 6-8' HIGH, ALIGN EQUIDISTANT AROUND TREE. KEEP PLUMB WITH TOPS EVEN. DRIVE 12" INTO UNDISTURBED SUBGRADE OUTSIDE PLANTING PIT. TREE STAKES LOCATED INSIDE WATERING SAUCER ON TREES GREATER THAN 3" CALIPER. USE GUYS AS PER DETAIL NO. 1500-8

WRAP ENTIRE SURFACE OF TRUNK FROM THE BASE UP TO BRANCHES WITH REQUIRED WRAPPING, WHEN SPECIFIED. REFER TO SPECIFICATIONS. SECURE AT TOP WITH DUCT TAPE.

ROOT FLARE TO BE AT OR SLIGHTLY ABOVE THE FINISHED GRADE. SET TRUNK PLUMB. SEE NOTES AND SPECIFICATIONS IN SECTION 1500.

APPLY SPECIFIED MULCH AT 0" DEPTH AT TRUNK AND 4" DEPTH AT EDGE OF RING, INSIDE 4" WATERING SAUCER. REMOVE SAUCER UPON SODDING/ SEEDING IN IRRIGATED AREAS.

4" HIGH WATER SAUCER TO BE 30" FROM TRUNK OF DECIDUOUS TREES.

SPECIFIED BACKFILL MIXTURE. AMENDMENTS AS SPECIFIED IN TOP 12" DEPTH.

REMOVE ALL TWINE AND BURLAP FROM TOP 1/3 TO 1/2 OF ROOTBALL. COMPLETELY REMOVE WIRE BASKET.

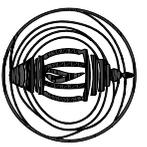
INITIAL STABILIZING BACKFILL 1/3 DEPTH, COMPACTED. SEE NOTES SPECIFICATIONS IN SECTION 1500.

UNDISTURBED SOLID GROUND PIT BOTTOM FOR ROOTBALL BASE.

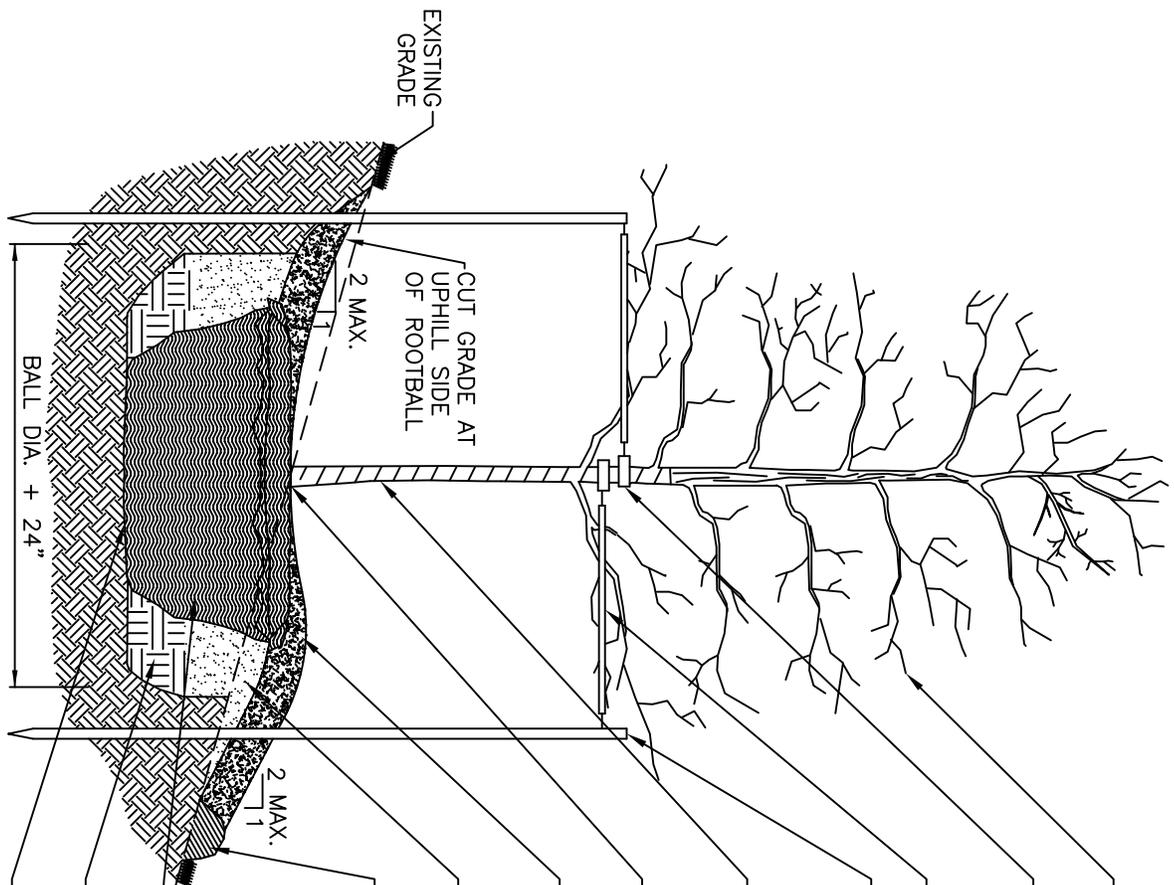
- NOTES**
1. GUYING AND STAKING TO BE REMOVED AFTER ONE GROWING SEASON.
  2. DO NOT PLANT ANY PLANT WITH A ROOTBALL THAT IS NOT IN COMPLIANCE WITH THE COLORADO NURSERY ACT REQUIREMENTS.

## DECIDUOUS TREE PLANTING

NTS



TOWN OF FREDERICK  
STANDARDS & SPECIFICATIONS



- DO NOT CUT OR DAMAGE LEADER, PRUNE DAMAGED OR DEAD BRANCHES AFTER PLANTING AND STAKING. KEEP CROWN SHAPE TYPICAL OF SPECIES.
- SPECIFIED TREE STRAP COLLAR, DO NOT TWIST. STAKES TO BE SECURED TO TREE ABOVE THE FIRST LATERAL BRANCHES BUT NO HIGHER THAN HALF OF THE TREE HEIGHT.
- 14 GAUGE GALV. WIRE WITH 1/2" DIA. X 18" WHITE PVC PIPE ON EACH WIRE.
- (3) SPECIFIED POSTS, 2" DIA., 6'-8' HIGH, ALIGN EQUIDISTANT AROUND TREE. KEEP PLUMB WITH TOPS EVEN. DRIVE 12" INTO UNDISTURBED SUBGRADE OUTSIDE PLANTING PIT. TREE STAKES LOCATED INSIDE WATERING SAUCER ON TREES GREATER THAN 3" CALIPER. USE GUYS AS PER DETAIL NO. 1500-8
- WRAP ENTIRE SURFACE OF TRUNK FROM THE BASE UP TO BRANCHES WITH REQUIRED WRAPPING, WHEN SPECIFIED. REFER TO SPECIFICATIONS. SECURE AT TOP WITH DUCT TAPE.
- ROOT FLARE TO BE AT OR SLIGHTLY ABOVE THE FINISHED GRADE. SET TRUNK PLUMB. SEE NOTES AND SPECIFICATIONS IN SECTION 1500.
- APPLY SPECIFIED MULCH AT 0" DEPTH AT TRUNK AND 4" DEPTH AT EDGE OF RING, INSIDE WATERING SAUCER. REMOVE SAUCER UPON SODDING/ SEEDING IN IRRIGATED AREAS.
- FILL DOWNHILL SIDE OF ROOTBALL WITH SPECIFIED BACKFILL MIXTURE. AMENDMENTS AS SPECIFIED IN TOP 12" DEPTH.
- WATER SAUCER AT LOWER HALF OF PLANT PIT, 4" IN HEIGHT OR AS NEEDED.
- REMOVE ALL TWINE AND BURLAP FROM TOP 1/3 OF ROOTBALL. COMPLETELY REMOVE WIRE BASKET.
- INITIAL STABILIZING BACKFILL 1/3 DEPTH, COMPACTED. SEE NOTES SPECIFICATIONS IN SECTION 1500.
- UNDISTURBED PIT BOTTOM FOR ROOTBALL BASE.

**NOTES**

1. THIS INSTALLATION SHALL APPLY TO ALL TREE TYPES AND SIZES PLANTED ON SLOPES 3:1 OR GREATER.
2. GUYING AND STAKING TO BE REMOVED AFTER ONE GROWING SEASON.
3. DO NOT PLANT ANY PLANT WITH A ROOTBALL THAT IS NOT IN COMPLIANCE WITH THE COLORADO NURSERY ACT REQUIREMENTS.

## DECIDUOUS TREE PLANTING ON SLOPE

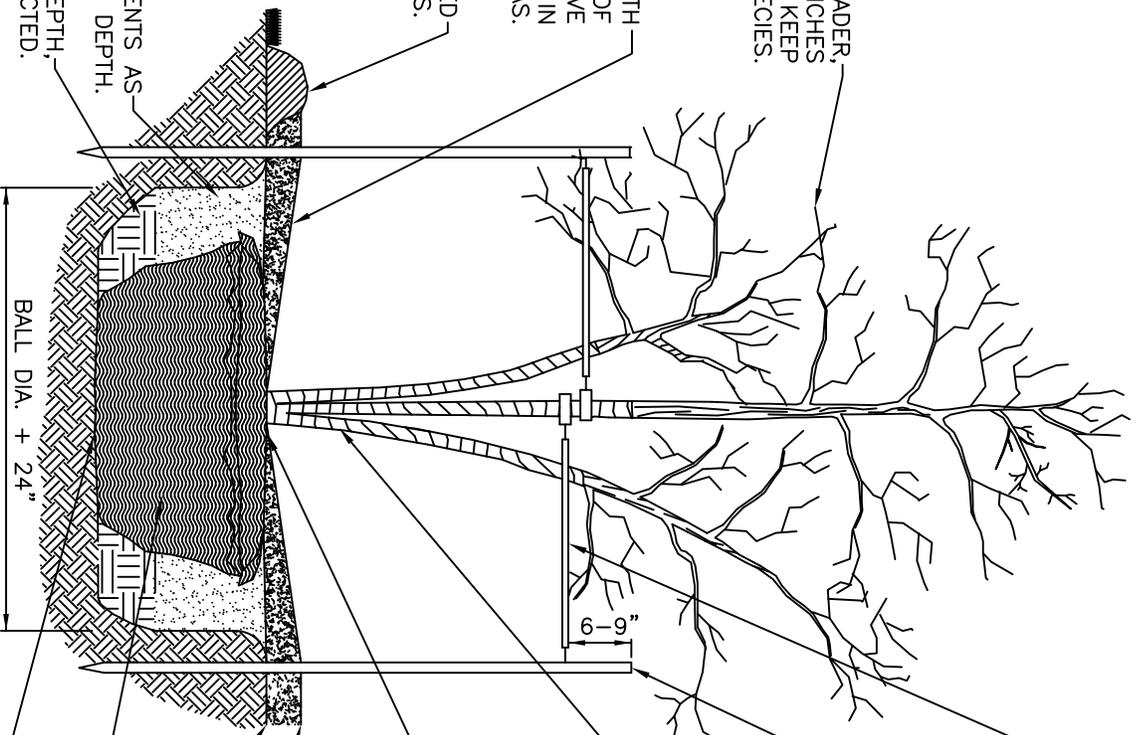


DO NOT CUT OR DAMAGE LEADER, PRUNE DAMAGED OR DEAD BRANCHES AFTER PLANTING AND STAKING. KEEP CROWN SHAPE TYPICAL OF SPECIES.

APPLY SPECIFIED MULCH AT 0" DEPTH AT TRUNK AND 4" DEPTH AT EDGE OF RING, INSIDE WATERING SAUCER. REMOVE SAUCER UPON SODDING/SEEDING IN IRRIGATED AREAS.

4" WATER SAUCER IN NON-IRRIGATED TURF AREAS.

SPECIFIED BACKFILL MIXTURE. AMENDMENTS AS SPECIFIED IN TOP 12" DEPTH. INITIAL STABILIZING BACKFILL 1/3 DEPTH, COMPACTED.



14 GAUGE GALV. WIRE, ATTACH TO SPECIFIED TREE STRAP COLLAR. DO NOT TWIST. THREE WIRE SUPPORTS ON MAIN STRUCTURAL BRANCHES. ALLOW FOR SLIGHT WIND MOVEMENT OF TRUNK(S). STAKES TO BE SECURED TO TREE ABOVE THE FIRST LATERAL BRANCHES BUT NO HIGHER THAN HALF OF THE TREE HEIGHT.

(3) SPECIFIED POSTS, 6'8" IN HEIGHT, ALIGN AS APPROVED. KEEP PLUMB WITH TOPS EVEN. DRIVE 12" INTO DISTURBED SUBGRADE OUTSIDE PLANTING PIT. TREE STAKES LOCATED INSIDE WATERING SAUCER ON TREES GREATER THAN 3" CALIPER. USE GUYS AS PER DETAIL NO. 1500-8.

WRAP ENTIRE SURFACE OF TRUNK FROM THE BASE UP TO BRANCHES WITH REQUIRED WRAPPING, WHEN SPECIFIED. REFER TO SPECIFICATIONS. SECURE AT TOP WITH DUCT TAPE.

ROOT FLARE TO BE AT OR SLIGHTLY ABOVE THE FINISHED GRADE. SET TRUNK PLUMB. SEE NOTES AND SPECIFICATIONS IN SECTION 1500.

MULCH BED LEVEL TO ADJOINING PLANTS. GROUND LEVEL.

REMOVE ALL TWINE AND BURLAP FROM TOP 1/3 OF ROOTBALL. COMPLETELY REMOVE WIRE BASKET. UNDISTURBED PIT BOTTOM FOR ROOTBALL BASE.

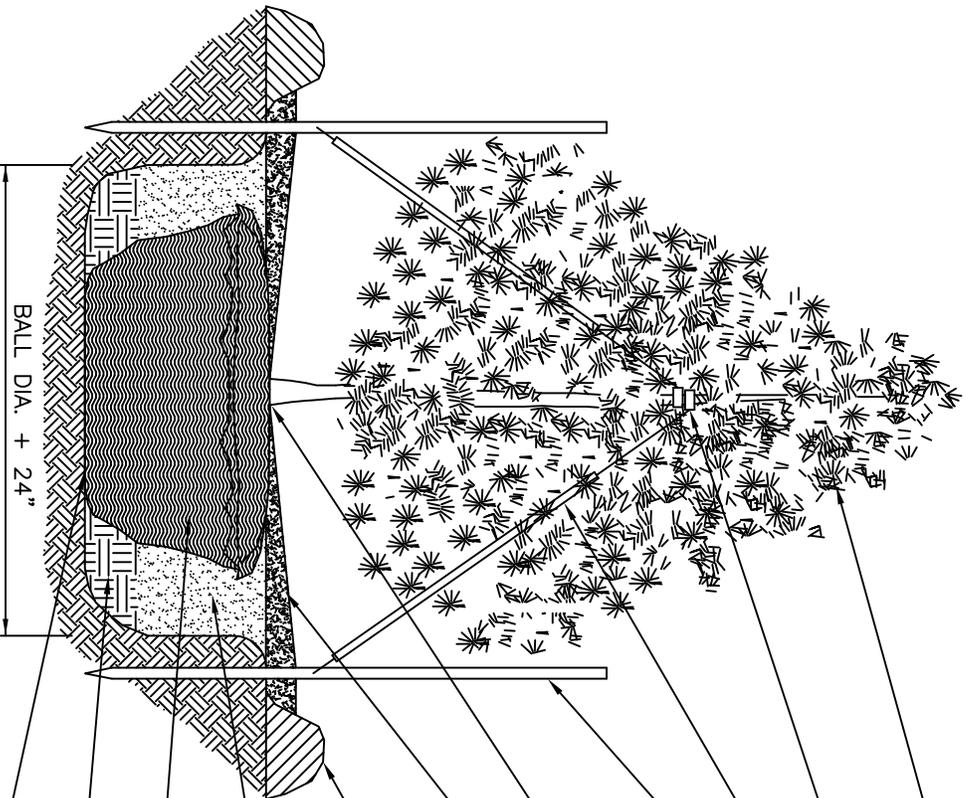
- NOTES
1. DO NOT ALLOW WIRE TO TOUCH OR RUB ADJACENT TRUNKS OR BRANCHES.
  2. GUYING AND STAKING TO BE REMOVED AFTER ONE GROWING SEASON.
  3. DO NOT PLANT ANY PLANT WITH A ROOTBALL THAT IS NOT IN COMPLIANCE WITH THE COLORADO NURSERY ACT REQUIREMENTS.

## MULTI-TRUNK TREE PLANTING

NTS



TOWN OF FREDERICK  
STANDARDS & SPECIFICATIONS



DO NOT CUT OR DAMAGE LEADER, PRUNE DAMAGED OR DEAD BRANCHES AFTER PLANTING AND STAKING. PRUNE TO TYPICAL FORM OF SPECIES. DO NOT PRUNE UP LOWER BRANCHES.

SPECIFIED HEAVY DUTY TRUNK COLLAR ATTACHMENT. DO NOT TWIST.

14 GAUGE GALV. WIRE WITH 1/2" DIA. X 36" WHITE PVC PIPE ON ALL GUY WIRES. KEEP GUY WIRES CLEAR OF BRANCHES TO PREVENT RUB DAMAGE.

(3) SPECIFIED POSTS, 2" DIA., 6'-8" HIGH, ALIGN EQUIDISTANT AROUND TREE. KEEP PLUMB WITH TOPS EVEN. DRIVE 12" INTO UNDISTURBED SUBGRADE OUTSIDE PLANTING PIT. TREE STAKES LOCATED INSIDE WATERING SAUCER ON TREES GREATER THAN 3" CALIPER.

ROOT FLARE TO BE AT OR SLIGHTLY ABOVE THE FINISHED GRADE. SET TRUNK PLUMB. SEE NOTES AND SPECIFICATIONS IN SECTION 1500.

APPLY SPECIFIED MULCH AT 0" DEPTH AT TRUNK AND 4" DEPTH AT EDGE OF RING, INSIDE 4" WATERING SAUCER. REMOVE SAUCER UPON SODDING/ SEEDING IN IRRIGATED AREAS.

4" HIGH WATER SAUCER TO BE OUTSIDE DRIP LINE OF EVERGREEN TREES.

SPECIFIED BACKFILL MIXTURE. AMENDMENTS AS SPECIFIED IN TOP 12"

REMOVE ALL TWINE AND BURLAP FROM TOP 1/3 OF ROOTBALL. COMPLETELY REMOVE WIRE BASKET.

INITIAL STABILIZING BACKFILL 1/3 DEPTH, COMPACTED. SEE NOTES SPECIFICATIONS IN SECTION 1500.

UNDISTURBED PIT BOTTOM FOR ROOTBALL BASE.

BALL DIA. + 24"

**NOTES**

1. GUYING AND STAKING TO BE REMOVED AFTER ONE GROWING SEASON.
2. DO NOT PLANT ANY PLANT WITH A ROOTBALL THAT IS NOT IN COMPLIANCE WITH THE COLORADO NURSERY ACT REQUIREMENTS.

**EVERGREEN TREE PLANTING**

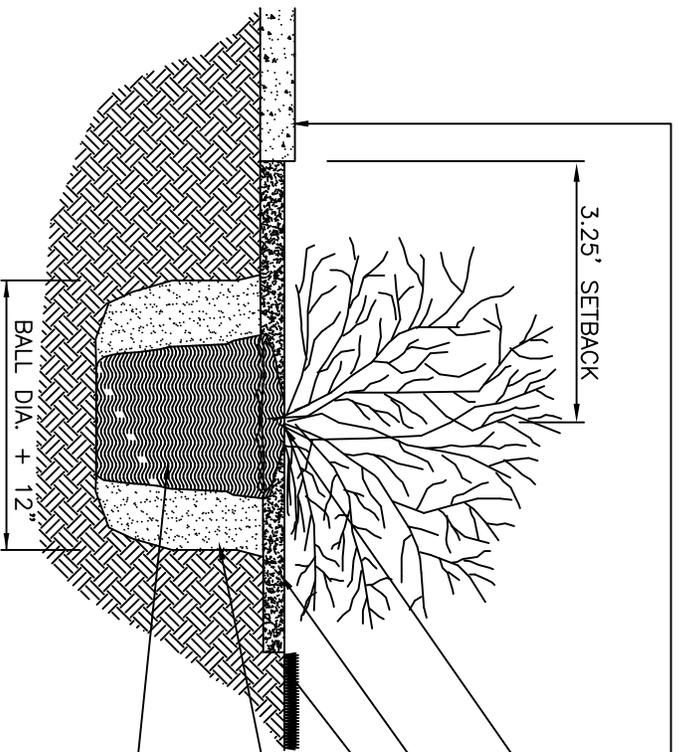
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TOWN OF FREDERICK  
STANDARDS & SPECIFICATIONS

1500-04





CONCRETE CURB EDGING, OR SIDEWALK. HOLD GRADE 1" BELOW EDGE. PRUNE ALL DAMAGED OR DEAD WOOD AFTER PLANTING AND MULCHING.

SET SHRUB AT THE GRADE AT WHICH IT GREW IN THE CONTAINER OR NURSERY. ALL JUNIPER PLANTS SHOULD BE PLANTED SO TOP OF ROOT MASS OCCURS AT FINISHED GRADE OF MULCH LAYER

APPLY SPECIFIED MULCH AT 4" DEPTH.

FINISHED GRADE

FILL PLANT PIT WITH SPECIFIED BACKFILL MIXTURE. SEE SPECIFICATIONS IN SECTION 1500 FOR COMPOSITION.

CONTAINER SHRUBS: REMOVE CONTAINER. PLACE ROOTBALL ON UNDISTURBED SOIL. SCORE CONTAINER ROOTBALLS WITH ENCRICLING ROOTS.

BALLED AND BURLAPPED SHRUBS: COMPLETELY REMOVE METAL BASKET. REMOVE TOP 1/3 OF TWINE AND TOP 1/3 OF BURLAP.

**NOTES**

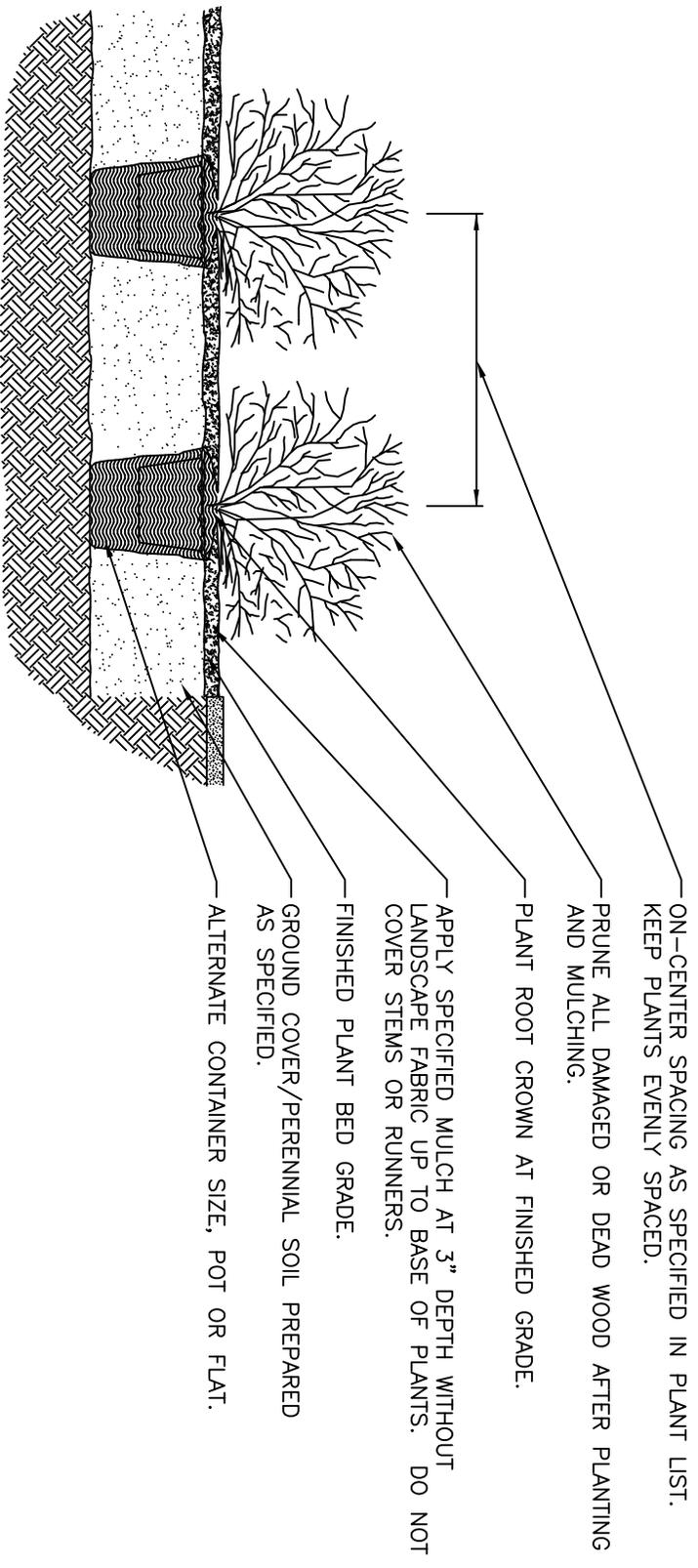
1. HOLD MULCH GRADE 1" BELOW EDGE OF SIDEWALK, EDGING, OR CURB.
2. DO NOT PLANT ANY PLANT WITH A ROOTBALL THAT IS NOT IN COMPLIANCE WITH THE COLORADO NURSERY ACT REQUIREMENTS.

# SHRUB PLANTING

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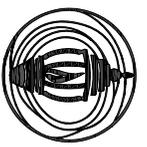


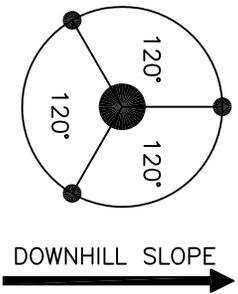
TOWN OF FREDERICK  
STANDARDS & SPECIFICATIONS



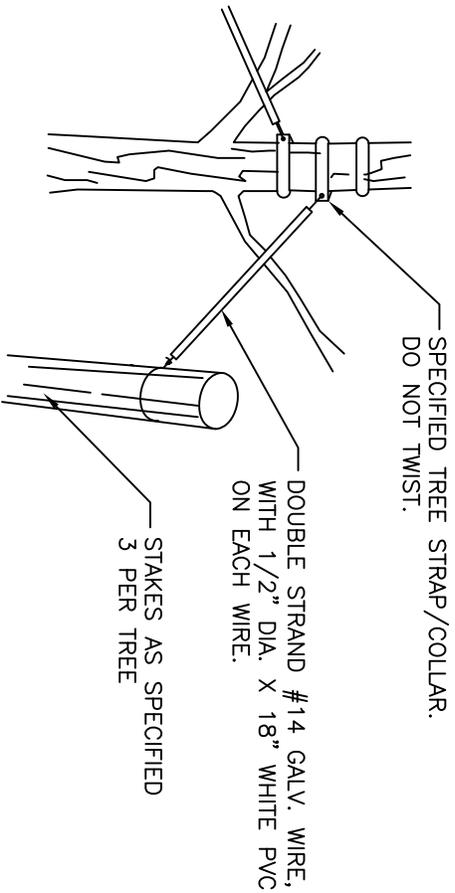
- NOTES**
1. HOLD MULCH 1" BELOW EDGE OF SIDEWALK, EDGING, OR CURB.
  2. HOLD PLANTS BACK 12"-18" FROM EDGE OF SIDEWALK, EDGING, OR CURB.
  3. DO NOT PLANT ANY PLANT WITH A ROOTBALL THAT IS NOT IN COMPLIANCE WITH THE COLORADO NURSERY ACT REQUIREMENTS.

**GROUND COVER/PERENNIAL PLANTING**  
NTS

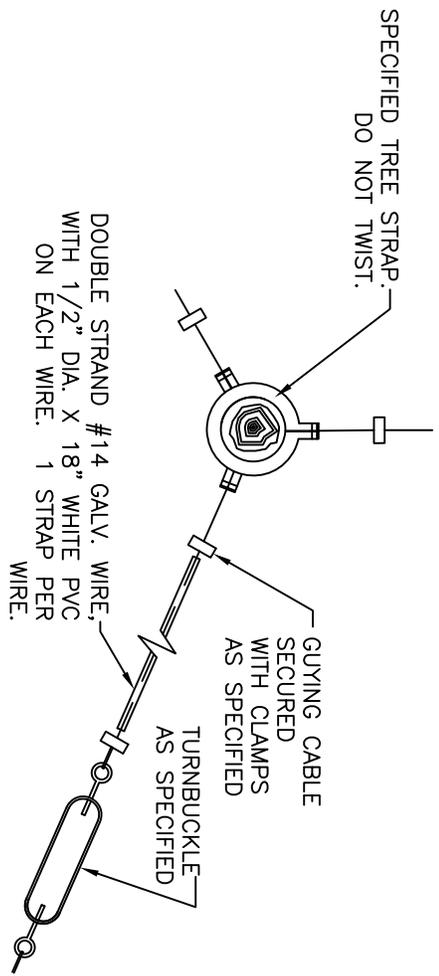




STAKING/GUYING PLAN SCHEMATIC



STAKING DETAIL



GUYING CABLE DETAIL

# TREE STAKING AND GUYING

NTS

