

Design Standards and Construction Specifications

For

Public Improvements



2025 EDITION



**DESIGN STANDARDS AND CONSTRUCTION SPECIFICATIONS
FOR PUBLIC IMPROVEMENTS**

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SECTION 100 GENERAL REQUIREMENTS**110.00 TITLE**

These regulations shall be known as the Town of Firestone Design Standards and Construction Specifications for Public Improvements 2025 Edition and may be cited as such and will be referred to herein as the STANDARDS AND SPECIFICATIONS.

111.00 Purpose

The purpose of these STANDARDS AND SPECIFICATIONS is to provide acceptable standards of design, construction, quality of materials, use, location, and maintenance of all public improvements and common facilities including, but not limited to, sanitary sewer systems, water supply systems, storm drainage systems, streets, open space, parking lots and appurtenances thereto.

120.00 SCOPE

The provisions of these STANDARDS AND SPECIFICATIONS shall apply to the construction, enlargement, alteration, moving, removal, conversion, demolition, repair, and excavation of any public improvements or common facilities specifically regulated herein except where an approved P.U.D. plan specifically states otherwise. The provisions of these STANDARDS AND SPECIFICATIONS apply to Town contracts, Developer contracts and private contracts.

Alterations, additions, or repairs to existing improvements shall comply with all requirements of these STANDARDS AND SPECIFICATIONS unless specifically exempted in writing, by the Town Engineer.

121.00 Alternate Materials and Methods of Construction

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 procedures, provided any alternate has been approved and its use authorized by the Town Engineer.

The Town shall require that sufficient evidence or proof be submitted to substantiate any claims that may be made regarding the alternate. The details of any action granting approval of an alternate shall be recorded and entered in the files of the Town.

122.00 Modifications

Whenever there are practical difficulties involved in carrying out the provisions of these procedures, for example in existing Town subdivisions, or a request for a change in the provisions, the Town may grant modifications for individual cases, provided the Town shall first find that a special individual reason makes these procedures impractical, that the request is in the best interest of the Town, that the modification is in conformity with the intent and purpose of these procedures, and providing that such modification does not lessen any design requirement or any degree of integrity or safety. The details of any action granting modifications shall be recorded and entered in the files of the Town. The Town Engineer shall make the interpretation and the interpretation shall be binding and controlling in its application.

123.00 Quality Control and/or Quality Assurance Testing

Whenever there is insufficient evidence of compliance with any of the provisions of these STANDARDS AND SPECIFICATIONS or evidence that any material or construction does not conform to the requirements herein, the Town Engineer shall require that the Contractor have tests performed which will be used as proof of compliance. Test methods will be as specified by these STANDARDS AND SPECIFICATIONS or by other recognized test standards. If there are no recognized and accepted test methods for the proposed alternate, the Town Engineer will determine test procedures. All tests will be made by an approved agency and all costs shall be the responsibility of the contractor. Reports of such tests shall be submitted and retained by the Town.

The person responsible for the Quality Control Testing and/or Quality Assurance Testing shall be registered as a professional engineer in the State of Colorado and practicing in this field.

Technicians shall be:

- A. Certified as Level II or higher NICET in the specific area where they perform tests, i.e. soils, concrete, etc.
 - 1. Technicians taking concrete samples and conducting field tests must have a valid ACI Field certification or equivalent.
 - 2. Technicians conducting tests of Portland Cement Concrete for compressive strength shall possess a valid ACI Laboratory Grade I certification or equivalent.
 - 3. Technicians conducting tests of Portland Cement Concrete for flexural strength and determining mixture design characteristics shall possess a valid ACI Laboratory Grade II certifications or equivalent.

- B. Technicians performing Quality Control and Quality Assurance sampling, splitting or testing on Hot Mix Asphalt Pavement materials in the field and laboratory must possess one or more of the following qualifications:
 - 1. Technicians sampling hot mix asphalt materials or conducting nuclear asphalt density tests must possess a valid LabCat Level A certification or equivalent.
 - 2. Technicians conducting tests of Asphalt Content, Bulk Specificity Gravity, Maximum Specific Gravity or Aggregate Gradation for hot mix asphalt must possess a valid LabCat Level B certification or equivalent.
 - 3. Technicians determining Asphalt Mixture Volumetric Properties, Hveem Stability or Resistance to Moisture Induced Damage must possess a valid LabCat Level C certification or equivalent.

Recognized equivalent certifications such as CDOT or Western Alliance for Quality Transportation Construction (WAQTC) certifications for each specified field can be submitted and will be reviewed on an individual basis.

124.00 Organization, Enforcement and Interpretation

The Town Engineer is authorized and directed to enforce all provisions of these STANDARDS AND SPECIFICATIONS and for such purposes he/she will have the powers of a peace officer. The Town Engineer may appoint a civil engineer, construction inspector, or other related technical officer or inspector, or other employee or consultant to act in his/her behalf.

Whenever any work is being done contrary to the provisions of these STANDARDS AND SPECIFICATIONS, the Town Engineer may order the work stopped by verbal notice by his appointed representative as defined above, followed by a written notice which will be served on any

persons engaged in the doing or causing of such work to be done, and any such persons will forthwith stop such work until authorized by the Town Engineer to proceed.

These STANDARDS AND SPECIFICATIONS are composed of written engineering standards, materials specifications and standard drawings. The Town Engineer shall make the interpretation of any Section, or of any difference between Sections, when appropriate, and his/her interpretation shall be binding and controlling in its applications.

125.00 Liability

The Town Engineer, or his authorized representative charged with the enforcement of these STANDARDS AND SPECIFICATIONS, acting in good faith and without malice in the discharge of his duties, will not thereby render himself personally liable for any damage that may accrue to persons or property as a result of any act or by reason of any act or omission in the discharge of his duties.

126.00 Violations

It shall be unlawful for any person, firm, or corporation to construct, enlarge, alter, repair, move, improve, remove, excavate, convert, demolish or operate any public improvements or common facilities or permit the same to be done in violation of these STANDARDS AND SPECIFICATIONS.

127.00 No Waiver of Legal Rights

The Town will not be precluded or stopped by any measurement, estimate, or certificate made either before or after the completion and acceptance of the work from showing the true amount and character of the work performed and materials furnished by the Contractor, or from showing that any such measurement, estimate or certificate is untrue or incorrectly made, or that the work or materials do not conform in fact to these STANDARDS AND SPECIFICATIONS.

128.00 Contractor's License

Any person performing work that requires a permit as detailed in Section 151.00 of these STANDARDS AND SPECIFICATIONS shall obtain a Contractor's License as set forth in the Town of Firestone's Municipal Code.

130.00 SCOPE OF WORK**131.00 Work Conditions**

131.01 Working Hours

All work to be completed on the project shall be performed during regular working hours as defined in Section 171.00 of these STANDARDS AND SPECIFICATIONS as adopted by Municipal Code. The Contractor will not permit overtime work outside of regular working hours or the performance of work on Saturday, Sunday or any legal holiday without receiving written consent from the Town Engineer. Requests for weekend work approval must be submitted, in writing to the Town of Firestone no later than Wednesdays at 3:30pm for subsequent weekend and requests for Holiday work approval must be submitted, in writing to the Town of Firestone no later than 7:00am two (2) business days prior to the Holiday. All expenses incurred by the Town shall be reimbursed at a rate to be determined by the Director of Finance.

131.02 Emergency Work

When, in the opinion of the Town, the Contractor has not taken sufficient precautions to ensure the safety of the public or the protection of the work to be constructed, or of adjacent structures or property which may be injured by processes of construction on account of such neglect, and an emergency may arise and immediate action is considered necessary in order to protect public or private, personal or public interests, the Town, WITH OR WITHOUT NOTICE to the Contractor or the Developer, may provide suitable protection by causing such 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 on presentation of the bills.

The 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.

In an emergency threatening loss of life or extensive damage to the work or to adjoining property, and where the Developer or Contractor is unable to obtain special instructions or authorization from the Town after diligent attempts to obtain such special instruction or authorization in sufficient time to take the necessary action, the Developer or Contractor is hereby permitted to act at his own discretion to prevent such threatening loss or damage.

131.03 Final Cleanup

Upon completion of the work, the Contractor shall remove from the project area all surplus and discarded materials, rubbish, and temporary structures, and leave the project area in a neat and presentable condition. The Contractor shall restore all work that has been damaged by his/her operations, to general conformity with the specifications for the item or items involved.

The Contractor shall inspect the interior of all manholes, valve boxes, and catch basins within the construction limits for construction materials, dirt, stones, or other debris deposited therein by the activities of the Contractor.

132.00 Control of Work

132.01 Authority of Town Engineer

The Town Engineer will have the authority to stop the work whenever such stoppage may be deemed necessary. The 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.

The Town Engineer may, when he/she deems it necessary, define the schedule and/or priority of the work to be completed on the project. The Contractor shall comply with this schedule. The Town Engineer must authorize any revision to the schedule in writing.

The Town Engineer shall resolve all questions that may arise relative to the performance of the work with respect to these STANDARDS AND SPECIFICATIONS.

132.02 Authority and Duties of Inspector

Inspectors are authorized to inspect all work completed 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. He/she is authorized to call the attention of the Contractor to any failure of the work or materials to conform to these STANDARDS AND SPECIFICATIONS. Inspectors are authorized to serve a "Field Order" when inspection of the project reveals violation(s) of these STANDARDS AND SPECIFICATIONS. The inspector will have the authority to reject materials until the Town Engineer can resolve any questions at issue.

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" 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.

The Town Engineer and inspector will, at all times, have reasonable and safe access to the work whenever it is in preparation or progress and the Contractor will provide proper facilities for such access and inspection.

132.03 Contractor's Responsibility for Work

In case of suspension of work for any cause, the Contractor, before leaving the job site, shall take such precautions as may be necessary to prevent damage to the project, provide for normal drainage and erect any necessary barricades, signs, or other facilities, at his/her expense, as directed by the Town Engineer and required by these STANDARDS AND SPECIFICATIONS.

132.04 Removal of Unauthorized and Unacceptable Work

Work, which does not conform to the plans 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, found to exist prior to the final acceptance of the work will be immediately removed and acceptably 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 surface to original or better than the original condition that existed before the repairs or replacement, regardless of improvements on lands where the repairs or replacement are required.

133.00 Control of Materials

133.01 Samples and Tests

To ascertain that materials comply with contract requirements, samples will be taken and/or tests made at the source or at the job destination, at the discretion of the Town Engineer and as often as he deems it advisable or necessary. Taking of samples and completion of tests will be in accordance with standard practices except where methods and procedures for sampling materials are otherwise set forth in these STANDARDS AND SPECIFICATIONS.

The Contractor shall furnish, without charge, all samples, tests and reports required by the Town Engineer and will afford such facilities as may be necessary for collecting and forwarding them. The contractor may be required to furnish, when requested by the Town Engineer, a written statement giving the origin, composition and process of manufacture of a material.

133.02 Storage of Materials

Materials shall be stored so as to insure 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 Town Engineer's approval, 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 materials and equipment but any additional space required will be provided by the Contractor at his expense.

133.03 Defective Materials

Materials not in conformance with requirements of these STANDARDS AND SPECIFICATIONS will be considered defective and will be rejected. Rejected materials shall be removed from the work site in the time indicated by the Town Engineer.

140.00 GENERAL REQUIREMENTS**141.00 Protection of Public and Utility Interests****141.01 Public Convenience and Safety**

Fire hydrants will be visible and accessible to the Fire Department from the street at all times. No obstructions will be placed within five (5) feet of a fire hydrant.

Unless otherwise specified, the Contractor will give notice, in writing, to the proper authorities in charge of streets, gas and water pipes, electric service, cable television and other conduits, railroads, poles, manholes, valve boxes, catch basins and all other property that may be affected by the Contractor's operations, at least seventy-two (72) hours before breaking ground. 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.

If a temporary utility outage is required to perform the work, the contractor shall be responsible to coordinate with the Town of Firestone for determination of minimum notification time requirements and maximum time allowed for the outage. Once determined, the contractor shall notify the affected utility customers.

The Contractor shall 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 electrical equipment can be installed at the proper time without delay to the Developer or Contractor or unnecessary inconvenience to the owner. The location of new underground utilities and electrical equipment shall not be covered with pavement prior to the installation 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 notice thereof, in writing with a copy to the Town.

141.02 Protection and Restoration of Property and Survey Monuments

The Developer and Contractor shall use every reasonable precaution to prevent the damage or destruction of public or private property such as poles, trees, shrubbery, crops, fences, and survey

monuments adjacent to or interfering with the work, and all overhead structures such as wires, cables, within or outside of the right-of-way.

The Contractor shall protect and support all water, gas, sanitary sewer, storm sewer or electrical pipes or conduits, and all railway tracks, buildings, walls, fences or other properties that are liable to be damaged during the execution of his work. He will take all reasonable and proper precautions to protect persons, animals, and vehicles from injury, and wherever necessary, 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 burning from twilight until sunrise. He will employ one or more watchmen as an additional security wherever they are needed or required by the Town Engineer.

The Contractor shall 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 progressing.

The Contractor must protect and carefully preserve all land boundary and Town survey control monuments. Any monument that may be disturbed shall be referenced and replaced by a Professional Land Surveyor registered in the State of Colorado. All monuments disturbed or removed by the Contractor, through negligence or carelessness on his part or on the part of his employees or subcontractors, shall be replaced at the Contractor's expense. Replacement of any monument shall be completed in accordance with the requirements set forth in Section 141.04 of these STANDARDS AND SPECIFICATIONS.

No person shall remove or disturb any grade or line stakes or marks set by the Town Engineer for all construction.

Developer and Contractor shall be responsible for the damage or destruction of property resulting from neglect, misconduct, or omission in his/her manner or method of execution or non-execution of the work, or caused by defective work or the use of unsatisfactory materials. They will restore such property to a condition similar or equal to that existing before such damage or injury was done, by repairing, rebuilding, or replacing it as may be directed, or they will otherwise make good such damage or destruction in an acceptable manner. Developer and Contractor will be responsible for the repair of underground pipes, wires, or conduits damaged by them or their subcontractors.

Developer and Contractor shall be liable for all damage caused by storms and fire, and will under no circumstances, start fires without first securing the necessary permits and approval of the authority having jurisdiction even though they may be ordered or required to do such burning. In burning brush, stumps, or rubbish, care must be taken not to damage any standing trees, shrubs or other property.

141.03 Surveys

Surveys will conform to Colorado Bylaws and Rules of Procedures and rules of Professional Conduct of the State Board of Registration for Professional Engineers and Profession Surveyors "Revised".

141.04 Survey Monuments

Permanent survey monuments (including the replacement of monuments) range points and lot pins shall be set in accordance with the requirements of Articles 51 and 53 of Title 38, Colorado Revised Statutes, and as required by the Bylaws and Rules of Procedure of the Colorado State Board of Registration for Professional Engineers and Professional Land Surveyors.

141.05 Protection of Streams, Lakes and Reservoirs

The Developer and Contractor will take all necessary precautions to prevent pollution of streams, lakes, and reservoirs with fuels, oils, bitumen's, calcium chloride, or other harmful materials. They will conduct and schedule their operations so as to avoid or minimize siltation of streams, lakes and reservoirs. See Section 151.00 Grading and Stormwater Quality Permit.

141.06 Dust proofing

The Contractor will take all necessary steps to control dust arising from operations connected with the work. Unless otherwise directed by the Town Engineer, a water truck shall always be on-site and all disturbed areas of a project shall be watered to prevent dust and wind-caused erosion.

141.07 Traffic Control, Barricades and Warning Signs

All construction, maintenance, park or utility work being completed within the Public Right-of-Way must have a Traffic Control Plan (TCP) accepted by the Town Engineer. The TCP is a plan for guiding and handling traffic safely through the construction work zone. The TCP must provide safe methods for movement of pedestrians and motorists that travel through the work zone and a safe area for all workers engaged in the construction activity. The TCP shall show the location, spacing and scheduling of the usage of advance warning signs, barricades, pavement markings and other control devices. All control devices must be installed and maintained in accordance with the "Manual on Uniform Traffic Control Devices" (MUTCD) and the "CDOT Work Zone Safety Handbook", latest editions.

Requirements contained in these manuals will be strictly enforced during the progress of the work.

The TCP must be job specific. In order for a TCP to be accepted by the Town Engineer it must contain, as a minimum, a drawing showing the project area and the street(s) that may be affected by the project. The drawing shall include the following information:

- A. Location and spacing of properly planned traffic control devices.
- B. The length of time that the construction will be in progress.
- C. The name and phone number(s) for twenty-four (24) hour contact of the Contractor's designated traffic control supervisor.
- D. Any special notes or information on how the traffic control operation is to be handled.

The responsibilities of the Contractor shall include the following:

- A. Obtain a Public Improvement Permit or Right of Way Permit from the Town of Firestone Engineering Division.
- B. Provide timely notification to, and coordination with, all affected agencies including the following:
 - 1. Frederick-Firestone Fire Protection District
 - 2. Firestone Police Department
 - 3. Firestone Public Works Department.
 - 4. CDOT
 - 5. Utility Companies.
 - 6. RTD
 - 7. St. Vrain Valley School District
 - 8. Post Office
- C. Inform occupants of abutting properties of access limitations made necessary by the work.

- D. Schedule and expedite the work to cause the least inconvenience to the public. Construction or repair work will not be permitted at or in the vicinity of signalized intersections or on major streets and State Highways without advance approval of the Town Engineer and CDOT as applicable.
- E. Furnish, install and maintain required traffic control devices and facilities, as required throughout the life of the contract (including periods of suspension).
- F. Provide flagmen when required.
- G. Assure that survey crews and other employees working in or adjacent to a traveled roadway wear flagging garments as required for flagmen.
- H. Provide adequate safeguards for workers and the general public.
- I. Patrol the construction site as required insuring that all devices are in place and operating at all times.
- J. Remove traffic control devices when they are no longer needed.

Intersections and driveways will be closed only for a minimum amount of time. The Contractor shall coordinate driveway closures with property owners with final approval by the Town Engineer.

All temporary traffic lanes shall be a minimum of ten (10) feet in width unless otherwise authorized. In addition, lane clearance shall be a minimum of five (5) feet from an open excavation and two (2) feet from a curb or other vertical obstruction.

Suitable surfacing must be provided for the temporary traffic lanes in work areas. When traffic is diverted from the existing pavement, temporary surfacing shall be provided as required by the Town Engineer.

Construction equipment not actively engaged in the work, employee vehicles and official vehicles of the agency shall not be parked in the vicinity of the work in such a manner as to further restrict traffic flow.

Vehicles and equipment in continuous or frequent use may be operated or parked in the same traffic lane as the work obstruction. Construction spoil or materials may be similarly stored in this area or on the nearby parkway or sidewalk area, provided four (4) feet of sidewalk is kept clear for pedestrian use. To prevent the spoil bank from occupying too great a space at its base, toe boards may be used to keep it two (2) feet from the edge of the excavation on one side and two (2) feet from the edge of the traffic lane on the other.

Whenever necessary, trenches and excavation shall be bridged to permit an unobstructed flow of traffic.

- A. Bridging must be secured against displacement by using adjustable cleats, angles, bolts, or other devices.
- B. Bridging shall be installed to operate with minimum noise.
- C. The trench must be adequately shored, to support the bridging and traffic.
- D. Temporary paving materials (premix) shall be used to feather the edges of the plates to minimize wheel impact.
- E. Bridges shall be designed by a P.E.

When the work area encroaches upon a sidewalk, walkway or crosswalk area, special consideration must be given to pedestrian safety. Since the pedestrian moves at a relatively slow rate, a minimum of advance warning is required. However, effort must be made to separate him from the work area.

All work shall be barricaded at all times and between the hours of sunset and sunrise and shall be properly lighted so as to warn all persons. The Contractor will be responsible for all damages to the

work due to failure of barricades, signs, lights, and flagmen and watchmen to protect it, and whenever evidence of such damage is found prior to acceptance the Town Engineer may order the damaged portion immediately removed and replaced by the Contractor.

142.00 Use of Town Water

If the Contractor requires Town water for any part of the project, he/she must request a "Town Fire Hydrant Meters Rental Agreement" from the Public Works Department. Any theft of water, including meter jumpers, hose connections in meter pits, drawing water from fire hydrants without a Town of Firestone hydrant meter installed, or any other unauthorized use of Town water will be considered a violation of both this manual and the current adopted Town of Firestone Municipal Code. Uncontrolled usage by contractors and subcontractors will be reported to the responsible property owner. Violations will be enforced in conjunction with the Town of Firestone Municipal Code and/or building permits and inspections may be withheld until such time as violations are corrected and the Town is satisfied that proper control channels are established.

143.00 Pavement Cuts

Boring, except for emergency repairs, shall be done for all underground utility installations crossing arterials streets. **No boring shall occur on Friday's or business days before Holidays, without the approval of the Town Engineer.** An exception may also be granted when a plan is submitted to overlay the entire street (block to block), or the Town Engineer accepts such other plan. All street cuts when accepted must be saw-cut prior to street patching and an approved hot/cold mix asphalt patch shall be placed the same day the cuts are employed. Street cuts when completed shall have permanent patching within five working days, unless otherwise directed. Permittee shall be responsible for maintenance of the permanent patch for a period of two years.

If a pavement cut is required, the Contractor will make every effort to install a permanent, hot mix, asphalt patch within twenty-four (24) hours. The Contractor will place a temporary, all weather surface patch in all street cuts immediately after completing backfill and compaction if a permanent patch cannot be installed within twenty-four (24) hours. The Contractor will submit a schedule for the hot mix patch installation to the Town Engineer for approval in the latter case. Refer to Standard Drawings for details.

When street cuts are required, the following conditions will be met so as to avoid interference with traffic:

- A. Street service cuts will be open only between 9:00 a.m. and 4:00 p.m.; and
- B. Two-way traffic will be maintained at all times around the construction area. A Traffic Control Plan (TCP) must be prepared in accordance with Section 141.08, Traffic Control, Barricades and Warning Signs, of these STANDARDS AND SPECIFICATIONS and submitted to the Town Engineer for his/her acceptance prior to the commencement of construction.

143.01 Pavement Replacement Construction Requirements

Pavement replacement for street cuts will be constructed according to the Standard Details.

144.00 Public Utility Easements

Easements must be dedicated for public utility mains and fire hydrants that extend onto or are looped through private property. Utility services that extend onto private property and service a single property are private and will be maintained by the property owner.

150.00 PERMITS AND INSPECTIONS**151.00 Stormwater Quality Permit**

It shall be unlawful for any person, firm or corporation to conduct any construction activity resulting in the disturbance of one acre or more or the disturbance is less than one acre but is part of a larger common plan of development without first obtaining a Stormwater Quality Permit (SQP) for such work from the Town of Firestone.

151.01 Application for Permit

Applicants for SQPs shall complete an application in writing on a form furnished by the Engineering Department. In support of the application, the applicant shall submit:

- A. All information required on the SQP permit and any additional information requested by the Town.
- B. The application signed by the person or persons responsible for compliance with the permit.
- C. Documentation of an application for a CDPHE stormwater general permit for construction activities
- D. A stormwater management plan (SWMP) that, in addition to the requirements of the CDPHE stormwater general permit, shall contain:
 1. At a minimum, pollutant sources associated with the following construction activities must be addressed:
 - a) All areas of land disturbance and storage of soils
 - b) Vehicle tracking
 - c) Loading and unloading operations
 - d) Outdoor storage of construction site materials, building materials, fertilizers and chemicals
 - e) Bulk storage of materials
 - f) Vehicle and equipment maintenance and fueling
 - g) Significant dust or particulate generating processes
 - h) Routine maintenance activities involving fertilizers, pesticides, detergents, fuels, solvents, and oils
 - i) Concrete truck/equipment washing, including the concrete truck chute and associated fixtures and equipment
 - j) Dedicated asphalt and concrete batch plants
 - k) Other areas or operations where spills can occur
 - l) Other non-stormwater discharges including construction dewatering not covered under the construction Dewatering Discharges general permit and wash water that may contribute pollutants to the MS4 work, access points with vehicle tracking, temporary/haul roads, and storage and staging areas.
 2. Specifications and details for installation and implementation of stormwater control measures. Appropriate control measures must be implemented prior to the start of construction activities, must control potential pollutants during each phase of construction, and must be continued through final stabilization. Appropriate structural control measures must be maintained in operational condition.
 3. A narrative description of non-structural control measures.
 4. An erosion control plan that contains control measures for each phase of construction. All construction projects shall require a phased (initial, interim, and final) erosion control plan.

151.02 Permit Issuance

The Town Engineer shall review the application, plans, specifications and other data filed by an applicant for a permit. Other departments of this jurisdiction may review the plans to verify compliance with any applicable laws. If the Town Engineer finds that the work described in an application for a permit and the plans and other data filed therewith conform to the requirements of these STANDARDS AND SPECIFICATIONS and other pertinent laws and Municipal Codes and that all required fees have been paid, he/she will issue a permit to the applicant.

The issuing of a permit based on plans, specifications or other data will not prevent the Town Engineer from requiring the correction of errors in said plans, specifications and other data, or from stopping construction operations which are in violation of these STANDARDS AND SPECIFICATIONS or any other regulations of this jurisdiction.

A pre-construction conference shall be required prior to the issuance of any permits for construction and may be held in conjunction with pre-construction conferences for other permits. Attendance shall include the Town Engineer or his representative, the Town Inspector, and the Developer/Owner. The Town Engineer will be notified two (2) working days (forty-eight [48] hours) before the planned construction is to begin.

151.03 Permit Suspension or Revocation

The Town Engineer may suspend or revoke any permit in writing, issued under the provisions of these STANDARDS AND SPECIFICATIONS whenever the permit is issued in error, or on the basis of incorrect information supplied by the applicant, or whenever such permit may have been issued in violation or is in violation of any Municipal Code or regulation of any of the provisions of these STANDARDS AND SPECIFICATIONS. In the event a permit is suspended or revoked, no refund of permit fees will be made.

151.04 Investigation Fees (Working without a Permit)

All work for which the required permit is not obtained shall cease upon written notice of the Town Engineer. A special investigation shall be made before a permit may be issued for such work.

An investigation fee shall be collected whether or not a permit is then or subsequently issued. The investigation fee shall be equal to the amount of the plan review fee, the Stormwater Quality Permit fee, and the fees for the inspection time required for the investigation. The payment of such investigation fees shall not exempt any person from compliance with all other provisions of these STANDARDS AND SPECIFICATIONS nor from any penalty prescribed by law.

152.00 Public Improvement Permit

It shall be unlawful for any person, firm or corporation to construct, enlarge, alter, repair, move, improve, remove, excavate, convert or demolish any public improvements or common facilities regulated by these STANDARDS AND SPECIFICATIONS without first obtaining a Public Improvement Permit for such work from the Town Engineer.

152.01 Application for Permit

Applicants for public (and private) improvement permits shall complete an application in writing on a Public Improvement Permit Fees (PIP) form furnished by the Engineering Division. Each application shall:

- E. Identify and describe the work to be covered by the permit for which the application is made.
- F. Describe the land on which the proposed work is to be done by legal description, street address, or similar description that will readily identify and definitely locate the proposed work.
- G. Indicate the type of work or improvement intended.
- H. Be accompanied by plans, diagrams, computations and specifications, and other data as required in Section 160.00 of these STANDARDS AND SPECIFICATIONS.
- I. Be accompanied by a Construction Traffic Routing Plan as defined in Section 162.02 of these STANDARDS AND SPECIFICATIONS.
- J. State the valuation and the quantities of the work to be performed.
- K. Be signed by the applicant or his/her authorized agent, who may be required to submit evidence to indicate such authority.
- L. Submit a starting and completion date and give such other data and information as may be required by the Town Engineer.

152.02 Permit Issuance

The Town Engineer shall review the application, plans, specifications and other data filed by an applicant for a permit. Other departments of this jurisdiction may review the plans to verify compliance with any applicable laws. If the Town Engineer finds that the work described in an application for a permit and the plans and other data filed therewith conform to the requirements of these STANDARDS AND SPECIFICATIONS and other pertinent laws and Municipal Codes and that all required fees have been paid, he/she will issue a permit to the applicant.

When the Town Engineer issues a permit for which plans are required, he will endorse the plans in writing or by stamping the plans and specifications "ACCEPTED FOR CONSTRUCTION". The accepted plans and specifications will not be changed, modified, or altered without authorization from the Town Engineer, and all work will be done in conformance with the accepted plans. Two sets of accepted plans, specifications, and computations will be retained by the Town and one set will be returned to the applicant and will be maintained at the work site at all times during the progress of the work.

A pre-construction conference shall be required prior to the issuance of any permits for construction. Attendance shall include the Town Engineer or his representative, the Town Inspector, the Developer/Owner, Design Engineer, General Contractor, and Sub-contractors including: earthwork, utilities, curb and gutter, paving, and signing. The Town Engineer will be notified two (2) working days (forty-eight [48] hours) before the planned construction is to begin.

The issuing and granting of a permit will not be construed to be a permit for, or an approval of, any violation of any of the provisions of these STANDARDS AND SPECIFICATIONS or of any regulations of this jurisdiction. No permit presuming to give authority to violate or cancel the provisions of these STANDARDS AND SPECIFICATIONS shall be valid.

The issuing of a permit based on plans, specifications or other data will not prevent the Town Engineer from requiring the correction of errors in said plans, specifications and other data, or from stopping construction operations which are in violation of these STANDARDS AND SPECIFICATIONS or any other regulations of this jurisdiction.

152.03 Permit Expiration

Every permit issued by the Town Engineer under the provisions of this section shall expire if the work authorized by such a permit is not substantially completed by the date noted on the permit. Before such work can be recommenced, a new permit must be obtained and the fee required will be one-fourth (1/4) of the amount required for a new permit to do such work, provided no changes have been made or required by the Town in the original plans and specifications, and, provided further, such suspension or abandonment has not exceeded one year from the completion date noted on the permit. If substantial changes have been made or required by the Town during this period, or should more than one year have expired, the permittee shall pay a new, full permit fee.

Any permittee holding a valid permit may apply, in writing, for an extension of the completion date noted on the permit if he/she is unable to complete the work by the completion date. The request must be based on good cause and the cause must be acceptable to the Town. The Town Engineer may extend the completion date for a period not to exceed one year, provided that circumstances beyond the control of the permittee have prevented action from being taken. No permit will be extended more than one (1) time.

152.04 Permit Suspension or Revocation

The Town Engineer may suspend or revoke any permit, in writing, issued under the provisions of these STANDARDS AND SPECIFICATIONS whenever the permit is issued in error, or on the basis of incorrect information supplied by the applicant, or whenever such permit may have been issued in violation of any Municipal Code or regulation of any of the provisions of these STANDARDS AND SPECIFICATIONS. In the event a permit is suspended or revoked, no refund of permit fees will be made.

152.05 Plan Review Fees

Plan review fees shall be paid in full at the time the Town Engineer accepts the plans and specifications and the Public Improvement Permit is issued. The plan review fees shall be sixty five (65) percent of the Public Improvement Permit fees. Applications for which no permit is issued within one hundred eighty (180) days following the date of the application shall expire, and plans and other data submitted for review may be returned to the applicant or destroyed by the Town Engineer. The Town Engineer may extend the time for action by the applicant for a period not exceeding one hundred eighty (180) days, upon receiving written request from the applicant showing that circumstances beyond the control of the applicant have prevented action from being taken. No application shall be extended more than once. In order to renew action on an application after expiration, the applicant shall resubmit plans and pay a new plan review fee.

152.06 Public Improvement Permit Fees

These fees shall be calculated on a cumulative basis. Public Improvement Permit fees shall be paid in full at the time the Town Engineer accepts the plans and specifications and the Public Improvement Permit is issued. A Public Improvement Permit shall be required for all construction work in the public right-of-way or in a public easement. However, the fee for construction of the Town's Capital Improvement Projects may be waived by the Town Engineer.

152.07 Investigation Fees (Working without a Permit)

All work for which the required permit is not obtained shall cease upon written notice of the Town Engineer. A special investigation shall be made before a permit may be issued for such work.

An investigation fee shall be collected whether or not a permit is then or subsequently issued. The investigation fee shall be equal to the amount of the plan review fee, the Public Improvement Permit

fee, and the fees for the inspection time required for the investigation. The payment of such investigation fees shall not exempt any person from compliance with all other provisions of these STANDARDS AND SPECIFICATIONS nor from any penalty prescribed by law.

153.00 Right of Way Permit

For work not covered by a Public Improvement Permit, it shall be unlawful for any person, firm or corporation to do any work including but not limited to; excavation, pothole underground facilities, install, repair or modify; utilities, drive access, curb, walk, or other underground or surface improvements, within the Town's property or right-of-way without first obtaining an Right of Way Permit for such work from the Town Engineer.

153.01 Application for Permit

Applicants for Right of Way permits shall complete an application in writing on a Right of Way Permit form furnished by the Engineering Division. Each application shall:

- A. Identify and describe the work to be covered by the permit for which the application is made.
- B. Describe the property or right of way location on which the proposed work is to be done by street address, or similar description that will readily identify and definitely locate the proposed work.
- C. Indicate the type of work or improvement intended.
- D. Be accompanied by plans, diagrams, computations and specifications, and other data as required in Section 160.00 of these STANDARDS AND SPECIFICATIONS.
- E. Be accompanied by a Construction Traffic Routing Plan as defined in Section 162.02 of these STANDARDS AND SPECIFICATIONS.
- F. Be signed by the applicant or his/her authorized agent, who may be required to submit evidence to indicate such authority.
- G. Submit a starting and completion date and give such other data and information as may be required by the Town Engineer.

153.02 Permit Issuance

The Town Engineer shall review the application, plans, specifications and other data filed by an applicant for a permit. Other departments of this jurisdiction may review the plans to verify compliance with any applicable laws. If the Town Engineer finds that the work described in an application for a permit and the plans and other data filed therewith conform to the requirements of these STANDARDS AND SPECIFICATIONS and other pertinent laws and Municipal Codes and that all required fees have been paid, he/she will issue a permit to the applicant.

The Town Engineer will be notified a minimum of two (2) working days (forty-eight [48] hours) before the planned construction is to begin. The issuing and granting of a permit will not be construed to be a permit for, or an approval of, any violation of any of the provisions of these STANDARDS AND SPECIFICATIONS or of any regulations of this jurisdiction. No permit presuming to give authority to violate or cancel the provisions of these STANDARDS AND SPECIFICATIONS shall be valid.

The issuing of a permit based on plans, specifications or other data will not prevent the Town Engineer from requiring the correction of errors in said plans, specifications and other data, or from stopping construction operations which are in violation of these STANDARDS AND SPECIFICATIONS or any other regulations of this jurisdiction.

153.03 Permit Expiration

Every permit issued by the Town Engineer under the provisions of this section shall expire if the work authorized by such a permit is not substantially completed by the date noted on the permit. Before such work can be recommenced, a new permit must be obtained.

Any permittee holding a valid permit may apply, in writing, for an extension of the completion date noted on the permit if he/she is unable to complete the work by the completion date. The request must be based on good cause and the cause must be acceptable to the Town. The Town Engineer may extend the completion date for a period not to exceed one year, provided that circumstances beyond the control of the permittee have prevented action from being taken. No permit will be extended more than one (1) time.

153.04 Permit Suspension or Revocation

The Town Engineer may suspend or revoke any permit, in writing, issued under the provisions of these STANDARDS AND SPECIFICATIONS whenever the permit is issued in error, or on the basis of incorrect information supplied by the applicant, or whenever such permit may have been issued in violation of any Municipal Code or regulation of any of the provisions of these STANDARDS AND SPECIFICATIONS. In the event a permit is suspended or revoked, no refund of permit fees will be made.

154.00 Access Permit

No person shall construct any access providing direct vehicular movement to or from any street from or to property in close proximity or abutting a street without an access permit issued by the Town Engineer. Access permits shall be issued only in compliance with the Access Code adopted pursuant to Section 12.06 of the Town of Firestone Municipal Code. In no event shall an access permit be issued if it is detrimental to the public health, welfare and safety. Direct access from a subdivision to a street shall be permitted only if the proposed access meets the purposes and requirements of the Access Code. Local traffic from a subdivision in close proximity to or abutting a street shall be served by an internal street system of adequate capacity, intersecting and connecting with the general street system in a manner that is safe and is consistent.

154.01 Application for Permit

Applicants for Access Permits shall complete an application in writing on a Access Permit form furnished by the Engineering Division. Each application shall:

- A. Identify and describe the work to be covered by the permit for which the application is made.
- B. Describe the property or right of way location on which the proposed work is to be done by street address, or similar description that will readily identify and definitely locate the proposed work.
- C. Indicate the type of work or improvement intended.
- D. Be accompanied by plans, diagrams, computations and specifications, and other data as required in Section 160.00 of these STANDARDS AND SPECIFICATIONS.
- E. Be accompanied by a Construction Traffic Routing Plan as defined in Section 162.02 of these STANDARDS AND SPECIFICATIONS.
- F. Be accompanied by a subdivision zoning or development plan.
- G. Be accompanied by a property map indicating other nearby or abutting accesses and public roads and streets.

- H. Be signed by the applicant or his/her authorized agent, who may be required to submit evidence to indicate such authority.
- I. Submit a starting and completion date and give such other data and information as may be required by the Town Engineer.

154.02 Permit Issuance

The Town Engineer shall review the application, plans, specifications and other data filed by an applicant for a permit. Other departments of this jurisdiction may review the plans to verify compliance with any applicable laws. If the Town Engineer finds that the work described in an application for a permit and the plans and other data filed therewith conform to the requirements of these STANDARDS AND SPECIFICATIONS and other pertinent laws and Municipal Codes and that all required fees have been paid, they will issue a permit to the applicant.

When the Town Engineer issues a permit for which plans are required, he will endorse the plans in writing or by stamping the plans and specifications "ACCEPTED FOR CONSTRUCTION". The accepted plans and specifications will not be changed, modified, or altered without authorization from the Town Engineer, and all work will be done in conformance with the accepted plans. Two sets of accepted plans, specifications, and computations will be retained by the Town and one set will be returned to the applicant and will be maintained at the work site at all times during the progress of the work.

The issuing and granting of a permit will not be construed to be a permit for, or an approval of, any violation of any of the provisions of these STANDARDS AND SPECIFICATIONS or of any regulations of this jurisdiction. No permit presuming to give authority to violate or cancel the provisions of these STANDARDS AND SPECIFICATIONS shall be valid.

The issuing of a permit based on plans, specifications or other data will not prevent the Town Engineer from requiring the correction of errors in said plans, specifications and other data, or from stopping construction operations which are in violation of these STANDARDS AND SPECIFICATIONS or any other regulations of this jurisdiction.

154.03 Permit Expiration

Every permit issued by the Town Engineer under the provisions of this section shall expire if the work authorized by such a permit is not substantially completed within 1 year of permit issuance.

Any permittee holding a valid permit may apply, in writing, for an extension of the completion date noted on the permit if he/she is unable to complete the work by the completion date. The request must be based on good cause and the cause must be acceptable to the Town. The Town Engineer may extend the completion date for a period not to exceed one year, provided that circumstances beyond the control of the permittee have prevented action from being taken. No permit will be extended more than one (1) time.

154.04 Permit Suspension or Revocation

The Town Engineer may suspend or revoke any permit, in writing, issued under the provisions of these STANDARDS AND SPECIFICATIONS whenever the permit is issued in error, or on the basis of incorrect information supplied by the applicant, or whenever such permit may have been issued in violation of any Municipal Code or regulation of any of the provisions of these STANDARDS AND SPECIFICATIONS. In the event a permit is suspended or revoked, no refund of permit fees will be made.

155.00 Inspections

All construction work for which a Public Improvement Permit, Right of Way Permit, or Access Permit is required shall be subject to inspection by the Town Engineer.

It shall be the responsibility of the person performing the work authorized by a permit to notify the Town Engineer or his/her authorized representative that such work is ready for inspection. Every request for inspection shall be filed at least one (1) working day (twenty-four [24] hours) before such inspection is desired unless otherwise stated in these STANDARDS AND SPECIFICATIONS. Such request may be in writing or by telephone, at the option of the Town Engineer.

It shall be the responsibility of the person requesting inspections required by these STANDARDS AND SPECIFICATIONS to provide access to and means for proper inspection of all work. The Town Engineer will have the authority to halt construction when, in his/her opinion, these STANDARDS AND SPECIFICATIONS and/or standard construction practices are not being followed, or the work is otherwise defective will inspect all work. Whenever any portion of these STANDARDS AND SPECIFICATIONS are violated, the Town Engineer shall give the Contractor written notice listing deficiencies to be corrected and may order further construction to cease until all deficiencies are corrected. If the deficiencies are not corrected within the time limit specified in the notice, the Town Engineer may evoke enforcement options authorized by the Town of Firestone Municipal Code and/or performance guarantees under which the work is being performed.

The procedure for final inspection and acceptance will be as specified in the contract documents or in Section 200, Acceptance Procedures, of these STANDARDS AND SPECIFICATIONS.

155.01 Additional Inspections and Re-inspections

The Town Engineer may make or require other inspections of any work as deemed necessary to ascertain compliance with the provisions of these STANDARDS AND SPECIFICATIONS and other provisions of the Town of Firestone Municipal Code.

A re-inspection fee may be assessed for each inspection or re-inspection when such portion of work for which inspection is called is not complete or when corrections called for have not been made.

Re-inspection fees may be assessed when the permit is not in the possession of the permit holder or his/her agent at the work site, when the accepted plans are not readily available to the inspector, or failure to provide access on the date for which inspection is requested, or for deviating from plans accepted by the Town Engineer.

This subsection is not to be interpreted as requiring re-inspection fees the first time a job is rejected for failure to comply with the requirements of these STANDARDS AND SPECIFICATIONS, but rather as controlling the practice of calling for inspections before a job is ready for such inspection or re-inspection.

To obtain a re-inspection, the applicant must file an application in writing upon a form furnished for that purpose and pay the re-inspection fee. In instances where re-inspection fees have been assessed, no additional inspection of the work will be performed until the required fees have been paid.

160.00 PLANS AND SPECIFICATIONS

Three (3) sets of plans, engineering calculations, diagrams and other data shall be submitted with each application for a permit. The Town will require that plans, computations and specifications be prepared and designed by a Registered Professional Engineer, licensed to practice in the State of Colorado.

EXCEPTION: THE TOWN ENGINEER MAY WAIVE THE SUBMISSION OF PLANS, CALCULATIONS, ETC., IF THEY FIND THAT THE NATURE OF THE WORK APPLIED FOR IS SUCH THAT REVIEWING OF PLANS IS NOT NECESSARY TO OBTAIN COMPLIANCE WITH THESE STANDARDS AND SPECIFICATIONS.

161.00 Construction Plan Requirements

All construction plans will be checked for conformance to the STANDARDS AND SPECIFICATIONS prior to acceptance by the Engineering Division. This acceptance shall be for conformance to Town design standards and other requirements; engineering design or needs will remain the responsibility of the professional design engineer. Three (3) sets of the final plans will be submitted to the Engineering Division for review prior to acceptance. Either written comments or one (1) marked up plan set will be returned if changes are required or recommended. The written comments and/or the marked up plan set shall be returned to the Engineering Division with the revised plan set. Upon final acceptance of the construction plans by the Town Engineer, a minimum of three (3) sets of 22" by 34" full size plans, one (1) set of 11" by 17" half size plans and an electronic version of the full set in PDF format will be submitted. The sets of plans shall be signed and sealed by the registered professional engineer, licensed in the State of Colorado (in accordance with The 1973 Colorado Revised Statutes, Title 12, Article 25, Paragraph 117) responsible for the design, and shall be signed by the Town Engineer. One (1) of the signed plans shall be returned to the developer/owner for the Contractor's use, and the Town shall keep two (2) sets. The Contractor shall keep the set returned to the contractor on the job for the duration of the project. All drawings and prints shall be drawn in 22" x 34" format. Should circumstances warrant changes to the accepted plans or specifications, written approval must be obtained from the Town Engineer. Copies will be given to the Developer or Contractor and the Design Engineer. It will be the duty of the design engineer and the Contractor to record any and all changes on "as-built" drawings at the completion of the project in compliance with Section 222.00, Acceptance Procedures, of these STANDARDS AND SPECIFICATIONS.

161.01 General Requirements

Plans and specifications shall be drawn to scale and shall have sufficient clarity to indicate the location, nature and extent of the work proposed and show in detail that they conform to the provisions of these STANDARDS AND SPECIFICATIONS and all relevant laws, Municipal Codes, rules and regulations.

Each set of construction drawings shall include an overall utility drawing(s). The overall utility drawing(s) shall be a plan drawing at a reasonable scale (preferably 1" = 50') and shall show all of the water, sanitary sewer, storm drainage and street construction to be completed under the project.

161.02 Preliminary Construction Plan Requirements

Preliminary Construction Plans shall accompany all Preliminary Plat submittals.

The following items will be shown on all plan sheets:

- A. Title Block (lower right-hand corner preferred)

- B. Scale (both horizontal and vertical for plans and profiles)
- C. Both original date and revision date
- D. Name of professional engineer or firm
- E. Professional engineer's seal
- F. Drawing number(s)
- G. Key map
- H. Vicinity Map (cover sheet only)
 - a. An up to date vicinity map at a scale of 1"=2000'.

161.02.01 Plan Details

- A. North arrow pointing to the top of the sheet or to the right except in special cases.
- B. Property lines; indicate lots to be served by solid lines; other property lines dotted
- C. Ownership or subdivision information
- D. Street names and easements with width dimensions
- E. Existing utility line (buried) locations and depth, water, gas, telephone, storm drain, irrigation ditches, and sanitary sewers.
- F. Other pertinent details, i.e. houses, curbs, water courses, etc.

161.02.02 Water Supply Construction Details

- A. Proposed water mains;
 - 1. Size
 - 2. Length
- B. Valves – Including hydrant and blow-off valves
- C. Fire Hydrants
- D. Plan for off-site transmission mains, pump stations, special valves, and vaults, tanks, etc.

161.02.03 Sanitary Sewer Construction Details

Details shall only be provided for sanitary sewer improvements proposed to be in Town right-of-way, easements, or any other Town owned property.

- A. Proposed sanitary sewer mains;
 - 1. Diameters
 - 2. Length between manholes
- B. Proposed manholes and cleanouts;
- C. Proposed future extensions
- D. Note if a proposed private under-drain will be needed

161.02.04 Storm Drainage Construction Details

- A. Drainage area plan; an overall plan of the area under study showing:
 - 1. North arrow
 - 2. Contours – existing and proposed finished (maximum two foot intervals)
 - 3. Location and elevation of benchmarks
 - 4. Property lines
 - 5. Boundary lines (counties, districts, tributary area, etc.)
 - 6. Streets and street names and approximate grades
 - 7. Subdivision (name and location by section)
 - 8. Existing irrigation ditches
 - 9. Existing drainage ways including gutter flow directions

- 10. Drainage sub-area boundaries
 - 11. Easements required
 - 12. Proposed curbs and gutters and gutter flow directions
 - 13. Proposed cross pans and flow directions
 - 14. Proposed piping and open drainage ways
 - 15. Flow calculations for 2, 5, and 100-year storm runoff
 - 16. Path of 100-year storm runoff flows
 - 17. Proposed inlet locations and inlet sizes
 - B. Proposed pipes;
 - 1. Plan
 - 2. Size, lengths between manholes and type of pipe
 - C. Proposed open channels;
 - 1. Plan
 - 2. Grades
 - 3. Typical cross section
 - D. Proposed special structures (manholes, headwalls, inlets, trash gates, etc.)
 - 1. Plan
- 161.02.05 Street Construction Details
- A. Existing irrigation ditches to be removed or piped
 - B. Proposed curb, gutter and sidewalk
 - C. Proposed cross-pans
 - D. Storm drainage facilities
 - E. Horizontal curve data, with radii, tangents, points of curvature, (P.C.), intersection (P.I.), tangency (P.T.), length of curve, and delta angle.
 - F. Typical section of street construction showing structure and dimensions
 - G. Stations and elevations of radius points flow line of curve.
 - H. Proposed profile of centerlines with horizontal stationing
 - I. Stations, lengths, and elevations of vertical curve P.C., P.I. and P.T.
 - J. Percent slope of tangent lines
 - K. Identify street classification, such as local, collector arterial, etc.

161.02.06 Easement Widths

Water, sanitary sewer, and storm sewer easements shall be a minimum of thirty feet (30') in width. Utility locations within easements shall be a minimum of ten feet (10') from the edge of the easement to the center of pipe and 10 feet from center of pipe to center of pipe for more than one utility. For utility lines buried greater than ten feet (10'), the Engineer shall submit proposed easement width for approval by the Town Engineer.

161.02.07 Specifications and Support Documentation

The following items shall also be included with submitted construction plans:

- A. Reference on plans to other agencies potential impacted by the project

161.03 Final Construction Plan Requirements

Final Construction Plans shall accompany all Final Plat submittals.

The following items will be shown on all plan sheets:

- A. Title Block (lower right-hand corner preferred)
- B. Scale (both horizontal and vertical for plans and profiles)
- C. Both original date and revision date
- D. Name of professional engineer or firm
- E. Professional engineer's seal
- F. Drawing number(s)
- G. Key map

The following items will be shown on the cover sheet only:

- A. Vicinity Map
An up to date vicinity map at a scale of 1"=2000'.
- B. Signature block for the Sanitary Sewer Service Provider.
- C. Signature block for Little Thompson Water District (Barefoot Lakes Subdivision only).
- D. Drawing Acceptance:

All work shall be constructed to *Town of Firestone Design Standards and Construction Specifications*. This drawing has been reviewed and found to be in general compliance with these STANDARDS AND SPECIFICATIONS and other Town requirements. **THE ENGINEERING DESIGN AND CONCEPT REMAINS THE RESPONSIBILITY OF THE PROFESSIONAL ENGINEER WHOSE STAMP AND SIGNATURE APPEAR HEREON.**

Accepted by: _____
Town Engineer Date

- E. Variance Statement (if necessary)

The applicant is requesting a variance from the Town of Firestone Design Standards and Construction Specifications for the following:

- 1. (list all applicable items)

Accepted by: _____
Town Engineer Date

161.03.01 Plan Details

- A. North arrow pointing to the top of the sheet or to the right except in special cases.
- B. Property lines; indicate lots to be served by solid lines; other property lines dotted
- C. Ownership or subdivision information
- D. Street names and easements with width dimensions
- E. Existing utility line (buried) locations and depth, water, gas, telephone, storm drain, irrigation ditches, and sanitary sewers.
- F. Other pertinent details, i.e. houses, curbs, water courses, etc.

161.03.02 Profile Details

- A. Vertical and horizontal grids with scales
- B. Ground surface existing (dotted) and proposed (solid)
- C. Existing utility lines where crossed
- D. Bench marks

- E. Existing manhole inverts and rim elevations

161.03.03 Water Supply Construction Details

In addition to the above general plan and profile details, all water supply construction plans will include the following items:

- A. Proposed water mains;
 - 1. Size
 - 2. Length
 - 3. Materials and types of joints
 - 4. Location dimensions
- B. Fittings;
 - 1. Tees
 - 2. Crosses
 - 3. Reducers
 - 4. Bends
 - 5. Plugs
 - 6. Blow-offs
- C. Valves – Including hydrant and blow-off valves
- D. Fire Hydrants
- E. Plan, profile and complete details for off-site transmission mains, pump stations, special valves, and vaults, tanks, etc.
- F. Standard bedding detail (cross-section)

161.03.04 Sanitary Sewer Construction Details

Details shall only be provided for sanitary sewer improvements proposed to be in Town right-of-way, easements, or any other Town owned property. In addition to the general plan and profile details, all sanitary sewer construction plans will include the following:

- A. Proposed sanitary sewer mains;
 - 1. Diameters
 - 2. Materials
 - 3. Gradients
 - 4. Length between manholes
- B. Proposed manholes and cleanouts;
 - 1. Stationing and other number designation
 - 2. Elevation of inverts in and out of manhole
 - 3. Elevation of manhole rim
- C. Location control dimensions
- D. Proposed future extensions
- E. Proposed service connections or stub-ins
- F. Proposed private under-drain and outfall
- G. Standard bedding cross-section
- H. Proposed concrete encasement
- I. Proposed cut-off walls

161.03.05 Storm Drainage Construction Details

In addition to the above general plan and profile details, all storm drainage construction plans will include the following:

- A. Drainage area plan; an overall plan of the area under study showing:
 - 1. North arrow
 - 2. Contours – existing and proposed finished (maximum two foot intervals)
 - 3. Location and elevation of benchmarks
 - 4. Property lines
 - 5. Boundary lines (counties, districts, tributary area, etc.)
 - 6. Streets and street names and approximate grades
 - 7. Subdivision (name and location by section)
 - 8. Existing irrigation ditches
 - 9. Existing drainage ways including gutter flow directions
 - 10. Drainage sub-area boundaries
 - 11. Easements required
 - 12. Proposed curbs and gutters and gutter flow directions
 - 13. Proposed cross pans and flow directions
 - 14. Proposed piping and open drainage ways
 - 15. Flow calculations for 2, 5, and 100-year storm runoff
 - 16. Path of 100-year storm runoff flows
 - 17. Critical minimum finished floor elevations for protection from 100-year runoff
 - 18. Proposed inlet locations and inlet sizes
- B. Proposed pipes;
 - 1. Plan showing stationing
 - 2. Profile
 - 3. Size, lengths between manholes and type of pipe
 - 4. Grades
 - 5. HGL for design storm
 - 6. Inlet and outlet details
 - 7. Manhole details (station number and invert elevations)
 - 8. Typical bedding detail
- C. Proposed open channels;
 - 1. Plan showing stationing
 - 2. Profile
 - 3. Grades
 - 4. Typical cross section
 - 5. Lining details
- D. Proposed special structures (manholes, headwalls, inlets, trash gates, etc.)
 - 1. Plan
 - 2. Elevation
 - 3. Details of design and appurtenances

161.03.06 Street Construction Details

In addition to the above general plan and profile details, all street construction plans will include the following:

- A. Existing irrigation ditches to be removed or piped
- B. Proposed curb, gutter and sidewalk
- C. Proposed cross-pans including spot elevation and flow direction
- D. Storm drainage facilities
 - a. 100-year ponding limits at all inlets
- E. Slope of curb return
- F. Location and elevation of bench marks
- G. Horizontal curve data, with radii, tangents, points of curvature, (P.C.), intersection (P.I.), tangency (P.T.), length of curve, and delta angle.

- H. Typical section of street construction showing structure and dimensions
- I. Stations and elevations of radius points flow line of curve.
- J. Proposed profile of centerlines and flow lines of curb with horizontal stationing
- K. Stations, lengths, and elevations of vertical curve P.C., P.I. and P.T.
- L. Percent slope of tangent lines
- M. Limits of construction
- N. Show sufficient existing or future construction to assure continuity of construction
- O. Stations and elevations of drainage facilities and other structures
- P. Street light and underground service cable locations
- Q. Identify street classification, such as local, collector arterial, etc.
- R. Signing and striping plan
- S. Traffic control plan – as needed

161.03.07 Area Grading Plan Details

All subdivisions shall include an Area Grading Plan that shall include all pertinent information necessary to construct a dwelling on each lot. At a minimum, the following shall be included:

- A. Grading and drainage patterns of existing lots adjacent to subdivision
- B. Lot corner elevations
- C. Building finished floor or top of foundation elevations
- D. Elevations of ground outside of building to ensure proper drainage away from the foundation
- E. Elevations and grades of all drainage swales and side lot lines
- F. Elevations of all high points
- G. One foot contours for lots over .25 acres.

The Area Grading Plan must follow the accepted Drainage Plan.

161.03.08 Erosion Control Plan Details

All subdivisions shall include an erosion control plan as specified in Section 151.00 of these Standards and Specifications. Erosion control plan drawings will use the same base map as that for the Drainage Plan and shall include, at a minimum, the following information:

1. A general location map with sufficient detail to identify drainage flow entering and leaving the development and general drainage patterns.
2. Major construction (i.e., development, irrigation ditches, existing detention facilities, culverts, storm sewers) along the path of drainage.
3. Basins and divides identified with topographic contours.
4. Specifications and details for erosion control measures.
5. A transition grading/drainage plan for construction activities that are phased or sequenced. All residential developments shall require a transition-grading plan.

161.03.09 Easement Widths

Water, sanitary sewer, and storm sewer easements shall be a minimum of thirty feet (30') in width. Utility locations within easements shall be a minimum of ten feet (10') from the edge of the easement to the center of pipe and 10 feet from center of pipe to center of pipe for more than one utility. For buried utility lines greater than ten feet (10'), the Engineer shall submit proposed easement width for approval by the Town Engineer.

161.03.10 Specifications and Support Documentation

The following items shall also be included with submitted construction plans:

- A. Town of Firestone General Notes and Standard Details.
- B. Reference on plans to other agency standards and specifications that are required or proposed
- C. Where reference to other commonly available standards and specifications will not suffice, copies of specifications are to be provided.
- D. Copies of written approval from other affected agencies as required.
- E. Soils and other test data and design calculations for street structural sections, drainage facilities and other appurtenances as required.

162.00 Engineering Reports

All engineering reports shall include on the title page 1) the type of report (preliminary or final; Phase I, II, or III for Drainage Reports), 2) the project name, 3) the preparer's name, date, and firm, and 4) P.E. seal of preparer.

162.01 Preliminary Reports

The following preliminary reports must accompany all preliminary plats. The Phase I Drainage Report will be required will be required with the zoning and/or Sketch Plan submittal (number of copies to be determined during the application process).

- A. Preliminary Utility Report
- B. Phase II Drainage Report
- C. Traffic Analysis Report
- D. Geotechnical Studies
- E. Additional reports as required by the Town of Firestone Municipal Code

162.01.01 Preliminary Utility Report Requirements

Preliminary utility reports will include the following information and data as a minimum:

- A. Sanitary Sewer
 - 1. Layout/Connection to Sewer
- B. Water System
 - 1. Layout/Connection with Town Water
 - 2. Potable Water Demand (peak and average)

162.01.02 Preliminary Geotechnical Report Requirements

Geotechnical and soils investigation studies are required for foundation design and pavement design. These two categories may be combined into one report when the purpose of the investigation includes both facets of design. A preliminary geotechnical report shall include the following information at a minimum:

- A. General Information
 - 1. Past and present land uses and features
 - 2. Proposed use of the land when developed
 - 3. Surface drainage characteristics
 - 4. A general geologic report on the area and a discussion of the soil profiles and subsurface features

5. Potential slope instability
6. High groundwater elevation
- B. Unusual Land Uses/Conditions
 1. Report which identifies all unusual land uses such as landfills, open dumps, wetlands, leach fields, areas of natural springs, faults, mines, etc. These shall be presented in a written and graphical format of suitable scale.

162.01.03 Preliminary Traffic Analysis Report

Required information for the preliminary traffic report shall include, but not be limited to the following.

- A. Land use, site and study area boundaries.
- B. Existing and proposed site uses.
- C. Existing and proposed roadways and intersections.
- D. Existing and proposed roadways and intersection capacities and volumes.
- E. Trip generation and design hour volumes.
- F. Trip distribution.
- G. Trip assignments.
- H. Existing and projected traffic volumes.
- I. Levels of service of all affected intersections for the design hour.

162.01.04 Preliminary Drainage Reports

Drainage report calculations and supporting data required as set forth herein shall be prepared in accordance with the UDFCD Urban Storm Drainage Criteria Manual.

All subdivisions, re-subdivisions, planned unit developments, or other development shall submit drainage reports, construction drawings, and as-built information in accordance with these CRITERIA.

Three copies of all drainage reports shall be submitted to the TOWN for review. The TOWN will retain two copies. All submitted reports should be clearly and cleanly reproduced. Photostat copies of charts, tables, nomographs, calculations, or any other reference material must be legible. Washed out or unreadable portions of the report are unacceptable and could warrant re-submittal of the report. All reports shall be typed on 8-1/2" x 11" paper and bound. The drawings, figures, plates, and tables shall be bound with the report or included in a pocket attached to the report. The report shall be prepared by or supervised by a professional engineer licensed in Colorado.

All reports shall include a cover letter presenting the report for review as well as a declaration of the type of report submitted (i.e., Phase-I, Phase-II, or Phase-III). Incomplete or absent information may result in the report being rejected for review.

Town staff will try to review the drainage reports and provide written review comments and/or acceptance within twenty-one (21) working days of the submittal. Town staff will make every effort to effect a complete review within the review period; however, Town staff cannot guarantee the review time since the response time varies with the workload being experienced. The drainage reports and/or construction plans cannot be accepted by default.

Phase I Drainage Report

The Phase I Drainage Report is the first step in the approval process. A Phase I Drainage Report must be submitted during the zoning and/or sketch plan process. This report will review at a conceptual level the feasibility and design characteristics of the proposed development and drainage system.

Report Contents

The Phase I Drainage Report shall be in accordance with the following outline and contain the applicable information listed:

- I. GENERAL LOCATION AND DESCRIPTION
 - A. Location
 1. All streets and highways within and adjacent to the site or the area to be served by the drainage improvements
 2. Township, range, section, 1/4 section
 3. All major drainageways and storm drainage facilities within or adjacent to the site
 4. Names of surrounding developments
 - B. Description of Property
 1. Area in acres
 2. Type of ground cover and vegetation
 3. Major drainageways within the property
 4. Irrigation facilities such as ditches and canals
 5. Proposed land use
 6. Identification of all wetland areas and the affected area in acres.
- II. DRAINAGE BASINS
 - A. Major Basin Description
 1. Reference to applicable major drainageway planning studies, flood hazard area delineation reports (FHAD), and flood insurance rate maps (FIRM)
 2. Major drainage basin characteristics such as existing and proposed land uses within the basin
 3. Discussion of existing drainage patterns
 4. Identification of all irrigation facilities within 150-feet of the property boundary
 5. Identification including ownership of all lakes and ponds which either influence or may be influenced by the local drainage. Identification of all dams under the State Engineer's Office jurisdiction including the dam's current rating, status, and pertinent sections and drawings of the dam breach analysis.
 - B. Sub-Basin Description
 1. Discussion of any Master Plan improvements designated for the site.
 2. Discussion of existing drainage patterns of the property
 3. Discussion of the downstream drainage flow patterns and the impact of the proposed development under existing and fully developed basin conditions
- III. DRAINAGE FACILITY DESIGN
 - A. General Concept

1. Discussion of existing drainage patterns
 2. Discussion of compliance with off-site runoff considerations both upstream and downstream
 3. Discussion of existing drainage problems or concerns both on-site and off-site
 4. Discussion of anticipated and proposed drainage patterns and facilities
 5. Discussion of wetlands issues (if any) such as mitigation or replacement
 6. Discussion of the content of tables, charts, figures, plates, or drawings presented in the report
 7. Discussion of assumptions, techniques, and methodologies utilized
 8. Discussion of all referenced reports and studies (i.e., are they valid, complete, etc.)
- B. Specific Details
1. Determine the major and minor drainage flows for the major basins
 2. Discussion of potential drainage problems encountered and solutions at specific design points
 3. General discussion of detention pond storage and outlet design
 4. Discussion of maintenance and access aspects of the drainage facility design
 5. Discussion of the drainage impacts to downstream properties
- C. Adaptations from Criteria
1. Identify provisions by section number for which a adaptation is requested
 2. Provide specific and detailed justification for each adaptation requested
- IV. SUMMARY
- A. Overall summary including conclusions and professional opinions on the existing drainage facilities and the proposed facilities
- V. REFERENCES
- A. Reference all criteria, storm water master plans, FHADs, FIRMs, and technical information used to support the conceptual design of the proposed drainage system

Drawing Contents

All drawings shall be a maximum 24" x 36" in size.

GENERAL LOCATION MAP

The map should be at a scale of 1-inch = 1000 feet to 1-inch = 4000 feet.

The map shall provide sufficient detail to identify drainage flows entering and leaving the proposed development. The map shall indicate the drainage flow paths from the upstream end of any off-site basin to the receiving major drainageway.

The map shall identify any major facilities (i.e., irrigation ditches, existing detention facilities, culverts, and storm sewers) along the flow path to the receiving major

drainageway. All major drainageways shall be identified and shown on the report drawings.

Major basins are to be identified.
Topographic contours are to be included

FLOODPLAIN INFORMATION

A map showing the location of the subject property shall be included with the report

DRAINAGE PLAN

Map(s) of the proposed development at a scale of 1" = 20' to 1" = 100' shall be included. The plan shall show the following:

1. Physical Characteristics
 - (a) Existing topography with contours shown in intervals of two feet or five feet for the entire project area
 - (b) Proposed topography with contours shown in intervals of two feet or five feet for the entire project, if available
 - (c) Existing off-site topography with contours shown in intervals consistent with the on-site information. Off-site topography should extend as follows:
 - (1) For projects less than one acre in size, off-site topography for a distance of at least fifty feet in every direction
 - (2) For projects larger than one acre in size, off-site topography for a distance of at least one hundred fifty feet in every direction or as directed by the Town staff
 - (d) Approved grading plans (shown in contour intervals consistent with the on-site information) for all adjacent properties which have not yet been constructed
 - (e) Existing vegetation and location, type, and size of significant trees
 - (f) All existing wetlands areas
2. All existing drainage facilities both on-site and off-site for a distance as determined in 1(c) above.
3. Major drainageways and the approximate 100-year floodplain limits based on the most current available information
4. Proposed drainage facilities including location of detention ponds, storm sewers, channels, and corresponding outlet flow paths in a detail consistent with the proposed development plan
5. Major drainage basin boundaries and sub-basin boundaries
6. Any off-site feature influencing the proposed development and the proposed drainage system
7. Proposed drainage flow paths
8. Legend to define map symbols

Title block with revision dates in lower right corner

Phase II Drainage Report

The purpose of the Phase II Drainage Report is to refine the conceptual drainage system and identify in greater detail the problems, which may occur both on-site and off-site as a result of the proposed development. The Phase II Drainage Report shall be submitted with the application for

the Preliminary Plat. The Phase II Drainage Report must be written in such a manner and contain enough detail to be self-explanatory (i.e., possession of the Phase I Drainage Report is not necessary to understand the Phase II Drainage Report).

The developer or his consultant is responsible for obtaining any and all permits, licenses, and any other documentation/correspondence that are necessary to address any additional issues such as wetlands, floodplains, irrigation facilities, groundwater dewatering, and protection of existing utilities.

Report Contents

The Phase II Drainage Report shall be in accordance with the following outline and contain the applicable information listed:

I. GENERAL LOCATION AND DESCRIPTION

A. Location

1. Township, range, section, 1/4 section
2. All streets and highways including the existing ROW widths within 150 feet of the site
3. Major drainageways and facilities within 150 feet of the site
4. Names of surrounding developments

B. Description of Property

1. Area in acres
2. Ground cover such as the type of trees, shrubs, vegetation, general soil conditions, topography, and slope
3. Major drainageways within and adjacent to the site
4. General project description
5. Irrigation facilities within and adjacent to the site
6. Proposed land use
7. Identification of all wetland areas including the affected area in acres
8. All existing easements within 150 feet of the site

II. DRAINAGE BASINS

A. Major Basin Description

1. Reference to applicable major drainageway planning studies, flood hazard area delineation reports (FHADs), and flood insurance rate maps (FIRMs)
2. Major basin drainage characteristics including existing and proposed land uses
3. Identification of all irrigation facilities within the basin
4. Identification including ownership of all lakes and ponds which either influence or may be influenced by the local drainage. Identify all dams under the State Engineer's Office jurisdiction including the dam's current rating, status, and pertinent sections and drawings of the dam breach analysis

B. Sub-basin Description

1. Discussion of historic drainage patterns of the site
2. Discussion of off-site drainage flow patterns and the impact of the proposed development under existing and fully developed basin conditions

III. DRAINAGE DESIGN CRITERIA

- A. Development Criteria Reference and Constraints
 - 1. Discussion of previous drainage studies (i.e., project master plans, Phase I Drainage Reports, etc.) for the site that influence or are influenced by the proposed drainage facilities
 - 2. Discussion of drainage studies for adjacent properties and their effect on the proposed drainage system
 - 3. Discussion of the drainage impact of site constraints such as streets, utilities, and existing structures
 - 4. Discussion of wetlands issues (if any) such as mitigation or replacement.
- B. Hydrological Criteria
 - 1. Identify design rainfall for the design recurrence intervals
 - 2. Identify runoff calculation method
- C. Hydraulic Criteria
 - 1. Determination of the capacity of the downstream drainage system and its ability to handle the drainage from the development site
 - 2. Preliminary storm sewer system layout including inlets
 - 3. Identify the allowed detention discharge and storage calculation method
- D. Adaptations from Criteria
 - 1. Identify provisions by section number for which a adaptation is requested
 - 2. Provide specific and detailed justification for each adaptation requested

IV. DRAINAGE FACILITY DESIGN

- A. General Concept
 - 1. Discussion of the proposed drainage system and typical drainage patterns
 - 2. Discussion of compliance with off-site runoff considerations
 - 3. Discussion of the content of tables, charts, figures, plates, or drawings presented in the report
 - 4. Discussion of the contents of referenced reports, studies, etc.
- B. Specific Details
 - 1. Discussion of drainage problems encountered and solutions at specific design points
 - 2. Discussion of detention pond storage and outlet design
 - 3. Discussion of maintenance and access aspects of the proposed design
 - 4. Discussion of the necessity of easements and tracts for drainage purposes including the limitations of use
 - 5. Discussion of the impacts on the downstream properties of flow release from the site
 - 6. Discussion of the impact on existing floodplains of major drainageways and the requirements if altering the existing 100-year floodplain

V. SUMMARY

- A. Discussion of compliance with CRITERIA, MANUAL, and major drainageway planning studies
 - B. Drainage Concept
 - 1. Describe how the drainage design will control damage due to storm runoff both on-site and off-site
 - 2. Influence of the proposed development on the Major Drainageway Planning Studies recommendations
- VI. REFERENCES
- A. Reference all criteria and technical information used
- VII. APPENDICES
- A. Hydrologic Computations
 - 1. Land use assumptions regarding adjacent properties
 - 2. Major and minor storm runoff peaks at specific design points
 - 3. Historic and fully developed runoff peaks at specific design points
 - 4. Time of concentration and runoff coefficients for each basin and sub-basin
 - B. Hydraulic Computations
 - 1. Existing and proposed culvert capacities
 - 2. Open channel typical sections, capacity, and depths
 - 3. Detention area, volume, and depth
 - 4. Downstream drainage system capacity to the major drainageway system
 - C. Approval and/or Agreement Letter(s)
 - 1. Approval letter(s) from other jurisdictions, canal companies, pond owners, etc., (if required)
 - 2. All permits, licenses, etc., for any wetland removal or mitigation as required by the USACE.

Drawing Contents

All drawings shall be a maximum 24" x 36" in size.

- I. GENERAL LOCATION MAP
- A. The map should be at a scale of 1-inch = 1000-feet to 1-inch = 4000-feet
 - B. The map shall provide sufficient detail to identify drainage flows entering and leaving the site as well as the drainage flow paths from the upstream end of any off-site basin to the major drainageway
 - C. The map shall identify any major facilities (i.e., irrigation ditches, existing detention facilities, culverts, and storm sewers) along the entire flow path. All major drainageways shall be identified and shown on the report drawings.
 - D. Major drainage basins are to be shown
 - E. Topographic contours are to be included
- II. FLOODPLAIN INFORMATION

- A. A map showing the location of the subject property shall be included with the report
- III. DRAINAGE PLAN
- A. Map(s) of the proposed development at a scale of 1" = 20' to 1" = 100' shall be included. The plan shall show the following:
1. Physical Characteristics:
 - (a) Existing topography with contours shown in intervals of two feet for the entire site
 - (b) Proposed topography with contours shown in intervals of two feet for the entire site
 - (c) Existing off-site topography shown at a maximum of five-foot contour intervals. The off-site topography should extend as follows:
 - (1) For projects less than one acre in size, off-site topography for a distance of at least fifty feet in every direction
 - (2) For projects larger than one acre in size, off-site topography for a distance of at least one hundred fifty feet in every direction or as directed by the Town staff.
 - (d) Approved grading plans (shown at a maximum of five-foot contour intervals) for all adjacent properties which have not yet been constructed
 - (e) First-floor elevations of any existing or approved structure within one hundred fifty feet of the property line of the project.
 - (f) Cross-sections as required by the Town Engineer to illustrate the relationship between the proposed facilities and the existing or approved facilities
 - (g) All existing wetland areas including their area in acres
 2. Existing property lines and easements
 3. Streets indicating their ROW width, flow line width, curb type, sidewalk width, and approximate longitudinal slope
 4. Existing drainage facilities and structures including irrigation ditches, roadside ditches, cross-pans, drainageways, and culverts. All pertinent information such as material, size, shape, slope, and location shall also be included.
 5. Overall drainage basin boundary and sub-basin boundaries
 6. The outfall points and flow rates for runoff from the proposed site. Delineation of the off-site flow path to the major drainageway. The drainage facilities necessary to convey the flows to the major drainageway without damaging downstream properties
 7. Routing and accumulation of design flows at various critical points for the minor storm runoff using the format shown in Table 202
 8. Routing and accumulation of design flows at various critical points for the major storm runoff using the format shown in Table 202
 9. Required volumes and release rates for detention pond facilities and general information on the triple stage outlet design

10. 100-year floodplain delineation and corresponding water surface elevations of all existing FHAD and FEMA floodplains affecting the property
11. Locations and elevations (if known) of all existing and proposed utilities affected by or affecting the drainage system design.
12. Routing of off-site drainage flow through the site
13. Legend of map symbols
14. Title block with revision dates in lower right hand corner

162.02 Final Engineering Reports

The following final reports must accompany all site plans, minor subdivision, and final plat applications (number of copies to be determined during the application process):

- A. Utility Report
- B. Phase III Drainage Report
- C. Traffic Analysis Report
- D. Geotechnical Studies
- E. Construction Traffic Routing Plan
- F. Additional reports as required by the Town of Firestone Municipal Code
- G. Acceptance Statement

The applicant shall note that acceptance of construction plans, specifications, and associated engineering reports by the TOWN shall only indicate that the plans, specifications, and reports are in general conformance with the Town’s submittal requirements, current design criteria, standard engineering principles and practices, and previously approved plans and reports. Acceptance shall not indicate that all assumptions, calculations, and conclusions contained within the reports and/or construction plans have been thoroughly verified by Town staff. **At all times, the professional engineer submitting the construction plans, specifications, and associated engineering reports shall be solely responsible for their accuracy and validity.**

All final engineering studies shall have the following certification and acceptance statements:

Engineer’s Certification

“I hereby certify that this **(report type)** for the design of **(project name)** was prepared by me (or under my direct supervision) in accordance with the provisions of the *Town of Firestone Design Standards and Construction Specifications* for the owners thereof. I understand that the Town of Firestone does not and will not assume liability for engineering facilities designed by others, including the designs presented in this report.”

(Name)
Registered Professional Engineer
State of Colorado No. (#)
(Affix Seal)

Town Acceptance

This report has been reviewed and found to be in general compliance with the *Town of Firestone Design Standards and Construction Specifications* and other Town requirements. **THE ACCURACY AND VALIDITY OF THE ENGINEERING DESIGN, DETAILS, DIMENSIONS, QUANTITIES, AND CONCEPTS IN THIS REPORT REMAINS THE SOLE RESPONSIBILITY OF THE PROFESSIONAL ENGINEER WHOSE STAMP AND SIGNATURE APPEAR HEREON.**

Accepted by: _____ Date _____
Town Engineer

If during the construction process or at any time within one year following final acceptance by the TOWN of the completed improvements, any deficiencies or errors are discovered in the construction plans, specifications, drainage/traffic/utility reports, or the actual constructed improvements, the TOWN shall have the right to require the developer to make any and all

corrections which may be deemed necessary by the TOWN. The costs associated with any such corrections shall be the sole responsibility of the developer.

Engineering conformance letters may be accepted with Town Engineer approval when referring to a master report that meets the criteria referenced above. Conformance letters will not be accepted without a master report under any circumstances.

162.02.01 Final Utility Report

Final utility reports will include the following information and data as a minimum:

- A. Sanitary Sewer
 - 1. Layout and connection to sewer
 - 2. Available existing downstream capacity
- B. Water
 - 1. Layout and connection with Town water
 - 2. Potable water demand (peak and average)
 - 3. Fire flow demand
 - 4. Peak instantaneous demand and meter sizing
 - 5. Available pressure and capacity
 - 6. Irrigation water demand
 - 7. Network model of system serving development
 - 8. Calculations for Average Day, Max Day and Peak Hour demands shall be presented.
 - a) Max Day plus Fire Flow and Peak Hour demand scenarios shall be evaluated for the greater of the two scenarios.

162.02.02 Final Traffic Impact Study

All preliminary plats, zoning, and commercial site plans will provide a Traffic Impact Study.

Guidelines for Traffic Impact Studies

The purpose of a Traffic Impact Study is to determine existing conditions in the vicinity of the development, forecast the additional traffic that it will generate, and identify internal and external transportation improvements that will be necessary to mitigate the resulting impacts. Following these guidelines when preparing a traffic impact study will present a standard format and facilitate the review process.

The Town of Firestone encourages developers to maintain contact with Town personnel throughout the development process. Traffic consultants are highly encouraged to discuss projects with the Town and its representatives prior to study startup. An early meeting may be appropriate for large projects to identify the study area and specific roads and intersections that will be analyzed. The study report should identify the individual who conducted the study.

All traffic impact studies shall contain, as a minimum, the following information:

- A. Summary of the existing conditions in the vicinity of the project
 - 1. Current use of the site and surrounding area (include map showing the general vicinity of the site)
 - 2. Existing roadway system and traffic (daily and peak hour volumes) on roadways and intersections that will be affected (include graphic). Field

- traffic count data should be included in an appendix.
3. Analysis of current traffic operations (include computer printouts - to appropriate level of detail - in appendix).
 4. Recent traffic accidents may need to be investigated and the effect of the proposed development determined.
 5. Discussion of other potential developments in the study area that might also affect traffic. Traffic forecasts from traffic impact studies of nearby developments may need to be included in the analysis.
- B. Description of the proposed development
1. Development proposal - Parcel size(s), proposed land use, number of units, size of developed area, density, etc. A site plan detailing uses, locations, and internal roads should be included if possible.
 2. Trip generation tabulation. Trip generation shall be based on average rates contained in the most recent edition of the Institute of Transportation Engineers' Trip Generation. The Town shall approve any estimated rates that deviate from ITE averages or for uses where ITE information is not available. Rate and trip information shall be provided in tabular form. Any trip reductions should be calculated based on procedures outlined in ITE's most recent Trip Generation Handbook and fully documented in the report.
 3. Alternative modes (transit, pedestrian, and bicycle) should be considered, as appropriate.
 4. The Town's latest transportation master plan should be reviewed to determine the project conformance with it and any deviations that are proposed.
- C. Traffic Forecasts
1. All project-generated traffic shall be assigned to existing and planned facilities in a manner consistent with accepted traffic patterns and approved by Town staff. A graphic should be included to illustrate the assumed trip distribution.
 2. Traffic volumes (peak hour and ADT) in graphical format should illustrate current year, short-term or build-out year, and long-term (20 year) traffic volumes for site-generated and total traffic. Phased development volumes and background traffic forecasts may also be appropriate. Long-range forecasts of background traffic may be based on the latest Firestone Transportation Plan or the current Regional Transportation Plan from DRCOG.
- D. Traffic Operations Analysis
1. The operational analysis should show impacts on the existing roadway system, the expected future roadway system, and any interim roadway system that may correspond to expected development phases.
 2. There should be graphical presentation(s) of the results of the level of service (LOS) analysis for intersections and/or roads, plus tabulations if necessary to show delays or v/c percentages. Output from the computer analysis should be included in an appendix.
 3. Signal warrants should be investigated at locations where signals are proposed.
 4. Progression and micro-simulation analysis may be required depending on project needs and complexity.

- E. Improvement recommendations
1. Roadway and intersection improvements necessary to mitigate the impacts of the project should be summarized in written format with supplemental tabulations and/or figures, which illustrate the locations and relationships of the recommendations.
 2. Proposed roadway cross-sections and auxiliary lanes at intersections are of particular concern. Storage and deceleration/acceleration lengths for turn lanes should be determined according to guidelines found in the State Highway Access Code, or other recognized reference.
 3. The use of low volume local road cross section within residential subdivisions should be justified.
 4. Access to arterial roadways generally follows guidelines set forth in the State Highway Access Code. Regional Arterials are classified by CDOT, Principal Arterials are considered equivalent to NR-A, and Minor Arterials are comparable to NR-B.

162.02.03 Final Geotechnical Report

Geotechnical and soils investigation studies are required for foundation design and pavement design. A Final Pavement Design Report is required following utility installation, completion of grading operations, and prior to placement of base course or paving materials. These two categories may be combined into one report when the purpose of the investigation includes both facets of design. A subsurface investigation for foundation and/or pavement design shall include the following information and data as a minimum:

- A. General Information
1. Past and present land uses and features
 2. Proposed use of the land when developed
 3. Structure type
 4. Groundwater
 5. Surface drainage characteristics
 6. A general geologic report on the area and a discussion of the soil profiles and subsurface features
 7. Potential slope instability
- B. Investigation Details
1. Type of equipment used in obtaining data
 2. Date of drilling
 3. Boring logs which show the elevation of the existing ground, the elevation of the top of each soil stratum encountered and the soil classification of each stratum encountered, the water level at the time of boring and the level at a later date and standard penetration test results for each soil stratum. Each hole shall be referenced to a fixed benchmark.
 4. A sketch of the tested area accurately showing the locations of the borings.
- C. Site Conditions/Foundation Design

1. Specific information including swell potential of the soil and the effect on foundations.
2. A recommendation as to foundation types and any special procedures that may pertain to construction.
3. The effect of ground water on construction and methods to deal with any problems that may exist.
4. Recommended allowable soil bearing pressures and unconfined shearing strength.
5. Methods of prevention of swell and shrinkage of expansive soils and minimizing their effect on structures.
6. Natural moisture content of the soil strata.
7. Specifications for any unusual or special construction materials required.

D. Unusual Land Uses/Conditions

1. Report which identifies all unusual land uses such as landfills, open dumps, wetlands, leach fields, areas of natural springs, faults, mines, etc. These shall be presented in a written and graphical format of suitable scale.

162.02.04 Phase III Drainage Reports

Drainage report calculations and supporting data required as set forth herein shall be prepared in accordance with the UDFCD Urban Storm Drainage Criteria Manual.

The purpose of the Phase III Drainage Report is to finalize the proposed drainage system discussed in the Phase II Drainage Report and to present the final design details and calculations. This report shall contain sufficient detail to be self-explanatory and shall include all reports referenced. (i.e., possession of the Phase I Drainage Report or Phase II Drainage Report is not necessary to understand the Phase III Drainage Report).

The Phase III Drainage Report shall be submitted with the final construction drawings. The Phase III Drainage Report (which updates the Phase II Drainage Report) must be reviewed and accepted by the Engineering Division before the site plan, minor subdivision, or final plat will be signed by the TOWN.

The Phase III Drainage Report shall be prepared in accordance with the outline shown in Section 162.01.04 Phase II Drainage Report - **Report Contents** with the exception of Part VII-B. For the Phase III Drainage Report, Part VII-B shall read as follows:

B. Hydraulic Computations

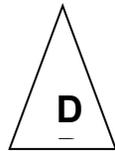
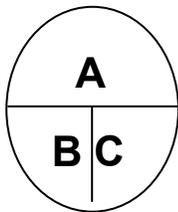
1. Existing and proposed culvert capacities
2. Storm sewer profiles including energy grade line (EGL) and hydraulic grade line (HGL) elevations with the associated hydraulic computations
3. Gutter and street cross-section capacities compared to the maximum allowable street flows
4. Storm inlet capacity including inlet control rating at connection to storm sewer
5. Open channel design: depth, capacity, velocity, and Froude number calculations
6. Check drop and/or channel drop structure design calculations
7. Detention area, volume, design depths, and outlet capacity
8. Detention pond outlet design

9. Downstream drainage system capacity to the major drainageway
10. Rip-rap design calculations

The report drawings shall follow the requirements presented in Section 162.01.04 Phase II Drainage Report - **Drawing Contents** with the following three items added to Part III-A:

1. Proposed gutter type, street capacity, roadside ditch, slope, flow directions, and cross-pans.
2. Proposed storm sewers including inlets, manholes, culverts, and other appurtenances
3. Proposed open channels with rip-rap protection

Table 202
Drawing Symbol Criteria and Hydrology Review Table



A = Basin Designation
 B = Area in acres
 C = Composite Runoff Coefficients
 D = Design Point Designation

Summary Runoff Table
(To be placed on the drainage plan)

Design Point	Contributing Area (acres)	Runoff Peak 5-year event (cfs)	Runoff Peak 100-year event (cfs)

All Phase III Drainage Reports shall have the certification and acceptance statements outlined in Section 162.02.

170.00 DEFINITIONS AND ABBREVIATIONS

171.00 Definitions

Whenever the following terms are used in these STANDARDS AND SPECIFICATIONS, they will be defined as follows:

Bonds - performance, labor or material payment bonds, irrevocable letters of credit and other instruments of security furnished by the Developer or Contractor and his surety in accordance with the Subdivision Agreements or other Agreements with the Town.

Town - the Town of Firestone acting through the Town Engineer or his/her authorized designee.

Town Municipal Code - the latest, officially adopted Town of Firestone Municipal Code.

Common Facilities - facilities serving or held in common title by the owners or occupants of two or more dwelling units or commercial or industrial enterprises and covered by these STANDARDS AND SPECIFICATIONS.

Contractor - a person that undertakes to construct, alter, move, demolish, repair, replace, excavate or add to any public improvements or common facilities covered by these STANDARDS AND SPECIFICATIONS.

Days - calendar days unless otherwise specified.

Developer - the person or persons legally responsible to the Town for construction of improvements within a subdivision.

Town Engineer - The Town's Town Engineer or his/her authorized designee.

Equipment - all machinery and equipment, together with the necessary supplies for upkeep and maintenance, and tools and apparatus necessary for the proper construction and acceptable completion of the work.

Field Order – are issued in writing when there is to be a change from what is shown on the plans and/or what is called for in the specifications, can be upgraded to a change order or construction modification order (extra work order) if costs are involved

Inspector - the authorized representative of the Town Engineer assigned to make detailed inspections of construction work to assure compliance with these STANDARDS AND SPECIFICATIONS and the plans as accepted by the Town.

Plans - profiles, cross sections, drawings, and supplemental drawings, accepted by the Town that show the locations, character, dimensions or details of the work.

Public improvements - improvements under the ownership or control of the Town including but not limited to the components of the water system, sewer system, street system, park system, and storm drainage system covered by these STANDARDS AND SPECIFICATIONS. The term also includes similar improvements being built in connection with a subdivision that are intended to be dedicated to the Town.

PVC (Polyvinyl Chloride) - a strong, tough plastic based on resins made by the polymerization of vinyl chloride or co-polymerization of vinyl chloride with minor amounts (not over 50%) of other unsaturated compounds, which are fashioned into sheets, tubing, pipe, conduit, containers, insulation, etc.

Regular working hours - Seven (7) A.M. until seven (7) P.M. or dusk (whichever occurs first) of the same day, Monday through Friday. Arterial Streets - Nine (9) A.M. until four (4) P.M. of the same day, Monday through Friday unless approved by the Town Engineer.

Special provisions - special directions, provisions or requirements peculiar to the project and not otherwise detailed or set forth in the specification.

Standards and Specifications - the body of directions, provisions, and requirements contained herein, describing the method or manner of construction and the qualities and quantities of the materials and work to be furnished.

Initial Acceptance - that date, as determined by the Town Engineer, when the construction project or a specified part thereof is sufficiently completed, in accordance with these STANDARDS AND SPECIFICATIONS, so that the project or a specified part can be utilized for the purposes for which it is intended and when the warranty period begins.

Supplier - an individual, firm or corporation having a direct contract with a developer or contractor or with any subcontractor for the manufacture or furnishing of any part of the supplies and/or materials to be used at or incorporated in, work at the site.

172.00 Abbreviations

AASHTO - American Association of State Highway and Transportation Officials

ACI - American Concrete Institute

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

AWG - American Wire Gauge

AWWA - American Water Works Association

BPR - Bureau of Public Roads

CDOT - Colorado Department of Transportation

CDPHE - Colorado Department of Public Health and Environment

FCC - Federal Communications Commission

gpcd - gallons per capita per day

gpm - gallons per minute

GRC - galvanized rigid conduit

IMSA - International Municipal Signal Association

IPCEA - Insulated Power Cable Engineers Association

ITE - Institute of Transportation Engineers

MGD - million gallons per day

MUTCD - Manual of Uniform Traffic Control Devices

NAPA - National Asphalt Paving Association

NEC - National Electrical Code as approved by the American Standards Association

NEMA - National Electrical Manufacturers Association

NFPA - National Fire Protection Association

psi - pounds per square inch

UBC - Uniform Building Code

UDFCD - Urban Drainage and Flood Control District

UPC - Uniform Plumbing Code

UL - Underwriters Laboratories, Inc.

USDA - United States Department of Agriculture

173.00 Terms

Whenever, in these STANDARDS AND SPECIFICATIONS, the words "as ordered", "as directed", "as required", "as permitted", "as allowed", or words or phrases of like import are used, it will be understood that the order, direction, requirement, permission, or allowance of the Town is intended.

Similarly, the words "approved", "reasonable", "suitable", "acceptable", "accepted", "properly", "satisfactory", or words of like effect and import, unless otherwise specified herein, will mean approved, reasonable, suitable, acceptable, accepted, proper, or satisfactory in the judgment of the Town. Whenever, in these STANDARDS AND SPECIFICATIONS, the words "Town Engineer" are used, it will be understood that the Town employee named therein will be whomever the Town Manager designates or whoever may be the authorized designee of the Town Engineer.

174.00 Specifications by Reference

All specifications, i.e., ASTM, ACI, etc. made a portion of these STANDARDS AND SPECIFICATIONS shall be from the latest edition of said reference.

Throughout these STANDARDS AND SPECIFICATIONS, any section referenced shall be deemed to include all sub-sections of that section. Any portion of these STANDARDS AND SPECIFICATIONS that may be applicable to any other section, whether referenced or not, shall apply.



SECTION 200 ACCEPTANCE PROCEDURES

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SECTION 200**ACCEPTANCE PROCEDURES****210.00 GENERAL CONDITIONS**

Prior to requesting inspection for Initial Acceptance of the work:

- A. All temporary structures, debris, mud and waste materials shall be removed from all public property.
- B. A complete and accurate set of "as built" drawings as described in Section 222.00 shall be submitted to the Town Engineer. Changes to the original design drawings must be supported by documentation that contains the signature and seal of a Colorado Registered Professional Engineer.
- C. All relative testing certifications and documentation shall be submitted to the Town Engineer. All required certifications must contain the signature and seal of a Colorado Registered Professional Engineer.
- D. All other supporting documentation as may be required shall be submitted to the Town Engineer as described in Section 222.00.

220.00 INITIAL ACCEPTANCE PROCEDURES FOR DEVELOPMENT PUBLIC IMPROVEMENTS**221.00 INSPECTION**

Upon completion of all construction and prior to requesting Town's Initial Acceptance, the Contractor and/or Owners representative should conduct their own inspection and make all necessary corrections.

When the improvements to be accepted are complete and ready for inspection, the inspection may be initiated by:

- A. Written request from the Developer to the Town Engineer outlining which facilities are ready for inspection, or
- B. The Town Engineer, if he/she determines it to be necessary, may inform the Developer that an inspection will be made, and outline those facilities which will be inspected.

The Town Engineer will then schedule a date and time for inspection with members of the Town staff within one (1) week of request. Within two (2) weeks after the initial acceptance inspection, a list of deficiencies will be prepared by the Town Engineer and presented to the Developer. Within one (1) week of receipt of this list, the Developer shall submit a satisfactory time schedule for correction of the deficiencies. After the Developer and the Contractor have corrected the deficiencies, the developer must inform the Town that repairs have been made, and a follow-up inspection will be scheduled.

The time schedule noted above may be extended only under special circumstances with the written approval of the Town Engineer. Should the deficiencies not be corrected in the time period outlined herein, the Town has the right to prepare another list of deficiencies and/or draw upon the performance guarantee as specified in the improvement or subdivision agreement to complete the improvements.

222.00 Initial Acceptance Procedures

After the Public Improvements have passed inspection, the Developer shall request in writing an Initial Acceptance letter within fifteen (15) days of inspection.

The following items must be submitted prior to Initial Acceptance being granted:

- A. An electronic copy of “As Built or Record Drawings” plan drawings in AutoCAD (.dwg) and PDF (.pdf) format. External references must be bound to the AutoCAD file or all drawing files shall be included in a folder that will enable the drawing files to open correctly so they will not require re-mapping.
- B. Field inspection reports as required in Section 160.00 of these STANDARDS AND SPECIFICATIONS.
- C. A final sworn affidavit of construction cost; and
- D. Any other items required under the subdivision agreement.
- E. Additional “As Built or Record Drawing” information is required for entry into Town’s GIS system in accordance with the current User Guide.

223.00 Warranty Period Repairs, Replacement, and Maintenance of Improvements

For a two (2) year period from the date of “Initial Acceptance” of any improvements related to the Development, the Owner shall, at his own expense, take all actions necessary to maintain said improvements and make all needed repairs or replacements which, in the reasonable opinion of Firestone, shall become necessary, except that Firestone shall be responsible for snow removal. If within thirty- (30) days after Owner’s receipt of written notice from Firestone requesting such repairs or replacements, Owner has not completed such repairs, Firestone may exercise its right to secure performance as provided in the Development Agreement.

At least thirty- (30) days before the two- (2) years has elapsed from the issuance of the Initial Acceptance, the Developer must request an inspection for consideration of completion of the warranty period. Following inspection, a list of deficiencies will be prepared. After repairs have been made, a follow-up inspection must be requested. The warranty period is not over until all warranty repairs have been made. The warranty period for repairs shall be one year.

230.00 INITIAL ACCEPTANCE PROCEDURES FOR PUBLIC IMPROVEMENTS CONTRACTED BY THE TOWN

The inspection and acceptance procedures for public improvements contracted by the Town are specified in the contract documents.

240.00 FINAL ACCEPTANCE PROCEDURES FOR DEVELOPMENT PUBLIC IMPROVEMENTS

241.00 Final Inspection

Thirty- (30) days prior to expiration of two- (2) year warranty period and prior to requesting Town final acceptance, owner’s representative should conduct their own inspection and make all necessary corrections. An inspection checklist may be obtained from the Engineering Division.

When the improvements to be accepted are complete and ready for final inspection, the final inspection may be initiated by:

- A. Written request from the Developer to the Town Engineer outlining which facilities are ready for final inspection, or
- B. The Town Engineer, if he determines it to be necessary, may outline those facilities that will be inspected.

The Town Engineer will then schedule a date and time for final inspection with members of the Town staff within one (1) week of request. Within two (2) weeks after the final inspection, a list of deficiencies will be prepared by the Town Engineer and presented to the Developer. Within one (1) week of receipt of this list, the Developer shall submit a schedule for correction of the deficiencies acceptable to the Town. After the Developer and the Contractor have corrected the deficiencies, the Developer must inform the Town that repairs have been made, and a follow-up final inspection will be scheduled.

The time schedule noted above may be extended only under special circumstances with the written approval of the Town Engineer. Should the deficiencies not be corrected in the time period outlined herein, the Town has the right to prepare another list of deficiencies and/or draw upon the performance guarantee as specified in the improvement or subdivision agreement to complete the improvements.

242.00 Final Acceptance Procedures

After the Public Improvements have passed the final inspection, the Developer shall request in writing a Final Acceptance Letter within fifteen (15) days of final inspection.

243.00 Repairs and Replacement

Upon issuance of Final Acceptance, the Town will take full responsibility of the improvements, except for repairs and replacements that, in the opinion of the Town Engineer, shall become necessary for those repaired/replaced items. At the end of the warranty, items repaired/replaced under the two (2) year warranty period will be subject to an additional one (1) year warranty. If, within ten (10) days after the Developer has received written notice from the Town Engineer requesting repairs or replacements, the Developer has not undertaken to make the repairs or replacements, the Town may make the repairs and replacements and draw upon the Developer's performance guarantee as specified in the subdivision agreement.

Approximately one (1) year following final acceptance, the Developer must request an inspection for consideration of completion of the warranty period. Following inspection, a list of deficiencies will be prepared. After repairs have been made, a follow-up inspection must be requested. The warranty period is not over until all warranty repairs have been made. The warranty period for repairs shall be one (1) year.

250.00 FINAL ACCEPTANCE PROCEDURES FOR PUBLIC IMPROVEMENTS CONTRACTED BY THE TOWN

The inspection and construction acceptance procedures for public improvements contracted by the Town are specified in the contract documents.

251.00 Final Warranty Inspection

Thirty- (30) days prior to expiration of two- (2) year warranty period and prior to requesting Town final acceptance, Contractor should conduct their own inspection and make all necessary corrections. An inspection checklist may be obtained from the Engineering Division.

When the improvements to be accepted are complete and ready for final inspection, the final inspection may be initiated by:

- A Written request from the Contractor to the Town Engineer outlining which facilities are ready for final inspection, or
- B The Town Engineer, if he determines it to be necessary, may outline those facilities that will be inspected.

The Town Engineer will then schedule a date and time for final inspection with members of the Town staff within one (1) week of request. Within two (2) weeks after the final inspection, a list of deficiencies will be prepared by the Town Engineer and presented to the Contractor. Within one (1) week of receipt of this list, the Contractor shall submit a satisfactory time schedule for correction of the deficiencies. THE DEFICIENCIES MUST BE CORRECTED WITHIN THIRTY-(30) DAYS OF THE RECEIPT OF THE LIST. After the Contractor has corrected the deficiencies, the Contractor must inform the Town that repairs have been made, and a follow-up final inspection will be scheduled.

The time schedule noted above may be extended only under special circumstances with the written approval of the Town Engineer. Should the deficiencies not be corrected in the time period outlined herein, the Town has the right to prepare another list of deficiencies and/or draw upon the performance guarantee as specified in the construction agreement to complete the improvements.

252.00 Final Acceptance Procedures

After the Public Improvements have passed the final inspection, the Contractor shall request in writing a Final Acceptance Letter within fifteen (15) days of final inspection.

253.00 Repairs and Replacement

Upon issuance of Final Acceptance, the Town will take full responsibility of the improvements, except for repairs and replacements that, in the opinion of the Town Engineer, shall become necessary for those repaired/replaced items. At the end of the warranty, items repaired/replaced under the two (2) year warranty period will be subject to an additional one (1) year warranty. If, within ten (10) days after the Contractor has received written notice from the Town Engineer requesting repairs or replacements, the Contractor has not undertaken to make the repairs or replacements, the Town may make the repairs and replacements and draw upon the Contractor's performance guarantee as specified in the construction agreement.

Approximately one (1) year following final acceptance, the Contractor must request an inspection for consideration of completion of the warranty period. Following inspection, a list of deficiencies will be prepared. After repairs have been made, a follow-up inspection must be requested. The warranty period is not over until all warranty repairs have been made. The warranty period for repairs shall be one (1) year.



SECTION 300 SITE WORK

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SECTION 300 SITE WORK

310.00 GENERAL

All site work and excavation shall comply with the requirements of the STANDARDS AND SPECIFICATIONS and any special criteria established by the Town. The Town Engineer, at a pre-design/pre-construction meeting, may establish special criteria. Site work shall be completed as detailed on the accepted engineering plans. Site work shall consist of demolition and removal of structures and obstructions; clearing and grubbing; overlot grading; subgrade preparation; removal of topsoil; site preparation; excavation and embankment; excavation, trenching, bedding and backfill of pipelines and service lines; excess excavation; borrow; and restoration and cleanup.

311.00 Local Laws, Ordinances and Codes

The Contractor shall comply with all current federal, state, county, and local laws, and codes pertaining to earthwork. The Contractor must obtain all necessary permits as required in Section 100, General Conditions, of these STANDARDS AND SPECIFICATIONS and/or any permits required by this Section prior to commencement of the work. The Contractor shall notify the Town Engineer forty-eight (48) hours before the start of the work or when work is to be resumed following a delay.

312.00 Protection of Public Improvements

The Contractor shall be held responsible for the protection of public improvements as stated in Section 141.00, Protection of Public and Utility Interests, of these STANDARDS AND SPECIFICATIONS. It will be the Contractor's responsibility to replace all public improvements so damaged at their own expense. Street cuts are restricted according to Section 143.00 of these STANDARDS AND SPECIFICATIONS.

312.01 Operation of Existing Valves

The Public Works Department will operate all existing valves, blow-offs, and curb stops. **The Contractor will operate no valve or other control device on any existing system for any purpose unless authorized by the Town.**

312.02 Interruption of Services

Before starting site work, the Contractor shall plan and coordinate for the disconnection or interruption of all services such as water, sewer, cable T.V., telephone, gas, electric power and traffic. Disconnection and/or interruptions shall be made in accordance with the regulations of the utility that controls the supply of the service. Whenever the flow of traffic is affected, a Traffic Control Plan shall be provided in accordance with Section 141.08, Traffic Control, Barricades, and Warning Signs, of these STANDARDS AND SPECIFICATIONS.

The Public Works Department shall provide a representative to be on site to observe and approve the Contractor's disconnection or interruption of the water services. Seventy-two (72) hours prior to the interruption of service, the Contractor will notify the Town of their plan and schedule. Twenty-four (24) hours prior to the interruption of service, the Contractor will notify all users in writing with a hand delivered notification whose service will be interrupted in order for them to make provisions for

necessary water storage. No line in service will be shut down for more than a four (4) hour period at one time. Prior approval by the Town Engineer is required for all shutdowns.

312.03 Equipment Operated on Streets

Only pneumatic-tired equipment shall be permitted to operate over paved surfaces. The Contractor shall be responsible for any damage to the street surface resulting from their operation.

320.00 DEMOLITIONS AND REMOVAL OF STRUCTURES AND OBSTRUCTIONS

The Contractor shall remove, wholly or in part and satisfactorily dispose of all foundations, signs, structures, fences, old pavements, abandoned pipelines, traffic signal material and any other obstructions which are not designated to remain, except for utilities and for those items which other provisions have been made for removal. All salvable material shall be clearly marked by the Town and will be removed, without unnecessary damage, in sections or pieces that 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, guardrail, walkway, roadway and parking appurtenances (traffic signals and attached hardware, including mast arms and span wire) and irrigation systems and appurtenances. The Contractor shall be required to replace any materials lost from improper storage methods or damaged by negligence. Removal of sign panel will include all work necessary to remove the panel and its attachment hardware from the existing installation. Concrete adhering to sign posts will be removed; pedestals and bases will be removed to one foot (1') below the surrounding ground or subgrade.

Where portions of structures are to be removed, the remaining parts shall be prepared to fit new construction. The work will be done in accordance with plan details and in such a manner that materials to be left in place will be protected from damage. The Contractor at their expense shall repair all damage to portions of structures that are to remain in place. Reinforcing steel, projecting from the remaining structure, shall be cleaned and aligned to provide bond with new extension. Dowels are to be securely grouted with approved grout. Depressions resulting from the removal of structures, footings, and other obstructions, shall be filled and compacted with clean fill materials so as to eliminate hazards of cave-in, accumulation and ponding of water.

Materials used in detour structures and supplied by the Contractor, shall be the property of the Contractor. After the detour is abandoned, they will completely remove the detour structure and will dispose of materials according to these STANDARDS AND SPECIFICATIONS.

Immediately following demolition and removal of rubbish from the site, provided additional work is not required, the Contractor shall grade the entire contract area by filling, compacting, and leveling the site to existing adjacent grades.

321.00 Bridges, Culverts and Other Drainage Structures

Bridges, culverts, and other drainage structures in use by traffic shall not be removed until the Town Engineer in accordance with Section 141.08, General Conditions, of these STANDARDS AND SPECIFICATIONS, has approved a Traffic Control Plan.

Unless otherwise directed, the substructures of existing structures will be removed down to one (1) foot below natural stream bottom or ground surface. Where such portions of existing structures lie

wholly or in part within the limits of a new structure, they will be removed as necessary to accommodate the construction of the proposed structure. Steel, pre-cast concrete and wood bridges shall be carefully dismantled without unnecessary damage. Steel members to be salvaged will be match-marked with waterproof paint.

322.00 Pipe

Unless otherwise provided, all pipe shall be carefully removed and cleaned; every precaution must be taken to avoid breaking or damaging the pipe. Pipes to be re-laid shall be removed and stored, when necessary, so that there will be no loss or damage before relaying.

Where culverts or sewers are to be left in place and plugged, the ends shall be filled with Type III concrete. Culvert and sewer ends are to be sufficiently filled to prevent future settlement of embankments.

When removing manholes, catch basins and inlets, any live sewer connected with these items will be properly reconnected, and satisfactory bypass service will be maintained during such operations.

323.00 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, the Town Engineer will order sawing. The sawing shall be done carefully, and the Contractor, at their expense will repair all damages to the concrete or asphalt to remain in place. The minimum depth of saw cuts in concrete will be two (2) inches.

The Contractor shall be responsible for the cost of removal and replacement of all over break as determined by the Town Engineer.

324.00 Disposal

The Contractor shall make all necessary arrangements for obtaining suitable disposal locations, and the cost involved will be included in the work. If disposal will be at other than established dumpsites, the Town Engineer may require the Contractor to furnish written permission from the property owner on whose property the materials will be placed.

330.00 SITE PREPARATION

The Contractor shall complete all work necessary to satisfactorily prepare the site as shown on the accepted drawings and as specified herein. Following this preparation, the site shall be in such a condition as to easily continue with the next operation whether it is excavating, backfilling, or any other operations that are a part of the project. Site preparation includes clearing, grubbing, grading, tree and shrub removal, native grass stripping and removing and disposing of all debris within the limits of the project and such other areas as may be indicated on the plans or required by the work, except such objects as are designated to remain or are to be removed in accordance with other sections of these STANDARDS AND SPECIFICATIONS. This work shall also include the preservation from injury or defacement of all vegetation and objects designated to remain.

331.00 Clearing

The Town shall establish construction lines and designate all trees, shrubs, plants and other things that are to remain. The Contractor shall preserve all things designated to remain. Paint required for cut or scarred surfaces of trees or shrubs selected to remain will be an approved asphalt base paint, prepared especially for tree surgery.

Branches on trees or shrubs shall be removed as directed. Branches of trees extending over the roadbed must be trimmed to give a clear working area above the roadbed surface. All trimming shall be done in accordance with Section 1000 of these Standards and Specifications.

Hedges will be pulled or grubbed in such a manner as to assure complete and permanent removal. Sod not required to be removed, must be thoroughly disked before construction of embankment.

All surface objects and trees, stumps, roots and other protruding obstructions not designated to remain will be cleared and/or grubbed as required, except nonperishable solid objects which will be a minimum of two (2) feet below subgrade.

Except in areas to be excavated, stump holes and other holes from which obstructions are removed must be backfilled with suitable material and compacted in accordance with these STANDARDS AND SPECIFICATIONS.

The Contractor will scalp areas where excavation or embankment is to be made. Scalping will include the removal of material such as brush, roots, sod, grass, residue of agricultural crops, sawdust, and other vegetable matter from the surface of the ground.

Clearing shall be performed in a careful and orderly manner with due consideration and protection of adjoining property, the public and workmen. Any damage to streets, parking lots, utilities, plants, trees, buildings or structures on private property, or to bench marks and construction staking due to the negligence of the Contractor, shall be repaired and restored to its original condition by the Contractor at their expense. Those areas which are to be saved will be clearly staked or fenced off by the Contractor per the Town's instructions and it will be the Contractor's responsibility to ensure that these areas are not damaged during the construction process. Following completion of construction, should any of these trees, shrubs or sod require replacement, it shall be done at the Contractor's expense.

332.00 Grading

A Grading and Stormwater Quality Permit shall be required as specified in Section 151.00 of these STANDARDS AND SPECIFICATIONS.

- A. If grading is in excess of 1 acre, additional requirements must be adhered to in accordance with the Town of Firestone's Standards.

Upon completion of the work, the Contractor shall provide the following information:

- A. An "as-graded" plan showing original ground surface elevations, as constructed ground surface elevations, lot drainage patterns, locations and elevations of all surface and subsurface drainage facilities.

- B. A soil grading report prepared by the soils engineer including locations and elevations of field density tests, summaries of field and laboratory tests and any other substantiating data and comments on any changes made during grading and their effect on the recommendations made in the soils engineering report.
- C. A geological report prepared by the engineering geologist including a final description of the geology of the site including any new information disclosed during the grading, and the effect of it on recommendations incorporated in the accepted grading plan.

All areas disturbed during grading operations shall have the final graded area drill seeded or re-vegetated with native grasses in accordance with the requirements of the Town of Firestone. Seeding must be completed within sixty- (60) days of the grading completion and no longer than one hundred eighty (180) days of the commencement of grading operations at the site.

The Contractor shall insure that the dust proofing requirements of Section 141.07, General Requirements, of these STANDARDS AND SPECIFICATIONS are strictly adhered to for the duration of the project.

Grading of filled and unfilled areas shall be to the lines and grades indicated on the accepted plans. Grading shall be performed in conjunction with all of the necessary clearing, grubbing, stripping, filling, and compacting operations to the satisfaction of the Town.

Grading shall be done by approved means. Areas adjacent to structures and other areas inaccessible to heavy grading equipment shall be graded by manual methods.

Final grading shall be performed in such a manner as to provide proper drainage. In no case shall drainage from the project site be so altered or controlled as to result in damage, or the potential for damage, to adjacent property or to any portion of the work executed under the project from erosion or flooding.

333.00 Disposal

The Contractor shall make all necessary arrangements for obtaining suitable disposal locations, and the cost involved will be included in the bid price. If disposal will be at other than established dump sites, the Town Engineer may require the Contractor to furnish written permission from the property owner on whose property the materials and debris will be placed. Materials and debris shall be disposed of in a manner acceptable to the Town Engineer. Burning shall not be permitted without prior written approval of the Town Engineer and the county health department.

334.00 Topsoil

The Contractor shall salvage within the project limits, or acquire when needed, loose friable loam reasonably free of admixtures of subsoil, refuse, stumps, roots, rocks, brush, weeds, heavy clay, toxic substances or other material which would be detrimental to the proper development of vegetative growth.

Topsoil shall not be placed until the areas to be covered have been properly prepared and grading operations in the area have been completed. Topsoil shall be placed and spread at locations and to the thickness shown on the plans and shall be keyed to the underlying material.

340.00 EARTHWORK

This work shall consist of excavation, disposal, shaping or compaction of all material encountered within the limits of the project, including but not limited to excavation of ditches and channels, surface boulders, muck, rock, concrete foundations, slabs, stripping, etc. Excavation will be performed to the line and grade and typical cross sections indicated on accepted plans or as required by the Town Engineer.

Excavation, dewatering, sheeting, and bracing shall be carried out in such a manner as to eliminate any possibility of undermining or disturbing the foundation of any existing structures or any work previously completed.

This Section does not include any work that is related to trenching, backfilling and compacting (refer to Section 350.00 of these STANDARDS AND SPECIFICATIONS).

Should the project warrant, the Town Engineer may require the Contractor to provide an earth-moving diagram and haul routes.

340.01 Definitions

Bedding material - material that is installed under pipelines (other than sanitary sewer and water lines), riprap, low flow channel or any other place considered necessary by the Town Engineer. The thickness of this material will be as shown on the accepted plans and will normally be six (6) inches under structures and three (3) inches under the bell of any pipe. Bedding material shall meet the gradation of CDOT "No.67 Coarse Aggregate" as specified in Section 703.02 in the latest edition of the CDOT "Standard Specifications for Road and Bridge Construction".

Borrow - backfill or embankment material that must be acquired from designated borrow areas to make up the deficient areas that cannot be completed from excavation within work limits. All sources of borrow material must be approved by the Town Engineer.

Embankment fill - earthwork consisting of embankments, including preparation of the area upon which they are to be placed, dikes within or outside right-of-way, placing and compacting of approved material within areas where unsuitable materials have been removed, and placing and compacting of embankment materials in holes, pits and other depressions to lines and grades shown on the accepted plans. Only suitable materials shall be used in construction of embankments and backfills.

Proof rolling - the application of test loads over a sub-grade surface by means of a heavy pneumatic-tired vehicle to locate weak areas in sub grade. See Section 344.00 for specifications.

Rock excavation - Igneous, metamorphic or sedimentary rock formations that cannot be excavated with a D-9 tractor in good repair with a single hydraulic ripper.

Stabilization material - material that is to be placed in areas of over excavation of unsuitable material, or in areas of high water table to stabilize the unsuitable material. Stabilization material shall meet the gradation of "No. 4 Coarse Aggregate" as specified in Section 703.02 of the CDOT "Standard Specifications for Road and Bridge Construction".

Structure backfill - earthen material that is installed around and over any structure as illustrated on the accepted plans. Imported structure backfill (Class 1) shall meet the general gradation of "Class 1 Structure Backfill Material" as specified in Section 703.08 of the CDOT "Standard Specifications for Road and Bridge Construction". On site Class 2 structure backfill shall also meet the requirements of Section 703.08 of the CDOT Specifications for Road and Bridge Construction.

Structure excavation - excavation of any and all materials over an area extending three (3) feet out from the outer most bottom edge of a proposed structure, up to existing grade or top of proposed grade (whichever comes first) at a one to one (1:1) slope. Rock formations within this area that can be removed by ripping with a D-9 tractor in good repair with a single hydraulic ripper shall be considered structure excavation.

Suitable material - any earthen material consisting of on-site or similar non-organic sands, gravels, clays, silts and mixtures thereof with a maximum size of six (6) inches. Bedrock that breaks down to specified soil types and sizes during excavation hauling and placement may be considered as suitable material.

Unclassified excavation - any and all earthen materials encountered, including rocks and boulders, during construction. Rock formations that can be removed by ripping with a D-9 tractor in good repair with a single hydraulic ripper are considered as unclassified excavation.

Unsuitable material - any earthen material containing vegetable or organic silt, topsoil, frozen materials, trees, stumps, certain man made deposits, or industrial waste, sludge or landfill, or other undesirable materials.

340.02 Grading Tolerances

All earthwork shall be carried out in such a manner that final grades, after excavation, compaction of backfill, placement of rip rap, and construction of channel lining, etc. shall conform to those illustrated by design cross sections. The final earthwork shall be considered acceptable, providing all final grade elevations do not vary from the designed elevations by more than the following:

- A. 0.3 feet at the top of any embankment where a cut side slope intersects the existing grade.
- B. 0.5 feet in all portions of the site not included in item A above.

340.03 Backfill and Embankment Material

Any suitable material or borrow as defined above. Free running water shall be drained from materials before placement.

341.00 Excavation

All excavated areas will be graded in a manner that will permit adequate drainage, will not disturb material outside the limits of slopes and will be within the tolerances noted in Section 340.02 of these STANDARDS AND SPECIFICATIONS. When practical, all suitable material removed from the excavation will be used in the formation of embankments, for backfilling, and for other purposes. Materials that are considered unsuitable material (including rock) or surplus by the Town Engineer

shall be disposed of by the Contractor at their expense, in accordance with Section 324.00 and 333.00 of these STANDARDS AND SPECIFICATIONS.

All water pumped or drained from the work shall be disposed of in a manner satisfactory to the Town Engineer, without undue interference with other work or damage to pavements, other surfaces, or property.

341.01 Excess Excavation

If in the opinion of the Town Engineer, the material at or below the depth to which excavation for structures would normally be carried is unsuitable for the required installation, it shall be removed to such widths and depths as directed by the Town Engineer and shall be replaced with stabilization material.

Where the bottom of the excavation, by error of the Contractor, have been taken to a depth greater than the depth specified, shown on the accepted plans or directed by the Town Engineer, said condition shall be corrected by refilling to the proper grade with structure backfill. Should this backfill for over excavation occur in areas of high groundwater, and then the backfill material shall be stabilization material. The Town Engineer shall approve all measures taken to rectify conditions caused by over excavation, and the cost resulting from such measures shall be borne by the Contractor.

If, through failure or neglect of the Contractor to conduct the excavation work in a proper manner, the surface of the subgrade is in an unsuitable condition for proceeding with construction, the Contractor shall, at their own expense, remove the unstable material and replace it with recycled concrete, structure backfill, or other approved material so that the condition of the subgrade meets with the approval of the Town Engineer before any work is placed thereon. Failure of the Contractor to control surface or groundwater adequately, premature excavation at the work site, or other manifestations of the Contractor's neglect or improper conduct of work, as determined by the Town Engineer, shall be grounds for requiring removal and replacement of unsuitable subgrade without additional compensation.

341.02 Excavation Near Existing Structures and Utilities

The Contractor's attention is directed to the fact that underground utilities may exist within or immediately adjacent to the areas of proposed construction. Where possible, these utilities are indicated on the accepted plans; however, all of the services may not have been shown on the accepted plans, and the completeness and accuracy of the information presented is unverified and without guarantee. This information is supplied for the purpose of providing the Contractor with an indication as to the approximate locations of utilities at the work areas so that he will be made aware of probable obstructions and the extent to which these may affect construction.

All utility lines shall be located on the ground with location equipment well ahead of the work at all times. All such locations shall be plainly marked by coded paint symbols on pavement or by marked stakes in the ground. The Contractor at no extra cost shall provide all such work.

342.00 Protection of Existing Structures and Utilities

All existing poles, pipes, wire, fences, curbs, property line markers, and other structures that, in the opinion of the Town Engineer, must be preserved in place without being temporarily or permanently

relocated, shall be carefully supported and protected from damage by the Contractor. In case of damage, the Contractor shall notify the property owner so that proper steps may be taken to repair any and all damage done. When the property owners do not wish to make the repairs themselves, the Contractor shall repair all damage; or if not promptly done by them, the Town may have the repairs made at the expense of the Contractor.

All utility services shall be supported by suitable means so that services do not fail during construction or when tamping and settling occur.

The Contractor shall be compensated for any additional work involved whenever a utility or underground structure that had not been previously anticipated is so encountered longitudinally within the excavation limits so as to severely hinder normal excavation and construction methods. The Town shall establish the cost of such work and the Contractor through a "Change Order" before any additional work is performed.

342.01 Relocation and Replacement of Existing Structures and Utilities

If, in the course of construction, the Contractor encounters utility services and/or structures of any kind not indicated on the plans, or otherwise provided for, which encroach upon or are encountered near and substantially parallel to the edge of the excavation and which, in the opinion of the Town Engineer, will impede progress to such an extent that satisfactory construction cannot proceed, they shall be relocated or removed, later to be restored or replaced as follows:

- A. Whenever the Contractor encounters any of the conditions as described above and is so ordered in writing, he shall do the whole of or such portions of the work as directed; change the location of, remove and later restore, or replace such structures; assist the Owner thereof in so doing. For such work the contractor shall be issued a change order for extra work.
- B. In removing existing pipes, or structures or utilities as described above, the Contractor shall use care to avoid damage to materials, and the Town Engineer shall include for payment only those new materials which, in their judgment, are necessary to replace those unavoidably damaged.

When fences interfere with the Contractor's operations, they may remove and, unless otherwise specified, later restore them to a condition at least as good as that in which they were found immediately before the work was begun, all without additional compensation. The restoration of fences shall be done as promptly as possible and not left until the end of the construction period.

343.00 Excavated Material

Excavated material shall be placed so as to minimize the inconvenience to occupants traveling on streets and driveways or adjoining properties. Excavated material shall not be deposited on private property unless written consent of the property owner(s) has been filed with the Town Engineer.

It is expressly understood that no excavated materials shall be removed from the site of the work or disposed of by the Contractor except as directed or approved by the Town Engineer, or as noted below.

Suitable excavated material shall be used as backfill, fill for embankments, or other parts of the work in accordance with the appropriate sections of these STANDARDS AND SPECIFICATIONS.

Disposal of surplus material shall be in accordance with Section 324.00 and 333.00 of these STANDARDS AND SPECIFICATIONS.

344.00 Proof Rolling

Proof rolling shall be required on all subgrades and aggregate base course or where required by the Town Engineer to locate weak areas. Proof rolling shall be carried out as designated with a fully loaded 2,000 gallon single axle water truck. No separate payment shall be made for proof rolling operations.

Areas of subgrade exposed and not previously disturbed but found to be weak and/or fail the test shall, at the direction of the Town Engineer, be excavated, scarified, wetted if necessary, and compacted with suitable backfill material to the requirements for density and moisture. After density and moisture requirements have been met, failed areas will require a subsequent proof roll. The Contractor shall be compensated for this work either at applicable unit bid prices or by change order.

Areas of subgrade already conditioned but upon proof rolling are found to be weak and/or fail the test shall be ripped, scarified, wetted if necessary, and compacted to requirements for density and moisture. After density and moisture requirements have been met, failed areas will require a subsequent proof roll. All reconditioning will be at the contractor's expense.

All proof rolls will be voided after twenty four (24) hours or a weather event

345.00 Embankment Fill

Earth fill shall be constructed in accordance with this Section, including placing and compacting of all embankment material, and all related work as required to ensure proper bond of materials with previously placed embankment.

No material shall be placed in any section of embankment until the foundation for that section has been cleared, stripped, and dewatered and compacted in accordance with these STANDARDS AND SPECIFICATIONS.

The suitability of each part of the foundation for placing embankment material thereon and of all materials for use in the embankment construction will be as determined by the Town Engineer or the projects' Soils Engineer. All materials shall be placed and compacted in approximately horizontal layers of the specified thickness

After subgrade has satisfactorily been prepared, the fill material shall be placed and compacted thereon and built-up in successive layers until the required elevation is reached. Fill shall be placed within the lines and grades shown on the accepted plans or as directed by the Town Engineer. No fill shall be placed on frozen surfaces, nor shall the fill material contain snow, ice, or other frozen materials.

Fill for embankment shall be a homogenous mixture of stockpiled suitable material. The characteristics of the material shall be in accordance with that of suitable material as defined in Section 340.01 of these STANDARDS AND SPECIFICATIONS.

The filling operation shall begin in the deepest part of the area to be filled and fill shall be brought up in essentially level lifts. Fill shall be placed in layers by an approved method. The entire surface of the work shall be maintained free from ruts and in a condition that will permit construction equipment to travel over any section readily.

The lifts may be discontinued, providing that the slopes of the bonding surfaces of adjoining portions of embankment shall not be steeper than 10:1 (horizontal to vertical). Previously placed material shall be moistened in such a manner and to such depths as will ensure a satisfactory bonding surface with a new material.

The Contractor shall maintain the embankment in a manner satisfactory to the Town Engineer until the Town has given final acceptance of all work.

Previously sprinkling, if required, to insure proper bond and compaction, shall moisten placed, or new materials. No compacting shall be done when the material is too wet, causing yielding. If the compacted surface of the fill layer is determined to be too smooth to provide an adequate bond with the succeeding layer, the surface shall be loosened by harrowing or by some other approved method before placement of the succeeding layer.

Excavated materials, which the Contractor desires to use for embankment, and which are otherwise suitable for embankment, except that, when excavated are too wet for immediate compaction, shall be dried such as to permit them to be placed in the embankment at the proper moisture content. No additional payment will be made for adding moisture to materials, whether added on fill, or for stockpiling, re-handling, or drying materials for use in the embankment.

The moisture content of the embankment prior to, and during, compaction shall be distributed uniformly throughout each layer of material. The placement moisture content for all materials shall be as noted below.

The Contractor will be responsible for insuring that compaction tests will be made when the Contractor has determined that he has properly compacted the embankment. Testing shall be completed in accordance with Section 354.00 of these STANDARDS AND SPECIFICATIONS.

All embankment fill shall be compacted to the percent of relative compaction shown in Table 345.00-1 and will be equal to or greater than the minimum values shown for the various types of soil. The moisture content will be maintained within \pm three percent (3%) of optimum moisture for A-1 through A-5 materials and optimum to 3% above for A-6 and A-7-6 materials during compaction. Each project shall have a soils report and specifications designed for that project, site specific.

TABLE 345.00-1

Soil Classification (AASHTO M 145)	AASHTO T 99 Min. Standard Proctor Relative Compaction (Percent)	AASHTO T 180 Min. Modified Proctor Relative Compaction (Percent)
A - 1	100	95
A - 3	100	95
A - 2 - 4	100	95
A - 2 - 5	100	N/A
All Others	95	N/A

If at any time the Town Engineer judges that the degree of compaction being obtained is insufficient, they may halt operations and order that compaction tests be taken at their direction. Areas found deficient in degree of compaction shall be recompacted and regraded, if necessary. Failed compaction tests, when ordered by the Town Engineer, shall be paid for by the Contractor.

345.01 Structure Backfill

Structure backfill material shall be used to backfill behind reinforced concrete structures as illustrated on the accepted plans. Structure backfill shall comply with material as described in Section 340.01 of these STANDARDS AND SPECIFICATIONS. In addition, this material shall have a liquid limit not exceeding 35 and a plasticity index of not over 15 when determined in conformity with AASHTO T 89 and T 90.

Areas adjacent to structures and other areas inaccessible to mobile compaction equipment shall be compacted with suitable power-drive hand tampers or other acceptable devices. Compaction by the latter method shall be done in six- (6) inch layers, unless otherwise directed by the Town Engineer.

Backfilling shall consist of placing materials in horizontal, uniform layers brought up uniformly on all sides of the structure.

Backfill material shall not be deposited against the back of concrete abutments, concrete retaining walls, or the outside of cast-in-place concrete structures until the concrete has developed a strength of not less than 2,500 pounds PSI in compression. Backfill placed within two (2) feet of any structure shall be covered up evenly on all sides to avoid unequal lateral pressures.

Compaction equipment or methods that produce horizontal or vertical earth pressures which may cause excessive displacement or may damage structures, shall not be used.

Unless otherwise indicated on the accepted plans or directed by the Town Engineer, all sheeting and the Contractor prior to backfilling shall remove bracing used in making structure excavation.

THE EXCESSIVE USE OF WATER DURING BACKFILLING OPERATIONS WILL NOT BE PERMITTED.

No compacting shall be done when material is too wet to be compacted properly; at such times the compacting work shall be suspended until the previously placed and new materials have dried out sufficiently to permit proper compacting, or such other precautions shall be taken as may be necessary to obtain proper compacting. The moisture content of the embankment prior to, and during, compaction shall be distributed uniformly throughout each layer of material. The moisture content will be maintained within \pm two percent (2%) of optimum moisture for A-1 through A-5 materials and optimum to three percent (3%) for A-6 and A-7-6 materials during compaction

In the event that sufficient satisfactory backfill material is not available on the site, the Town Engineer shall direct the Contractor to import Class 1 structure materials as defined in Section 340.01 of these STANDARDS AND SPECIFICATIONS. The Contractor shall not be required to excavate below the depths of excavation indicated on the accepted plans to provide structural backfill material. However, to the extent that acceptable material is available within the excavation limits, the Contractor will be required to excavate, transport, and compact the material without compensation beyond that which may be included for "Unclassified Excavation used as Structural Backfill" or as may be allowed for in the bid documents.

Where pipe is connected to a structure being backfilled, the bedding and backfilling procedure shall conform to the requirements of Section 352.00 and 353.00 of these STANDARDS AND SPECIFICATIONS.

The Contractor shall apply the proper compactive effort and moisture control throughout the backfilling process. The Contractor shall be responsible for ensuring that compaction tests are made of the fill when the Contractor has determined that they have properly compacted the structural backfill. Testing shall be completed in accordance with Section 354.00 of these STANDARDS AND SPECIFICATIONS.

Structure backfill shall be compacted in conformance with Table 345.00-1.

If at any time the Town Engineer determines that the degree of compaction being obtained is insufficient, they may halt operations and order that compaction tests be taken at their direction. Areas found deficient in degree of compaction shall be recompacted and regraded, if necessary. Failed compaction tests, when ordered by the Town Engineer, shall be paid for by the Contractor. The Town will pay for additional tests ordered by the Town Engineer when test results meet the requirements of these STANDARDS AND SPECIFICATIONS.

345.02 Roadway Excavations, Backfill and Compaction

Roadway excavation shall be in accordance with unclassified excavation as defined in Section 340.01 of these STANDARDS AND SPECIFICATIONS, except for areas of rock excavation as defined in the same Section. The material and execution for the roadway backfill shall conform to Section 345.00 of these STANDARDS AND SPECIFICATIONS.

All roadway backfill shall be compacted to at least ninety-five percent (95%) of maximum density at optimum moisture content in accordance with ASTM Specification Designation D-698-70 (Standard Proctor). Water shall be applied uniformly during compaction to control moisture content. The moisture content will be maintained within +/- two percent (2%) of optimum moisture for A-1 through A-5 materials and optimum to two percent (2%) above for A-6 and A-7-6 materials during compaction.

Prior to placement and compaction of roadway fill, all existing rubble and organic material shall be removed down to suitable existing material. The existing material shall then be scarified and roadway fill placed in accordance with Section 345.00 of these STANDARDS AND SPECIFICATIONS.

346.00 Grading

Grading shall be completed in accordance with Sections 332.00 and 340.02 of these STANDARDS AND SPECIFICATIONS.

347.00 Moisture Control

Moisture in fill materials shall be equal to that found in the natural unexcavated condition insofar as is practicable. If the Town Engineer determines that the fill material to be used is extremely wet, the Contractor shall spread the material on the areas to be filled and the fill shall be permitted to dry to allowable moisture content. Harrowing where necessary shall assist the drying process.

If, in the opinion of the Town Engineer, additional moisture is required, water shall be applied by some sprinkling device in such a way as to provide uniform distribution over the area to be treated with accurate control of the rate and quantity of water applied. If excessive amounts of water are added or if rain should cause excessive wetness, the area shall be allowed to dry as described above.

The moisture content of the fill shall be as near to optimum moisture content as possible, to create the least compactive effort to obtain maximum density.

348.00 Borrow

It will be the Contractor's responsibility to stockpile suitable backfill material, both for embankment fill and structure backfill, in anticipation for use in other areas of the project. Only at the time that they estimate that they have sufficient suitable backfill material stockpiled to complete the project, should they proceed to haul excavated material from the site. If the Contractor should fail to preserve, on-site, sufficient suitable material, and should haul off and dispose of suitable material, they shall be responsible for recovering said suitable material to the site for use, at their sole cost.

Should there be an insufficient quantity of material available on site for completion of the necessary embankment and structure backfill operations, the Contractor shall furnish approved backfill material as defined in Section 340.01 of these STANDARDS AND SPECIFICATIONS.

350.00 TRENCHING, BACKFILLING AND COMPACTING

This work shall consist of furnishing all labor, materials, tools and equipment for trenching, bedding, backfill and compaction for all underground utilities as specified herein and shown on the accepted plans. The excavation shall be made to lines and grades shown on the accepted plans and as established by the Town Engineer. Except where shown otherwise on the accepted plans and except where the Town Engineer gives written permission to do otherwise, all trench excavation shall be made by open cut to the depth required to construct the pipelines as shown on the accepted plans. All excavation shall be unclassified.

When excavating in concrete or asphalt areas, the limits of the trench shall be string lined and the surface cut in a vertical plane by sawing, cutting wheel or jack hammering. Vertical edges shall be cut to a vertical plane to a point one (1) foot outside the limits of excavation prior to placing the resurfacing material.

The maximum size of street cut in existing major arterial or collector streets will be eight (8) feet square; pushing or boring, unless otherwise approved in writing by the Town Engineer, will install the remainder of the line under the finished street.

Surface materials such as concrete and asphalt shall be disposed of independently of the underlying soil; base course and gravels are to be salvaged to stockpile, protected from contamination and reused for suitable material for backfill. The Contractor, in accordance with Sections 324.00 and 333.00 of these STANDARDS AND SPECIFICATIONS must dispose of all unsuitable materials unacceptable for use as backfill.

All excavated material which meets the requirements for backfill materials shall be stockpiled in a manner which will not endanger the performance of the work, endanger the workers, at a sufficient

distance from the banks to avoid overloading, obstruct sidewalks, driveways, or streets, AND provide the least possible interference with traffic.

In existing developments excavation will not be permitted to advance more than one hundred fifty (150) feet ahead of pipe laying and two hundred (200) feet in advance of the backfill operations. No trench will be left open overnight without written permission of the Town Engineer.

The contractor shall provide and maintain adequate equipment to properly remove and dispose of all surface or ground water entering the trench. A Construction Dewatering permit must be obtained from the Colorado Department of Public Health and Environment (CDPHE). Water shall be disposed of in a suitable manner without damage to adjacent property or without being a nuisance to public health and convenience. The use of any sanitary sewer to dispose of trench water will not be permitted. The trench shall be dry at all times during pipe installation and so maintained until the joining operation is complete.

350.01 Special Conditions

Subsurface investigation - Prior to the connection of any planned utility line to an existing line, the Contractor shall expose the existing utility at the points of connection in order to verify the elevations and materials of construction. The Town Engineer shall be notified a minimum of two (2) working days before such an investigation is performed. The Contractor shall also expose utilities as they cross each other to allow for verification of elevation and materials of construction. The Town Engineer will evaluate this information and provide revisions, if required, within three (3) working days of the completion of the investigation.

Telephone, Fiber Optic, Cable TV, and all other "Wire Utility" lines - Where underground "wire utility" lines are encountered which were not shown on the accepted plans, they shall be relocated as directed by the Utility Company and in accordance with its specifications. The Contractor shall coordinate this work with all other phases of construction to avoid further conflicts.

Gas and electric lines - Where underground gas and electric lines are encountered which were not shown on the accepted plans, they shall be relocated as directed by the Utility Company, and in accordance with its specifications. The Contractor shall coordinate this work with all other phases of construction to avoid further conflicts.

351.00 Trench Excavation for Pipelines and Service Lines

Trenches shall be adequately supported and the safety of workers provided for as required by the most recent Occupational Safety and Health Administration (OSHA) "Safety and Health Regulations for Construction". These regulations are described in Subpart P, Part 1926 of the Code of Federal Regulations. Sheet piling and shoring shall be utilized where required to prevent any excessive widening or sloughing of the trench which may be detrimental to human safety, to the pipe being placed, to trees, or to any existing structure. Where excavations are made under severe conditions, it may be required that the contractor use an approved piling instead of sheet piling and shoring.

Excavated material shall not be placed nearer than two (2) feet from the sides of the trench. Heavy equipment shall not be used or placed near the sides of the trench unless the trench is adequately braced.

The width of the trench must comply with the requirements set forth in these STANDARDS AND SPECIFICATIONS and will be ample to permit the pipe to be laid and joined properly and backfill to be placed and tamped. The allowable trench width, regardless of the type of soil encountered, the depth of excavation or method of bedding densification, shall not exceed the outside diameter of the pipe barrel plus twenty-four (24) inches, or be less than the outside diameter of the pipe barrel plus twelve (12) inches when measured at any point below the top of the pipe bell, flange or collar.

Where the width of the lower portion of the trench exceeds the maximum width herein stated, the Contractor, at their expense, shall furnish and install special pipe embedment or concrete encasement to protect the pipe from the additional loading. The pipe supplier shall determine the type and quantities of special pipe embedment, using trench-loading criteria based upon saturated backfill weighing 120 pounds per cubic foot and allowance for truck and other superimposed live loads.

351.01 Removal of Water

The Contractor shall provide and maintain at all times ample means and devices with which to remove promptly and properly dispose of all water entering the trench excavation. Water shall be disposed of in a suitable manner without damage to adjacent property or without being a nuisance to public health and convenience and in conformance with State and Local dewatering requirements.

Dewatering shall be accomplished by well points, sumping or any other acceptable methods that will insure a dewatered trench. All dewatering methods will be subject to the approval of the Town Engineer. A Construction Dewatering permit must be obtained from the Colorado Department of Public Health and Environment (CDPHE).

351.02 Preparation of Foundation for Pipe Laying

When the excavation is in firm earth, care shall be taken to avoid excavation below the established grade plus the required specified over depth to accommodate the pipe bedding material.

In case soft or otherwise unsuitable foundation material is encountered in the bottom of the trench, the Town Engineer may order its removal and replacement with stabilization material to provide a suitable foundation for the pipe. The fact that the trench bottom is wet will not be considered as evidence that the trench bottom is unstable. The bottom of sumps utilized for dewatering shall be two (2) inches minimum below the bottom of the trench excavation to prevent the upward flow of water into the excavation resulting in unstable bottom conditions.

352.00 Bedding for Pipelines and Service Lines

All pipe shall be installed on sufficient bedding material (as defined in Section 340.01 of these STANDARDS AND SPECIFICATIONS or set forth below) so as to provide a minimum of six (6) inches separation between the subsoil and the pipe and shall extend up to the spring line of the pipe. The bedding material will be tamped around the full length of the pipe barrel to assure support for the total pipe length. The pipe barrel will be uniformly supported along the entire length of the pipe. Bedding material will be placed to a depth of twelve inches (12") above the top of all PVC pipe, HDPE pipe, and ductile iron pipe and to the spring line of all other pipe unless otherwise noted on the accepted plans. Suitable backfill material, as defined in Section 340.01 and modified in Section 353.00 of these STANDARDS AND SPECIFICATIONS, shall be placed from spring line to a minimum of twelve (12) inches over the top of the pipe and carefully tamped in place. Each type of

pipe shall be installed as specified in the appropriate Section. Bedding material for sanitary sewer and water lines shall be a clean, well-graded #8 or #9 bedding material, and shall conform to the following limits when tested by means of laboratory sieve:

1/2" x #4 BEDDING MAT		SQUEEGEE SAND	
Sieve size	Percent Passing	Sieve size	Percent Passing
3/4 inch	100%	3/4 inch	
1/2 inch	98%	1/2 inch	
3/8 inch	70%	3/8 inch	100%
No. 4	14%	No. 4	95% - 100%
No. 8	7%	No. 8	80% - 100%
No. 16	5%	No. 16	50% - 85%
No. 30	4%	No. 30	25% - 60%
No. 50	4%	No. 50	10% - 30%
No. 100	3%	No. 100	2% - 10%
No. 200	2.1%	No. 200	.5%

Bedding material for all other pipe (except as noted below) will be as defined in Section 340.01 of these STANDARDS AND SPECIFICATIONS.

Bedding for underdrain pipe or for gravel underdrain without pipe, if required by the approved construction plans, shall be composed of washed gravel or crushed rock well graded in the size range from one-half (1/2) inch minimum to one (1) inch maximum.

352.01 Bedding Compaction

All bedding material and suitable material placed to twelve (12) inches above the top of the pipe shall be carefully compacted to at least 70% of maximum relative density in accordance with ASTM D 4253 and 4254.

353.00 Backfill for Pipelines and Service Lines

Suitable backfill shall be as defined in Section 340.01 of these STANDARDS AND SPECIFICATIONS. In addition, all wood or other organic material and deleterious substances must be removed. Clay and similar material with a liquid index in excess of 35 and a plasticity index in excess of 6 (determined in conformity with AASHTO T 89 and T 90) for import material will not be considered suitable for backfilling in trenches located in improved streets, roads, highways and thoroughfares.

When the excavated material is unsuitable for compaction, other material must be provided which will meet the requirements of the following table:

SUITABLE BACKFILL MATERIAL	
Sieve size	Total Percent Passing by Weight
2 inch	100
No. 4	30 - 100
No. 50	10 - 60
No. 200	5 - 20

Additionally, structure backfill (flow-fill) meeting the following requirements may be used to backfill pipelines and service lines when specified in the Contract.

Mix

- Minimum 24-hour strength - 10 PSI
- Maximum 28-day strength - 60 PSI
- Maximum aggregate size - 1"
- Cement - Type I-II (Ideal ASTM C 150)
- Slump - 6" minimum
8" maximum

MIX PROPORTIONS (per cubic yard of concrete)	
Cement	50 Lbs.
Water	325 Lbs. (39 gallons)
1" Aggregate (ASTM C33, Size No. 57)	1700 Lbs.
Sand - ASTM C33	1845 Lbs.
Air (Entrapped)	5.0 ounces

- Theoretical Unit Weight - 143.7 lbs/yd³ @ 1.5% air
- Theoretical Yield - 27.23 ft³ @ 1.5% air
- % Sand of Total Aggregate - 52%

Note: Aggregate weights are based upon the materials being in a saturated surface-dried condition.

Materials used above the subgrade level must conform to the requirements for sub base and base course materials as defined in Section 500, Street Construction, of these STANDARDS AND SPECIFICATIONS.

Any bracing installed to prevent cave-ins will be withdrawn in a manner that will maintain the desired support during the backfill operations. Driven sheet pilings shall be cut off at or above the top of pipe, and the portion below the cut-off line will be left in the ground.

During construction the trench backfill shall be topped out with not less than nine (9) inches of CDOT Class 5 or 6 aggregate base course and maintained free of chuckholes, ruts and loose rock, until permanent asphalt surfacing is in place.

353.01 Backfill Compaction

Bedding material shall be hand placed in loose six (6) inch lifts, hand tamped, and each lift thoroughly consolidated to the level(s) described in Section 352.00 of these STANDARDS AND SPECIFICATIONS. The remainder of the trench backfill will be placed in loose six (6) inch lifts and each lift thoroughly consolidated by tamping, vibrating, or a combination thereof, until the relative compaction density is equal to or greater than the minimum value shown in Table 345.00-1 of these STANDARDS AND SPECIFICATIONS for the various classes of soil and type of compaction. The moisture content will be maintained within \pm two percent (2%) of optimum moisture during compaction.

Pipes, culverts, sewer and other miscellaneous structures outside the roadway prism or sidewalk and not subject to traffic loads or heavy loads for a period of two (2) years shall be backfilled in layers as described above but shall be compacted to approximately the density of the surrounding earth.

Consolidation shall be obtained by the use of hand tampers having a minimum weight of twenty (20) pounds and a facial area in excess of twenty-four (24) square inches. Hydro hammers shall not be used in existing streets and neighborhoods. Large roller, tractor drawn equipment shall not be used within eighteen (18) inches of rigid pipe or thirty-six (36) inches of flexible pipe. Flooding or jetting of trenches will not be permitted.

353.02 Maintenance of Backfill

All backfill shall at all times during construction be maintained to the satisfaction of the Town Engineer. Access across trenches for driveways and streets shall be maintained free of hazards to traffic or pedestrians.

354.00 Compaction Testing

The compaction of the bedding and all types of backfill shall be tested at a rate of at least one (1) test per 200 cubic yards of fill material or portions thereof and at least one (1) test per 200 lineal feet per lift starting at two (2) feet above the pipe, whichever controls. The testing shall be at various depths and locations. The Town Engineer may require additional testing around structures, manholes, valve boxes, etc. The Contractor shall also have tests provided to the Town for water and/or sewer service lines as directed by the Town Inspector.

Initial test results shall be submitted to the Town Engineer within twenty-four (24) hours of the test or on the next working day.

Private engineering or geotechnical firms shall perform compaction testing at the Contractor's expense. A qualified technician who works under the direct supervision of a Registered Professional Engineer shall perform this testing. Final soils compaction reports shall be prepared and signed by a Registered Professional Engineer who is registered in the State of Colorado, and who is qualified to prepare such reports. Reports shall be submitted to the Town Engineer within one (1) week of the test.

355.00 Cable Installation

355.01 General

Unless otherwise approved in writing by the Town Engineer, all cable installation must be within public right-of-way or within a dedicated utility easement. All cable must be installed at a minimum depth of twenty-four (24) inches in accordance with the requirements of Article 300-5 of the National Electric Code (NEC).

355.02 Underground Installation

All underground installation shall be in accordance with Article 300-5 of the NEC.

355.03 Overhead Installation

All overhead installation shall be in accordance with Article 230-24-(b) of the NEC.

360.00 RESTORATION AND CLEANUP

At all times during construction, the Contractor shall maintain the site, partially finished structures, material stockpiles and other like areas in a reasonable state of order and cleanliness.

The surface grade and condition of all un-surfaced areas shall be restored to the grade and condition immediately prior to construction. The Contractor shall restore or replace all sod, trees, shrubbery, sprinkler systems, fences, and any other items, to a condition equal to that before the work began and to the satisfaction of the Town Engineer. See Section 1030.00 Seeding Specifications regarding appropriate mix for specific areas.

All roadway surfacing, curbing, sidewalks, and gutters shall be restored or replaced to a condition equal to that before the work began and to the satisfaction of the Town Engineer. All roadway surfacing between the vertical surface cuts on each side of the excavation shall be removed and replaced with base course material and/or hot mix bituminous or concrete surfacing.

Pavement repair shall be completed as described in Section 143.00, Pavement Cuts, of these STANDARDS AND SPECIFICATIONS.

Before final acceptance, the project area, material pits, and ground occupied by the Contractor in connection with the work shall be cleaned of all rubbish, excess materials, temporary structures, and equipment, and all parts of the work shall be left in acceptable conditions to the satisfaction of the Town Engineer.

In the event of the Contractor's failure to perform the above work, the Town at the expense of the Contractor may perform the work.



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SECTION 400 CONCRETE WORK**410.00 GENERAL**

All Portland Cement concrete work within any street, parking lot or alley right-of-way or in any part of the water system, sewage system, or storm drainage system of the Town shall meet the requirements of these STANDARDS AND SPECIFICATIONS. Engineering, plans, licenses, permits, inspection, warranties and acceptance will be as detailed in these applicable STANDARDS AND SPECIFICATIONS for the type of construction involved.

Permits will be obtained BEFORE work begins. The Contractor shall call for inspection, giving one (1) working day (twenty-four [24] hours) notice, and inspection will be made before placement of concrete can occur. Inspector's approval to place materials will be obtained by the Contractor AFTER inspection has been made and BEFORE concrete is placed. Notice of rejection shall be given to Contractor in the event any aforementioned conditions given by the Town Engineer are not met, and work shall be halted until such time as corrective action is taken. Copies of the accepted drawings and the permit shall be on the job site and available to the inspector.

420.00 MATERIALS

Concrete will be composed of Portland Cement, aggregate, and water, and shall be reinforced with steel bars or steel wire fabric where required. Admixtures other than air-entraining agents require written permission of the Town Engineer.

421.00 Cement

All cement used in concrete work shall be Portland Cement conforming to the requirements of ASTM C-150, Type I or Type II. In general, cement meeting the requirements of ASTM C 150 Type II cement shall be used in concrete that will be in contact with the soil, unless otherwise allowed or directed by the Town Engineer. Cement, which for any reason has become partially set or which contains lumps of caked cement, shall be rejected.

The Contractor shall be responsible for the proper storage of all cement until it is used. When requested by the Town Engineer, the Contractor will, at his own cost and expense, furnish the Town Engineer with a certificate from the manufacturer or an acceptable testing laboratory for each carload of cement from which cement is taken for use in the work, stating that the cement meets the requirements of these STANDARDS AND SPECIFICATIONS for Portland Cement.

422.00 Fly Ash

Fly ash may be utilized in the design mix when allowed by the Town Engineer. Fly ash shall conform to the requirements of ASTM C 618 for Class C or Class F. The pozzolanic index shall be eighty-five (85) for Class C and Class F fly ash. Class C fly ash will not be permitted where sulfate resistant cement is required.

The Contractor shall notify the Town Engineer of the source of the fly ash for review prior to use in the project. The fly ash to be used on any project shall have been tested by the Contractor for compliance with these specifications. The results of this testing shall be submitted to the Town Engineer prior to its use on the project.

When required by the Town Engineer, the Contractor shall provide the fly ash analysis performed by the fly ash supplier along with the concrete mix proportions.

423.00 Water

Water for concrete will be clean and free from sand, oil, acid, alkali, organic matter, or other deleterious substances and will meet the requirements for mix water as published in ASTM C 94. Water from public supplies or water that has been proven to be suitable for drinking is satisfactory.

424.00 Admixtures

The Contractor will use air-entraining admixtures for all surfaces of exposed concrete. Air entraining admixtures shall meet ASTM C 260. All other chemical admixtures shall meet ASTM C 494.

425.00 Fine Aggregate

Fine aggregate shall 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. Fine aggregate will be well graded from course to fine and when tested by means of laboratory sieves will meet the requirements of ASTM C 33.

Sieve Size	Percent Passing
3/8"	100
#4	95 - 100
#8	80 - 100
#16	50 - 85
#30	25 - 60
#50	10 - 30
#100	2 - 10

426.00 Coarse Aggregate

The coarse aggregate shall consist of broken stone or gravel composed of clean, hard, tough and durable stone and will be free from soft, thin, elongated or laminated pieces, disintegrated stone, clay, loam, organic, or other deleterious matter.

Coarse aggregate shall be well graded and when tested by means of laboratory sieves will meet the requirements of AASHTO M 43 #67

Sieve Size	Percent Passing
1"	100%
3/4"	90 - 100
3/8"	20 - 55
#4	0 - 10
#8	0 - 5

427.00 Colored Patterned Concrete

Where required on the accepted plans, colored patterned concrete shall comply with all applicable portions of this Section 400. In addition, the following shall apply:

- A. Minimum twenty-eight (28) day compressive strength of concrete shall be 4,000 psi.
- B. Air-entrainment shall be six percent (6%) [\pm 1%] for maximum aggregate size of three-quarter inch (3/4") or one inch (1") and shall be seven and one-half percent (7.5%) [\pm 1%] for a maximum aggregate size of three-eighth inch (3/8") or one-half inch (1/2").
- C. Normal set or retarded set water reducing admixture shall comply with ASTM C 494.
- D. No calcium chloride shall be added to the concrete mix.
- E. Matching integral color shall be used as a supplement, but not as a color hardener.
- F. Color hardener; Specially formulated for installation of pattern concrete, grade "Heavy Duty". Color shall be as noted on the accepted drawings or as approved by the Town Engineer.
- G. Color curing compound shall comply with ASTM C 309 and with all applicable air pollution regulations.

When approved by the Town Engineer, reinforcing fibers may be used in the mix design. The fibers must comply with Section 441.00 of these STANDARDS AND SPECIFICATIONS.

428.00 Flowfill Concrete

The following is the specification of the flowfill concrete as directed by the Town Engineer:

Mix Specifications:		
Material	ASTM Specification	Weight
Cement	ASTM C-150	42 to 50 lbs
Sand	ASTM C-33	1845 to 1850 lbs
Aggregate	ASTM C-33	1700 to 1750 lbs
Air Entrainment	ASTM C-260	5.0 ounces
Water	ASTM C-94	39 gallons

* Slump shall be six (6) to eight (8) inches

430.00 MIXING

431.00 General

All concrete shall be thoroughly mixed in a batch mixer of an approved type and capacity for a period of not less than two (2) minutes after all the materials, including the water, have been placed in the drum. During the period of mixing, the drum shall be operated at the speed specified by the manufacturer of the equipment. The entire contents of the mixer will be discharged before recharge, and the mixer will be cleaned frequently. The concrete shall be mixed only in such quantities that are required for immediate use. No re-tempering of concrete will be permitted. Hand-mixed concrete will not be permitted except by written approval of the Town Engineer.

432.00 Design of the Mix

432.01 General

Concrete mix information shall be prepared and submitted in accordance with ACI 301 Section 4.2. Proportions shall be submitted to the Town Engineer, along with at least two (2) sets of certified twenty-eight (28) day test results, for review and acceptance. No concrete will be incorporated into the work until the Town Engineer has accepted the proportions.

432.02 Classification

Concrete will conform to the following:

Minimum compressive strength - 28 days*	4000 psi
Minimum cement - sacks/cubic yard	6 = 564 lbs
Maximum water/cement ratio - by weight	.45
Slump - inches	1-4
Air entrainment - % by volume	5-8

* When tested in accordance with ASTM C-31

433.00 Ready-Mixed Concrete

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; all concrete must conform to all requirements ASTM C-94. The information included on the delivery system should be in accordance with ASTM C-94 section 16.

Concrete shall 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 one and one-half (1-1/2) hours after it comes in contact with the mixing water or with the aggregates. Retempered concrete will not be allowed.

The Town will have free access to the mixing plant at all times. The organization supplying the concrete will have sufficient plant and transportation facilities to assure continuous delivery of the concrete at the required rate. (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). Batch tickets will provide the following information in accordance with ASTM C-94:

- A. Name of ready-mix batch plant
- B. Serial number of ticket
- C. Date
- D. Truck number
- E. Name of purchaser
- F. Specific designation of job (name and location)
- G. Specific class or designation of the concrete in conformance with that employed in job specifications

- H. Amount of concrete in cubic yards
- I. Time loaded or of first mixing of cement and aggregates
- J. Water added by receiver of concrete and his initials
- K. Weights of fine and coarse aggregates
- L. Type, brand, and amount of cement
- M. Type, brand and amount of admixtures
- N. Weight (in gallons) of water including surface water on aggregates

440.00 REINFORCING STEEL AND FORMS

The placing, fastening, splicing and supporting of reinforcing steel and wire mesh or bar mat reinforcement shall be in accordance with the plans and the latest edition of "CRSI Recommended Practice for Placing Reinforcing Bars". All reinforcing steel shall be epoxy coated. Before being positioned, all reinforcing steel shall be thoroughly cleaned of mill and rust scale and of coatings that will destroy or reduce the bond. Where there is delay in depositing concrete, reinforcement will be re-inspected and, if necessary, cleaned.

Reinforcement shall be carefully formed to the dimensions indicated on the accepted plans by the cold bending method. Cold bends shall be made so that the inside diameter of the bend measured on the inside of the bar shall be as follows:

Bar Size	Grade 60
#3 through #8	6 bar dia.
#9, #10, and #11	8 bar dia.
#14 and #18	10 bar dia.

The inside diameter of bend for stirrups and ties shall not be less than four bar diameters for sizes #5 and smaller, and five bar diameters for #6 and #8 inclusive. Reinforcement shall not be bent or straightened in a manner that will injure the material. Bars with kinks or bends not shown on the plans will not be used. Heating of reinforcement will not be permitted.

Reinforcing steel will be accurately placed and secured against displacement by using annealed iron wire of not less than No. 18 gauge, or by suitable clips at intersections. Where necessary, reinforcing steel will be supported by metal chairs, spacers, precast mortar blocks, or metal hangers. Splicing of bars, except where shown on the plans, will not be permitted without approval of the Town Engineer.

Welded wire fabric for concrete reinforcement shall be of the gauge, spacing, dimensions, and form specified on the plans or detailed drawings and will comply with "Specifications for Welded Steel Wire Fabric for Concrete Reinforcement" (ASTM A-185) or "Specification for Welded Deformed Steel Wire Fabric for Concrete Reinforcement" (ASTM A-497).

Contractor shall submit to the Town Engineer shop drawings of the reinforcement for his review and acceptance. The Town Engineer' acceptance of shop drawings and bar schedules will not relieve the Contractor of fulfilling his responsibilities as outlined in the plans and specifications of the contract.

Unless otherwise shown on the plans, the minimum clear cover for reinforcing steel will be the following, which is specified in ACI 301, Sec. 5.5:

Bottom bars on soil bearing foundations & slabs 3 inches

- Bars adjacent to surfaces exposed to weather on earth backfill:
- For bars more than 3/4" in diameter 2 inches
 - For bars 3/4" or less in diameter 1-1/2 inches
- Interior Surfaces: slabs, walls, joints with 1-3/8" diameter or smaller 3/4 inches

Whenever necessary, forms will be used to confine the concrete and shape it to the required lines. Forms shall have sufficient strength to withstand, without deformation, the pressure resulting from placement and vibration of the concrete. Forms shall 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 had the surface prepared with a commercial form oil that will effectively prevent bonding and that will stain or soften concrete surfaces must not be used.

Plywood forms, plastic coated plywood forms, or steel forms shall be used for all surfaces requiring forming which are exposed to view, whether inside or outside any structure. Surfaces against backfilled earth, interior surfaces of covered channels, or other places permanently obscured from view, may be formed with forms having sub-standard surfaces.

Forms will not be disturbed until the concrete has hardened sufficiently to permit their removal without damaging the concrete or until the forms are not required to protect the concrete from mechanical damage. Minimum time before removal of forms after placing concrete will be one (1) day for footings and two (2) days for all other concrete except in curbs, gutters, and sidewalks.

441.00 Fibrous Reinforcing

When shown on the accepted plans or approved by the Town Engineer, fibrous reinforcing may be utilized. Fibrous concrete reinforcement shall be one hundred percent (100%) virgin polypropylene fibrillated fibers specifically manufactured for use as concrete reinforcement, containing no reprocessed olefin materials. The fibers shall have the following physical characteristics:

- A. Specific gravity - 0.91
- B. Tensile strength - 70,000 to 110,000 psi
- C. Fiber length - per manufacturer's recommendation for specific use (three quarters inch [3/4"] for sidewalks)

Add fibrous concrete reinforcement to concrete materials at the time the concrete is batched in the amounts recommended by the manufacturer (1.5 lb./cubic yard for sidewalks) or as indicated on the accepted plans.

Concrete shall be mixed in strict accord with the fibrous concrete reinforcement manufacturer's instructions and recommendations to assure uniform and complete dispersion.

450.00 PLACING CONCRETE

451.00 General

Before depositing concrete, debris will be removed from the space to be occupied by the concrete and the forms, including any existing concrete surfaces, shall be thoroughly wetted. Concrete shall not be placed until all forms and reinforcing steel have been inspected and accepted by the Town

Engineer. Concrete shall be handled from the mixer to the place of final deposit as rapidly as possible by methods that prevent separation or loss of ingredients. The concrete shall be deposited in the forms as nearly as practicable in its final position to avoid rehandling.

It will be deposited in continuous layers, the thickness of which generally will not exceed twelve (12) inches. Concrete shall be placed in a manner that will avoid segregation and will not be dropped freely more than five (5) feet. If segregation occurs, the Town Engineer may require the concrete to be removed and replaced at the Contractor's expense. Concrete will be placed in one continuous operation, except where keyed construction joints are shown on the plans or as approved by the Town Engineer. Delays in excess of thirty- (30) minutes may require removal and replacement of that pour, as determined by the Town Engineer.

452.00 Vibrating

Concrete shall be thoroughly compacted or vibrated. All concrete will be compacted by internal vibration using mechanical vibrating equipment, except that concrete in floor slabs, sidewalks, or curb and gutter, not poured against form linings, will be either tamped or vibrated. Care must 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 Publication 309, Chapter 5. Vibrators shall not be used to move or spread the concrete.

Any evidence of lack of consolidation or over-consolidation will be regarded as sufficient reason to require the removal of the section involved and its replacement with new concrete at the Contractor's expense. The Contractor shall be responsible for any defects in the quality and appearance of the completed work.

453.00 Workability

The consistency of concrete will be kept uniform for each class of work and will be checked by means of slump tests. The workability of the concrete will be varied as directed by the Town Engineer. 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, through accident, intention, or error in mixing, any concrete fails to conform to the proportions of the approved mix design, such concrete will not be incorporated in the work but shall be discarded off the project site as waste material at the Contractor's expense. If approval is obtained and water is added at the job site, slump tests will be run and test cylinders cast following the addition of the water. Any expense incurred in excess of ordinary tests will be borne by the Contractor.

454.00 Colored Patterned Concrete

Special concrete mix with integral color shall be placed and screeded to the proper grade, and floated to a uniform surface in the normal manner for slabs on grade.

While the concrete is still plastic, the imprinting tools shall be applied to make the desired patterned surface. The pattern shall be matched at imprint edges and joints.

Color Curing Compound, thinned in the proportion of one (1) part cure to one (1) part mineral spirits (paint thinner), shall then be applied uniformly with a roller or sprayer. The coverage shall be

approximately six hundred (600) to six hundred fifty (650) square feet per gallon of un-thinned curing compound. At times when the air temperature is at or near freezing, the slab shall instead be cured using a suitable curing blanket and, if possible, the slab shall later be sealed with the Color Curing Compound at such time as the air temperature is above freezing.

Use blankets and/or heaters as may be necessary to maintain the concrete at or above fifty -(50) degrees Fahrenheit for three (3) days after placement.

The surface shall be cleaned to remove any residual materials.

460.00 JOINTS

461.00 Materials

Joint materials will conform to AASHTO Specifications according to type as follows:

Concrete joint sealer, hot-poured elastic.....	M 173
Preformed expansion joint filler (Bituminous Type).....	M 33
Preformed sponge rubber and cork expansion joint fillers	M 153
Preformed expansion joint fillers - non-extruding & resilient bitum.....	M 213

Non-bituminous types shall be placed in widths shown on the accepted plans or three-eighths inch (3/8") when not specified. Bituminous type shall be used for concrete paving and structural construction where joint sealers are not called for.

462.00 Spacing

462.01 Expansion Joints

Expansion joint material will be provided at the following locations and will be in place prior to the placing of concrete:

- A. at each end of curb return;
- B. between back of sidewalk and driveway slab or service walk;
- C. between new concrete and existing masonry buildings;
- D. as shown on the drawings;
- E. as directed by the Town Engineer;
- F. between new and existing concrete.

462.02 Contraction Joints

For Curb, Gutter & Sidewalks: Transverse joints will be placed at maximum intervals of ten (10) feet to control random cracking; joints will be sawed or tooled to minimum depth of one-fourth (1/4) of the total thickness (no less than one and one-half [1 ½] inches).

For Concrete Trails greater than 5' (feet): Transverse joints will be placed at maximum intervals of ten (10) feet to control random cracking; joints will be sawed to minimum depth of one-fourth (1/4) of the total thickness (no less than one and one-half [1 ½] inches).

462.03 Tool or Saw Joints

Tool or saw joints will be spaced as follows:

- A. Not more than ten (10) feet nor less than five (5) feet apart in curb and gutter and combination curb-walk
- B. Not more than ten (10) feet nor less than five (5) feet apart in sidewalk
- C. At least two joints, equally spaced at not greater than ten (10) foot intervals as applicable in driveways
- D. As directed by the Town Engineer

470.00 FINISHING AND CURING

Exposed faces of curbs and sidewalks shall be finished to true-line and grade as shown on the plans. Surface will be floated to a smooth but not slippery finish. Sidewalk and curb will be broomed or combed and edged, unless otherwise indicated 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 three-eighths inch (3/8") radius.

No dusting or topping of the surface to facilitate finishing will be permitted.

Immediately following the removal of the forms, all fins and irregular projections will be removed from all surfaces except from those that are not to be exposed or are not to be waterproofed. On all surfaces, the cavities produced by form ties, honeycomb spots, broken corners or edges, and other defects, shall be thoroughly cleaned, moistened with water and carefully pointed and trued with a mortar consisting of cement and fine aggregate. The surface must be left sound, smooth, even, and uniform in color. Mortar used in pointing will not be more than thirty (30) minutes old. All construction and expansion joints in the completed work shall be left carefully tooled and free of all mortar and concrete. The joint filler shall be left exposed for its full length with clean and true edges.

Fresh concrete shall be adequately protected from weather damage and mechanical injury during the curing periods. Curing processes described herein may be used at the option of the Town Engineer. The selected curing process shall be started as soon as it can be done without injury to the concrete surface. The use of a membrane-curing compound is recommended. The following curing procedures may be used subject to the approval of the Town Engineer:

- A. ponding (for slabs or footings)
- B. spraying
- C. wet burlap, earth, or cotton mats
- D. waterproof paper or polyethylene plastic cover

Membrane curing compound will not be used when the concrete surface will be painted. The type of membrane curing compound chosen shall not permanently discolor the concrete surface. Where membrane-curing compound is not used, the curing process will be carefully adhered to as follows:

- A. Surfaces being wetted by ponding, spraying, or wetted material will be kept completely wetted, with an excess of free water on the surface, at all times for the first seventy-two (72) hours. After this period, but for the remaining four (4) days, a wetting schedule will be followed whereby the concrete is wetted on a schedule approved by the Town Engineer.

- B. Surfaces being protected by waterproof paper or polyethylene plastic cover will receive special attention during the first seventy-two (72) hours to insure there is actually free moisture on the surface of the concrete under the waterproof surface. The Town Engineer may require the removal of the cover and a wetting of the surface when, in his judgment, there is insufficient moisture for curing. After the first seventy-two (72) hours the cover will be kept tightly in place for the remainder of the curing period.

480.00 PROTECTION

481.00 Cold Weather Concreting

During extreme weather conditions, placing of concrete will be permitted only when the temperature of the concrete placed in the forms shall not be less than 50 degrees F nor more than 90 degrees F. To maintain this temperature range, the Contractor shall provide acceptable heating apparatus for heating the aggregates and the water. Cold weather placement of concrete shall follow the requirements and recommendations of ACI Manual 306.

Concrete may be placed when the air temperature in the shade is 35 degrees F, **and rising**.

No concrete shall be placed, regardless of the present temperature, when the weather forecast promises freezing weather before final set of the concrete unless special means of heating and protection are used, which must be approved 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.

Small structures and slabs may be protected by completely covering fresh concrete with blankets. Large structures or vertical walls will be protected against freezing by enclosing the structure and heating with salamanders, heaters, or other devices capable of providing uniform and even heat throughout the structure. Heaters must be vented so that combustion gases are exhausted outside the enclosure in order to avoid carbonation of the fresh concrete.

Cold weather is defined as a period when, for more than three (3) consecutive days, the following conditions exist:

- A. The average air temperature is less than 40 degrees F, and
- B. The air temperature is not greater than 50 degrees F for more than one half of any 24 hr. period.

Concrete placed in cold weather will be protected from extreme temperatures as follows:

- A. A temperature of at least 50 degrees F for the first seventy-two (72) hours will be maintained.
- B. After the first seventy-two (72) hours and until the concrete is seven (7) days old; it will be protected from freezing temperatures.
- C. Concrete adjacent to heaters or salamanders will be insulated from direct heat of the unit that may dry it out prior to being properly cured.
- D. Temperatures will be measured by maximum and minimum thermometers furnished by the Contractor and installed adjacent to the concrete.

Concrete slabs will not be placed, regardless of temperature conditions, if the supporting ground is frozen or contains frost. Use of salt or other additives to prevent concrete from freezing is not allowed. Concrete that has been frozen will be completely removed and replaced as directed by, and to the satisfaction of, the Town Engineer.

482.00 Hot Weather Concreting

Except by written authorization, concrete will not be placed if the temperature of the plastic concrete cannot be maintained at 90 degrees F or lower. The placement of concrete in hot weather shall comply with ACI 305. Forms and reinforcing shall be cooled to a maximum of 90 degrees F or lower.

490.00 MISCELLANEOUS**491.00 Repairs**

After stripping of the forms, if any concrete is found to be not formed as shown on the accepted plans or 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 and will be removed and replaced by the Contractor at his expense unless the Town Engineer gives written permission to patch the defective area. In this case, patching shall be done as described in the following paragraphs. Defects that require replacement or repair are those that contain honeycomb, damage due to stripping of forms, loose pieces of concrete, bolt-holes, tie-rod holes, uneven or excessive ridges at form joints, and bulges due to movement of the forms. Ridges and bulges will be removed by grinding. Honeycombed and other defective concrete that does not affect the integrity of the structure shall be chipped out, and the vacated areas will be filled in a manner acceptable to the Town Engineer. The repaired area shall be patched with a non-shrink, non-metallic grout with a minimum compressive strength of five thousand (5,000) psi in twenty-eight (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.

Bolt-holes, tie-rod holes, and minor imperfections as approved by the Town Engineer, will be filled with dry-patching mortar composed of one (1) part Portland cement to two (2) parts of regular concrete sand (volume measurement) and only enough water so that after the ingredients are mixed thoroughly, the mortar will stick together on being molded. 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. The mortar mix proportions described above are approximate.

An approved mix will be prepared by a commercial testing laboratory to insure that grout has a twenty-eight (28) day compressive strength equal to that of the area on which it is placed. All costs for mix design and the Contractor will pay testing. Those areas with excessive deficiencies as determined by the Town Engineer will be removed and replaced at the Contractor's expense. Where repairs are made in existing sidewalks, all edges of the old sidewalk allowed to remain will be sawcut to a minimum depth of one half ($\frac{1}{2}$) the existing thickness of concrete. No rough edges will be permitted where new construction joins the old section. Unless directed by the Town Engineer, no section less than five (5) feet in length will be placed or left in place. Where new sidewalk construction abuts existing sidewalks, the work will be accomplished so that there is no abrupt change in grade between the old section and the new work.

492.00 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.

493.00 Backfilling

When side forms are removed and the concrete has gained sufficient strength, the space adjoining the concrete shall 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 two (2) feet and then sloped as shown on the accepted plans or as directed by the Town Engineer. The Contractor, at his expense, will repair existing pavement that is damaged during construction. The first two (2) feet of patching to match existing asphalt or concrete will be the Contractor's responsibility.

494.00 Testing

494.01 General

The 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.

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 E329.

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.

The testing agency shall 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 of specimen prior to testing, the project number, and the location of the concrete (curb, manhole, inlet, sidewalk, paving, etc.).

The testing agency or its representative is not authorized to revoke, alter, relax, enlarge or release any requirements of these STANDARDS AND SPECIFICATIONS, nor approve or accept any portion of the work.

494.02 Tests Provided by the Contractor

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

- A. Conduct strength test of the concrete during construction in accordance with the following procedure: Secure composite samples in accordance with AASHTO T141;

mold and cure specimens from each sample in accordance with AASHTO T23. The maximum time between sampling and casting the cylinders or beams shall be forty-five (45) minutes. If they cannot be returned to the laboratory and cast within the forty-five (45) minutes, they will be cast in the field and transported to the laboratory in twelve (12) to twenty-four (24) hours. One test series will be taken per fifty (50) cubic yards (or fraction thereof) of the concrete placed per day, or as directed by the Town Engineer.

1. Field cured test series:
Four (4) cylinders; one (1) to be broken at seven (7) days; one (1) to be broken at fourteen (14) days; one (1) to be broken at twenty-eight (28) days; one (1) to be held or as directed by the Town Engineer.
2. Lab cured test series:
Four (4) cylinders; One (1) to be broken at seven (7) days; two (2) to be broken at twenty-eight (28) days*; one (1) to be broken at fifty-six (56) days if necessary.
**If the specified strength is not obtained at twenty-eight (28) days, one (1) cylinder is to be broken at fifty-six (56) days.*

- B. Determine slump of the concrete sample of each strength test whenever consistency of concrete appears to vary, or when directed by the Town Engineer, in accordance with AASHTO T119.
- C. Determine air content of the concrete sample for each strength test in accordance with AASHTO T152 (pressure method), T196 (volumetric method), or T121 (gravimetric method).
- D. Sample additional concrete at point of placement, and perform other testing or inspection service as required.
- E. When required by the Town Engineer, the Contractor or Developer will provide concrete mix designs, the results of which will be immediately reported to the Town Engineer. When pumped concrete is to be used, a separate mix design will be required. Mix designs will be in accordance with ACI 211 and 304, as applicable.
- F. Additional testing and inspection required because of changes in materials or proportions.
- G. If the work fails to pass inspection or previous tests fail to meet specifications, additional tests will be taken as directed by the Town Engineer.
- H. Core samples will be obtained and tested when samples of fresh concrete were not obtained and tested in accordance with the provisions of these STANDARDS AND SPECIFICATIONS. Obtaining and testing cores will be in accordance with ASTM C42. 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 eighty-five percent (85%) of the specified strength f_c , and if no single core is less than seventy-five percent (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.
- I. Failure of the Contractor to furnish testing as herein described will be sufficient cause for rejection of the work in question.

494.03 Test Result Submittals

The testing agency shall submit field and laboratory test results to the contractor upon completion of sampling and testing. Any failing or sub-standard results shall be submitted to the Town



Inspector immediately. All results shall be submitted to the Town of Firestone Town Engineer prior to Initial Acceptance.

494.04 Responsibility and Duties of the Contractor

The Contractor will provide the testing agency with the following:

- A. Any labor necessary to assist the designated testing agency in obtaining and handling samples at the project or from other sources of material.
- B. Provide and maintain for the sole use of the testing agency adequate facilities for safe storage and proper curing of concrete test specimens on the project site as required by AASHTO T23.

The use of testing services shall not relieve the Contractor of the responsibility to furnish material and construct in full compliance with these STANDARDS AND SPECIFICATIONS.

DSECTION 500 ROADWAY & ASHPALT DESIGN

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SECTION 500 ROADWAY & ASHPALT DESIGN**510.00 GENERAL****511.00 Applicability**

This Section contains design and testing criteria that must be met on all newly designed and constructed streets and parking lots (public or private) in the Town.

511.01 Situation Variances

Where any particular requirements contained in this Section of these STANDARDS AND SPECIFICATIONS can be shown to be inappropriate when applied to an out-of-the-ordinary situation, variances to said minimum requirements will be considered and may be authorized by the Town Engineer. The proposed variance in the requirements must result in a level of safety, service, and quality equal to or greater than that intended by the application of said requirements.

512.00 Private Street Systems

Private street systems will be subject to all requirements of these STANDARDS AND SPECIFICATIONS. The Town Engineer, as provided for in Section 511.01 of these STANDARDS AND SPECIFICATIONS, may allow variances, subject to the review and acceptance.

513.00 Town Capital Improvement Projects

It is recognized that the requirements contained in these STANDARDS AND SPECIFICATIONS are not necessarily sufficient for plans, specifications, and contract administration purposes for Town administered street capital improvement projects. Accordingly, the Town Engineer is authorized to develop and/or approve such additional requirements and procedures necessary for bidding, award, and construction administration for such projects. Additional said requirements and procedures must be consistent with these STANDARDS AND SPECIFICATIONS and all applicable provisions of other Town codes.

514.00 Final Overlay

Final Overlay shall not be scheduled until 2 years have expired since the initial construction surface was installed, at 100% built out, or as approved by the Town Engineer.

When determined necessary by the Town Engineer, prior to installation of the final bituminous surface course, the developer will furnish the Town Engineer with two (2) copies of a report, prepared by a Registered Professional Engineer licensed to practice in Colorado, utilizing non-destructive deflection testing to assess and predict the performance of the pavement.

The Professional Engineer will have a past history and knowledge in performing these tests. Qualifications of Professional Engineer must be submitted to the Town Engineer for acceptance before the start of work.

The pavement evaluation will be performed in accordance with good engineering practices. The report will generally embody the following testing and pavement evaluation techniques:

- A. Environmental study (frost cycle, drainage, etc.)
- B. Pavement surface evaluation
- C. Soil borings in areas of high deflections
- D. Pavement deflection analysis (Dynaflex, Benkelman Beam, etc.)

The report will evaluate the existing condition of the base and binder course by performance of deflection tests at a minimum of one hundred foot (100') spacing per traffic lane. The report will determine the thickness of the final lift to ensure that the pavement section will meet a twenty (20) year (or greater) pavement life.

The Pavement Evaluation Report will not be considered valid unless the wearing surface is applied during the same construction season as the testing was done.

515.00 Traffic Control Plan

Contractor will be responsible for submitting a traffic control plan that was designed and approved by a certified TCS (Traffic Control Supervisor) for review and acceptance prior to construction. The Traffic Control Plan must be in conformance with Section 141.08, Traffic Control, Barricades and Warning Signs, of these STANDARDS AND SPECIFICATIONS.

520.00 DESIGN CRITERIA

Street design, construction and right of way requirements will conform to the provisions of these STANDARDS AND SPECIFICATIONS. Street design criteria for various street types are listed in Table 500-3, Section 525.00 Vertical Alignment, and the Standard Details. The requirements of the Town's Municipal Code and Comprehensive Master Plan will be met. Throughout this Section reference to a "Qualified Soils Engineer" shall mean a soils engineer who is a Registered Professional Engineer licensed to practice in Colorado.

521.00 Geometric Cross Sections, Intersections and Street Layout

Street cross sectional elements will conform to the Town of Firestone's Transportation Master Plan. Generally, local residential cross sections will be used in areas where average daily traffic (ADT) is not likely to exceed one thousand (1,500) vehicles per day. Collector and arterial streets will be constructed whenever the alignment of the proposed street is generally the same as the collector and arterial streets shown on the Transportation Master Plan, and whenever a traffic engineering analysis of the future traffic volumes indicates the need of a cross section greater than that of a local service street.

Additional right of way may be required to satisfy other criteria contained in these STANDARDS AND SPECIFICATIONS. Areas outside the Right of Way will be graded, compacted, and sloped, as required for proper drainage, soil stability, and maintenance accessibility. Cuts and fills proposed on slopes greater than four horizontal to vertical (4:1) will require supporting calculations done by a qualified soils engineer based on a soils analysis.

521.01 Alleys

All alleys, when permitted by the Town Engineer, shall be paved to a full width and shall provide paved access to a paved street at both ends. Minimum right-of-way widths are 16' without utilities and 30' with utilities. Pavement minimum width is 12'. Dead end alleys shall be 150' maximum length

and alleys greater than 600' in length shall have a secondary access to a residential street. Any more restrictive requirements by the Fire Department shall supersede these standards.

521.02 Emergency Access

Emergency access roads shall have a minimum of right-of-way width of 20' and a minimum roadway width of 18'.

521.03 Intersection Design Guide

The purpose of this document is to identify the mandatory requirements and to provide guidelines for choice where alternatives exist. The guidelines represent a combination of material from authoritative references and research reports combined with the consensus of a broad based Technical Advisory Committee of transportation professionals.

521.03.01 Requirements and Objectives

The guidelines presented in this document are based on the premise that the design of an intersection must conform in all respects to the provisions of the Colorado Statutes and rules, plus all authoritative references that have been adopted as standards by Colorado Department of Transportation (CDOT).

In addition, the design should be such that it provides:

- Safe and convenient operation for all road users, including cyclists and pedestrians;
- Proper accessibility for pedestrians with special needs;
- Adequate capacity for peak-hour demand on all movements;
- Adequate maneuvering space for design vehicles;
- Resolution of conflicts between competing movements;
- Reasonable delineation of vehicle paths;
- Adequate visibility of conflicting traffic;
- Storage for normal queuing of vehicles;
- Appropriate access management application;
- Minimum delay and disutility to all road users;
- Proper drainage of storm water;
- Accommodation for all utilities, both above and below the ground;
- Necessary regulatory, warning and informational messages for all road users;
- Suitable advance warning of all hazards;
- Uniformity of treatment with similar locations;

521.03.02 Intersection Geometric Design Guide

General Design Analysis

Geometric design involves the proportioning of the visible elements of highway facilities. It includes the design of horizontal alignment, vertical alignment, and cross section elements such as shoulder, median, curb, barrier, sidewalk, etc. These elements provide the framework for the design of other highway elements including traffic control devices, roadway lighting, pavement design, drainage, and structural design.

Although the design of an intersection may be influenced by constraints unique to its particular location or situation, it conforms generally to the following design principles:

- The design of intersections along a given street or highway should be as consistent as possible.
- The layout of the intersection should be as simple as is practical.
- The design of all intersection elements should be consistent with the approach design speeds.
- The approach roadways should be free from steep grades or sharp horizontal or vertical curves.
- Intersections should be as close to right angle as practical.
- Sight distance should be sufficient for crossing and turning maneuvers.
- The intersection layout should encourage smooth flow and discourage wrong way movements.
- Auxiliary turn lanes should be provided on high-speed and/or high-volume facilities.
- Acceleration lanes are desirable for entrance maneuvers onto high-speed facilities.
- Design must give special attention to the provision of safe roadside clear zones and horizontal clearance.
- The intersection arrangement should not require sudden and/or complex decisions.
- The layout of an intersection should be clear and understandable.
- Special consideration should be given to requirements for accommodating bicycle and pedestrian movements.

521.03.03 Functional Classification

Functional classification is the assignment of roads into systems according to the character of service they provide in relation to the total road network. The three main categories of roads are arterials, collectors and locals. All roads on section lines shall be designed as arterial streets. All trails located on roads on section lines shall be 10' wide. Collector streets are defined as having projected traffic volumes of 1,500 vehicles per day or more. The design engineer shall consider existing and future traffic flows when designing streets and determining classification.

521.03.04 Intersection Control

At-grade intersections on that are typically controlled by stop signs (i.e., stop controlled) or traffic signals (i.e., signalized). The type of intersection control has a direct effect on a number of geometric design features, including sight distance and storage length of auxiliary lanes.

Area type is typically classified as urban or rural. Each of these area types has fundamentally different characteristics with regard to development and types of land use, density of street and highway network, nature of travel patterns and ways in which these elements are related. Consequently, the intersection design requirements for each of these areas vary.

Design speed is a principal design control that regulates the selection of many of the project standards and criteria used to design a roadway project. It must be selected very early in the design process. The selection of an appropriate design speed must consider many factors. The AASHTO Green Book has a thorough discussion on design speed and these factors.

521.03.05 Intersection Vertical Alignment Grade Considerations

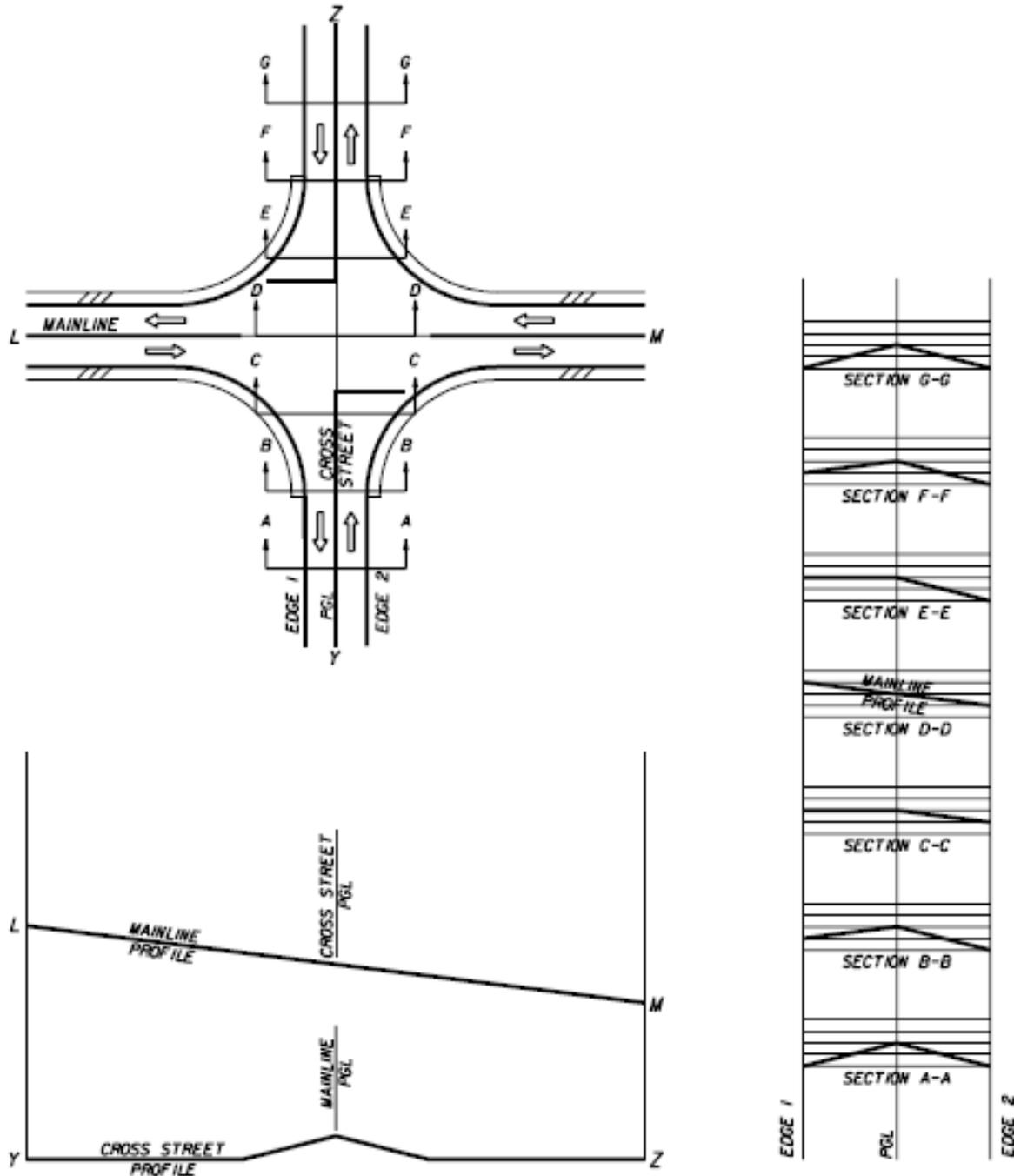
The profile grade line defines the vertical alignment for roadway and bridge construction. As with other design elements, the characteristics of vertical alignment are influenced greatly by basic controls related to design speed, traffic volumes, and functional classification, drainage, and terrain conditions. Within these basic controls, several general criteria must be considered, including minimum and maximum grades, vertical curvature, and maximum change in grade without vertical curves, vertical clearance, and design high water.

As a rule, the alignment and grades are subject to greater constraints at or near intersections than on the open road. Their combination at or near the intersection should produce traffic lanes that are clearly visible to drivers at all times and clearly understandable for any desired direction of travel, free from sudden appearance of potential conflicts and consistent in design with the portions of the highway just traveled.

Combinations of grade lines that make vehicle control difficult should be avoided at intersections. Substantial grade changes should be avoided at intersections. Adequate sight distance should be provided along both intersecting roads and across their included corners, even where one or both intersecting roads are on vertical curves. The gradients of intersecting roads should be as flat as practical on those sections that are to be used for storage of stopped vehicles.

Most drivers are unable to judge the increase and decrease in stopping or accelerating distance that is necessary because of steep grades, grades listed in Section 500 Town Street Construction should be used on intersecting roads in the vicinity of the intersection.

The profile grade lines and cross sections on the intersection legs should be adjusted for a distance back from the intersection proper to provide a smooth junction and proper drainage. Normally, the grade line of the major road should be carried through the intersection and that of the minor road should be adjusted to it. This design involves a transition in the crown of the minor road to an inclined cross section at its junction with the major road, as demonstrated in the following figure.



521.03.06 Special Intersection Profiles

To ensure a safe, efficient, well drained, and smooth roadway system, the profiles of some roadway elements requiring special analysis must be provided. These elements include pavement edges or gutter flow line at street intersections, profile grade line, intersection plateau, curb returns and roadway sections requiring special super elevation details. The special profiles shall include details at close intervals and at a scale large enough to clearly identify all construction details of these elements.

521.03.07 Intersection Plateau

The profile of the major highway generally takes precedence over the minor cross street. This results in a hump for the cross street profile which is particularly undesirable for signalized intersections where the cross street traffic may enter the intersections without stopping. In some instances the designer may determine that the cross street should receive the same profile considerations as the major highway due to similar traffic demands. To provide this "equal treatment", with respect to profile, a technique commonly known as intersection plateauing is applied. Plateauing refers to the transitioning of the roadway profiles and cross slopes at the approaches of an intersection.

521.03.08 Cross Slope

The rate of change in pavement cross slope, when warping side streets at intersections, shall not exceed one (1) percent every twenty five (25) feet horizontally on local streets/roads, one (1) percent every thirty seven and one half (37.5) feet horizontally on collector streets/roads, or one (1) percent every fifty six and one half (56.5) feet horizontally on arterial streets/roads to ensure public travel safe transition.

521.03.09 Auxiliary Lanes

Auxiliary lanes provide for the safe acceleration or deceleration of turning traffic on and off roadways and help reduce the accident potential of turning vehicles. All auxiliary lane requirements are in accordance with the latest edition Colorado Department of Transportation's (CDOT) State Highway Access Code and the Town's Street Design Criteria found in Table 500-3 at the end of Section 500. Background traffic from adjoining developments must be considered to anticipate future street system use. The developer shall be responsible for the cost of all additional auxiliary lanes needed to comply with the Town of Firestone access code.

Right-turn Deceleration Lane

	Minimum Right-Turns to Require Deceleration Lane (vph)	Deceleration Lane and Taper Length (ft)	Taper Rate
Principal Arterial (CDOT NR-A)	25	435	13.5:1
Minor Arterial (CDOT NR-B)	25	370	12:1
Collector (CDOT NR- C)	50	310	10:1

Left-turn Deceleration Lane

	Minimum Left-Turns to Require Deceleration Lane (vph)	Deceleration Lane Including Taper Length (ft)	Taper Rate
Principal Arterial (CDOT NR-A)	10	435 + Storage	13.5:1
Minor Arterial (CDOT NR-B)	10	Storage + Taper	12:1
Collector (CDOT NR-C)	25	Storage + Taper	10:1

Storage Lengths

Turning Vehicles Per Hour	< 30	30-59	60-99	100-199	200-299	>300
Storage Length (ft)	25	40	50	100	200	300

Right-turn Acceleration Lane

	Minimum Right-Turns to Require Acceleration Lane (vph)	Acceleration Lane Including Taper Length (ft)	Taper Rate
Principal Arterial (CDOT NR-A)	50	550	13.5:1
Minor Arterial (CDOT NR-B)	N/A	--	--
Collector (CDOT NR-C)	N/A	--	--

Redirect Tapers for Through Lane

Posted Speed in MPH	30 or less	35	40	45	50	55	60	65	70
Straight Taper Ratio	15:1	20:1	30:1	45:1	50:1	55:1	60:1	65:1	70:1

521.04 Medians

All medians shall be designed so that there is no interference with traffic flow. The nose of medians shall be a minimum of 10 feet behind the flowline of the intersected street. The minimum radius shall be 2 feet to flowline. Only spill curb & gutter should be used to construct all medians unless otherwise approved by the Town Engineer.

522.00 Half Streets

Where half streets are allowed, sufficient additional right of way will be dedicated and additional width will be constructed to allow sufficient paved width to accommodate two directions of traffic and emergency parking by offsetting the geometric cross section.

523.00 Structural Sections

523.01 Structural Sections for Streets

Structural sections for streets shall be composite sections of base and asphalt.

Structural sections for streets shall be designed by a qualified soils engineer based on the Equivalent (18 Kip) Daily Load Applications (EDLA) for a twenty (20) year service life and the subgrade support analysis. The soils analysis shall be performed in accordance with AASHTO standard methods of surveying and sampling Soils. The field investigation shall consist of boring subgrade soils to a depth of at least four feet below proposed subgrade elevation (nine (9) feet below proposed subgrade on arterial roadways), at spacing of not more than two hundred fifty (250) feet, or a minimum of one boring for each section of street. The Hveem Stabilometer design method will be used for arterial streets, and either the Hveem Stabilometer or the California Bearing Ratio (CBR) design method will be used for all other streets. The *preliminary* structural section will be a twenty (20) year design section with a temporary cross slope of 1.2% - 1.6% from flow line to centerline as shown in the Standard Drawings. The following standards provide the minimum acceptable pavement sections for public roadways in the Town of Firestone. These pavement thicknesses may be used for preliminary planning purposes. Final pavement designs must be based on a geotechnical pavement design.

	EDLA	Composite Section	
		Base	Asphalt
Local Residential			
< 50 D.U.	8	8"	4"
> 50 D.U.	10	8"	4"
Collector			
70' Right-of-way Width	30	8"	4"
80' Right-of-way Width	100	9"	6"
Minor Arterial	200	9"	6"
Principal Arterial	200	12"	8"

Portland Cement concrete pavement designs may be allowed with Town Engineer approval of the design thickness.

524.00 Horizontal Alignment

Streets shall generally be aligned to bear a reasonable relationship to topography. Horizontal curves will conform to the street design criteria listed in Table 500-3 and Section 525.00 Vertical Alignment. Minimum spacing between intersection centerlines will be as follows:

Street Type	Spacing
Local Residential	150'
Collector	400'
Arterial	1000'

Where the minimum centerline radius, noted in Table 500-3 and Section 525.00 Vertical Alignment, for through local residential streets cannot be achieved due to difficult parcel configurations and other constraints, a lesser centerline radius with a bulb on the outside of the curve as shown in the Standard Drawings will be allowed. The minimum centerline radii noted in Table 500-3 and Section 525.00 Vertical Alignment are permitted only where sufficient sight distance to the intersection is provided to enable the driver entering the curve and approaching the intersection to perceive that a stop condition exists, warranting at least a voluntary 10 m.p.h. reduction in speed before entering the curve.

Angles of intersection should, wherever possible, be maintained at ninety- (90) degrees. Horizontal and vertical alignment and right of way limits will be coordinated so as not to obstruct sight distance at intersections, in accordance with the Standard Drawings. Curb return radii will be as shown on Table 500-3 and Section 525.00 Vertical Alignment. Where two different street types connect, the larger curb return radius will apply.

525.00 Vertical Alignment

Street centerline profile grades will be as shown on Table 500-3 and Section 525.00 Vertical Alignment. Where a street is curved and minimum profile grade is desired, the centerline grade will be adjusted so that the curb line grade on the outside of the radius will be no less than the minimum street grade specified on Table 500-3 and Section 525.00 Vertical Alignment. Safe stopping sight distances are illustrated in the Standard Drawings.

Centerline profile grades will not exceed four percent (4%) for a distance of at least one hundred feet (100') either side of an intersecting centerline. Gutter flow line grades will be no less than eight-tenths percent (0.5%) along curb returns, in cul-de-sacs and bulb areas, and other areas where gutter flow line grades do not directly parallel centerline profile grades.

525.01 Roadway Functional Classification

See Section 521.03.03 for definitions.

525.02 Vertical Curve

Vertical curves to effect gradual changes between tangent grades may be any one of the crest or sag types. Vertical curves should be simple in application and should result in a design that is safe and comfortable in operation, pleasing in appearance, and adequate for drainage. The major control for safe operation on crest vertical curves is the provision of ample sight distances for the design speed selected. It is recommended that all vertical curves should be designed to provide at least the stopping sight distances shown in the approved tables within this document.

525.03 Crest Vertical Curves

Minimum lengths of crest vertical curves based on sight distance criteria generally are satisfactory from the standpoint of safety, comfort, and appearance. Computations are based on

3.5 feet for height of eye in passing sight situations and 2 feet for height of object for stopping sight situations.

The minimum lengths of vertical curves for different values of A (algebraic difference) to provide the minimum stopping sight distance for each design speed are listed below in the table. K values are based on the following formula $V = K * A$ (V – Vertical Curve Length; K – rate of vertical curvature; A – Algebraic Difference) and the designer should solve for K, to evaluate and compare to the table listed below.

For example: A design speed of 25 mph requires a minimum K value of 15 and anything less than 15 would not satisfy the required 25 mph speed limit for safety and stopping sight distance based on AASHTO criteria.

Design Controls for Stopping Sight Distance and for Crest Vertical Curves

Design Speed (mph)	Stopping Sight Distance (feet)	Rate of Vertical Curvature (K)
15	80	5
20	115	10
25	155	15
30	200	20
35	250	30
40	305	45
45	360	65
50	425	85
55	495	115

For minimum passing sight distances the lengths of crest vertical curves are substantially longer than those for stopping sight distances. Generally it is impractical to design crest vertical curves to provide for passing sight distance because of high cost. Passing sight distance on crest vertical curves may be practical on roads with unusual combinations of low design speeds and gentle grades or higher design speeds with very small algebraic differences in grades.

The minimum lengths of vertical curves for different values of A (algebraic difference) to provide the minimum passing sight distance for each design speed are listed below in the table.

Design Controls for Crest Vertical Curves Based on Passing Sight Distance

Design Speed (mph)	Stopping Sight Distance (feet)	Rate of Vertical Curvature (K)
20	710	180
25	900	290
30	1090	425

35	1280	585
40	1470	775
45	1625	945
50	1835	1205
55	1985	1410

525.04 Sag Vertical Curves

There are at least four different criteria for establishing lengths of sag vertical curves recognized to some extent. They are headlight sight distance, passenger comfort, drainage control, and general appearance. For overall safety a sag vertical curve should be long enough that the light beam distance is nearly the same as the stopping sight distance.

Drainage affects design of vertical curves in a sag condition especially in a curbed roadway section. Given a length of curve that is relatively flat with a “K” value of 51 or greater can drastically change the actual low spot in relation to the sag curve PVI.

The minimum lengths of vertical curves for different values of A (algebraic difference) to provide the minimum stopping sight distance for each design speed are listed below in the table.

K values are based on the following formula $V = K * A$ (V – Vertical Curve Length; K – rate of vertical curvature; A – Algebraic Difference) and the designer should solve for K, to evaluate and compare to the table listed below.

For example: A design speed of 25 mph requires a minimum K value of 15 and anything less than 15 would not satisfy the required 25 mph speed limit for safety and stopping sight distance based on AASHTO criteria.

Design Controls for Sag Vertical Curves

Design Speed (mph)	Stopping Sight Distance (feet)	Rate of Vertical Curvature (K)
15	80	10
20	115	20
25	155	30
30	200	40
35	250	50
40	305	65
45	360	80
50	425	100
55	495	115

The designer should further explore the narrative under “Combinations of Horizontal and Vertical Alignment” and “Other Elements Affecting Geometric Design” that is found within the AASHTO Green book starting on Page 283.

526.00 Cul-de-sacs

Cul-de-sacs will conform to the Standard Drawings. Lengths of cul-de-sacs are recommended to be between one hundred forty feet (140') and seven hundred and fifty feet (750').

Surface drainage shall be directed toward the intersecting street, or if this is not reasonably practical, a drainage structure and easement will be provided at the end of the cul-de-sac. Specially designed temporary cul-de-sacs may be allowed when approved by the Town Engineer.

527.00 Major Structures

Major structures, such as retaining walls, box culverts and bridges, that are appurtenant to proposed street and/or parking lot construction, will conform to the structural design and loading requirements of the Colorado Department of Transportation Standard Specifications for Road Bridge Construction and the geometric and drainage requirements of the Town Engineer. Plans and supporting calculations for a qualified structural engineer who is a Registered Professional Engineer licensed to practice in Colorado must prepare major structures.

528.00 Design Element Coordination

Horizontal and vertical alignment continuity will be provided between new and existing streets to achieve safe and aesthetically pleasing transitions. Sufficient data on existing facilities will be depicted on plans, and limits of construction will be designated so as to assure that the desired continuity will be achieved. Drainage and utility facilities are to comply with all applicable sections of these STANDARDS AND SPECIFICATIONS and are to be fully coordinated with the street design and proposed construction. These facilities will be staged to eliminate grade and alignment conflicts and unnecessary damage to existing or newly constructed facilities.

529.00 Requirements of Other Jurisdictions

Where proposed street construction will affect other agencies such as the Colorado Department of Transportation, adjacent cities and counties, utility companies or ditch companies, said construction will be subject to the review of said agencies. A copy of the governing agencies review report shall be submitted to the Town Engineer prior to Final Plat approval or the issuance of a permit. Generally, where more than one requirement is imposed, the more restrictive requirement will govern. The Town Engineer must authorize exceptions in writing.

530.00 SITE WORK AND EARTHWORK

531.00 General

Refer to Section 330.00, Site Preparation Work, and Section 340.00, Earthwork, of these STANDARDS AND SPECIFICATIONS.

All workmanship and materials will be in accordance with the requirements of these STANDARDS AND SPECIFICATIONS and in conformity with the lines, grades, quantities, and the typical cross section shown on the plans, or as directed by the Town Engineer.

532.00 Clearing

Refer to Section 331.00, Clearing, of these STANDARDS AND SPECIFICATIONS.

533.00 Demolition and Removal of Structures

Refer to Section 320.00, Demolition and Removal of Structures and Obstructions, of these STANDARDS AND SPECIFICATIONS.

533.01 Salvage

All salvageable material shown on the accepted plans will be removed without unnecessary damage in sections or pieces, which may be readily transported and will be stored by the Contractor in locations approved by the Town Engineer. The Contractor will be required to replace any materials lost from improper storage methods or damaged by negligence.

533.02 Disposal

Refer to Section 333.00, Disposal, of these STANDARDS AND SPECIFICATIONS.

533.03 Backfill

Refer to Section 345.00, Embankment Fill, of these STANDARDS AND SPECIFICATIONS.

534.00 Protection of Existing Structures and Utilities

Refer to Section 342.00, Protection of Existing Structures and Utilities, of these STANDARDS AND SPECIFICATIONS.

535.00 Protection of Public and Private Installations

Refer to Section 141.00, Protection of Public and Utility Interests, of these STANDARDS AND SPECIFICATIONS.

The Contractor will take proper precautions at all times for the protection of and replacement or restoration of driveway culverts, street intersection culverts or aprons, storm drains or inlets, fences, irrigation ditches, crossings and diversion boxes, mail boxes, shrubbery, flowers, ornamental trees, driveway approaches, and all other public and private installations that may be encountered during construction. The Contractor will have the responsibility of providing each property with access to and from the property during the time of construction. Existing driveways will be cut, filled, and graded as required and as directed by the Town Engineer to provide permanent access. Existing driveways will be resurfaced with the presently existing type of surfacing whenever the existing surface is destroyed.

536.00 Excavation and Embankment

Refer to Section 340.00, Earthwork, of these STANDARDS AND SPECIFICATIONS.

537.00 Borrow

Refer to Section 348.00, Borrow, of these STANDARDS AND SPECIFICATIONS.

538.00 Subgrade

The bottom of the excavation for the pavement, or top of the fill, will be known as the pavement subgrade and will conform to the lines, grades, and cross sections shown on the accepted plans. All applicable portions of Section 345.02, Roadway Excavation, Backfill and Compaction, of these STANDARDS AND SPECIFICATIONS, shall apply.

Prior to the street being excavated, all service cuts will be checked to confirm the backfill meets density requirements. If deficient, they will be re-compacted and brought up to specified density.

After excavation and embankment is completed and the subgrade brought to final grade, it will be rolled with a rubber-tired roller which is a minimum size of eight (8) to twelve (12) tons and other compaction equipment as required to bring the subgrade to the required density and stability. The following standards will be in effect: Soils meeting AASHTO M-145 Soil Classifications of A-1, A-2-4, A-2-5, and A-3 will be compacted to a minimum of one-hundred (100) percent of maximum dry density as determined by AASHTO T-99. All other soil classifications will be compacted to a minimum of ninety-five percent (95%) of maximum dry density as determined by AASHTO T-99. The moisture content will be maintained within +/- two percent (2%) of optimum moisture for A-1 through A-5 materials and optimum to two percent (2%) above for A-6 and A-7-6 materials during compaction. Additional wetting may be required when the minimum water requirement is not sufficient to produce a stable condition in the subgrade soil. The maximum length of any road section being worked at any one time shall not exceed three hundred feet (300') without the approval of the Town Engineer.

No paving, subgrade, or base will be placed on soft, spongy, frozen unstable subgrade, which is considered unsuitable by the Town Engineer.

Proof rolling shall be completed in accordance with Section 344.00.

Soft and yielding material and portions of the subgrade which show deflection will be scarified and re-rolled or will be removed and replaced with subgrade course material, then placed and compacted as specified herein. Subgrade will not be approved for base course construction until it is uniformly stable.

538.01 Subexcavation for Expansive Soils

Soils with a Plasticity Index (P.I.) over ten (10) and less than thirty- (30) shall be sub excavated and recompacted per the soils reports and as approved by the Town Engineer.

539.00 Subgrade Construction

539.01 Materials

Subgrade material will be composed of granular material consisting, essentially, of sand, gravel, rock, slag, disintegrated granite or a combination of such materials. The coarse portions of the material will be sound fragments of the crushed or uncrushed materials enumerated above. Supplied material will be a well-graded mixture containing sufficient soil mortar, crushed dust, or other proper quality binding material which, when placed and compacted in the roadway structure, will result in a firm, stable foundation.

Material composed of uniform size particles, or which contains pockets of excessively fine or excessively coarse material, will not be acceptable for use.

This material need not be crushed but will be graded within the following limits:

Standard-Size of Sieve	% By Weight Passing Sieve
2-1/2 inch	100
2 inch	95 - 100
No. 4	30 - 60
No. 200	5 - 15
Liquid Limit	35 Maximum
Plasticity Index	6 Maximum

539.02 Construction

The construction of subgrade will consist of preparing the approved subgrade material to form a stable foundation on which to construct base course, in conformity with the lines, grades and typical cross sections shown on the plans, and as staked by the developer's engineer. In addition, subgrade material will be used to replace unsuitable foundation materials at locations shown on the plans, or as directed by the Town Engineer.

Each layer of material will be placed and spread so that after compaction it will conform to the width and crown of the typical cross sections. The wetting of subgrade layers will be done with sprinkling equipment of a type, which insures uniform and controlled distribution of the water. All wetting will be done by uniformly sprinkling each layer of material being placed with only that amount of water needed to obtain maximum density of the material.

Travel may be allowed over subgrade to assist in compaction of the material. Mixing and blading of the subgrade material on the street will be required if the material is spotty and non-uniform. However, blading will be held to a minimum in order to avoid the floating of the heavier rock particles to the surface.

Concurrently with the wetting operations, the material will be uniformly compacted by rolling. Rolling equipment will consist of one or more of the following: rubber tired roller, sheep foot roller and flat wheel steel roller.

539.03 Underdrain

Landscape medians and landscaping next to curb and gutter shall be provided with underdrain to handle sprinkler runoff and nuisance flows. All roads with detached sidewalk and landscaped tree lawns will require curb underdrains. See Standard Details ST 17 and ST 18.

540.00 BITUMINOUS CONSTRUCTION**541.00 General**

The intent of this section is to specify materials and methods to be used for the construction, overlaying, seal coating and pavement rejuvenating of streets, parking lots, walks, drain ways, and other miscellaneous work requiring the use of aggregates. The work covered will include general requirements that are applicable to aggregate base course, bituminous base and pavements of the plant mix type, bituminous prime coat, bituminous tack coat, rejuvenating applications, and asphalt concrete overlay. All workmanship and material will be in accordance with requirements of these STANDARDS AND SPECIFICATIONS and in conformity with the lines, grades, depths, quantity requirements, and the typical cross section shown on the plans or as directed by the Town Engineer.

542.00 Base Course

This item shall consist of a foundation course composed of crushed recycled concrete and filler, constructed on the prepared subgrade. Crushed gravel or crushed stone may be used with approval of the Town Engineer. Materials and construction will be in accordance with the requirements of Section 703.03, Table 703-2, of the Colorado Department of Transportation Standard Specifications for Road and Bridge Construction. Gradation will be Class 5 (1-1/2" maximum) or Class 6 (3/4" maximum).

The base course material shall be placed on the previously prepared subgrade at the locations and in the proper quantities to conform to the typical cross sections as shown on the accepted plans and as directed by the Town Engineer. Base course shall be placed under curb, gutter, and attached sidewalk. Placing and spreading will be done by means of a spreader machine, moving vehicle, motor grader, or by other approved equipment methods. The material will be placed without segregation. Any segregated areas will be removed and replaced with uniformly graded material at the Contractor's expense.

The base material may be placed in lifts of up to six inches (6"), providing that after compaction, uniform density is obtained throughout the entire depth of the lift. If the required depth exceeds six inches (6"), it will be placed in two or more lifts of approximate equal thickness. If uniform density cannot be obtained by six-inch (6") lifts, the maximum lift will not exceed four inches (4") in final thickness.

Base material shall not be placed on a foundation that is soft or spongy or one that is covered by ice or snow. Base material will not be placed on a dry or dusty foundation where the existing condition would cause rapid dissipation of moisture from the base material and hinder or preclude its proper compaction. Such dry foundations will have water applied to them and will be reworked or recompacted.

Rolling will be continuous until the base material has been compacted thoroughly in accordance with Section 304 of the Colorado Department of Transportation Standard Specifications for Road

and Bridge Construction. Water will be uniformly applied as needed during compaction to obtain optimum moisture content and to aid in consolidation. The surface of each layer shall be maintained during the compaction operations in such a manner that a uniform texture is produced and the aggregates are firmly placed.

The finished base course surface shall be smooth and free of ruts and irregularities, and will be true to grade and crown as shown on the plans or as directed by the Town Engineer. The base course will be maintained in this condition by watering, drying, rolling, or blading or as the Town Engineer may direct until the surfacing is placed.

543.00 Prime Coat

(Left Blank Intentionally)

544.00 Hot Bituminous Pavement

All pavements shall be hot bituminous pavement of the plant mix type unless otherwise approved in writing by the Town Engineer. Materials and construction will be in accordance with the latest edition of the Colorado Department of Transportation Standard Specifications for Road and Bridge Construction, and the following requirements:

- A. The asphalt cement shall be a Superpave Performance graded (PG) binder and content determined by the mix design. Superpave PG asphalt binders shall comply with CDOT Standard Specifications for Road and Bridge Construction. The asphalt contractor shall furnish certified test results from an independent asphalt testing laboratory to show compliance of the proposed Superpave PG asphalt binder with the Superpave requirements for that mix.
- B. The gradation of the mineral aggregate will be grading SG (1 1/2" nominal), or S (3/4" nominal) for new street construction. Grading SX (1/2" nominal) shall be used for top lifts and overlays or in special cases as required on the accepted plans or authorized in writing by the Town Engineer.
- C. All mixes shall be designed with 1% lime.
- D. A maximum of twenty percent (20%) Reclaimed Asphalt Pavement (RAP) will be allowed in (non-polymer or non-rubberized) mixes, provided that all the requirements for hot bituminous pavement are met.
- E. The mix will conform to the job mix formula specified by the Town Engineer for the pit-supplied materials, if a current job mix formula is available. A copy of the mix formula will be submitted to the Town Engineer for review and approval at least seven (7) days prior to starting paving work.

All testing done throughout this construction period, which is necessary to assure conformance of materials and workmanship to the specifications, will be at the Contractor's expense. Two copies of all test reports will be submitted directly to the Town Engineer.

In the event that a current job mix formula is not available for the materials proposed for use, the Contractor will submit a job mix formula prepared by a recognized testing laboratory for review and acceptance by the Town Engineer. A report giving the properties of the materials and certifying their conformance to or deviations from the requirements of the specifications will accompany the job mix formula.

When tested in accordance with the requirements of ASTM D-1559, the mixture will conform to the following limits:

**TABLE 500-1
MIX DESIGN PROPERTIES**

Low EDLA ≤ 40	
Marshall Stability (minimum) ¹	1800 lb./ S 37
Marshall Flow (minimum) hundredths of an inch	8
Flow (maximum) hundredths of an inch	18
Air voids, total mix, %	3 to 5
VMA ³	12-13-14
Percent voids filled with bitumen	65-75

High EDLA ≥ 40	
Marshall Stability (minimum) ²	2000 lb./ S 39
Marshall Flow (minimum) hundredths of an inch	8
Marshall Flow (maximum) hundredths of an inch	16
Air voids, total mix, %	3 to 5
VMA ³	12-13-14
Percent voids filled with bitumen	65-75

¹ - Marshall Stability (50 Blow)/Hveem Stability

² - Marshall Stability (75 Blow)/Hveem Stability³ - Refer to Table 500-2

**TABLE 500-2
VOIDS IN THE MINERAL AGGREGATE¹**

Nominal Maximum Particle Size	Mix Air Voids, Percent		
	3.0	4.0	5.0
3/4"	12.0	13.0	14.0
1/2"	13.0	14.0	15.0

¹ - Interpolate minimum voids in the mineral aggregate (VMA) for design air void values between those listed.

Determination of the effect of water on the cohesion of the bituminous mixture will be made in accordance with AASHTO T-283 (Lottman). Retained strength will be a minimum of eighty percent (80%). The use of an "anti-stripping" admixture to improve the retained strength characteristics will be permitted only by written permission of the Town Engineer. The cost of admixtures will be borne by the Contractor.

All commercial testing and laboratory work necessary to establish the job mix formula and all testing necessary to assure conformance of materials and workmanship to the requirements of the specifications throughout the construction period will be performed at the Contractor's expense. Two copies of all test reports will be submitted directly to the Town Engineer.

544.01 Asphalt/Polymer Combinations

The Contractor may submit to the Town Engineer for his review and acceptance a design for the upper three inches (3") of the pavement section utilizing a polymer modified pavement design. These

designs will be reviewed on an individual project basis and must be accepted by the Town Engineer prior to construction.

544.02 Weather Limitations

Bituminous plant mix shall be placed only on properly constructed and accepted layers that are free from water, snow, or ice. The bituminous mixtures shall be placed only when weather conditions permit the pavement to be properly placed and finished as determined by the Town Engineer. The bituminous mixtures shall be placed in accordance with Table 401-3, Placement Temperature Limitations, of the Colorado Department of Transportation Standards and Specifications for Road and Bridge Construction.

Air temperature is taken in the shade. Surface is defined as the existing base on which the new pavement is to be placed.

Under certain circumstances, the Town Engineer may waive minimum temperature requirements for placing prime coats and layers of bituminous mixtures below the top layer of the completed pavement.

545.00 Tack Coat

When tack coat is specified on the accepted plans or required by the Town Engineer, all materials and construction shall be in accordance with the requirements of Section 407 of the Colorado Department of Transportation Standard Specifications for Road and Bridge Construction. Bituminous material will be SS-1 emulsion, diluted by mixing one (1) gallon of SS-1 emulsion with one gallon of clean water, applied at the rate of five one-hundredths (0.05) to fifteen one-hundredths (0.15) gallons per square yard.

546.00 Seal Coat

When seal coat is required, all materials and construction shall be in accordance with the requirements of Section 409 of the Colorado Department of Transportation Standard Specifications for Road and Bridge Construction. The type of bituminous material, cover aggregate, and rates of application will be as shown on the accepted plans.

547.00 Rejuvenating Agent

When a rejuvenating agent is specified on the accepted plans or required by the Town Engineer, all materials and construction will be in accordance with the requirements of Section 407 of the Colorado Department of Transportation Standard Specifications for Road and Bridge Construction.

548.00 Heating and Scarifying

When heating and scarifying treatment is specified on the accepted plans or required by the Town Engineer, all materials and construction shall be in accordance with requirements of Section 405 of the Colorado Department of Transportation Standard Specifications for Road and Bridge Construction.

549.00 Grinding

Grinding will consist of “milling”, “grinding”, or “cold planning” the existing pavement surface to establish a new surface profile and cross section in preparation for a bituminous overlay. After grinding, the surface will have a grooved or ridged finish, uniform and resistant to raveling or traffic displacement. This textured surface will have grooves of one-quarter inch (1/4”) ± one-eighth inch (1/8”). The existing surface to be ground will include bituminous pavement, concrete utility patches, and a very small amount of concrete pavement.

“Wedge cut” grinding will consist of grinding the existing pavement surface a minimum of six feet (6’) wide at the existing concrete gutter. The edge of the gutter, end of the finished wedge cut will be one and one-half (1-1/2) inches below the edge of the existing concrete gutter. The centerline of street edge of the wedge cut will be cut one-eighth inch (1/8”). The depth of cut will be determined by measuring to the top of the ridges by placing a five-foot (5’) straight edge perpendicular to the grooving pattern. “Full width” grinding will consist of grinding the existing pavement surface from edge of gutter to a minimum depth of two inches (2”) unless otherwise specified in the contract or directed by the Town Engineer.

Grinding around utility castings to the depth of cut before and after encountering the castings will be included in the area of the pavement surface ground. The Contractor may choose to remove the entire existing bituminous pavement around the castings where grinding is not completed, and replace it with bituminous surface course placed and compacted in three inch (3”) lifts. The Contractor will vertically cut the limits of the area to be patched, mechanically compact the existing base course, and prime the bottom and vertical edges before backfilling.

The Contractor will remove the millings immediately behind the grind machine by belt loader, end loader, power sweeper, and/or by hand. The removed material belongs to the Town and will be disposed of as approved by the Town Engineer.

The grinding machine shall be a power operated, self-propelled machine, having a cutting drum with lacing patterns that will attain a grooved surface and produce grinding chips of less than one inch (1”) in size. The grinding machine will be equipped with a pressurized watering system for dust control. The equipment will be a type that has successfully performed similar work.

The cleaning equipment shall be a type, which will efficiently remove all loosened material and load into trucks for hauling and spreading. Because of the nature of the streets to be ground and the traffic restrictions, a belt loader followed by a power sweeper and manual sweeper is the most desirable method. **FLUSHING INTO THE TOWN’S STORM SEWER SYSTEM AS A MEANS OF CLEANUP IS PROHIBITED.**

550.00 CONCRETE PAVEMENT

The installation of concrete pavement, including materials, equipment, foundation and construction methods must be in conformance with Section 412, “Portland Cement, Concrete Pavement” of the Colorado Department of Transportation Highways Standard Specifications for Road and Bridge Construction, except as modified herein or as modified with the approval of the Town Engineer.

Specifications for concrete work, Section 400, Concrete Work, of these STANDARDS AND SPECIFICATIONS, must be followed. Concrete pavements will be installed as shown on the accepted plans or as approved by the Town Engineer. When concrete pavement is constructed on

a curve, flexible forms will be used having a radius of two hundred feet (200') or less, unless otherwise directed by the Town Engineer. The Contractor will furnish steel pins to use in setting grades for concrete pavement.

550.01 Lime Treated Subgrade

In those instances where deemed necessary by a qualified Soils Engineer and accepted by the Town Engineer, Portland Cement treated base may be required. When required, this base shall comply with Section 307, Lime Treated Subgrade, of the Colorado Department of Transportation Standard Specifications for Roads and Bridge Construction.

560.00 APPURTENANT CONCRETE STRUCTURES**561.00 General**

Curb, curb ramps, gutter, sidewalk, cross pan, and driveway construction will conform to all applicable provisions of these STANDARDS AND SPECIFICATIONS and the Standard Drawings.

562.00 Materials**562.01 Cement Concrete**

All cement concrete materials, reinforcing steel, and concrete work will conform to the requirements of Section 400, Concrete Work, of these STANDARDS AND SPECIFICATIONS.

562.02 Forms

Forms may be wood or metal and will have a depth equal to or greater than the slab thickness. The face of curbs will be formed, unless otherwise permitted by the Town Engineer. Forms will have a cross section and strength and be secured so as to resist the pressure of the poured concrete without springing or settlement. The connection between sections will be performed by a method in which the joint thus formed will be free from movement in any direction. Each section of form will be straight and free from warps or bends. The maximum deviation of the top surface will not exceed one-eighth inch (1/8") inside face not more than one-fourth inch (1/4") from a straight line in ten feet (10'). Approved flexible forms will be used for construction where the radius is one hundred fifty feet (150') or less.

563.00 General Requirements**563.01 Curb and Gutter Section**

The section to be constructed will be as identified on the approved plans or as shown on the Standard Drawings.

563.02 Sidewalks

Sidewalks will be six inches (6") thick where detached or attached, unless noted otherwise on the accepted plans, and shall be constructed to the dimensions shown on the accepted plans. All areas

of sidewalk that will be constructed in parks, open spaces or greenbelts as indicated on the accepted plans or required by the Town Engineer will be constructed with six inch (6") thick concrete. Six-inch (6") thick sidewalks shall be constructed to the dimensions shown on the accepted plans or as required by the Town Engineer.

563.03 Crossspans and Curb Return Fillets

Crossspans and curb return fillets will be constructed eight inches (8") thick with #4 rebar (place at 18" centers, each way) or ten inches (10") without rebar in residential, commercial and industrial areas. Typical crossspan sections are shown in the Standard Drawing. Where unusual conditions prevail, additional reinforcing steel and special joints may be required by the Town Engineer.

563.04 Curb Cuts and Driveways

Curb cuts in six-inch (6") vertical curbs will be provided at all driveway locations and at additional locations, as shown on the accepted plans for residential lots. Commercial lots shall be eight-inch (8"). Construction of curb cuts will be as shown in the Standard Drawings. Spacing will be as shown in the Standard Drawings.

563.05 Curb Ramps

Curb ramps for the handicapped will be installed at locations designated by the Town Engineer. Curb ramps will be constructed as shown in the Standard Drawings.

563.06 Sidewalk Chase Drains

Where three or more lots drain to a shared lot line swale, a sidewalk chase drain will be installed to convey drainage through the sidewalk to the gutter. In areas with detached sidewalk and trees lawns, the chase will continue through the tree lawn and curb to the gutter.

564.00 Construction Requirements

564.01 Staking and Grade Control

Control and construction stakes will be set by field parties under the supervision of a Registered Professional Engineer or a Registered Land Surveyor licensed to practice in Colorado who shall be paid by the Contractor. These field parties will be available to check field control and to provide assistance to the Contractor. The Contractor will keep a set of accepted plans on the job site at all times.

It will be the responsibility of the Contractor to maintain the grade and alignment as shown on the accepted plans. The alignment and grade elevation of forms will be checked, and any necessary corrections will be made before placing the concrete. When any form has been disturbed or any subgrade there under has become unstable, the form will be reset and rechecked after the subgrade has been replaced or recompacted.

564.02 Excavation and Embankment

Excavation or fill will be made to the required grade, and the base on which the curbing section is to be set will be compacted to a smooth, even surface. All material placed in fill and the top six inches (6") of the subgrade in cut sections will be compacted to at least ninety-five percent (95%) of maximum dry density as determined by ASTM D-698. Where spongy or unsuitable materials are encountered which will not provide a stable subgrade. The material will be removed and replaced with suitable material and compacted to the specified density.

The subgrade will be compacted within the forms by a vibratory compactor or other approved method whenever any loose subgrade material is present. Immediately prior to placing the concrete, the subgrade will be tested for conformity to the specified cross section. Materials will be removed or added to bring all portions of the subgrade to the correct elevation. The subgrade will be thoroughly compacted and again tested for proper cross section. Concrete will not be placed on any portion of the subgrade that has not been inspected by the Town Engineer for correct elevation and proper compaction. The subgrade will also be cleared of any loose material that may have fallen on it.

The subgrade will be in a moist condition to a depth of six inches (6") at the time the concrete is placed. It will be thoroughly wetted a sufficient amount of time in advance of the placing of the concrete to insure that there will be no puddles or pockets of mud when the concrete is placed.

564.03 Form Setting

Forms that have become worn, bent, or broken will not be used. The Contractor will have set and graded a minimum length of three hundred feet (300') of forms prior to placing concrete. In cases where the length of one run is less than three hundred feet (300'), the Contractor will set and grade forms for the entire run.

On curves with radii of one hundred fifty feet (150') or less, flexible forms, which can be readily formed to the desired radius, will be used. Face forms will be preformed to the proper radius. In any case, care will be exercised to insure the maintenance of the required cross section around the entire radius.

The Contractor will provide an approved metal straight edge, ten feet (10') in length, to check the alignment of the forms prior to placing the concrete and also to check the concrete surface during the finishing operation.

Forms, except for curb face, will remain in place at least twelve (12) hours after concrete has been placed against them, or for a longer period if so directed by the Town Engineer. Crowbars or other heavy tools will not be used against green concrete in removing the forms. Forms will be thoroughly cleaned before re-oiling and reuse.

564.04 Concrete Placement

When placed in the forms the concrete will be properly graded with the forms and will at no time deviate more than one-quarter inch (1/4") from an accurate straight edge ten feet (10') in length. The concrete will be placed on damp but not wet or muddy subgrade. The operation of depositing and compacting the concrete will be conducted so that the concrete will be smooth and dense, free from honeycomb and free from pockets of segregated aggregate. Sections of segregation or honeycomb revealed by removal of the forms will be removed and replaced or otherwise repaired to the satisfaction of the Town Engineer. At the end of the day, or in case of an unavoidable interruption of



more than thirty- (30) minutes, a transverse construction joint will be placed at the point of stopping work, provided that the section on which work has been suspended will not be less than five feet (5'). Sections less than five feet (5') in length will be removed. Concrete will not be placed when the weather is stormy, dusty, or otherwise inclement to the point that it precludes good workmanship.

564.05 Joints

All joints will be constructed straight and plumb and will extend through the entire section from edge to back and to the depths specified herein.

- A. Expansion Joints: Expansion joint filler, which is one-half inch (1/2") thick, preformed, non-extruding bituminous-treated fiberboard conforming to AASHTO Specification M-213, will be used to form transverse expansion joints. Expansion joints will be constructed as directed by the Town Engineer. Expansion joints will be formed at the contact of the new construction with concrete driveways, intersecting sidewalks or other unyielding structures unless otherwise directed.
- B. Block Joints: The curb and gutter or curb walk will be divided into blocks not less than six feet (6') nor more than ten feet (10') long using metal templates not less than one-sixteenth inch (1/16") nor more than one-quarter inch (1/4") thick. Templates will be a minimum of four inches (4") deep. The block length to be used will be approved by the Town Engineer prior to starting construction and will be maintained constant throughout the project. The templates will be designed to attach securely to the forms in such a manner as to prevent movement while the concrete is being placed and consolidated. Templates will be removed prior to the concrete taking its initial set.
- C. If curbing machine or other methods not requiring the use of templates is approved, dummy joints formed by a jointing tool or other acceptable means will be used. Dummy joints will extend into the concrete for at least one-third (1/3) of the depth (no less than two inches [2"]) and will be approximately one-eighth inch (1/8") wide.
- D. Construction Joints: As required at the end of a day's run, construction joints will be made at right angles to the longitudinal axis of the curb and gutter and will be located at the regular spacing designated for block joints unless otherwise specifically permitted by the Town Engineer. In no case will any length of curb and gutter be less than five feet between (5') joints. Construction joints will be formed by use of a bulkhead or divider, which will be removed before continuing with the next run. The construction joints will be edged to form a recess for sealing compound similar to that for expansion joints.

564.06 Finishing

Where applicable, finishing will be done with a metal screed designed to give proper shape to the section as detailed. Particular care will be used to finish the gutter flowline to a true, uniform grade. When using face forms, they will be left in place until the concrete has hardened sufficiently so that they can be removed without injury to the curb.

The Contractor will use at all times, a ten-foot (10") straightedge for finishing curb and gutter sections. When irregularities are discovered, they will be corrected by adding or removing concrete. All disturbed places will be floated with a wooden or metal float, which is not less than three feet (3') long and not less than six inches (6") wide, and again straightened. No water or cement will be added to the surface of the concrete to aid in finishing. Before final finishing is complete and the concrete has taken its initial set, edges of the concrete and joints will be carefully finished with an edger having a one-eighth inch (1/8") radius. Concrete will be finally finished with a wood float and lightly broomed to a slightly roughened surface. On grades less than one percent (1%), the Contractor will check for depressions before final finish so that no water holes exist. Any water holes or "bird baths" larger

than one square foot and deeper than three-eighths inch (3/8") will be cause for removal and replacement of the defective sections of concrete.

564.07 Marking

Sidewalks shall have the name of the contractor and the year of construction impressed therein, using block letters not less than one inch (1") high and three-eighths inch (3/8") deep. Impressions will be made in sidewalks at each end of each Town block, or at the end of construction if other than at the end of the block.

564.08 Curing

Curing will be accomplished in accordance with Section 400, Concrete Work, of these STANDARDS AND SPECIFICATIONS.

564.09 Protection Against Vandalism

It will be the responsibility of the Contractor to protect all concrete work against damage or vandalism. When required, a guard will be stationed over fresh work until the concrete is sufficiently set to prevent its being marked by plastic deformation of the exposed surface of the concrete. Expense of the guard will be borne by the Contractor. Concrete damaged in any way by vandals will be removed and replaced at the Contractor's expense.

564.10 Cleanup

Within forty-eight (48) hours after forms are removed, the area behind and in front of the sidewalk or curb will be cleaned, backfilled and graded to provide a smooth even surface.

564.11 Concrete Testing

Routine testing will be accomplished in accordance with Section 400.00, Concrete Work, of these STANDARDS AND SPECIFICATIONS. In the case of questionable concrete materials or work, the Town Engineer may direct that core tests be made on all questionable concrete placement. The expense of the tests will be borne by the Contractor. If the concrete tested shows inadequate strength or other deficiencies, it will be removed and replaced by the Contractor at his expense. If any core shows a deficiency of thickness greater than one-half inch (1/2"), exploratory cores will be taken in five-foot (5') increments, and all concrete deficient more than one-half inch (1/2") will be removed and replaced by the Contractor at his expense.

570.00 INSPECTION**571.00 General**

Refer to Section 154.00, Inspections, of these STANDARDS AND SPECIFICATIONS.

572.00 Required Inspections

Adequate inspections assure compliance to Town requirements and are the basis for the Town's recommendation that said streets are accepted for maintenance and for release of performance

guarantees. It is the responsibility of the Contractor to contact the Town Engineer a minimum, of one (1) working day in advance of the required inspections. Required inspections include:

- A. Culverts - trenching, grade, bedding, installation, backfill and compaction. Inspection to be requested when backfill is completed to one-half (1/2) the depth of the culvert.
- B. Concrete - finished excavation, grade, forming, reinforcing steel.
- C. Structures - concrete pour, surface finish, and test cylinders. Three inspections are required: (1) prior to placing steel; (2) prior to concrete pour; and (3) during and after final pour.
- D. Street - four inspections are required; (1) subgrade; (2) base course; (3) prime &/or tack, and (4) paving, all of which are required prior to proceeding with the next phase. Locations of required samples for testing will be designated by the Town Engineer. Non-destructive deflection testing, as specified in Section 514 of these STANDARDS AND SPECIFICATIONS, will be performed.
- E. Acceptance - a request for an inspection and Initial Acceptance for maintenance or release from performance guarantee must be made only after all preceding inspections have been passed. Acceptance procedures are outlined in Section 200, Acceptance Procedures, of these STANDARDS AND SPECIFICATIONS.

573.00 Required Testing

When required by the Town Engineer, a Professional Engineer will certify the quality of materials or construction. All testing will be by recognized methods as specified in these STANDARDS AND SPECIFICATIONS and will be at the Contractor's expense.

574.00 Utility Installations

Prior to the installation of street subgrade, base, paving and concrete materials, utility installations will be made, service lines stubbed to the right-of-way line, and all trenches will be backfilled and properly compacted.

575.00 Street Lighting

At the time of inspection, all street lights will be in place as shown on the approved plans and will be operating as set forth in Section 925.00, Street Lighting Procedure, of these STANDARDS AND SPECIFICATIONS.

580.00 STREET LANDSCAPING

581.00 Installation

All installation of landscaping and irrigation in Town Right-of-way must be done in accordance with SECTION 1000 PARKS AND RECREATION of these STANDARD and SPECIFICATIONS.

582.00 Maintenance

The maintenance of landscaping and irrigation located in and/or over Town right-of-way is the responsibility of the adjoining property owner with the exception of landscape medians on Town designated Arterial roadways which are the Town's responsibility. All landscaping shall be maintained in accordance with the follow requirements:

- A. Tree branch growth shall be maintained at a height no lower than ten (10) feet over a public sidewalk, walkway, or trail and no lower than fourteen (14) feet over the travel lanes of a street or alley.
- B. All woody plant growth lower than ten (10) feet shall not encroach upon the plane of a public road, sidewalk, walkway, or trail and must be trimmed back within the inside edge of all sidewalks, walkways, or trails.
- C. Tree branch growth shall be maintained so that branches do not interfere with the proper spread of light along the street from any street light.
- D. Trees and other woody plants growth shall be maintained not to come within three (3) feet of fire hydrants.
- E. Visibility triangle distances shall be maintained to protect visual clearances for motorists and pedestrians. No landscaping plant material shall be allowed within the visibility triangle that exceeds over thirty-six (36) inches higher than the street level in this triangle. Trees located within the visibility triangle must be trimmed at the trunk to at least eight (8) feet above the level of the ground surface, provided that such trees are spaced so that trunks do not obstruct the vision of motorists and pedestrians.

590.00 TRAFFIC CONTROL DEVICES

591.00 General

The installation of traffic control devices and street lighting shall comply with all applicable portions, as from time to time amended, of the CDOT Standard Specifications for Road and Bridge Construction, the Manual on Uniform Traffic Control Devices (MUTCD) and the accepted plans. These STANDARDS AND SPECIFICATIONS and any other requirements determined by the Town Engineer shall apply to all materials supplied, methods and procedures of work. The Town Engineer must approve a traffic control device, sign layout plan, and a street lighting layout plan.

592.00 Signs

592.01 Street Name Signs

Street name signs shall be bought by the Contractor or Developer and will be installed by the Contractor or Developer. Sufficient signs and posts shall be provided to allow installation on two (2) corners of each intersection in business district, on principal arterials and on one corner in the residential areas, as directed by the Town Engineer. All letters shall be Federal Highway Administration Series C2000. Please reference the Street Sign Detail of our Standards & Specifications.

All street signs shall be aluminum 5052-H38 (Conversion coated) minimum thickness of .080.

Retroreflective sheeting for letters and background shall be required in accordance with the MUTCD.

Unless directed otherwise by the Town Engineer, signs shall be installed on square stock tubing at eighteen (18) inches behind the curbwalk or curb and gutter, whichever is closest to the street. Anchors shall be galvanized (G90) 12GA steel with seven-sixteenths (7/16) inch diameter holes, one (1) inch on center, two-one fourth (2 ¼) inch square and three (3) feet in length. During installation, the anchors may only be between a minimum of four (4) and maximum of six (6) inches above the ground. Posts shall be of galvanized (G90) 12GA steel with seven-sixteenths (7/16) inch diameter holes, one (1) inch on center, two (2) inches square and to length to meet mounting requirements

set forth in the M.U.T.C.D. All posts and signs shall be affixed using the appropriate size of bolts, washer and nuts (NO RIVETS).

4" diameter PVC pipe sleeves shall be placed in concrete where sign posts are to be installed to accommodate sign post installation and replacement.

592.02 Illuminated Signs

Internally illuminated street name signs shall be furnished and installed by the Contractor or Developer. Signs shall be installed on each traffic signal mast arm at each intersection. Sign lettering shall be in the ten (10) inch uppercase. Suffixes are to be five- (5) inch uppercase letters. Lettering for supplementary to indicate the type of street or section shall be at least four (4) inches where a two-line application is desired or three (3) inches where a three-line application is desired.

592.02.01 Borders

Reserved.

592.02.02 Spacing

Interline spacing shall be approximately one half (1/2) to three-fourths (3/4) the average of uppercase letter heights in adjacent lines of letters. The spacing to the top and bottom borders shall be equal. The lateral spacing to the vertical edges shall be essentially the same as the height of the largest letter. Spacing used in words, words and arrow, a letter and arrow, or a word and numeral in a line copy should be approximately one (1) to one and one half (1 1/2) times the uppercase letter height used in that line of copy.

592.02.03 Arrows

Arrows shall be in accordance to the MUTCD standards as illustrated in the Standard Highway Sign Handbook.

592.02.04 Color

Letters and numbers are to be white on a green background face. When a "Town Logo" is required, the Town approved logo shall be used.

592.02.05 Sign Housing

The street name sign shall be free swinging or limited swinging. Sign fixture and panels shall withstand 90 mph wind loading, with structural requirements meeting AASHTO "Standard Specifications for Structural Supports for Highway Signs, Luminars and Traffic Signals" latest edition. Illuminated street name housing shall be constructed of extruded aluminum. The design shall be rigidly constructed to resist torsional twist and warp. All ferrous parts shall be galvanized or cadmium plated. The front and back sign panels of the cage shall be hinged, to provide access to

the lamps. Neoprene gaskets shall be installed between the sign panels frame and fixture housing to prevent dust and water entrance. The latching devices can be either screw type or latch type to provide a secured attachment of the sign face to the case. Screened weep holes are to be provided on the housing bottom for drainage. The overall weight of the completed sign assembly, including mounting brackets, shall not exceed 90 pounds.

592.02.06 Illumination Source

The entire surface of the sign panel shall be evenly illuminated. The illumination source shall be fluorescent lamps, powered for low temperature operation. There shall be separate ballast for each fluorescent lamp. Photoelectric controls are required and shall be the "hail resistant" type and of the load intended. The reflectors shall have a minimum reflectance of 85%.

592.02.07 Final Layout

Final layout and lettering details are to be submitted to the Town prior to fabrication.

592.03 Stop Signs

Stop signs shall be installed at all approaches to streets designated by the Town as through streets. Stop signs shall be mounted on the same support posts as street name signs where possible.

592.04 Other Signs

Twenty-five (25) MPH speed limit signs shall be installed at all subdivision entrances. Speed limit signs, school signs, and crosswalk signs shall be installed at locations designated by the Town Engineer.

592.05 Private Street Signs

All subdivisions with private streets shall install private street signs as shown in Standard Details-Streets at all entrances to the private streets.

593.00 **Striping**

The Contractor shall submit a striping plan to the Town Engineer for acceptance prior to beginning work. The striping plan shall meet the requirements for such work as outlined in the MUTCD. Yellow centerline and lane line markings shall be applied to streets designated by the Town as through streets. All temporary striping and markings of roadways shall consist of paint pavement marking materials conforming to Section 713 of the CDOT Standard Specifications for Road and Bridge Construction and installed per Section 627 of the CDOT Standard Specifications for Road and Bridge Construction all striping and markings of roadways minus the top lift shall consist of paint pavement marking materials conforming to Section 713 of the CDOT Standard Specifications for Road and Bridge Construction and installed per Section 627 of the CDOT Standard Specifications for Road and

Bridge Construction. All striping of the top-lifted roadways shall consist of epoxy pavement marking material conforming to Section 713 of the CDOT Standard Specifications for Road and

Bridge Construction and installed per Section 627 of the CDOT Standard Specifications for Road and Bridge Construction. All markings of the top-lifted roadways shall consist of preformed thermoplastic marking material conforming to Section 713 of the CDOT Standard Specifications for Road and Bridge Construction and installed per Section 627 of the CDOT Standard Specifications for Road and Bridge Construction. Standard twelve (12) inch wide stop bars shall be provided at all stop locations and intersections adjacent to schools, parks, commercial, and other areas as determined by the Town. Crosswalks will be marked with two (2) foot by eight (8)

foot bars, and layout shall conform to CDOT M&S Standards, typical pavement markings, Standard Plan No. S-627-1.

594.00 Sign Supports

All sign supports or posts shall conform to specifications for perforated square steel tubing and to Standard Specifications for Cold Rolled Carbon Steel Sheets, Commercial Quality, ASTM Designation A-366. The cross section will be square and consist of ten (10) gauge or twelve (12) gauge steel (0.135" U.S.S. Gauge or 0.105" U.S.S. Gauge) carefully rolled to size and continuously welded at the corner and will conform to CDOT M&S Standards, Mounting Data, Standard Plan No. S-614-3. Sign sizes not included in this data shall be:

<u>Total Sign Area</u>	<u>Side Dimensions</u>
Less than 800 sq. inches	2" x 2"
800 to 1000 sq. inches	2" x 2"
Over 1000 sq. inch	CDOT S-614-3

The finished members shall be straight and have a smooth, uniform finish. It will be possible to telescope consecutive sizes of tubes freely with a minimum amount of play. All holes and cut-off ends shall be free from burrs. Seven-sixteenth (7/16) inch diameter holes shall be punched on one (1) inch centers on all sides of the tube. All posts shall be weather protected by galvanizing. Posts shall be formed from cold rolled steel strip that has been zinc coated and is commercial quality (1.25 oz.) conforming to ASTM Specification A-525.

595.00 Street Lighting Procedure To A High Source

The developer shall submit a written request for street light design to the electrical utility company (United Power) along with three sets of street and utility plans and one copy of the plat map. The electrical utility company shall submit the final design to the Town Engineer for review and approval. Developer shall pay the electrical utility company the total costs of installation for all street lighting within thirty (30) days of receipt of written notice.

The developer shall coordinate the location of the mail boxes and the street lighting with the United States Postal Service to ensure adequate light is available at each mail box. Lighting shall conform to the requirements of the United Postal Service.

All luminaries for street lighting must be LED and have written approval of the Director of Planning and Development prior to installation.

The spacing and illumination which will be used is set forth in Table 900-1:

TABLE 500-1

<u>Street Type</u>	<u>Average Foot Candles</u>	<u>Lamp Lumens</u>	<u>Pole Spacing</u>
Local Residential	0.15	9,500	300' ± *
Rural Residential	0.15	9,500	At Intersections
Collector	0.25	9,500 to 27,500	200' ± *
Arterial	0.50	27,500	150' ± *

* Poles shall be placed on alternating sides of the street.

595.01 Residential Street Lighting

All intersections and cul-de-sac bulbs shall have a minimum of one light. If a segment of street between intersections is greater than 450 feet and less than 600 feet, a light shall be installed at the center of the segment. A light shall also be placed at all community mailboxes and trail crossings. Residential lighting shall be 25 feet in height unless otherwise approved by the Town.

595.02 Collector Street Lighting

Collector lighting shall be 250 watt equivalent luminaries on metal or fiberglass poles 25 feet in height. The light fixture shall have a flat lens and the poles shall be dark in color unless otherwise approved by the Town. A minimum of two lights shall be placed on diagonal corners at all intersections and on all corners of a signalized locations. A light shall also be placed at all community mailboxes and trail crossings. Collector lighting shall be 25 feet in height unless otherwise approved by the Town.

595.03 Arterial Street Lighting

Arterial lighting shall be 250 watt equivalent luminaries on metal or fiberglass poles, 35 feet in height. The light fixture shall be 35 feet in height, have a flat lens, and on 10-foot long mast arms unless otherwise approved by the Town. The poles shall be dark in color unless otherwise approved by the Town. A minimum of two lights shall be placed on diagonal corners at all intersections and on all corners of signalized locations.

**TABLE 500-3
STREET DESIGN CRITERIA**

Design Element	Principal Arterial	Minor Arterial	Collector	Residential Collector	Local Street
Right-of-way Width	120'	120'	80'	70'	60'
Flow Line Curb Radius - Arterial	50	50	30	30	**
Flow Line Curb Radius - Collector	30	30	25	25	20
Flow Line Curb Radius - Local	**	**	20	20	15
Design Speed	55 mph	50 mph	45 mph	30 mph	25 mph
Typical Posted Speed Limit *	45 mph	40 mph	35 mph	25 mph	25 mph
Maximum Degree of Curve (degrees)	6	7.4	12	32.7	32.7
Minimum Curve Radius (feet)	955	775	475	300	175
Cross Slope without Super Elevation		Maximum 4% - Minimum 2%			
Super Elevation Maximum	4% required	Reverse crown	Normal crown	Normal crown	Normal crown
Maximum Street Grade	5%	5%	6%	6%	6%
Minimum Street Grade	0.5%				
Maximum Grade at Intersection	2% for 300'	3% for 300'	4% for 150'	4% for 150'	4% for 150'
Min. Approach Tangent @ Intersections	300'	300'	200'	200'	100'
Min. Tangent Between Vertical Curves	50'				

* Posted speeds limits may be changed from based on current engineering studies in accordance with the current State of Colorado Model Traffic Code.

** Intersections of Local streets and Arterial streets are not allowed.

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SECTION 600 WATER SYSTEM

610.00 DESIGN CRITERIA

610.01 General

All water distribution systems shall comply with the requirements of the STANDARDS AND SPECIFICATIONS for water main and service line construction and may include special criteria established by the Town for the overall hydraulics of the water utility system. Special criteria shall be outlined at pre-design meetings scheduled, as determined necessary, by the Town Engineer. The requirements set forth in the latest edition of the Denver Water Board Engineering Standards shall apply for information omitted in these STANDARDS AND SPECIFICATIONS. The developer and/or developer’s engineer must consult with the Fire District to review any special conditions that exist of that need to be addressed in the design of the Town’s water utility system.

610.02 Water Supply

Potable water is supplied to the Town by the Central Weld County Water District (CWCWD) via the Town owned Cleveland Hill water tank (1/2 mile south of WCR 16 on WCR 17). The base of the tank is at an elevation of approximately 5100 MSL and is 40 feet tall.

611.00 Design Flow Requirements

The design of the water distribution system shall be based on the following:

UNIT WATER DEMANDS FOR FUTURE LAND USE

Land Type	Avg. Demand	Max. Day/Avg. Day	MAX. HR./FLOW RATIO
Residential	140 GPCD*	2.60	3.9
Commercial	1651 GPD/Acre	2.00	3.0
Industrial	1651 GPD/Acre	1.32	3.0

*Gallons Per Capita/Day

Fire flows may be calculated from more than one hydrant, providing the hydrants used are directly accessible to all possible fire locations in the area served. Fire flows, per Frederick-Firestone Fire Protection District, shall be:

- A. Available fire flow must be 20 psi residual minimum.
- B. Minimum fire flow (2 hour duration) for any newly developed areas:

1. 1 and 2 family units 1,000 gpm
2. Multi-family units 1,500 gpm
3. Institutional development 2,000 gpm
4. Commercial development 2,500 gpm
5. Industrial development 3,500 gpm

Note: above fire flow requirements may be increased due to type of construction and size of building, per direction of the Fire Marshall.

612.00 Operating Pressure Requirements

All areas shall be designed to provide a maximum static head of two hundred ninety (290) feet (one hundred twenty five [125] psi) and a minimum static head of one hundred (100) feet (forty-three [43] psi). Distribution systems shall also be designed to maintain a twenty (20) psi residual pressure during required fire flow and a forty- (40) psi residential residual during peak residential flows. The maximum pressure drop from static head to either fire flow or peak residential flow shall not exceed thirty- (30) psi.

613.00 Fire Hydrant Spacing

In single-family residential areas, fire hydrants shall be spaced a maximum of five hundred (500) feet apart as measured along street curb line and at an overall spacing that will average not less than one hydrant to two hundred thousand (200,000) square feet accessible to the fire hydrant throughout an individual subdivision. A hydrant shall be placed in the end of each cul-de-sac.

In business, industrial, and high-density residential areas, hydrants shall be spaced not greater than three hundred feet (300) apart or as approved by Frederick-Firestone Fire Protection District.

614.00 Fire Lines

The property owner shall maintain all fire lines extending from the valve on the Town water main. Valves on newly constructed fire lines shall be located on the tee at the main line. Fire lines are to be used exclusively for fire protection. Domestic water taps and/or irrigation taps shall not be allowed on the fire line. Fire lines valve boxes will have "FIRE" printed on the valve lid instead of "WATER".

615.00 Distribution System Layout

Distribution mains and lateral lines shall be located as indicated on the accepted plans, and shall be a minimum of eight inch (8) diameter pipe.

Dead ends shall be minimized by looping whenever possible. Lines at ends of long cul-de-sacs shall be looped along lot lines to adjacent streets. Dead ends shall be provided with a fire hydrant.

Mains and laterals shall be extended to the boundaries of Filings and completely across the frontage of individual lots.

The developer/property owner is responsible to construct on-site, adjacent, and off-site mains and transmission lines necessary to serve the property in conformance with the Town's Water Master Plan.

616.00 Valve Spacing and Marking

Valves shall be placed with a maximum spacing of six hundred (600) feet in all distribution mains and lateral lines. Valve layout shall be designed such that future repairs or maintenance may be isolated with disruption of service to as few customers as possible. Valves shall also be placed to insure that only one hydrant will be out of service in the event of a line break.

Tees shall require three (3) valves. Crosses shall require four (4) valves. For a succession of short blocks perpendicular to the direction of the distribution main and without residential or commercial services between, one or more intersection(s) shall have the valve in that direction omitted, but must maintain the six hundred (600) foot maximum spacing requirement.

Valves shall also be placed at each end of a line running through an easement on private property, on each side of a major creek or channel crossing, and on each side (at property lines extended) of a distribution line that provides service to a hospital, school or large industrial user.

617.00 Air Relief Valves

Air relief valves shall be installed at each high point in all distribution mains and at high points of lateral lines as may be required by the Town Engineer.

Air relief valves shall be installed in precast manholes or vaults fitted with air vents open to the atmosphere and in accordance with the Standard Drawings. (Also see Section 632.10 Air Relief Valves).

618.00 Temporary Blow-off Valves

Provisions shall be included in the design to allow for the flushing of distribution mains and lateral lines at any low point in the system, or at any point noted on the accepted plans. Fire hydrants shall be used for all permanent blow-offs, however for temporary dead end waterlines, a temporary blow off valve may be permitted. The blow-off assembly

shall be installed perpendicular to and on the downhill side of the main or line and shall drain to the nearest gutter line or drainage channel. The blow-off assembly standpipe must have a threaded end to accept a fire hose coupling. The top of the standpipe shall be between four to six inches (4" - 6") below grade in accordance with the Standard Drawings.

619.00 Pipe

All pipe used for distribution mains and lateral lines having a diameter of twelve inches (12") or less shall be PVC pipe unless otherwise approved in writing by the Town Engineer. Distribution mains in excess of twelve inches (12") in diameter shall be subject to approval and as directed by the Town Engineer. The design engineer will specify the pipe class as required for specific project conditions (see Section 632.00).

619.01 Hydraulic Design

All pipes shall be designed to provide a maximum velocity of ten feet (10') per second. Distribution mains and lateral lines shall be designed using the Hazen-Williams friction coefficients and maximum head losses noted below:

Pipe Size	Hazen-Williams Friction Coeff.	Max. Head Loss
8" - 12"	C-100	2' per 1,000'
14" - 16"	C-110	2' per 1,000'
20"	C-130	1.5' per 1,000'
Over 20"	As directed by the Town Engineer	

619.02 Location (Typical)

Water mains will typically be located ten feet (10') north or west of the centerline of the street unless otherwise approved by the Town Engineer.

At street intersections, valves will be located at tees or cross with 5' of separation between valves. Fire hydrant gate valves shall be placed at swivel tee. All fire hydrants shall have a restrained connection directly to the tee off the main (see the Standard Drawings).

In all instances, the water mains shall extend to the boundary line of the property or subdivision served. A main serving one lot shall extend the entire way across the frontage for that lot. Mains serving a subdivision shall extend to the center of boundary streets, to boundary lines or to the outside of paved areas as may be noted on the accepted plans.

619.03 Pipe Deflection

Changes in the direction of the waterline pipe shall require bends in all instances. Axial deflection at the joints shall not be allowed. The use of High Deflection Couplers may be

allowed for vertical deflections. Areas of use must be shown on the Drawings. At a minimum, stationing and degree of deflection must be shown in each instance.

619.04 Minimum Depth

All pipe shall be installed with a minimum of five feet (5') of cover from finished grade of street to the top of the pipe barrel. Trenching, backfilling and compacting shall be completed in accordance with Section 350.00, Trenching, Backfilling and Compacting, of these STANDARDS AND SPECIFICATIONS.

619.05 Service Connections

See Section 640.00 of these STANDARDS AND SPECIFICATIONS for details on Town standards for service stub-ins and house service connections.

620.00 GENERAL PROVISIONS

621.00 General

All water main construction within the Town and all water service line construction connecting to the Town's water mains shall be done in accordance with these STANDARDS AND SPECIFICATIONS and the accepted plans and shall apply to new water system construction as well as to repairs to existing facilities.

When special conditions are encountered or deviations from these STANDARDS AND SPECIFICATIONS are required by the Town Engineer, and such changes are in the best interests of the Town, the decision of the Town Engineer shall be final.

622.00 Permits Required

A public improvement permit shall not be issued until the Town Engineer has accepted the water main plans. A pre-construction meeting with the Town Inspector and Town Engineer, the Developer and the Contractor shall be scheduled and completed prior to the commencement of any construction. The Town Engineer shall be notified two (2) working days (forty-eight [48] hours) before construction is to begin.

623.00 Maintenance of Traffic

When street cuts are required for water facilities construction, the following conditions shall be met to avoid interference with traffic:

- A. Street service cuts shall be open only between 9:00 a.m. and 4:00 p.m.

- B. Two-way traffic shall be maintained at all times around the construction area. A Traffic Control Plan (TCP) must be prepared in accordance with Section 141.08, Traffic Control, Barricades and Warning Signs, of these STANDARDS AND SPECIFICATIONS and submitted to the Town Engineer for his approval prior to the commencement of construction.

624.00 Irrigation Rain Sensor

All new public and private irrigation systems shall include an automatic electromechanical interrupt which engages to interrupt the irrigation system during a rainfall event (i.e. rain sensor). The device shall be a Hunter model Rain-Clik or approved equal.

630.00 WATER MAIN CONSTRUCTION

631.00 Site Work and Earthwork

Earthwork shall be performed in accordance with Section 340.00, Earthwork, of these STANDARDS AND SPECIFICATIONS.

631.01 Trenching, Backfilling and Compacting

Trenching, backfilling and compacting shall be performed in accordance with Section 350.00, Trenching, backfilling and Compacting, of these STANDARDS AND SPECIFICATIONS.

631.02 Preservation of Monuments

Refer to Section 141.00, Protection of Public and Utility Interests, of these STANDARDS AND SPECIFICATIONS.

632.00 Materials

632.01 General

All references cited in these STANDARDS AND SPECIFICATIONS as the Denver Water Board Specifications shall mean the latest edition of the Engineering Standards of the Board of Water Commissioners of Denver, Colorado.

632.02 Pipe

All pipe for waterline construction shall be as described in Section 619.00 of these STANDARDS AND SPECIFICATIONS.

PVC Pipe: All PVC pressure pipe in sizes up through twelve inches (12") in diameter shall be in conformance with AWWA C-900 or AWWA C-909 Class 150 and have a minimum working pressure of 150 psi (DR-18).

PVC pressure pipe fourteen inches (14") through forty-eight inches (48") in diameter and shall have a minimum working pressure of 235 psi (DR-18).

Installation of PVC pipe shall be in accordance with the manufacturer's recommendations and these STANDARDS AND SPECIFICATIONS.

Ductile Iron Pipe - All ductile iron pipe shall be in compliance with AWWA C151. Class designation shall be as shown on the accepted plans or as designated by the Town Engineer for each individual project. Joints shall be mechanical or push-on, in conformance with AWWA C111. Ductile iron pipe shall have a standard cement mortar lining in conformance with AWWA C104, and a bituminous outside coating approximately one (1) mil thick. Each pipe shall be marked with the weight, class designation and size.

632.03 Polyethylene Wrap for Ductile Iron Pipe

The Polyethylene encasement material shall be in accordance with Section 632.17 of these STANDARDS AND SPECIFICATIONS.

632.04 Fittings

Ductile iron fittings shall be in conformance with AWWA C110 and/or C153. Class designation shall be compatible with the pipe class designated for the project. Joints shall be either mechanical, push-on type or integral restrained joints conforming to the requirements of AWWA, rubber gasket joints shall be in conformance with AWWA C111. A standard thickness cement mortar lining shall be applied in conformance with AWWA C104. All fittings shall receive a bituminous outside coating approximately one (1) mil thick or lined and coated with fusion banded epoxy coating in accordance with AWWA C116.

632.05 Gate Valves

Gate valves in sizes four inches (4") to twelve inches (12") shall be of the ductile iron body, non-rising bronze stem, resilient-seated type manufactured in accordance with AWWA standard C515 with the specific requirements outlined.

General: Valves shall provide zero leakage at working pressures up through two hundred and fifty (250) psi in either direction. They shall open left and be furnished with a two-inch (2") square operating nut (underground) or hand wheel (vault) as indicated. End connections shall be furnished with all necessary joint materials and shall have a full opening flow way of equal diameter to the nominal size of the connecting pipe.

Design: The disc shall have an integrally cast ASTM B-62 ductile iron stem nut to prevent twisting or angling of the stem. The disc casting shall be open on one side so as to form no cavities for the accumulation of solids and permit the application of the protective coating. The sealing mechanism shall consist of a replaceable, contoured natural rubber disc seat ring internally reinforced by a steel ring and molded separately from the disc. The seat ring shall be secured to the disc with self-locking stainless steel screws and shaped so that it cannot be installed improperly. The seat ring shall seal against an accurately formed machined surface in the valve body.

Valves shall be provided with three (3) O-ring stem seals with two (2) placed above and one (1) below the thrust collar. The two (2) upper O-rings shall be replaceable with the valve fully open and under pressure. The area between the O-rings shall be filled with a lubricant to reduce friction and to lubricate the O-ring each time the valve is operated. An anti-friction washer shall be placed above the thrust collar to further minimize operating torque. Structural design of the valve shall be such that if excessive torque is applied to the stem, failure of the pressure retaining parts will not occur. Stem failure under such conditions shall occur externally at such a point as to enable the stem to be safely turned by use of a pipe wrench or other such readily available tool after exposure of the valve. The stem shall then be replaceable through removal of the two-bolt stuffing box.

Coating: Coatings shall be equal to or exceed AWWA C550-81 and the specific requirements outlined. All internal ferrous metal surfaces shall be fully coated, holiday free, to a minimum thickness of four (4) mils. The coating shall be a two-part thermosetting epoxy suitable for field over-coating and for touchup with the same coating material without special surface preparation or extreme heat. The supplier shall furnish detailed performance tests of adhesion, hardness and abrasion resistance of the furnished coatings. Coatings shall have a successful record of performance in valves, pipe or other allied equipment, for a minimum of ten (10) years.

632.06 Butterfly Valves

Butterfly valves not allowed without approval from the Town Engineer and only on water lines greater than twelve (12") inches. When allowed they must meet the following:

All valves having a nominal diameter of greater than twelve (12) inches or greater shall be geared butterfly valves designed for direct burial and shall conform to AWWA specification C504, Class 150-B. Valves shall be of the tight closing rubber seat type with rubber seats which are bonded to the valve body. No metal-to-metal sealing surfaces will be permitted. Valves shall be bubble tight at one hundred fifty (150) psi rated pressure with flow in either direction. Valve discs shall rotate 90 degrees from the full open position to the tight shut position. Butterfly valves used with Class 200 PVC shall include a standard pipe spacer to allow for unobstructed movement of the valve. Coatings shall conform to standards specified in Section 632.04. Valve bearings shall be sleeve-type corrosion-resistant, and self-lubricating with the load not to exceed twenty-five hundred (2500) psi.

Valve operators shall be the traveling nut type designed to withstand three hundred (300) foot pounds of input torque at full open or closed positions without damage to the valve or operator; shall be fully gasketed, grease packed, and designed to withstand submersion in water to ten (10) psi; and shall close with a clockwise rotation of a two inch (2") square AWWA nut, seventeen (17) to thirty (30) turns depending upon size. Hydrostatic and leakage tests shall be conducted in accordance with AWWA C504, Section A.6.

632.07 Pressure Reducing Valves

Pressure reducing valves shall be installed at the location(s) noted on the accepted plans. This valve shall be capable of maintaining a constant downstream pressure regardless of varying inlet pressure. This valve shall be a hydraulically operated, diaphragm-actuated, globe or angle pattern valve. It shall contain a resilient, synthetic rubber disc, having a rectangular cross-section, contained on three and one-half (3-1/2) sides by a disc retainer and forming a tight seal against a single removable seat insert. The diaphragm assembly containing a valve stem shall be fully guided at both ends by a bearing in the valve cover and an integral bearing in the valve seat. This diaphragm assembly shall be the only moving part and shall form a sealed chamber in the upper portion of the valve, separating operating pressure from line pressure. The diaphragm shall consist of nylon fabric with synthetic rubber and shall not be used as a seating surface. Packing glands and/or stuffing boxes are not permitted and there shall be no pistons operating the valve or pilot controls. All necessary repairs shall be made possible without removing the valve from the line. The valve shall be furnished with indicator rod to show valve position.

The pilot control shall be a direct-acting, adjustable, spring-loaded, normally open, diaphragm valve, designed to permit flow when controlled pressure is less than the spring setting. The control system shall include a fixed orifice.

The valves shall be Clayton 90-01BYKC and/or a Clayton 90-01ASKC Pressure Reducing Valve-manufactured by Cla-Val Co., or an approved equal. The bypass valve shall be 2-inch for main line sizes up to 12-inch. Main sizes larger than 12-inch will require an engineered design submitted for review and approval.

All pressure reducing valves shall be 150 class. Distribution main and lateral line pressure reducing valves shall be installed in a vault and contain parallel valves for high and low flow ranges. Piping must be ductile iron through the vault walls extending three (3) feet past the vault walls and shall be as shown on the Standard Drawings. Oil filled differential gauges shall be installed.

The calibration of the pressure reducing valves shall be the responsibility of the Developer or Contractor installing the valves. The Town shall be notified prior to scheduling the calibration. The calibration shall be to the satisfaction of the Town.

632.08 Fire Hydrants

Fire hydrants shall conform to the requirements of AWWA standard for dry-barrel fire hydrants (ANSI\AWWA C-502-85), and in addition, shall be listed by Underwriters Laboratories and Factory Mutual Research Corporation. Casting marks or other permanent means shall be used to identify the fire hydrant as conforming to these standards.

Fire hydrants shall also conform to the following supplementary specifications:

- A. Hydrants shall be rated at 1.5 times the operating line pressure and tested at 500 PSI per Section 5.1 of AWWA C502. Production testing of each hydrant shall be performed at 500 psi to assure proper assembly and operation and detection of any imperfections. All iron parts as designated in Section 3.1.2 of AWWA C502-85 shall be ductile iron – Class 52.
 - a. Hydrant testing shall be conducted during the initial and final filings of the development (one test per filing).
 - i. The hydrant may be located at the designated park site
 - ii. Hydrant must be positioned downstream of all meter pits and backflow prevention devices.
- B. The bury depth (distance from ground line to insert of the hydrant inlet) shall be specified here in after or as shown on drawing.
- C. Nozzles shall be two 2-1/2" hoses 180 degrees apart and one 4-1/2" pumper. All nozzles shall be at the same elevation. Nozzle threads shall be National Standard Fire Hose coupling screw thread as described in Appendix A of AWWA C502, unless otherwise specified. Nozzles caps shall be provided with chains and gaskets. Nozzles caps shall have nut configuration the same as the hydrant-operating nut. Nozzles shall be reverse threaded into the upper barrel and mechanically locked in place.
- D. Hydrant main valve shall be 5-1/4" (or 4-1/2" specified one or the other) minimum and shall be of the full compression design, opening against and closing with the pressure. The main valve seat ring shall thread into a bronze sub-seat and all gaskets sealing the seat ring shall be on a bronze-to-bronze seating surface. The seat ring threads shall not serve as pressure seal. The entire valve and rod assembly shall be removable by use of a small lightweight seat removal wrench.
- E. The drain valves shall allow complete drainage of all residual water in the hydrant. The circumferential drain passage inside the hydrant shall be bronze on all surfaces. The draining system of the hydrant will be bronze, with a sliding bronze drain valve. Sliding drain valves made of rubber, plastic, or leather will not be allowed.
- F. All exterior bolting and fasteners below the ground line shall be plated steel.
- G. Hydrants shall be the breakaway types with a frangible ground line and rod coupling designed to break upon traffic impact to prevent further damage to the hydrant and connecting pipe. The frangible coupling shall allow the

upper section to be rotated to any desired position. Couplings, which employ lug devices or a breakaway barrel, are not acceptable. Frangible bolts are not acceptable due to the possibility for the use of non-frangible bolts.

- H. Hydrant operating nut shall be ductile iron and shall be pentagonal in shape, 1-1/2" point to flat (AWWA Standard). The operating nut shall also function as a weather shield. Hydrant shall open left (counter clockwise).
- I. The operating machine shall utilize two (2) O-ring seals between the revolving nut and bronze-sheathed upper section of the valve rod. The top of the rod shall also be fitted with a travel stop nut to limit downward travel on the rod. All-weather grease shall be used to provide permanent lubrication. A thermoplastic trust washer shall be used to reduce friction in the trust collar while opening the hydrant.
- J. The hydrant inlet shall be either a mechanical joint or tyton joint restraint, if specified shall be accomplished for mechanical joint by use of mechanical joint gripper glands and for tyton joints with field-lock gaskets.
- K. Hydrants shall be painted red and shall be repainted at time of final acceptance. Hydrants for non-potable use shall be painted purple.
- L. Manufacturer shall certify that the hydrants furnished meet this specification.
- M. Fire hydrants shall be:
 - a. Waterous Pacer WB-67-250
 - b. Mueller Super Centurion 250, A423
 - c. Clow Medallion Hydrant

632.09 Valve Boxes

Valve Boxes shall be Tyler Union screw-type cast iron valve box assembly Series 6860 with oval base #160, or an approved equal. See detail W3.

All buried valves shall be provided with a valve box. Valve boxes shall be gray cast iron, ASTM A48 Class 20A, three (3) piece adjustable screw boxes with an oval base and a five and one-fourth (5-1/4) inch screw-type shaft suitable for depth of cover as required. Valve box lids for water lines shall be marked with the word "WATER," valve box lids for fire lines shall be marked "FIRE," and valve box lids for Non-Potable water lines shall be marked "NON-POTABLE WATER."

All valves set at greater than normal depth shall have an extension stem provided and installed with the valve box so that the valve may be operated with a standard seven (7) foot valve key. A valve operating nut at six (6) foot or greater below final grade shall have an extension stem provided to bring the operating nut to a depth of four (4) feet below final grade. Coatings shall conform to standards specified in Section 632.05. The Town Engineer shall accept valve boxes and final grade only when the final grade is completed.

Boxes shall be Tyler Pipe screw-type cast iron valve box assembly Series 6850, or an approved equal.

632.10 Air Relief Valves

Air relief valves shall be designed to allow large quantities of air to escape out of the orifice when the pipeline is being filled and shall close water tight when water enters the valve. To break the vacuum, the valve shall also allow large quantities of air to enter the pipeline when the pipeline is being drained, or a break has occurred.

The valve shall consist of a body, cover, baffle, float and seat. The float shall be stainless steel designed to withstand a maximum pressure of 1,000 psi. All material shall conform to ASTM A126 GR. B and ASTM A240.

Air relief valves shall be installed in a vault in accordance with the Standard Drawings. Galvanized piping or fittings shall not be allowed, see Section 617.00 Air Relief Valves.

632.11 Temporary Blow-off Assembly

The temporary blow-off shall be through a two-inch (2) stop and waste valve with a two-inch (2) gate valve operating nut, box, piping and cover. Unless otherwise approved in writing by the Town Engineer, all piping shall be threaded copper and valves shall be brass. Galvanized piping or fittings are prohibited. Refer to the Standard Drawing W14.

632.12 Vaults

Vaults may be precast or poured-in-place and shall be constructed in accordance with these STANDARDS AND SPECIFICATIONS. Precast vaults shall be so designed that all joints and corners are waterproof. Precast and poured-in-place vaults shall be made waterproof after construction by use of sealants, epoxies, or other approved methods.

The vault roof shall be designed to support the overhead fill, any surcharge and an H-20 traffic loading. Particular care shall be taken in selecting precast vaults that the application not be one of either shallow or deep cover over the roof. Should the cover over the roof be less than two and one-half (2-1/2) feet or more than five (5) feet, concern for adequacy of the roof, or the ability to remove and replace a one (1) piece roof slab resting upon deflecting side walls may dictate a poured-in-place vault.

Poured-in-place meter vaults shall conform to the Standard Drawings.

632.13 (Left Blank Intentionally)

632.14 (Left Blank Intentionally)

632.15 Sump Pits for Vaults and Manholes

Sumps with a gravity drain line or sump pump, are required for vaults or manholes in areas where there is a history of seepage into existing vaults and in all telemetry equipment and pressure regulating valve manholes and vault installations, as determined by the Town Engineer.

Normal practice in constructing a sump is to excavate a thirty- (30) inch diameter hole about three (3) feet deep. A six-inch (6) floor is poured and allowed to set. Then a twenty-four inch (24) diameter cardboard tubing is used for an inside form, and concrete is poured behind it approximately three inches (3) thick.

632.16 Vent Pipes

Unless otherwise approved by the Town Engineer, vent pipes shall be used in vaults and pits to allow gases to escape. Installations that contain electrical equipment shall have a blower attached to the vent system. Vent pipes shall be field located at the nearest intersection of the street property line and the side lot line. Refer to the Standard Drawings.

Above ground vent pipe shall be six (6) inch nominal diameter galvanized steel pipe, Grade 40, conforming to ASTM Standard Designation A 53 painted black. The vent screen shall be a three (3/4) fourths inch No. 9-11 flattened expanded galvanized metal screen painted black. Below ground vent pipe shall be six (6) inch, scheduled 40 PVC with glued joints. A PVC glued joint by standard pipe thread female adapter shall be used to connect the steel pipe to the PVC pipe at ground level.

632.17 Corrosion Protection Systems

When soil resistivity is less than two thousand five hundred (2,500) ohm-centimeters (OHM-CM), but greater than one thousand (1,000) OHM-CM, ductile iron pipe may be used, but it must be protected against corrosion.

632.17.01 Polyethylene Encasement Material

Polyethylene wrap shall be used on all cast iron or ductile iron pipe, fittings, rods, and appurtenances. Refer to the Standard Drawings. Polyethylene wrap for non-potable use shall be purple.

Twenty-four (24) inch flat width tubing shall be used with four inch (4), six (6) inch and eight (8) inch diameter pipe. Thirty inch (30) flat width tubing shall be used with all twelve (12) inch diameter pipes. Thirty-six (36) inch flat width tubing shall be used for sixteen (16) inch diameter pipe. Fifty-two (52) inch flat width tubing shall be used with twenty (20) inch and twenty-four (24) inch diameter pipe.

Harness rods shall be covered by a four (4) inch wide flat polyethylene tubing. The entire joint shall be covered by a cigarette-wrap of forty-eight (48) inch wide polyethylene sheet material over each set of lugs. Irregular shaped valves and fittings shall be covered with a forty-eight (48) inch wide flat polyethylene sheet material.

632.17.02 Insulators

Insulators shall be installed at the outlet end of the corporation stop. Insulators shall be Ford Service Insulators or an approved equal for service lines. Refer to the Standard Drawings.

632.17.03 Tape

The polyethylene seams and overlaps shall be wrapped and held in place by means of two-inch wide plastic-backed adhesive tape. The tape shall be Polyken #900 (polyethylene), Scotchrap #50 (polyvinyl) or equal. The tape shall be such that the adhesive will bond securely to both metal surfaces and polyethylene film.

632.18 Tracer Wire and Warning Tape

A No. 12 AWG insulated, single strand copper wire shall be attached to all pipes, for the purpose of future locating, as detailed in the Standard Drawings. A three (3) inch wide, detectable warning tape shall be installed above all pipe, for the purpose of warning of location of buried pipeline as detailed in the Standard Drawings. Certification of continuity testing required at time of Initial Acceptance.

632.19 Bedding Materials

Bedding materials shall be #8 or #9 and in accordance with Section 352.00, Bedding for Pipelines and Service Lines, of these STANDARDS AND SPECIFICATIONS.

632.20 Concrete

All concrete shall conform to Town Standards for Portland Cement Concrete Work as specified in Section 400 of these STANDARDS AND SPECIFICATIONS and applicable referenced portions of the Denver Water Board Specifications.

632.21 Plastic Liner Pipe (slip lining)

Water main slip lining materials shall comply with all applicable requirements of Section 732.09, Plastic Liner Pipe (slip lining), of these STANDARDS AND SPECIFICATIONS and as herein noted.

632.22 Steel Casings for Bores

Pipe casings shall meet the following and follow Detail W19.

Pipe casing shall be smooth wall welded steel cylinder fabricated in accordance with AWWA C200. It shall be round, straight, and free from defects or damage due to improper manufacturing or handling with a minimum yield strength of 35,000 psi.

Pipe casing shall be designed by the pipe manufacturer with sufficient wall thickness to resist the loads applied. The inside diameter shall be at least four inches greater than the outside diameter of the bell or joint of the carrier pipe to be installed therein. External loading shall be AASHTO H20 highway loading or E-80 railroad loading, plus jacking load.

The minimum wall thickness of the casing shall be:

CARRIER PIPE NOMINAL DIA.	CASING MIN. WALL THICKNESS
4"	0.375"
6"	0.375"
8"	0.375"
12" to 20"	0.500"

Casing spacers shall be stainless steel, bolt on style type with a shell made of at least two (2) halves, as manufactured by Cascade Waterworks Manufacturing Company, CCS-JR and CCS-ER, or approved equal. The bands shall be fourteen (14) guage at a minimum; the risers shall be ten (10) gauge at a minimum. If restrained joint pipe is not used, Joint Restraint Casing Spacers (Carrier pipe skids) shall be installed at each pipe joint with the spigot side of the Restraint Joint Casing Spacer positioned at the "home line" and the bell side at the edge of the bell, per manufacturer's recommendations. The spacers shall provide sufficient restraint to prevent "over-belting" of the joint. The Contractor shall TV Carrier pipe after installation to verify that the spigot has not been over-inserted.

The four (4) runners shall be eleven (11) inches long as a minimum and manufactured of high abrasion resistant, low coefficient of friction, Ultra High Molecular Weight Polymer (UHMW) or Glass Filled Polymer. Runner heights shall be set to center the carrier pipe in the casing.

Casing end seals shall be designed to prevent the entry of water or loss of material from casing. The end seals shall be 1/8-inch-thick sixty (60) durometer EDPM or neoprene rubber and shall be one-piece pull-on type. The seals shall overlap the casing by two (2) inches and shall be held on with AISI 304 stainless steel worm gear clamps.

Steel casing pipe shall comply with all applicable requirements of Section 732.10, Steel Casings for Bores, of these STANDARDS AND SPECIFICATIONS.

633.00 Installation**633.01 General**

All work shall conform to applicable portions of AWWA C600, "Installation of Ductile Iron Water Mains", and to the pipe manufacturer's installation instructions except as modified by these specifications.

Pipes cannot be installed when temperatures are under 30 degrees Fahrenheit.

633.02 Alignment and Grade

Field parties, under the supervision of a licensed surveyor or a professional engineer, will determine alignment and grade of the pipe and the location of fittings, valves, and hydrants. The required minimum depth of cover between the top of the pipe barrel and the finished street grade is four (4) feet six (6) inches. The water main shall be laid to the required lines and grades with fittings, valves, and hydrants at the required locations. As-built drawings of pipe alignment, verified by a licensed surveyor or a professional engineer, shall be furnished to the Town Engineer.

633.03 Protection of Existing Underground Utilities

The Contractor shall be held responsible for the protection of public improvements as stated in Section 141.00, Protection of Public and Utility Interests, of these STANDARDS AND SPECIFICATIONS. It shall be the Contractor's responsibility to replace all damaged public improvements at his own expense.

633.04 Interruption of Services

Interruption of services shall be accomplished in accordance with Section 312.00, Protection of Public Improvements, of these STANDARDS AND SPECIFICATIONS.

633.05 Pipe Installation

Proper equipment, tools, and facilities shall be provided and used by the Contractor for safe and convenient performance of the work. All pipe, fittings, valves, and hydrants shall be carefully lowered into the trench piece-by-piece in such a manner as to prevent damage to pipe materials and to protect coatings and linings. Under no circumstances shall pipe or fittings be dropped or dumped into the trench; any pipe or fittings that are dumped shall be removed from the work site and shall not be used.

All pipe and fittings shall be carefully examined for cracks and other defects, while suspended above the trench, immediately before installation in final position. The groove in the bells of ductile iron pipe shall be full and continuous or the pipe will be rejected. Defective pipe or fittings shall be removed from the job site within twenty-four (24) hours. All foreign matter or dirt shall be removed from the interior and ends of pipe and accessories before they are lowered into position in the trench.

Every precaution shall be taken to prevent foreign material, including trench water from entering the pipe. If the pipe laying crew cannot lower the pipe into the trench and into place without getting earth into it, the representative of the Town Engineer shall require that before lowering the pipe, a heavy, tightly woven canvas bag of suitable size be placed over each end of the pipe and left there until the connection is made to the adjacent pipe. During construction, no debris, tools, clothing, gravel or other foreign materials shall be placed in the pipe. During construction the Contractor shall provide and maintain adequate equipment to properly remove and dispose of all water entering the trench or any other part of the work.

When buried, all ductile iron pipe fittings and appurtenances shall be protected with thick polyethylene film wrap. Miscellaneous steel or other ferrous pipe for blow-offs, etc., shall be similarly protected.

Methods for applying the wrap will conform to the following procedure:

- A. Take up pipe by a crane at the side of the trench using either a sling or pipe tongs, and raise the pipe about three (3) feet off the ground. Slip a section of polyethylene tube over the spigot end of the pipe and bunch-up, accordion fashion, between the ends of the pipe and the sling. The tube shall be cut to a length approximately two (2) feet longer than the length of the pipe.
- B. Lower the pipe into the trench. Seat spigot end in bell of adjacent pipe and lower pipe to the trench bottom. A shallow bell-hole shall be provided in the trench bottom to facilitate wrapping of the joint.
- C. Make up the pipe joints in the normal fashion.
- D. Remove sling from center of pipe and hook into bell cavity; raise bell end three (3) or four (4) inches to permit tube of polyethylene film to be slipped along the full length of the barrel. Enough film shall remain bunched-up, accordion fashion, at each end of the pipe to overlap adjoining pipe about one (1) foot.
- E. To make an overlap joint; (1) pull film over bell of pipe; (2) fold film around adjacent spigot and wrap with about three (3) circumferential turns of the two (2) inch wide plastic adhesive tape to seal the tube of film to the pipe. The tube of the adjacent pipe shall be pulled over the above wrap on the pipe bell and sealed in place behind the bell using about three (3) circumferential turns of the two (2) inch plastic adhesive tape.

- F. The resulting wrap on the bell of the pipe shall be loose and will be pulled firmly around the barrel of the pipe; excess material shall be folded over at the top and the
- G. fold held in place by means of six (6) inch strips of two (2) inch wide plastic adhesive tape at intervals of about three (3) feet along the pipe barrel.
- H. Fittings, valves, hydrants, etc., shall be hand-wrapped using sheet polyethylene film held in place with plastic adhesive tape. Bends, reducers, and offsets shall be wrapped with polyethylene tube in the same manner as pipe. Valves shall be wrapped by bringing tube wrap on adjacent pipe over bells or flanges of the valve and sealing with adhesive tape. The valve bodies must then be wrapped with a flat sheet of film, passed under valve bottom and brought up around body of stem, and fastened in place with adhesive tape. Hydrants shall be wrapped with polyethylene tube slipped over hydrant to encase it from the lead-in valve to the ground level of the hydrant. All fittings requiring concrete backing shall be completely wrapped prior to placement of concrete thrust block.

According to the manufacturer's recommendation, as each length of pipe is placed in the trench, the circular rubber gasket must be lubricated and installed. The plain end shall be centered in the socket with care to keep the joint from contacting the ground. The pipe shall then be properly seated and brought to correct line and grade. After installation of the polyethylene protective wrap as described above, pipe shall be secured in place by installation of backfill or bedding material, tamped under and along it up to the spring line of the pipe.

Whenever pipe lying is not in progress, the open ends of pipe shall be closed by means of a watertight plug. Cutting of pipe for inserting valves, fittings, or closures pieces shall be done in a neat and professional manner without damage to the pipe or lining, so as to assure 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.

The Town Engineer shall be notified at least one working day (twenty-four [24] hours) in advance of when pipe is to be laid in any trench. No pipes shall be covered until a representative of the Town has inspected them.

633.06 Thrust Blocking, Restrained Joints and Fittings

Thrust blocks and mechanical restraints shall be used at all valves, bends, fittings with mechanical or push-on type connections and dead ends length shall be as required by the design engineer.

Thrust blocking shall be in accordance with the Standard Drawings. Care shall be taken not to block outlets or to cover bolts, nuts, clamps or other fittings or to make them inaccessible. A bond breaker shall be placed between the pipe and the thrust block to aid in ease of future removal. Large thrust blocks shall be separated into sections by a

suitable material. The thrust block shall bear against undisturbed earth. Mechanical restraints shall be required if a thrust block cannot bear against undisturbed earth.

All forming for thrust blocks and anchors shall be done by bulk heading around the shape of the thrust block or anchor with wood, burlap, or reinforced paper sacks filled with sand or earth. Wood

forms shall be removed before backfilling. Newly placed thrust blocks shall be allowed to set, undisturbed, for a minimum of twenty-four (24) hours prior to any backfilling, tamping or compaction.

Mechanical restraints shall be used at all valves, bends, fittings with mechanical or push-on type connections and dead ends. Restraints shall be protected in accordance with Section 632.17 of these STANDARDS AND SPECIFICATIONS. Mechanical restraints shall be "Mega Lugs", "Star Products", "All Grip" Series 3600, uni-flange Series 1400 and 1500 or approved equal.

633.07 Setting Valves and Hydrants

Immediately prior to installation of a valve or hydrant, the following operations shall be performed. The valve or hydrant shall be carefully inspected. The interior shall be thoroughly cleaned; the valve or hydrant shall be operated as many times as necessary to determine that all parts are in proper working order with the valve seating properly and the hydrant drain valve operating properly. Valves and hydrants shall be set plumb, in a vertical position and securely braced in place.

Each hydrant shall have a six (6) inch gate valve on the inlet line and shall be connected to the main by a six (6) inch ductile iron, polyethylene wrapped pipe. The valve shall be firmly anchored to the tee. Where hydrants are connected to mains larger than eight (8) inches, the gate valve will have a restrained connection directly to the tee off the main.

Hydrants shall be set with the bury line at the established finished grade and with hose nozzles parallel to the curb with the pumper nozzle facing the curb and at least six inches (6") behind the curb or sidewalk.

Valves shall be provided with valve boxes centered and plumb over the operating nut of the valve. The boxes will be supported to prevent any shock or stress being transmitted to the valve. All valves shall be installed using a valve box adaptor to insure the proper centering of the valve box during backfill and to maintain valve box location during the life of the valve. Valve boxes shall be maintained in this position during backfilling and covers shall be set to finished position during backfilling. Valve box covers shall be set to finished grade but may be first positioned below the subgrade level to prevent damage during street construction and later adjusted to grade at the time of paving. If the top of the valve-operating nut is greater than six (6) feet below finished grade a valve nut extension shall be installed to bring the operating nut up to four (4) feet below finished grade.

Hydrants shall be provided with a drainage pit with nine (9) square feet of surface area and two (2) feet of depth below the barrel of the inlet. Pits shall be backfilled with one and one-half (1-1/2) inch, washed, crushed rock to a level six (6) inches above the barrel drain hole. A concrete thrust block will be provided at the bowl of each hydrant as shown on the Standard Drawings and shall be placed to prevent obstruction of the barrel drain hole. Hydrants and valves shall be backfilled to the ground surface as specified in Section 350.00 of these STANDARDS AND SPECIFICATIONS.

633.08 Plastic Liner Pipe (Slip lining)

Plastic liner pipe shall be installed in accordance with all applicable portions of Section 733.09, Plastic Liner Pipe, of these STANDARDS AND SPECIFICATIONS.

633.09 Steel Casing and Carrier Pipe Installation

Steel casing and carrier pipe shall be installed in accordance with Section 632.22, Steel Casing and Carrier Pipe Installation, of these STANDARDS AND SPECIFICATIONS.

633.10 Test Stations

Underground pipeline test stations shall be installed at the locations shown on the accepted plans and in accordance with the details shown on the Standard Drawings.

633.11 Plugging of Dead Ends

Standard plugs or caps shall be installed at temporary dead ends of all fittings and pipes, and an adequate thrust block will be provided. Mechanical restrained joints shall be provided as required by the Town Engineer. Dead ends on any line shall be provided with a fire hydrant and proper valve.

633.12 Filling and Venting the Line

The Town Public Works Department shall operate all valves. The line shall be slowly filled with water and all air expelled from the pipe. Care shall be taken that all available hydrants (including hydrant gate valves), air relief valves, and other vents are open during the filling of the line. Where hydrants or other vents are not available in the line, the Contractor shall make whatever taps are required for venting purposes. The rate of filling the line shall not exceed the venting capacity.

633.13 Disinfection and Flushing of Mains and Fire Lines

All mains and fire lines shall be disinfected in accordance with the requirements of the Colorado Department of Health and the procedure set forth in AWWA C651, "Standard for Disinfecting Water Mains".

The chlorine solution shall be retained in the line for at least twenty-four (24) hours. The chlorine residual at the pipe extremities and other representative points shall be at least twenty five (25) parts per million at the end of the twenty-four (24) hour period. If the test is unsatisfactory, the disinfection shall be repeated until a twenty five (25) parts per million chlorine residual is obtained.

Following chlorination, the main shall be thoroughly flushed through all extremities until the water runs clear with no chlorine residual in excess of that carried in the existing system. As a minimum, the total capacity of that portion of the line(s) being tested must be flushed.

The line shall be tested for turbidity at the discretion of the Town Engineer. If the test is above one (1) NTU, the line shall be flushed again. If the turbidity test fails a second time the line shall be re-chlorinated as noted above and then re-flushed.

Two twenty-four (24) hour Bacteriological tests, from multiple points to be determined by the Town Engineer, for total coli-form bacteria shall be performed by the Town a minimum of 24 hours apart. If either of these tests fail, the line shall be re-chlorinated, re-flushed and then retested. The Developer and/or Contractor shall be responsible for reimbursing the Town for all costs associated with the water quality testing. The Contractor shall contact both the Town and the Town's water quality lab to arrange for testing a minimum of two (2) working days (forty-eight [48] hours) prior to testing.

The Contractor shall take all necessary precautions to prevent the flow of strong chlorine solution into existing water facilities and shall assume all responsibility for damages done by heavily chlorinated water. No water mains shall be placed in service or tapped until a written release is obtained from the public health authority having jurisdiction and a copy of that release furnished to the Town Engineer.

633.14 Leakage

Pressure and leakage tests shall be conducted according to the applicable sections of AWWA C600/605 to a pressure of one hundred and fifty (150) pounds per square inch (psi) or 1.5 times the line pressure, whichever is greater. Pressure is not to exceed two hundred (200) psi at the low point of the section being tested for the duration of two (2) hours. The maximum length of line to be tested shall be one thousand (1,000) feet. All joints in connections are to be watertight within tolerances allowed by the specifications in AWWA C600/605. Any leakage that is discovered by observation or tests shall be located and made watertight by the Contractor. Pressure and leakage tests shall be conducted before the line has passed all required disinfection tests. All bacteriological testing will follow pressure testing and leak repairs.

633.15 (Left Blank Intentionally)

633.16 Inspections

Refer to Section 154.00, Inspections, of these STANDARDS AND SPECIFICATIONS.

634.00 NON-POTABLE WATER SYSTEM

634.01 General

The minimum standards for the Non-Potable Water System shall be similar to those given in Section 630.00 for Water Distribution Systems with the exceptions as listed hereinafter.

634.02 Design/Sizing

Non-Potable Water Main sizing shall be to deliver not less than twenty (20) psi dynamic pressure at the Non-Potable Water Main during peak flow rate (demand) conditions. The Non-Potable Water System will not be designed to provide any fire protection flows.

634.03 Non-Potable Water Main Materials

Non-Potable Water Mains shall be purple and shall conform to AWWA C900 PVC, Purple Pressure Pipe for Non-Potable water, minimum Pressure Class 235. DR 18.

634.04 Valve Boxes:

Valve boxes shall be in accordance with Section 632.09 and Drawing No. W3. The triangular valve box covers shall be Model # 4TC116S by Castings, Inc. or approved equal and shall have "Non-Potable Water" cast on the cover.

634.05 Warning Notification on Lines and Tape

All Non-Potable Water Mains shall be installed with warning tapes and with the warning printed directly onto the Non-Potable Water Main. The warning tape, and printing directly on the Non-Potable Water Main, shall state: "NON-POTABLE LINE – DO NOT DRINK".

634.06 Non-Potable Water Main Installation

All mains shall be flushed in accordance with Section 633.13. Disinfection of Non-Potable Water Mains is not required.

The Non-Potable Water Main shall not be installed closer than ten feet (10') horizontally to the Potable Water Main or Sanitary Sewer.

640.00 WATER SERVICE LINE CONSTRUCTION

641.00 General

All water service line locations shall be marked on the curb with a "W" or "V" symbol where services cross under the curb. Water service shall be in a separate trench and shall be a minimum of ten (10) feet from the sewer service line. The water service line shall be a minimum of eighteen (18) inches above any sanitary sewer crossing. All service lines shall be stubbed into the lot either ten (10) feet beyond the back of the walk or five (5) feet past any utility easement, whichever is greater, and shall be marked at the end of the water service with a 2x4 painted blue.

The water service line at the curb stop shall be no deeper than five (5) feet - six (6) inches. The water service line shall be a minimum of two (2) feet from the property line and shall not be located under a driveway unless approved by the Town Engineer.

641.01 Excavation

All excavation shall be performed in accordance with Section 341.00 of these STANDARDS AND SPECIFICATIONS.

642.00 Equipment and Materials

642.01 General

All references cited in these STANDARDS AND SPECIFICATIONS as the Denver Water Board Specifications shall mean the latest edition of the Engineering Standards of the Board of Water Commissioners of Denver, Colorado.

642.02 Service Lines

Service lines shall be of the size that is adequate to supply the requirements of the property being served. The minimum size line shall be three (3/4) fourths inch. The only acceptable materials for a service line are seamless copper tube and ductile iron pipe. Plastic pipe shall not be accepted as service pipe material for services under three (3) inches in diameter. All service pipes shall conform to one of the following specifications:

- A. Seamless copper tube of the type designated as "Type K" (soft) in the industry shall be used for service lines three (3/4) fourths inch through two (2) inches.
- B. Ductile Iron Pipe or PVC pressure pipe conforming to the Denver Water Board Specifications may be used for three-inch (3") service lines, and shall be used for all service lines larger than three inches (3").

Service lines shall be of the same type material from beginning to end, unless the appropriate insulator is installed at the junctions of dissimilar metals and unless approved by the Town Engineer.

642.03 Service Saddles

Service saddles shall be used for wet tapping of all PVC mainline for service taps. Service saddles shall be ROMAC 202 B, or approved equal.

642.04 Meters

All meters shall be shipped and installed by the Town.

642.05 (Left Blank Intentionally)

642.06 (Left Blank Intentionally)

642.07 Outside Meter Settings

The meter shall be furnished and installed by the Town, in a pit, manhole, or vault which shall allow for free and easy access with adequate room for installation, inspection and maintenance and shall provide protection from freezing in accordance with the Standard Drawings.

642.08 Inside Meter Setting and Remote Readers

All inside meters shall only be used with special approval of the Town Engineer. All inside meter settings shall be installed in a manner which will allow free access and adequate room for inspection and maintenance and will protect the meter from freezing in accordance with the Standard Drawings.

642.09 Meter Bypass Line

A locking bypass line shall be required for all non-irrigation meters one and one half (1-1/2) inches and larger, unless otherwise approved by the Town Engineer, whether installed in an inside or outside setting. Bypass lines shall contain an independent control

valve and shall contain no tees, plugs, or other outlets through which water could be withdrawn, as indicated on the Standard Drawings.

642.10 Meter Check Valves

Swing check valves shall be required for all meters one and one-half (1-1/2) inch and larger unless otherwise approved by the Town Engineer, whether installed in an inside or outside setting. Check valves may be required on meters smaller than one and one-half (1-1/2) inch where any condition might exist that could cause a flow of water from the property to the main.

Valves for Use With Meters-

Gate valves three (3) inch and smaller to be used with copper service pipe shall be brass, with non-rising stems and solid wedge disc, manufactured in accordance with ASTM Specification B 62-76 and Federal Specification WW-V-54 Class A 125 PSI WSP, 150 PSI, WOG Gate valves shall meet the requirements of AWWA Standard C800. Also refer to the Standard Drawings of these STANDARDS AND SPECIFICATIONS.

Valves larger than three (3) inches for use with ductile iron service pipe shall be gate valves with cast iron bodies. All gate valves larger than three (3) inches shall be supported by adjustable steel valve supports.

642.11 (Left Blank Intentionally)**642.12 Meter Yokes (Copper Setters)**

Meter Yokes (Copper Setters) shall be a Ford Series 80, McDonald Series 31, Cambridge Series 6040, Mueller Series P-2474, or James Jones Company Series J04 with an angle ball valve and a padlock wing on the inlet side of meter. Yoke shall have a dual check valve on the outlet side. Service connections shall be compression fittings, with a "110", "Cam Pack", or "Mac Pack" type fitting and shall be vertical.

642.13 Residential Meters

The standard residential meters shall be 3/4 x 5/8. 3/4 x 3/4 meters must be approved by Public Works.

642.14 Residential Meter Pits and Covers

Meter pits shall be PVC or HDPE, four (4) foot tall, twenty-four (24) inch diameter body, twenty (20) inch diameter top opening in accordance with ASTM/D1505 and ASTM/D746. Meter pit covers shall be tight-fitting with a double cover and shall be Rotec DFW 12" AMR, Nicor Read Rite AMR or approved equal. The meter pit cover shall be installed at two (2) inches above final grade. The frost proof lid shall be per meter pit standard detail.

642.15 Corporation Stops

Corporation stops shall provide the connection for the service line to the main. Corporation stops shall be Ford model F1000, McDonald model 4701, Cambridge model 301, Mueller model 300, James Jones Company series J1949, with compression fittings with a "110", "Cam Pack", or "Mac Pack" type fitting. See the Standard Drawings.

642.16 Curb Stops

Curb stops are set on the service line on the inlet side of the meter pit to provide a means to shut off the service line. Placement of the curb stop and stop box shall be one (1) foot from the meter pit. Curb stops shall be Ford model B44-333, McDonald model 6100, Cambridge model 301, Mueller model 300, James Jones Company model J3401, with compression fittings with a "110", "Cam Pack", or "Mac Pack" type fitting. See the Standard Drawings.

642.17 Curb Stop Service Boxes

Curb stop service boxes shall be cast iron and shall be Minneapolis type. The bottom part shaped like an inverted U straddling the service line shall have a flanged bottom so as to support itself. Curb stop service boxes shall be located and be two (2) inches above grade.

643.00 Tapping the Main

ALL TAPS SHALL BE WET TAPS. SHUT DOWN OF ANY PORTION OF THE WATER SYSTEM SHALL ONLY BE ALLOWED WHEN UNCONTROLLED CIRCUMSTANCES DO NOT PERMIT A WET TAP. ANY SHUT DOWN OF THE WATER SYSTEM MUST BE APPROVED IN WRITING BY THE TOWN ENGINEER.

The Developer's contractor shall do tapping of all mains. Notification must be given to the Construction Inspector two working days (forty-eight [48] hours) in advance of the tap in order to provide ample time to schedule inspection of the work.

THE TOWN SHALL BE RESPONSIBLE FOR MAINTAINING THAT PORTION OF THE SERVICE LINE FROM THE CORP STOP UP TO AND INCLUDING THE METER PIT.

644.00 Inspection

All taps, meter sets, and inspections must be scheduled during regular working hours a minimum of two working days (forty-eight [48] hours) in advance. All installations by Contractors must meet these STANDARDS AND SPECIFICATIONS. Unnecessary recall inspections or meter installations are subject to an assessment that will equal the expenses accrued to complete the inspection. This amount will be one and one-half (1½) times that of the inspector's wages.

645.00 NON-POTABLE WATER SERVICES.

645.01 General

The Non-Potable Water Service Lines shall be installed similarly to the standards designated in Section 640.00 for Water Service Lines; with the exceptions in materials and installation as itemized below. Non-Potable Water Service Lines shall be marked on the curb with an "R" where the service line cross under the curb.

645.02 Non-Potable Water Service Line Materials

All Non-Potable Water Service Lines outside the meter pit shall be of plastic materials, as follows:

Three-quarter inch (3/4") through three-inch (3") size Non-Potable Water Service Lines shall be polyethylene, non-jointed, conforming to AWWA C901, minimum Class 160 psi, using HDPE 3408 material. All PE service lines shall conform to Iron Pipe Size (IPS) sharing the same O.D. as Schedule 40 and 80 PVC. The pipe shall have purple color coding, permanently co-extruded stripes on the pipe.

Non-Potable Water Service Lines four-inch (4") diameter and larger shall be AWWA C900 Purple Pressure Pipe for reclaimed water, minimum Pressure Class 235. DR 18.

645.03 Warning Notification on Non-Potable Water Service Line and with Tape

All Non-Potable Water Service Lines shall be installed with warning tapes and with the warning printed directly onto the pipe. Warning tapes shall be installed directly on top of the Non-Potable Water Service Line longitudinally and shall be centered. Acceptable tape or printing directly on the Non-Potable Water Service Line shall state: "NON-POTABLE LINE – DO NOT DRINK".

645.04 Meters and Meter Pits

Three-quarter inch (3/4") and one inch (1") meters shall be installed per Drawing W12A; one and one-half (1-1/2") and two-inch (2") meters shall be installed per Drawing W13. The requirements of Potable Water meters shall apply except; polyethylene by copper compression couplings shall be provided at the meter pit inlet and outlet, the meter color shall be purple, the pre-cast polyethylene meter pit interior color shall be purple, and by-pass piping is not needed. The ball valves shall have an enlarged tee-head embossed with "Non-Potable Water". The meter and meter pit cover shall be marked for identification purposes with a color designated by the Town.

645.05 Non-Potable Water Service Line Installation

The Non-Potable Water Service Line shall not be installed closer than ten feet (10') horizontally to the Water Service Line or Sewer Service Line. No Non-Potable Water Service Lines shall be installed inside a building or within five feet (5') of a building foundation. A marking tape with the words "NON-POTABLE LINE – DO NOT DRINK" shall be installed just above the Non-Potable Water Service Line. If the meter is not installed at the time of Non-Potable Water Service Line installation, in the right-of-way, a one and one-half inch (1-1/2") black PVC or Acrylonitrile-Butadiene-Styrene marker pipe six feet (6') long, shall be installed vertically at the end of the Non-Potable Water Service Line as a marker.

650.00 PUMPING FACILITIES**651.00 General**

In those locations where the Town's water distribution system may not be capable of providing adequate water pressure, the Town may require the construction of a pumping facility in order to provide proper service. The Town may not approve the installation of a pumping facility where, in the opinion of the Town Engineer, such installation would be injurious to the operation, or future operation, of the Town's water system. The Developer must provide the Town Engineer with a set of design calculations and drawings for review and acceptance by the Town Engineer as required under Section 160.00, Plans and Specifications, of these STANDARDS AND SPECIFICATIONS.

The pumping facility must satisfy all requirements of the Colorado Department of Health and of these STANDARDS AND SPECIFICATIONS. The Town shall require that the Developer prepare a set of Mylar "as built" drawings and an AutoCAD file of the pumping facility in accordance with Section 222.00, Initial Acceptance Procedures, of these STANDARDS AND SPECIFICATIONS. Upon completion of the pumping facility, the Contractor shall also provide the Town with two (2) copies of an "Operation & Maintenance Manual" for the facility.

652.00 Design Criteria**652.01 Pumps and Pump Station**

All pertinent portions of the Denver Water Board Specifications Section 5.08, Pumping Facilities, shall apply. Applicable portions of the Denver Water Board Specifications Section 6.46, Electric Pump Motors, shall also be followed.

A STANDBY GENERATOR, CAPABLE OF OPERATING THE ENTIRE STATION, SHALL BE PROVIDED. THE GENERATOR MAY BE HOUSED INSIDE OF A SEPARATE ALL WEATHER ENCLOSURE.

652.02 Controls and Supervisory Control and Data Acquisition (SCADA)

All new controls and telemetry equipment must be compatible with and easily integrated into the Town's system. Controls and SCADA systems are subject to review and acceptance by the Town Engineer prior to installation.

652.03 Site Improvements

Refer to Section 762.04, Site Improvements, of these STANDARDS AND SPECIFICATIONS.

660.00 TRENCHING, BACKFILLING AND COMPACTING

Trenching, backfilling and compacting shall be performed in accordance with all applicable portions of Section 350.00, Trenching, Backfilling and Compacting, of these STANDARDS AND SPECIFICATIONS.

670.00 RESTORATION AND CLEANUP

Restoration and cleanup shall be completed in accordance with Section 360.00, Restoration and Cleanup, of these STANDARDS AND SPECIFICATIONS.

SECTION 700 SANITARY SEWER SYSTEM

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SECTION 700 SANITARY SEWER SYSTEM

710.00 DESIGN CRITERIA

711.00 General

The St. Vrain Sanitation District provides sanitary sewer service to the Town. The Developer shall design and construct all of the proposed sanitary sewer facilities to the Districts standards and criteria, in addition to these STANDARDS AND SPECIFICATIONS. Any proposed resolutions of conflicts in the two standards shall be approved by the Town Engineer.

712.00 Design Details

712.01 Sewer Mains

Sewer mains shall ordinarily have a minimum of eight (8) feet of cover to finished ground surface. Where this will provide less than nine (9) feet of elevation difference between the finished lot grade at building line and the top of the sewer main, it will be indicated on the plans that the lot is served by a "shallow sewer" and appropriate elevation information will be given. Where pipe has less than (4) feet of cover, provisions shall be made to protect the pipe from impact and loading.

Sewer mains shall be extended at least ten (10) feet uphill from the lowest lot corner of the uppermost lot to be served adjacent to the sewer main. Sewer mains will terminate in a manhole. Manholes will be stubbed out with suitable size pipe wherever future extension of the sewer is anticipated.

713.00 Location Details

Unless approved otherwise by the Town Engineer, sanitary sewer mains installed in local or collector streets shall be located ten (10) feet east or south of the centerline of these streets. Service connections will not be permitted to cross an arterial street.

714.00 Relation to Water Mains

Water, sanitary sewer and storm sewer lines shall have a minimum horizontal separation of ten (10) feet. When a ten (10) foot separation is not provided or when sewer and storm sewer lines cross water lines with less than one and one-half (1½) feet of vertical separation, sewer and storm sewer line joints shall be concrete encased. For perpendicular crossings, encased joints shall extend ten (10) feet, perpendicular to the water line in both directions.

Minimum protection shall consist of the installation of an impervious and structural sewer. Sewer pipe will be encased in reinforced concrete. The encasement shall be at least six (6) inches thick around the entire pipe and will extend a distance of ten (10) feet on either side of the water main. In all cases, suitable backfill or other structural protection must be provided to preclude settling and/or failure of the higher pipe.

715.00 Underdrain Pipe - Private

Underdrain systems shall be private and will **NOT** be maintained by the Town of Firestone.

Underdrain pipe shall be installed at locations shown on the accepted plans. Underdrain pipe will be installed at those locations where excessive groundwater is encountered and the Soils Engineer recommends it. Underdrain installations will require the approval of the Town Engineer.

Should the Developer desire to install an underdrain system to specifically collect the discharge of peripheral drain systems from individual house foundations or from sump pumps installed as a part of a peripheral drain system for house foundations, such a system shall be constructed for the exclusive advantage of the Developer and will **NOT** be maintained by the Town of Firestone. Any such system shall **NOT** be tied into the sanitary sewer collection system in any manner. Clean outs shall **NOT** be installed within a sanitary sewer manhole and will **NOT** be maintained by the Town of Firestone. Any such system will require the approval of the Town Engineer and must meet all applicable portions of Sections 732.02 and 733.04 of these STANDARDS AND SPECIFICATIONS.

720.00 GENERAL PROVISIONS

721.00 Permits Required

A public improvements permit shall not be issued until the St. Vrain Sanitation District has accepted the sanitary sewer main plans.

722.00 Maintenance of Traffic

When street cuts are required for sanitary sewer facilities construction, the following conditions will be met so as to avoid interference with traffic:

- A. Street service cuts will be open only between 9:00 a.m. and 4:00 p.m.; and
- B. Two-way traffic will be maintained at all times around the construction area. A Traffic Control Plan (TCP) must be prepared in accordance with Section 141.08, Traffic Control, Barricades and Warning Signs, of these STANDARDS AND SPECIFICATIONS and submitted to the Town for approval prior to the commencement of construction.

730.00 SANITARY SEWER MAIN CONSTRUCTION

731.00 Site Work and Earthwork

731.01 General

Site work and earthwork shall be performed in accordance with Section 300.00, Site Work and Earthwork, of these STANDARDS AND SPECIFICATIONS.

731.02 Trenching, Backfilling and Compacting

Except where otherwise approved in writing by the Town Engineer, all major arterial or collector streets shall have pipe installed by pushing or boring.

Trenching, backfilling and compacting shall be performed in accordance with Section 350.00, Trenching, Backfilling and Compacting, of these STANDARDS AND SPECIFICATIONS.

731.03 Preservation of Monuments

Refer to Section 141.00, Protection of Public and Utility Interests, of these STANDARDS AND SPECIFICATIONS.

732.00 Materials

732.01 Underdrain Pipe - Private

Underdrain systems shall be private and will **NOT** be maintained by the Town of Firestone. If required as described in Section 717.00 of these STANDARDS AND SPECIFICATIONS, underdrain pipe shall be provided with joints which will prevent any shifting or misalignment of the line. Where under drains are to be constructed under sewer mains, clean-outs shall **NOT** be allowed in manholes. Suitable fittings shall be provided which will allow construction of clean-outs and bends outside of manholes.

The design engineer will determine all underdrain pipe and fittings.

732.02 Manholes

Manholes may be constructed of cast-in-place concrete or precast concrete. Concrete precast reinforced risers and tops must conform to ASTM Designation C-478 except that wall thickness may be either wall "A" or wall "B" as described in ASTM Designation C-76. Manholes shall conform to details shown on the Standard Drawings unless otherwise approved by the Town Engineer. Cones will be of the eccentric type.

The top of the manhole vault shall be a minimum of twelve (12) inches and a maximum of eighteen (18) inches below the finished street or ground surface elevation. Concrete extension risers or collars shall be used to bring the manhole ring and cover up to finished street or ground surface elevation.

Manhole rings and covers (all traffic covers shall be designed for H-20 traffic loading):

- A. Twenty-four (24) inch manhole rings and covers; cover weight = approximately one hundred sixty-five (165) pounds, ring weight = approximately two hundred forty (240) pounds.
- B. Twenty-four (24) inch by thirty-six (36) inch double ring and cover (36" cover with auxiliary 24" opening and cover);

36" cover weight = approximately two hundred fifty (250) pounds.

24" cover weight = approximately one hundred sixty five (165) pounds.

36" ring weight = approximately two hundred eighty (280) pounds.

732.03 Concrete

Concrete shall conform Section 400.00, Concrete Work, of these STANDARDS AND SPECIFICATIONS. Type II cement will be used. Concrete encasement of sewer pipe shall conform to the details outlined in Section 716.00 of these STANDARDS AND SPECIFICATIONS.

732.04 Bedding Materials

The design engineer will determine the bedding materials needed for under drains, if required by the accepted plans.

733.00 Installation

733.01 General

Installation of PVC sewer main will conform to ASTM Designation D-3034, "Recommended Practice for Underground Installation of Flexible Thermoplastic Sewer Pipe". All work shall conform to the accepted plans, specifications, special provisions and the above designation, except as modified herein.

733.02 Alignment and Grade

Sanitary sewers and structures appurtenances shall be constructed accurately to the line and grade as shown on the accepted plans. Construction stakes shall be placed by field parties under the direct supervision of a Registered Professional Land Surveyor licensed to practice in the State of Colorado.

"As-built" drawings, as described in Section 161.00, Construction Plan Requirements, of these STANDARDS AND SPECIFICATIONS, shall be furnished to the Town Engineer.

733.03 Protection of Existing Underground Utilities

The Contractor will be held responsible for the protection of public improvements as stated in Section 141.00, Protection of Public and Utility Interests, of these STANDARDS AND SPECIFICATIONS. It will be the Contractor's responsibility to replace all public improvements so damaged at his own expense.

733.04 Underdrain Pipe - Private

Underdrain systems shall be private and will **NOT** be maintained by the Town of Firestone.

Under drains shall be installed where shown on the accepted plans as required by Section 717.00 of these STANDARDS AND SPECIFICATIONS. Under drains will be day-lighted to the nearest suitable point acceptable to the Town Engineer. The trench will be excavated to the required depth and width and backfilled with underdrain bedding material.

Underdrain pipe to be determined by the design engineer.

Where underdrain pipe is required the thickness of underdrain bedding shall be increased to provide six (6) inches of bedding material under the underdrain pipe and six (6) inches of bedding material between the underdrain pipe and the sewer pipe. The underdrain pipe shall be installed to a true line and grade and held in place with underdrain bedding material as shown on the Standard Drawings. Underdrain pipe shall be continued around manholes by use of suitable bends and other fittings and have a cleanout installed outside the manhole.

733.05 Handling Pipe and Fittings

All pipe, fittings, and specials will be unloaded, stockpiled, hauled, distributed, installed and otherwise handled in a manner that will prevent breakage or other damage thereto and which will insure delivery and installation in a sound and acceptable condition.

740.00 SANITARY SEWER SERVICE LINE CONSTRUCTION

741.00 Trenching, Backfilling and Compacting

Trenching, backfilling and compacting shall be completed in accordance with Section 350.00, Trenching, Backfilling and Compacting, of these STANDARDS AND SPECIFICATIONS.

742.00 Materials

742.01 Polyvinyl Chloride (PVC)

Pipe and fittings shall conform to the requirements of ASTM D3034. All joints shall be factory prepared compression type (elastomeric gasket joint), providing a watertight seal. A compression stop, as recommended by the pipe joint manufacturer, will be provided to seal the end joint of dead-end stubs.

742.02 Inspection

All pipes shall be subject to inspection at the point of delivery in Firestone. The purpose of this inspection is to reject pipe that fails to conform to the requirements of these STANDARDS AND SPECIFICATIONS. Plastic joint material damaged in any way shall be cause for rejection of that joint of pipe.

743.00 Installation

743.01 Location and Alignment of Service

Sanitary sewer service lines shall be constructed on the shortest and straightest route possible. Unless specific approval is obtained in writing from the Town Engineer, all sanitary sewer service lines shall have a minimum depth of three (3) feet.

At no time shall the service line be closer than three (3) feet to a side property line, and no service line may be constructed through or in front of an adjoining property. Sewer service lines shall be typically located a minimum of ten (10) feet to the low side of the water service, generally five (5) feet from the centerline of the lot, or as shown on the accepted plans.

743.02 Crossing Sidewalk or Curb (Existing or Proposed)

In no instance will a trench extend beneath an existing sidewalk or curb. The pipe must be bored, jacked or tunneled through the earth under the sidewalk or curb. If the service line is installed prior to the placement of the sidewalk or curb, the trench shall be backfilled in accordance with Section 353.00, Backfilling for Pipelines and Service Lines, of these STANDARDS AND SPECIFICATIONS.

743.03 Service Stub-ins to Property Line

All sewer service lines shall be marked on the curb with an "X" or "S" symbol where the service crosses under the curb. All service stub-ins shall be stubbed into the lots, ten (10) feet beyond the back of walk or five (5) feet past any utility easement which ever is greater. All service stub-ins shall be located with the end marked with a 2x4 painted green.

750.00 RESTORATION AND CLEANUP

Restoration and cleanup shall be completed in accordance with Section 360.00, Restoration and Cleanup, of these STANDARDS AND SPECIFICATIONS.



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SECTION 1100 TRAFFIC SIGNALS**910.00 GENERAL REQUIREMENTS****910.01 Traffic Control and Street Closure**

The Contractor or Developer will be required to maintain access to all properties throughout the period of construction for this project. The Contractor or Developer shall be required to erect, maintain, and remove all barricades, traffic control signs and devices necessary for any street closure including detour signs. Any signs not in use shall be turned away from traffic or removed from the job site. All traffic control devices shall be in good condition. Signs shall be clean, retro reflective, and free of scratches and graffiti.

Any street closure must be pre-approved by the Town Engineer. All such barricades and traffic control signs and devices shall be in accordance with the latest edition of the Manual on Uniform Traffic Control Devices (MUTCD) for Streets and Highways including the Colorado Supplement. Traffic control plans shall be submitted to the Town Engineer for review no later than two (2) weeks in advance of any work.

910.02 Protection of Property

The Contractor or Developer shall assume full responsibility and expense for the protection of all public and private property, structures, water mains, sewers, utilities, etc., both above and below ground, at or near the site or sites of the work being performed under the Contract, or which are in any manner affected by the prosecution of the work or the transportation of personnel and materials in connection therewith.

The Contractor or Developer shall give notice of not less than forty-eight (48) hours to the Town Engineer and to other owner or owners of public or private property or utilities when they will be affected by the work to be performed under the Contract; and shall make all necessary arrangements with the Town, owner or owners for the removal, replacement, or protection of such property or utilities.

The Contractor or Developer shall be responsible for insuring that all work sites are properly cleaned and barricaded prior to the completion of the day's activities.

910.03 Intersection Power

The Contractor or Developer shall notify the Town Engineer a minimum of three (3) weeks prior to the signal turn-on so that orders may be issued for service inspection and power connection as applicable.

910.04 Field Location

All loops, poles, control cabinets, pull boxes, pole foundations and permanent pavement markings shall be field located by the Town Engineer.

910.05 Intersection Phasing

Intersection phasing shall be as defined in the table below regardless of direction of the coordinated vehicular movements. When intersection phasing defined in the plans and/or project specials conflicts with that defined here within, the Town Engineer shall make final determination as to the intersection phasing.

Controller Phase	Vehicular Movement
1	Main Street Left Turn (SB/WB)
2	Main Street Through (NB/EB)
3	Side Street Left Turn (NB/WB)
4	Side Street Through (SB/EB)
5	Main Street Left Turn (NB/EB)
6	Main Street Through (SB/WB)
7	Side Street Left Turn (SB/EB)
8	Side Street Through (NB/WB)

910.06 License and Permits

The Contractor or Developer shall obtain any, and all, permits as necessary from the Town’s Engineering Division and CDOT as may be applicable.

910.07 Utilities

All utility locations and elevations will require field verification in cooperation with the affected companies and public agencies. The Contractor or Developer shall be responsible for locating all underground utilities, valve boxes, manholes, etc., and insuring that they are properly protected and adjusted as called for in the plans and/or project specials. When utility adjustments are required, but have not been called for in the plans and/or project specials, the Contractor or Developer shall notify the Town.

910.08 Work Hours

Working hours shall be as defined in sections 131.01 and 171.00 of these STANDARDS AND SPECIFICATIONS. The Contractor or Developer, upon approval of the traffic control plan by the Town Engineer, will only be allowed lane closures in the public roadway during normal working hours and/or at other times as requested by the Contractor or Developer, and approved by the Town Engineer via written approval.

910.09 Inspection

Prior to both Construction Acceptance and Final Acceptance, the Town Engineer will employ the services of the Town’s designated Traffic Signal Maintenance Contractor to assist with the said inspection. The Contractor or Developer shall reimburse the Town for the actual cost associated with the utilization of the Town’s designated Traffic Signal Maintenance Contractor for the inspections.

910.10 Design and Submittal Review

The Town Engineer may elect to employ the services of the Town's designated Traffic Signal Maintenance Contractor to review design drawings, shop drawings, and specifications for equipment and materials. In such cases, the Contractor or Developer shall reimburse the Town the actual costs associated with the utilization of the Town's designated Traffic Signal Maintenance Contractor for the review.

910.11 Regulations and Code

All materials and workmanship shall conform to the standards of the latest edition of the Colorado Department of Transportation Standard Specifications for Road and Bridge Construction. If conflicts arise between the Colorado Department of Transportation Standard Specifications for Road and Bridge Construction and these STANDARDS AND SPECIFICATIONS, these STANDARDS AND SPECIFICATIONS shall take precedence. In addition to requirements of the Colorado Department of Transportation Standard Specifications for Road and Bridge Construction, and the Contract Documents, all material and work shall conform to the requirements of the National Electrical Line Construction of the Public Utilities Commission, the Standards of the American Society for Testing and Materials (ASTM), the American Standards Association (ASA), and any local ordinance which may apply.

910.12 Equipment Lists and Drawings

After contract award, prior to installation, and/or at the Town Engineer's request, the Contractor or Developer shall submit shop drawings and specifications for equipment and materials the Contractor or Developer proposes to furnish. The shop drawings and specifications shall be complete as to name of manufacturer, size, and catalog number of unit, and shall be supplemented by such other data as may be required. The Town Engineer's approval shall be required prior to installation.

Inspection or sampling of any materials, other than those materials already approved by the Town Engineer, must be made by the Town Engineer prior to installation. If the Contractor or Developer proposes a substitution of material called for in the plans, project specials, as specifically defined in these specifications, or as shown in approved submittals and shop drawings, the Contractor or Developer shall provide additional information to prove the substitution item is of equal or superior quality. Any material and/or equipment installed by the Contractor or Developer that is not in conformance with these specifications shall be removed and/or replaced solely at the Contractor or Developer's expense.

920.00 TRAFFIC SIGNAL CONSTRUCTION**920.01 Excavation and Backfill**

Excavations for the installation of conduit, foundations, and other appurtenances shall be performed in such a manner as to cause the least possible injury to the streets, sidewalks and other improvements. The trenches shall not be excavated wider than necessary for the proper installation of conduit, foundations, and other appurtenances. Excavating shall not be

performed until immediately before installation of conduit, foundations, and other appurtenances. The material from the excavation shall be placed in a position where the least interference with the surface drainage will occur and without obstruction to vehicular or pedestrian traffic. All excavations shall be done in conformance with OSHA regulations. Excavated material shall be removed at the completion of the project or as directed by the Town Engineer.

Excavations, after backfilling, shall be kept well filled and maintained in a smooth and well-drained condition until permanent repairs are made. The Colorado Department of Transportation latest edition of Standard Specifications for Road and Bridge Construction shall be used for standards for compaction, except as outlined in Section 5.3 herein.

Trench excavation for conduit within the roadway shall be 2-inches wider than the outside diameter of the conduit but shall not exceed 6-inches. Backfilling and patching of roadway cuts shall refer to section 500.00 of these STANDARDS AND SPECIFICATIONS.

At the end of each day's work and any other time construction operations are suspended, all construction equipment and other obstructions shall be removed from that portion of the roadway open for use by public traffic.

Excavations in streets or highways shall be performed in such a manner that, at a minimum, one (1) lane of traffic in each direction shall be open to public traffic during the approved work hours.

When excavations remain open overnight when approved by the Town Engineer, they shall be properly marked to warn motorists and/or pedestrians. The excavation shall be properly barricaded for vehicles and/or pedestrians.

Excavating and backfilling for foundations shall be incidental to the pay item for which a foundation is required. Excavating and backfilling for conduit trenches shall be paid for under the appropriate conduit trenching pay item.

920.02 Removing, Replacing, and Resetting Improvements

The Contractor or Developer shall replace or reconstruct sidewalks, curbs, gutters, rigid or flexible pavement, and any other improvements removed during construction according to section 400.00 of these STANDARDS AND SPECIFICATIONS.

Removal items shall be as indicated in the pay item list and shall consist of the items specifically identified on the plans, or in writing by the Town Engineer. It shall be the Contractor or Developer's responsibility to assure that the Contractor or Developer has a full and complete understanding of included items prior to bidding.

Removal of poles and controllers shall include foundation removal to the depth indicated by the Town Engineer. Otherwise, removal shall consist of complete elimination of the specified items. Any conduit runs associated with the foundation shall be extended or abandoned as called for on the plans.

Where traffic signal equipment and/or materials are slated for removal, the Town shall define which traffic signal equipment and/or materials are to remain property of the Town, being kept for future reuse. All traffic signal materials and/or equipment which is to remain the property of the Town shall be delivered to the Town storage site with the address being provided by the Town.

Reset pay items shall be as indicated in the pay item list and shall consist of the items specifically identified in the plans, or in writing by the Town Engineer. It shall be the Contractor or Developer's responsibility to assure that the Contractor or Developer has a full and complete understanding of included items prior to bidding.

Reset items are to be initially removed, then adjusted or modified as directed by the Town Engineer, and finally reinstalled to full operational capability. Modifications and adjustments shall be detailed on the plans or stated in writing by the Town Engineer, and shall be incidental to the reset pay item.

930.00 TRAFFIC SIGNAL MATERIALS

930.01 Foundations

All concrete foundations shall be of a class as defined by the most recent revision of the Colorado Department of Transportation latest edition of Standard Specifications for Road and Bridge Construction or as otherwise directed by the Town Engineer.

The bottom of foundations shall rest on properly compacted ground. Cast-in-place foundations shall be poured monolithically. The exposed portions shall be formed to present a neat appearance.

Pre-cast pole footings, if used, shall be used only for roadway lighting and pedestal poles. They shall be installed in drilled holes, with tamped sand backfill material.

Forms shall be true to line and grade. Tops of foundations, except as noted on plans, shall be finished to curb or sidewalk grade, or as ordered by the Town Engineer. Forms shall be rigid and securely braced in place, and inspected prior to the pouring of concrete. Conduit ends and anchor bolts shall be placed in proper position and to template until the concrete sets.

Anchor bolts shall conform to the manufacturer's specifications and each individual bolt shall have a minimum of two (2) flat washers, one (1) lock washer, and two (2) nuts. Shims or other similar devices will not be allowed for plumbing or raking.

Both forms and ground, which will be in contact with the concrete, shall be thoroughly moistened before placing concrete. Forms shall not be removed until the concrete has thoroughly set.

Reinforcing steel shall be installed in foundations as specified in the Construction Plans.

All foundations (concrete and fiberglass) shall be incidental to the pay item for which a foundation is required. Ground rods shall be provided as indicated in the standard details, and these shall be incidental to the installation pay item as well.

930.02 Conduit

All cables and conductors not shown on the plans as aerial cable shall be installed in conduit unless installed in poles, pedestals, or master arms. All metal conduits referred to in the specifications and shown on the plans shall be the rigid pipe type of ductile steel that is adequately galvanized. All PVC conduits shall be Schedule 80 or heavier. For new conduit installations, PVC or Schedule 80 polypipe shall be understood unless otherwise defined.

The Contractor or Developer, at his sole expense, may use larger conduit than specified in the plans, if desired. Where larger conduit is used, it shall be for the entire length of the run from outlet to outlet. No reducing couplings will be permitted underground.

The ends of all metal conduit, existing or new, shall be well reamed to remove burrs and rough edges. Field cuts of existing or new conduit shall be made square and true, and the ends shall butt together for the full circumference thereof. Slip joints or running threads will not be permitted for coupling metal conduit. When a standard coupling cannot be used, an approved threaded union coupling shall be used. All couplings shall be screwed up tight until the ends of the metal conduits are brought together.

Where a "stubout" is called for on the plans, a sweeping ell shall be installed in the direction indicated and properly capped. The locations of ends of all conduits in structures or terminating at curbs shall be marked by a "Y" at least three (3) inches high cut into the face of curb, gutter or wall directly above the conduit.

Conduit bends, except factory bends, shall have a radius of not less than six (6) times the inside diameter of the conduit. Where factory bends are not used, conduit shall be bent without crimping or flattening, using the longest radius practicable. Conduit bends feeding pull boxes and foundations shall have an eighteen (18) inch radius as shown on the standard details.

Conduit shall be laid at a depth of not less than thirty (30) inches below the finished roadway grade and twenty-four (24) inches below the finished grade in all other areas.

Conduit under railroad tracks shall be at the minimum depth below the bottom of tie required by the particular railroad company.

Conduit shall always enter a pedestal base, pull box, pole foundation, cabinet foundation, or any other type structure from the direction of the run only. Conduit connections at junctions shall be tightly secured.

Conduit terminating in a standard or pedestal shall extend approximately two (2) inches vertically above foundations.

All conduit runs that exceed ten (10) feet in length shall have a continuous $\frac{3}{4}$ " polyester mule tape pulled into the conduit along with the specified electrical cables. The line shall be firmly

secured at each end of the conduit run with three (3) feet of slack. The purpose of this line is to be able to pull future electrical cable through the existing conduit runs.

A 14 AWG locate wire shall be installed for the complete length of all new conduit runs installed as part of the project. No less than three (3) feet of slack shall remain in each pull box in which the conduit terminates. Where joint trenching is used, only one locate wire need be installed for each joint trench. Splicing of the locate wire within conduits shall not be permitted. Locate wires installed within interconnect conduits shall be spliced in each pull box as to provide an uninterrupted run between intersections.

Existing underground conduit to be incorporated into a new system shall be cleaned with a mandrel and blown out with compressed air.

New conduit runs shown on the plans are for bidding purposes only and may be changed at the direction of the Town Engineer.

Any spare or unused conduits shall be capped using industry standard end caps.

Polypipe to PVC coupling shall be completed with the use of "E-Loc" couplings or approved equal.

When a cabinet is defined as a master cabinet, a two (2) inch PVC conduit shall be installed from the controller cabinet to the designated telephone company demarcation point.

A two (2) inch PVC conduit shall be installed between the local utility company demarcation point and the electrical service, and additionally from the electrical service to the controller cabinet home run pull box.

A two (2) inch PVC conduit shall be installed to all signal poles for exclusive use in providing electrical power for luminaires. The conduit may be laid in trenches cut for signal wire conduit and shall run from the controller cabinet home run pull box to signal poles through associated signal pole pull boxes.

The following conduit schedule is in effect unless otherwise specified in the traffic signal plans.

Run Type	Qty	Size	Use
Street Crossing	1	3"	120VAC Signal Load Wiring
	1	3"	Low Voltage Signal Wiring & Interconnect
	1	2"	Spare
	1	2"	Luminaire Wiring
Signal Pole	1	2"	All Signal Wiring
	1	2"	Luminaire Wiring
Controller Cabinet	1	3"	120VAC Signal Load Wiring
	1	3"	Low Voltage Wiring & Interconnect
	1	2"	Spare
	1	2"	Public Service Utility Power Feed
Inductance Loop	1	2"	Inductance/Micro Loops
Interconnect	1	2"	Interconnect

Service Points	1	2"	Public Service Utility Power Feed
	1	2"	Telephone Service Feed

Conduit shall be measured and paid for by the linear foot of conduit installed from center of pull box to center of pull box, center of pull box to center of pole, or center of pull box to center of cabinet and shall include all labor, equipment, and materials necessary to install the item complete-in-place. Conduit shall be paid for under the "conduit" pay item.

930.03 Pull Box

A pull box shall be installed at all locations shown on the plans and at such additional points as ordered by the Town Engineer.

Pull boxes shall be installed so that the covers are level with curb or sidewalk grade or level with the surrounding ground when no grade is established. The bottoms of all pull boxes shall be set on twelve (12) inches of crushed rock.

Pull box size shall be as shown in the Plans. With the exception of water valves, pull boxes shall be of "Quazite" or pre-cast polymer concrete type with both boxes and lids rated for 20K lb. loads. The following pull box schedule is in effect unless otherwise specified in the traffic signal plans:

Pull Box Usage	Size	Pull Box Lid Marking
Cabinet Home Run Pull Box	24" x 36" x 18"	Traffic
Signal Pole Pull Box	17" x 30" x 12"	Traffic
Detector Pull Box (Side of Road)	12" x 12" x 12"	Traffic
Detector Water Valve	Water Valve	Traffic
Communication Vault (T/S Cabinet)	30" x 48" x 18"	T/S Communications
Communication Vault (Intermediate Locations)	24" x 36" x 18"	T/S Communications
Telephone Demarcation	13" x 24" x 12"	T/S Communications
Electrical Demarcation	13" x 24" x 12"	Electric

Pull box lids shall be imprinted with markings as defined in the pull box schedule. Painted markings shall not be permitted.

When a new conduit run enters an existing pull box, the Contractor or Developer shall temporarily remove the pull box, or tunnel under the side at no less than eighteen inches (18") below the pull box bottom, and enter from the direction of the run. No new conduit will be allowed to enter a new or existing pull box in any other manner than that shown on the standard details.

All interconnect pull boxes shall include wire mesh installed between the pull box and crushed rock base to prevent ingress of varmints. The wire mesh shall extend beyond the outside edges of the pull box by a minimum of 3".

Pull boxes shall be measured and paid for per unit count and shall include all labor, equipment, and materials necessary to install the item complete-in-place. Pull boxes shall be paid for under the "pull box" pay item.

930.04 Cabinet Bases

Controller cabinet bases shall be fiberglass type, sized to match with the controller cabinet, and set with approximately 50% of height extending below grade and 50% extending above grade.

Controller cabinet bases shall be set on a twelve (12) inch deep bed of crushed rock. The interior of the base shall be filled to grade level with crushed rock.

Conduits within the controller cabinet base shall extend a minimum of 6" above the crushed rock. Conduits shall be installed in such fashion as to prevent undo bend stress on cables being fed into the cabinet through these conduits.

Cabinet bases shall be incidental to the pay item for which a cabinet base is required. Ground rods shall be provided as indicated in the standard details, and these shall be incidental to the installation pay item as well.

930.05 Conductor and Cable

Wiring shall conform to appropriate articles of the Colorado Department of Transportation Standard Specifications for Road and Bridge Construction, and/or the National Electrical Code, as applicable. Wiring within cabinets, junction boxes, etc., shall be neatly arranged. Signal conductors shall be No.14 AWG stranded, conforming to IMSA Spec 20-1-1984.

Power feed cable shall be THHN/THWN copper, installed in conduit, and be sized for the electrical load served. The power feed cable shall have a minimum size of #8 and be sized such that the overall voltage drop, between the local utility company demarcation point and controller cabinet, does not exceed 5%. The Contractor or Developer shall install power feed cable from the local utility company power demarcation point to the controller cabinet thru an URD Mold connector located in the controller cabinet home run pull box. URD Mold connectors shall be installed in the home run pull box and shall be used to extend electrical service from the local utility company power demarcation point to the controller cabinet and to street lights on signal poles.

Whenever a raceway is not UL approved, direct burial type insulation shall be required on all associated wiring.

Power cable between the controller cabinet home run pull box and the street lights pole bases shall be type 12-2 UF. Daisy chaining of power cable thru the pole bases using SLK connectors shall be permitted. With the exception of the URD Mold connector in the controller cabinet home run pull box, power cable splices within pull boxes shall not be permitted.

Power cable from the end of each street light davit to the base of the signal pole shall be type 12-2 UF with ground. All street light feeds shall be independently fused at the base of each pole.

All signal cables shall be labeled with colored electrical tape based on the table below.

Direction	Tape Color
Northbound Thru	Red
Northbound Left Turn	Red + White
Northbound Right Turn	Red + Brown
Northbound Pedestrian	Red + Yellow
Southbound Thru	Green
Southbound Left Turn	Green + White
Southbound Right Turn	Green + Brown
Southbound Pedestrian	Green + Yellow
Eastbound Thru	Orange
Eastbound Left Turn	Orange + White
Eastbound Right Turn	Orange + Brown
Eastbound Pedestrian	Orange + Yellow
Westbound Thru	Blue
Westbound Left Turn	Blue + White
Westbound Right Turn	Blue + Brown
Westbound Pedestrian	Blue + Yellow

Signal circuit wiring shall be accomplished in the following manner:

A separate 25 conductor cable shall be installed between the cabinet and each signal pole. Cables shall be continuous with no splices. Conductor usage has been defined in the table below. All unused conductors shall become spare conductors and shall be coiled and taped back to minimize the chance for a short.

25 Conductor Color to Phase Assignment	
Main Street	
Color	Phase
Solid Green	Green
Solid Orange	Yellow
Solid Red	Red
Solid Blue	Left Turn Green
Solid Black	Left Turn Solid Yellow
Solid Black #2	Left Turn Flashing Yellow
Red with White Trace	Left Turn Red
Blue with White Trace	Walk
Black with Red Trace	Don't Walk
Side Street	
Green with Black Trace	Green
Orange with Black Trace	Yellow
Red with Black Trace	Red
Blue with Black Trace	Left Turn Green
Black with White Trace	Left Turn Solid Yellow
Solid Green #2	Left Turn Flashing Yellow
Red with Green Trace	Left Turn Red
Blue with Red Trace	Walk

Orange with Green Trace	Don't Walk
Right Turn	
Green with White Trace	Right Turn Green
Orange with Red Trace	Right Turn Yellow
AC Return	
Solid White	AC Return
Solid White #2	AC Return
White with Black Trace	AC Return
White with Red Trace	AC Return

Each signal head shall have its own signal cable to the base of the pole that it is mounted on. Cables shall be continuous with no splices. Conductor usage has been defined in the table below. All unused conductors shall become spare conductors and shall be coiled and taped back to minimize the chance for a short.

Conductor Color	7 Conductor (5 Section Head / 4 Section Head)	5 Conductor (3 Section Head)	5 Conductor (Pedestrian Head)
Red	Red Ball	Red Ball or Red Arrow	Don't Walk
Orange	Yellow Ball	Yellow Ball or Yellow Arrow	Spare
Green	Green Ball	Green Ball or Green Arrow	Walk
Blue	Green Arrow	Not Available	Not Available
Black	Solid Yellow Arrow	Spare	Spare
White/Black	Flashing Yellow Arrow	Not Available	Not Available
White	AC Return	AC Return	AC Return

Outboard signal heads shall use "7 Conductor" cable to accommodate for present or future left turns.

When a cabinet is defined as a master cabinet, phone cable shall be installed in conduit from the controller cabinet to the designated telephone company demarcation point. Phone cable shall be #REA-PE54 or equivalent for telephone service. The cable shall be continuous with no splices and run from the telephone service point to the controller cabinet. Adequate cable length shall remain on both cable ends to permit for proper termination.

Pedestrian push button wire shall be shielded single or multiple twisted pairs in polyethylene jacketed cable. Conductors shall be No. 18 AWG stranded copper, minimum. A stranded tinned copper drain wire shall be provided.

Pedestrian push button common wire shall not be connected to the signal neutral circuit.

Inductance detector loop lead-in cable shall be shielded single or multiple twisted pairs in polyethylene jacketed cable. Conductors shall be No. 18 AWG stranded copper, minimum. A stranded tinned copper drain wire shall be provided.

Emergency vehicle detection wiring, Opticom wiring, shall be of the type as specified by equipment manufacturer.

Splicing any conductor, cable or wiring, except loop detector wiring and power cable as defined in these specifications, shall not be permitted in conduit or in pull boxes. All signal conductor splices shall be in the signal pole near the hand hole above grade. Signal load splices shall utilize copper crimp sleeves that compress from four directions as manufactured by Buchanan Company, or approved equal. The crimped sleeve shall then be protected within a flexible rubber insulating cover as manufactured by Ideal Wrap Company, or approved equal. Detector loop lead-in splices in pull boxes below grade shall be fully waterproofed using a DBY-6 splice kit as manufactured by 3M, or approved equal. A minimum of 12-inches of slack shall be left at each splice.

Powdered soapstone, talc, or other approved lubricant shall be used in placing conductors in conduit.

A small permanent tag with the direction and phase printed on it shall be securely attached near the end of each conductor in the controller cabinet. An example is "Ø1-NBLT" where Ø1 is the phase number.

Cabling shall be paid for on a lump sum basis and shall include all labor, equipment and materials necessary to install the item complete-in-place. Cabling shall be paid for under the "wiring" pay item.

930.06 Interconnect

Interconnect shall only be installed where identified in the project plans and/or specifications. Where identified, interconnect shall be of the manufacture and model number as defined or, where no manufacturer and model number is specified, meeting or exceeding material specifications.

Where identified, interconnect shall include all cabling, hardware, and communications equipment as identified in the project plans and specifications as to provide for end-to-end communications; master to local, or to the local from the central system where a Centralized system is in use.

Where communications equipment is Ethernet based, the Contractor or Developer turn the communications equipment over to the Town for setup and programming prior to field installation. Upon completion of setup and programming by the Town, the Contractor or Developer shall complete the field installation as to provide for end-to-end communications.

930.07 Video Detection

Video detection shall be installed unless otherwise defined in the project plans and specifications.

Video detection systems shall consist of one video detection camera and one video processor. The system shall be Iteris or approved equal. For Iteris systems, the camera shall be model

RZ-4 with Wide Dynamic Range (WDR) or approved equal. The processor shall be Vantage Edge 2 or approved equal.

The system shall include software that detects vehicles in multiple lanes using only the video image with the availability for up to twenty four (24) detection zones per camera.

The camera shall be mounted on the luminaire davit when luminaire davit is present, mast arm when luminaire davit is not present, or other location as defined on the plans or as directed by the Town Engineer. The camera shall view approaching vehicles at a distance not to exceed 350 feet for reliable detection.

The camera shall be housed in an environmentally sealed enclosure and shall be equipped with a sun shield that prevents sunlight from directly entering the lens. The camera shall be less than 6 inches in diameter, less than 18 inches long and shall weight less than 6 pounds when the camera and lens are mounted inside the enclosure.

The camera enclosure shall include all required environmental controls as defined by the camera manufacturer and may include a thermostatically controlled heater and/or fan to assure proper operation of the lens iris at both low and high temperatures, and prevent moisture condensation of the optical faceplate of the enclosure. The camera shall operate within the temperature range of -30 degrees Fahrenheit to +140 degrees Fahrenheit.

When a variable focal length lens with variable focus control is supplied as part of the camera, the lens shall be adjusted to suite the site geometry without opening up the camera housing.

Control and other cables required for installation, setup, and operation of the camera and/or video detection system, shall be of the size and type required per manufacturer's specifications and the National Electric Codes. Control cables shall terminate within the controller cabinet.

The power cable shall be 16 AWG three conductor cable. The cabling shall comply with local and National Electric Codes.

The complete video detection system shall be warranted to be free of defects in material and workmanship for a period of not less than three years from the date of final acceptance and warranty initiation. During the warranty period, the Contractor or Developer shall be responsible for the repair or replacement, at no charge to the Town, of any product of the video detection system which fails to operate properly with the exception of failures as a result of vandalism, accident, and/or act of God.

Video detection systems shall be paid for on a unit basis and shall include all labor, equipment and materials necessary to install a video detection system for a single approach, complete-in-place. The video detection system shall be paid for under the "Video DetectionSystem" pay item.

930.08 Inductance Loop Detection

Inductance loops shall only be installed where/when specifically defined in project plans and specifications or as otherwise directed by the Town Engineer. When defined for use,

inductance loops shall be installed in accordance with specifications approved by the Town Engineer and the construction plans.

930.09 Pedestrian Push Buttons

Pedestrian push button assemblies shall be Pelco model SE-2005-08 (ADA pedestrian push button), or approved equal. The button housing shall be black in color. A separate 9" W x 12" H decal sign, MUTCD Reference # R10-3d, or approved equal shall be installed with each pedestrian push button.

Audible and/or tactile pedestrian push buttons shall only be used where specified in the plans and project specials, and may be considered by the Town Engineer on a per project basis. When audible and/or tactile pedestrian push buttons are requested, the audible and/or tactile function shall be integrated into the pedestrian push buttons. Pedestrian push buttons shall be of the manufacturer and model number specified, and shall conform to the MUTCD.

Pedestrian push buttons shall be paid for on a unit price basis and shall include all labor, equipment and materials necessary to install the item complete-in-place. Pedestrian push buttons shall be paid for under the "pedestrian push button" pay item.

930.10 Emergency Vehicle Detection

Global Traffic Technologies (GTT) Opticom phase selectors and detectors shall be of the most current model, or as specified herein. Opticom Detectors shall be installed as specified in the plans and may include model numbers 711, 721, and/or 722. Opticom Phase Selectors shall be model number 762.

Opticom phase selectors and detectors shall be paid for on a unit price basis based on quantities and model numbers and shall include all labor, equipment and materials necessary to install the item complete-in-place. Opticom phase selectors shall be paid for under the "Opticom Phase Selector" pay item. Opticom detectors shall be paid for under the "Opticom Detector" pay item.

930.11 Electrical Services

Electrical services shall be installed for all new signals or as otherwise directed by the Town Engineer. Services shall be 240VAC, Single Phase, providing for two separate 120VAC, Single Phase, circuits. One circuit shall be used as the traffic signal cabinet feed. The second circuit shall be used as the street light feed.

Unless otherwise directed by the utility company and agreed upon by the Town Engineer, electrical services shall be metered.

Electrical service shall be installed as per NEC or as amended by the Town. The grounding and bonding of services shall be completed in accordance with Article #250.

Electrical service shall be paid for on a unit price basis and shall include all labor, equipment and materials necessary to install the electrical service, complete-in-place. The electrical service shall be paid for under the "Electrical Service" pay item.

930.12 Bonding and Grounding

Metallic cable sheaths, conduit, metal poles and pedestals shall be effectively grounded. Bonding and grounding jumpers shall be copper wire or copper strap of the same cross-sectional area, No. 8 AWG for all systems. Loop lead-in cable for inductance loops is to be grounded in controller cabinet only. The other end of the inductance loop lead-in shall remain ungrounded, being taped back.

Bonding of standards shall be by means of a bonding strap attached to a brass bolt or a 3/16-inch or larger brass or bronze bolt installed in the lower portion of the shaft.

The controller cabinet and each individual pole and/or pedestal shall be attached to its own separate ground electrode via #6 solid bare copper wire. The ground electrodes may be placed in the foundation of the item to be grounded or may be placed in an adjacent pull box located no more than 6-feet away from said foundation. Ground electrodes shall be a one piece copper weld rod of 5/8-inch diameter, 8-feet in length.

Grounding shall be incidental to the pay item for which it is associated.

930.13 Controller and Cabinet

This specification sets forth the minimum requirements for a 170/2070 traffic control modular cabinet assembly. The cabinet assembly shall meet, as a minimum, all applicable sections here within.

All controller cabinets shall be stretched 333SD type traffic control cabinets except when used at two phase pedestrian crossings and/or fire signals. Two phase pedestrian crossing and fire signal controller cabinets shall be pole mount 303 type traffic control cabinets unless otherwise called for on the plans.

Controller cabinets shall have a powder coated finish, "silver wheel" in color, with anti-graffiti coating. All cabinets and conduits into the cabinet shall be made to be rodent resistant.

A controller shall consist of a complete electrical mechanism to control the operation of traffic control signals, including the timing mechanism and all necessary auxiliary equipment. Controllers shall be Econolite Cobalt-C. All equipment furnished shall be the manufacturers' latest, current production model, complete with all standard accessories, tested and delivered by domestic manufacture who is regularly engaged in the construction of such equipment. Each cabinet shall be furnished with a full complement of auxiliary equipment (loop amps, load switch, etc.) regardless of specific intersection design.

For base mounted cabinets, all electrical conduits running to the control cabinet shall enter from the bottom only, except as noted on the plans. No holes shall be drilled in any part of the cabinet other than the bottom, unless otherwise called for on the plans.

All controller cabinets and control equipment shall be factory wired, ready for operation. Contractor or Developer shall test cabinet and controller in his shop prior to installation. Field work will be limited to placing cabinets and equipment and the connecting of field wiring to field terminal strips. All cabinet wiring shall be neat and firm.

Controller cabinets shall be furnished with all mounting hardware.

All controller cabinets shall be equipped for and wired for two Opticom card rack mounted Global Traffic Technologies (GTT) Model 752 phase selectors. The phase selector cards, field wiring, and detectors shall not be supplied, unless called for in the Bid Schedule.

Controllers and cabinets shall be measured and paid for per unit count and shall include all labor, equipment, and materials necessary to install the item complete-in-place. Traffic signal cabinets shall be paid under the "Traffic Signal Cabinet" pay item. Traffic signal controllers shall be paid under the "Traffic Signal Controller" pay item.

930.14 On-Street Master Controller

An on-street master controller shall only be installed where identified in the project plans and/or specifications. Where identified, an on-street master controller shall be of the manufacture and model number as defined.

930.15 Traffic Signal Heads

All vehicular traffic signal heads shall be 12-inch, 100% polycarbonate, black in color, with black, detachable, tunnel visors. Use of 8-inch signal traffic signal heads shall not be permitted.

Retro-reflective back plates shall be installed on all mast arm mounted traffic signal heads and shall be louvered, black in color, with retro-reflective strip. Back plates shall not be mounted on side-of-pole mounted traffic signal heads.

All pedestrian signal heads shall be single section, 16", clam shell, black in color.

LED indications shall be furnished for all indications with the exception of side-of-pole red indications. Side-of-pole red indications shall be incandescent type to aid in snow melt during the winter. All LED indications shall be warranted for a minimum of seven years by the manufacturer.

LED ball modules shall be incorporate a clear front shell and be GE models DR6-GCFB-VLA, DR6-YCFB-VLA, and/or DR6-RCFB-VLA or approved equal.

LED arrow module shall be DR6-GGE models TAAN-17A, DR6-YTAAN-17A, and/or DR6-RTAAN-17A or approved equal.

Pedestrian signals shall 16" x 18", countdown type, and be GE model PS7-CFF1-27A or approved equal.

Incandescent bulbs, as required for the side-of-pole red indications, and as otherwise directed for use by the Town Engineer, shall be Philips, Sylvania, or Town Engineer approved alternate. They shall be 116 watt, 130 volt, with a minimum life hour rating of 8,000 hour.

All signal head locations shall be approved by the Town Engineer.

Astro-brac or Sky-brac type mounting hardware shall be used to attach all traffic signal heads mounted on mast arms.

Side of pole traffic signal heads shall use industry standard side of pole hardware on both the top and bottom traffic signal head sections for mounting.

All Band-it material, including buckles, shall be $\frac{3}{4}$ " stainless steel.

During construction, traffic signal heads that have been installed but are not ready for actual electrical connection shall be bagged with a dark opaque material.

Signal and pedestrian heads shall be paid for on a unit price basis and shall include all labor, equipment and materials necessary to install the signal head, complete-in-place. Signal and pedestrian heads shall be paid for under the "traffic signal head" and "pedestrian head" pay items respectively.

930.16 Traffic Signal Poles, Mast Arms and Luminaire Davits

Traffic poles, mast arms, and luminaire davits shall meet the requirements of the standard details, which indicate the critical dimensions that must be met exactly or within stated tolerances. The intent is to provide traffic poles, mast arms, and luminaire davits that match the overall appearance as illustrated and meet the performance requirements of the details and these specifications. Traffic pole, mast arm, and luminaire davit supplier submittals shall be required and shall demonstrate conformity with this intent.

Traffic poles, mast arms, and luminaire davits shall be wrapped for shipping from the factory in heavy duty paper or plastic to protect them from scratches and abrasions in transit.

Traffic poles, mast arms, and luminaire davits shall be paint over hot-dipped galvanized, black in color. Hot-dip galvanized shall be as per ASTM A123 and A153. Prior to the installation of traffic poles, mast arms, and/or davits, the Contractor or Developer shall wipe clean the outer surfaces. Following the installation of the traffic poles, mast arms, and/or luminaire davits, the Contractor or Developer shall touch up nicks and abrasions using paint of similar color and sheen.

Nicks and abrasions greater than 1/8 inch deep shall be spray painted with zinc rich paint (greater than 90%) that matches the galvanized finish, such as Brite Products Brite Zinc Galvanizing Compound prior to paint touch up.

Two hand holes shall be provided on each pole; one at the base, one flush hand hole behind the signal mast arm connection. The flush covers shall be flush with the base metal giving them a hidden appearance. A "J-hook" wire support shall be provided in each pole shaft above the hand hole behind the mast arm connection. One grounding attachment shall be provided in each pole shaft near the hand hole cover at the base of the pole.

Anchor bolt base covers shall be provided in a two piece, tamper-resistant style. A locking device shall be provided to prevent lifting or creeping of the base cover.

Mast arm connecting bolts shall be of sufficient strength to conform to current AASHTO specifications.

All mast arm and pole shaft end openings shall be provided with set screw caps.

All welding shall conform to AWS D1.1 Sections 1 through 8 and shall be performed by welders certified in accordance with AWS code. All butt welds shall be ground flush with base metal to provide a uniform smooth finish.

By American Provision, all steel materials permanently incorporated into the work shall be certified to have been produced in the United States. All manufacturing processes for these materials must occur in the United States and be new domestic steel. Certifications that steel has been manufactured in the United States shall be provided to the Town by the manufacturer.

All materials shall be of the ASTM type as called for in this specification. Mill certifications shall be supplied for proof of compliance to these Specifications.

Valmont brand traffic signal poles, mast arms, and luminaire davits have been pre-approved to meet Town specifications. Other brands must be approved by the Town Engineer prior to ordering the poles, mast arms, and/or luminaire davits.

Traffic signal poles, mast arms, and luminaire davits shall be measured and paid for per unit count and shall include all labor, equipment, and materials necessary to install the item complete-in-place. Traffic signal poles, mast arms, and luminaire davits shall be paid for under the "Street Light Pole, and/or "Traffic Signal Pole" pay item as appropriate.

930.17 Pedestrian Pole

Pedestrian poles shall be designed to meet the structural requirement given in the latest edition of "Standard Specifications for Structural Support for Highway Signs, Luminaires and Traffic Signals", published by AASHTO, for a wind velocity of 90 MPH.

Pedestrian poles shall be aluminum of the appropriate length of 8-feet, 12-feet, or 15-feet as required for signal equipment mounting heights in compliance with the latest MUTCD standards. When aluminum poles are not of adequate strength for the given wind load to meet the above AASHTO requirements, use of a Schedule 40 galvanized steel pole shall be required. Pedestrian poles shall be painted black in color.

With the exception of beacon assemblies, top mounting of signal heads shall not be permitted.

The pole base shall be frangible, of the same material as the pole.

After installation where galvanized steel poles have been installed, nicks and abrasions greater than 1/8 inch deep shall be spray painted with zinc rich paint (greater than 90%) that matches the galvanized finish, such as Brite Products Brite Zinc Galvanizing Compound.

Pedestrian poles shall be measured and paid for per unit count and shall include all labor, equipment, and materials necessary to install the item complete-in-place. Pedestrian poles shall be paid for under the "Pedestrian Pole" pay item.

930.18 Pedestrian Push Button Pole

Pedestrian push button pole shall be as illustrated in the standard details, constructed of Schedule 40 galvanized steel painted black. Pole base shall be frangible.

After installation, nicks and abrasions greater than 1/8 inch deep shall be spray painted with zinc rich paint (greater than 90%) that matches the galvanized finish, such as Brite Products Brite Zinc Galvanizing Compound.

Pedestrian push button poles shall be measured and paid for per unit count and shall include all labor, equipment, and materials necessary to install the item complete-in-place. Pedestrian push button poles shall be paid for under the "Pedestrian Push Button Pole" pay item.

930.19 Illuminated Street Name Signs

Illuminated street name signs shall be RAZOR Internally-Illuminated LED Street Name Signs as manufactured by Temple Edge-Lit or approved equal.

Illuminated street name signs shall be double sided unless otherwise defined in the project plans and/or specifications.

Illuminated street name signs housings shall be constructed of 6000 series aluminum.

Sheeting shall be 3M Electro Cut film #1178 with white lettering over a green background.

The sign shall be provided with a manufacturer approved under-hang mast arm mount.

Illuminated street name signs shall have a minimum wind load rating of 150 MPH with 1.14 gust factor and ice loading as per AASHTO LTS-4 2001.

LEDs shall be high-intensity, rated for a minimum of 60,000 hours.

Illuminated street name signs shall be warranted for a minimum of 5 years.

Illuminated street name signs shall be measured and paid for per unit count and shall include all labor, equipment, and materials necessary to install the item complete-in-place. Illuminated street name signs shall be paid for under the "Illuminated Street Name Sign" pay item.

930.20 Blank Out Regulatory/Warning Signs

Blank out regulatory or warning sign housings shall be constructed of aluminum unless directed otherwise by the Town Engineer. All ferrous hardware parts shall be galvanized cadmium plated, or stainless steel.

The lens panel shall be capable of removal or be swung open without the use of tools.

The sign panel shall be completely blanked out when not energized. The sign color shall not fade when exposed to an accelerated test of ultraviolet light equivalent to five years of outdoor exposure.

The entire surface of the sign panel shall be evenly illuminated. All messages shall be clearly legible attracting attention under any lighting conditions for an advance distance of at least 500 feet. When illuminated, the sign shall be visible anywhere within the approximately a 60 degree cone centered about the optic axis.

Terminal blocks shall be molded, phenolic, barrier type rated at 15 ampere, 1000 V and shall have waterproof marking strips. No wiring splices will be permitted within the sign without the permission of the Town Engineer.

The overall weight of the complete sign assembly including mounting hardware shall not exceed 90 lbs.

Blank out regulatory or warning signs shall be of LED or fiber optic light source type as specified in the project plans and specifications.

If a fiber optic light source is specified, the lamps shall be 50 watts or less, operating at 15 volts or less and shall have an average rated life of 8,000 hours or more. The color of any message shall be changeable in the field by replacement of the color filters without removing the sign from the case.

Blank out regulatory/warning signs shall be measured and paid for per unit count and shall include all labor, equipment, and materials necessary to install the item complete-in-place. Blank out regulatory/warning signs shall be paid for under the "Blank Out Regulatory/Warning Sign" pay item.

930.21 School Flashing Beacon Assembly

A school flashing beacon assembly shall be as shown in the standard details.

LED indications shall be furnished for all indications. For 120VAC installations, LED indications shall be warranted for a minimum of seven years by the manufacturer. For solar installations, LED indications shall be warranted for a minimum of five years by the manufacturer.

Each school flasher beacon assembly shall include a NEMA Type 4 enclosure for housing the associated time clock unit and electrical connections. When solar power is used in conjunction with the school flashing beacon assembly, the NEMA Type 4 enclosure shall be of sufficient size to house all associated solar power equipment, including the battery(s), as may be applicable.

The NEMA Type 4 enclosure shall be lockable and provided with a treasury type lock Corbin number R357SGS, or exact equivalent

A time clock, RTC model number AP21T, or approved equal shall be incorporated in the school flashing beacon assembly NEMA Type 4 enclosure.

Terminal blocks shall be molded, phenolic, barrier type rated at 15 ampere, 1000 V. No wiring splices will be permitted within the school flasher beacon assembly or NEMA Type 4 enclosure without the permission of the Town Engineer.

Signs shall be supplied and installed by the Contractor or Developer as an integral part of the flashing assembly.

For 120VAC installations, a main circuit breaker shall be installed in the NEMA Type 4 enclosure between the service feed and school flashing beacon assembly electronics. Fuse(s) in place of the circuit breaker shall not be permitted. A main circuit breaker shall not be required for solar type installations.

For 120VAC installations, a 120VAC receptacle shall be installed within the NEMA Type 4 enclosure.

School flashing beacon assemblies shall be paid for on a unit price basis and shall include all labor, equipment, materials, and electrical service connections necessary to install a school flashing beacon assembly, complete-in-place, on a single pole. School flashing beacon assemblies shall be paid for under the "School Flashing Beacon Assembly" pay item.

930.22 Warning or Regulatory Sign Flashing Beacon Assembly

A warning or regulatory sign flashing beacon assembly shall be as shown in the standard details.

LED indications shall be furnished for all indications. For 120VAC installations, LED indications shall be warranted for a minimum of seven years by the manufacturer. For solar installations, LED indications shall be warranted for a minimum of five years by the manufacturer.

All terminations shall be made on a terminal block located within the signal head. Terminal blocks shall be molded, phenolic, barrier type rated at 15 ampere, 1000 V. No wiring splices will be permitted within the warning or regulatory sign flashing beacon assembly without the permission of the Town Engineer.

Signs shall be supplied and installed by the Contractor or Developer as an integral part of the flashing assembly.

Warning or regulatory sign flashing beacon assemblies shall be paid for on a unit price basis and shall include all labor, equipment, materials, and electrical service connections necessary to install a warning or regulatory sign flashing beacon assembly, complete-in-place, on a single pole. Warning or regulatory sign flashing beacon assemblies shall be paid for under the "Warning/Regulatory Sign Flashing Beacon Assembly" pay item.

930.23 Solar Power System

The solar power system shall be of sufficient size to adequately support the power requirements of the attached equipment year-round. It shall incorporate a solid-state solar controller including a high output solar regulator and low voltage disconnect. The system shall operate on input voltages ranging from 11.5 VDC to 25 VDC. The solar regulator's minimum rating shall be 25A at 12 VDC, temperature compensation.

The solar panel position shall be field settable to the correct degree required at the location and shall use automatic night dimming to conserve power.

The solar power system shall not be paid for separately but shall be included in the cost for the equipment it is powering and shall include all labor, equipment, and materials necessary to install a solar power system, complete-in-place, on a single pole.

930.24 Uninterruptable Power Supply (UPS)

A UPS shall be installed for all new traffic signals and shall be a Clary SP1250LX or approved equal. It shall include a bypass switch by which the user can manually bypass the UPS and power the signal via utility power.

The UPS shall include a weatherproof generator receptacle accessible via the exterior of the traffic signal cabinet. The UPS generator receptacle shall be mounted at a minimum height of two feet as measured from the bottom of the cabinet.

The UPS shall be configured such that the UPS provides regulated 120VAC, 60 Hz, single phase output power to run the signal in full operation and recharges the UPS batteries while under generator power. The unit shall automatically sense when generator power is applied, and when generator power fails. When generator power is applied, the UPS unit shall be configured such that it automatically reverts to generator power. The unit shall be configured such that it automatically reverts back to either utility power or UPS battery power respectively, based upon the availability at the time, when the generator power falls outside of acceptable signal tolerances.

The UPS shall be supplied with a minimum of six (6) 12V, sealed, maintenance free batteries as approved for use by the manufacturer.

Programming software and manuals shall be supplied with each UPS and shall become the property of the Town at the completion of the project.

UPS units shall be initially programmed to provide two (2) hours of normal operation before transitioning to flash mode.

A UPS shall include all labor, equipment, and materials necessary to install the item complete-in-place.

UPS shall be measured by the units installed and shall include all labor, equipment, and materials necessary to install a UPS, complete-in-place. UPS shall be paid for under the pay item "Uninterruptible Power Supply".

930.24 Miscellaneous Hardware

All ferrous mounting hardware and weather heads shall be galvanized, cadmium plated, or made of stainless steel to resist corrosion.

940.00 POST CONSTRUCTION**940.01** Field Testing

Prior to completion of the work, the Contractor or Developer shall cause the following tests to be made on all traffic signals in the presence of the Town Engineer:

Each circuit shall be tested for continuity and for grounds.

A functional test shall be made in which it is demonstrated that each and every part of the system functions as specified or intended herein. The functional test for the traffic signal installation shall consist of not less than fourteen (14) days of continuous, satisfactory operation following a three to five day mandatory flashing period, or other flash period as directed by the Town Engineer.

Signal turn-on, following the mandatory flashing period to transition into the functional test, shall be scheduled with the Town Engineer, completed Monday-Thursday during normal business hours.

940.02 Maintenance and Emergency Repairs During and After Construction

During the construction, reconstruction, fourteen-day test period, and until signal Construction Acceptance by the Town, the Contractor or Developer shall maintain the system or systems on a 24 hour basis. The cost of any maintenance necessary except electrical energy, and maintenance due to damage by public traffic, shall not be paid for separately but shall be included in the cost of the work.

Acceptance by the Town of the work performed by the Contractor or Developer shall only take place after all punch list items have been satisfactorily completed and inspected by the Town.

The Contractor or Developer shall provide the Town with a 24 hour one call phone number for reporting of any and all signal malfunctions. Fees incurred for such service shall not be paid for separately but shall be included in the cost of the work.

All malfunctions of a controller and its accessory equipment shall be considered an emergency unless otherwise identified by the Town. Equipment malfunctions and/or damage, which in the opinion of the Town Engineer constitutes a serious hazard or inconvenience to the public, shall be considered an emergency. The Contractor or Developer shall undertake emergency repairs no later than two (2) hours after the Town notifies the Contractor or Developer of the emergency.

Malfunctions of a controller and its accessory equipment, which are identified by the Town Engineer as non-emergency repairs shall be considered non-emergency. The Contractor or

Developer shall undertake non-emergency repairs no later than 24 hours after the Town notifies the Contractor or Developer of the non-emergency.

If the Contractor or Developer fails to respond within the defined response time, the Town Engineer may elect to employ the services of the Town's designated Traffic Signal Maintenance Contractor to perform the said maintenance work. In such cases, the Contractor or Developer shall reimburse the Town for labor, equipment, and material charges associated with the utilization of the Town's designated Traffic Signal Maintenance Contractor plus a fifteen percent administration fee.

SECTION 800 STORM DRAINAGE SYSTEM

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SECTION 800 STORM DRAINAGE SYSTEM

810.00 STORM DRAINAGE DESIGN AND TECHNICAL CRITERIA

811.00 Scope

Section 800 sets forth the design and technical criteria and specifications for the analysis and design of drainage systems. All subdivision plats, site improvement plans, planned building groups and other proposed construction submitted to the Town for acceptance will be accompanied by a storm drainage analysis. Appropriate drainage system design must be submitted to and accepted by the Town Engineer for each phase of construction. Such analysis and design will conform to the criteria set forth herein. Acceptance of the analysis and design is subject to the following conditions:

- A. Construction of the system must commence within 365 days of the date of acceptance.
- B. No construction has been completed on any adjacent property that may have affected the drainage pattern within the basin.

In either case, the Town Engineer may require a new submittal.

A large portion of the criteria and design aids included in these STANDARDS AND SPECIFICATIONS originated from the Urban Drainage and Flood Control District (UDFCD) Urban Storm Drainage Criteria Manual (USDCM). For any information not detailed in these specifications, refer to this manual.

812.00 General Provisions

812.01 General Design Criteria

Except where specified here, the procedure, criteria, and standards set forth in the latest revision of the "Urban Storm Drainage Criteria Manual" will be instituted for the analysis of any drainage system. Sound knowledge of current engineering practices and drainage methodology, as well as common sense, will be involved with the analysis of any drainage system.

All development must be in conformance with the current Master Drainage Plan or Outfall System Plan for the drainage basins where the development is located. For areas not included within a Master Drainage Plan or Outfall Systems Plan, onsite historic peak flows shall be calculated using the present land use of the site. For offsite areas draining onto the site, peak flows shall be calculated using the current land use for areas that are fully developed without an existing stormwater detention pond or for areas that are undeveloped that will be required to provide stormwater detention if improved. For offsite areas that are currently developed with an existing stormwater detention pond, the peak detention pond discharge rates shall be used for the peak flows.

Conveyance must be provided downstream of the site to the major drainageway with sufficient capacity to pass the one hundred (100) year storm event. Easements for these conveyance systems must be provided and shown on the drainage plan. If it is not possible to obtain an easement and construct drainage improvements on the downstream property, runoff must be reduced to historic rates and concentrated flows must be spread out to stimulate existing conditions to minimize the potential for erosion.

All major storm floodplain boundaries will be available from the Town Engineer and must be shown on all preliminary and final drainage plans. All pond facilities will be of the detention type. The Town Engineer will approve methods of detention. Retention facilities will only be allowed with the written approval of the Town Engineer.

Construction that will impair surface drainage will not be accepted. The Town reserves the right to issue and enforce more stringent criteria should adverse conditions exist. Designs varying from the criteria will require a variance with written approval by the Town Engineer prior to final acceptance of the plans.

812.02 Design Principals

Natural topographic features will be the basis of location for easements and future runoff calculations. In developed and undeveloped areas, average land slopes may be utilized in runoff computations. Wherever existing drainage patterns and slopes are defined, these will be used. The drainage facilities so designed must be able to handle the design flows with no erosion damage to the system.

Streets will not be used as primary floodways for major storm runoff. The amount of runoff in the streets will not exceed the limits established in Section 815.02 of these STANDARDS AND SPECIFICATIONS.

Stormwater detention facilities and natural drainageways are to be used whenever feasible. Any alteration to natural drainage patterns will not be approved unless a thorough investigation and analysis shows no hazard or liability. The Town Engineer will have final authority over any system design.

The planning and design of the drainage system will not be such as to simply transfer the problem from one location to another or create a more hazardous condition downstream. Provisions will be made in every development in the form of an easement or Right of Way for the 100-year storm to pass through that development, including tributary offsite runoff.

Enhancement of stormwater runoff quality is required for all developments within the Town of Firestone through the use of structural or nonstructural permanent control measures (CMs). Please refer to Section 815.05 for more information.

All drainage improvements will be as natural in appearance as possible to be aesthetically pleasing. Maintenance access will be provided for all drainage and flood control facilities.

Irrigation ditches cannot be used as an outfall point for the storm drainage system because of physical limitations. Variances can occur when the capacity of the irrigation ditch is adequate to carry the normal ditch flow plus the storm runoff with adequate freeboard to avoid creating a hazard to those below the ditch. Written approval must be obtained from the ditch owner stating that the owner understands the physical and legal (i.e., liability) consequences of accepting said runoff. However, without major reworking of irrigation ditches to provide major carrying capacity without undue hazard to those downstream or below the ditch, the ditches are almost always totally inadequate for such a use and should not normally be used as an outfall. Moreover, because ditches are normally privately owned, one cannot assume the perpetual existence or function of a ditch. If a variance is requested to the Town Engineer for use of a ditch as an outfall, it is the design engineer's responsibility to complete all studies and designs

deemed necessary by the Town Engineer to support the use of the ditch as well as a secondary drainage design should the ditch cease to exist.

Expressed written approval must be obtained from the managing organization for irrigation ditches being considered for crossing or easements.

813.00 Design Methods**813.01 Initial and Major Design Storms**

Every urban area has two separate and distinct drainage systems whether or not they are actually planned for and designed. One is the initial system corresponding to the initial (or ordinary) storm recurring at regular intervals. The other is the major system corresponding to the major (or extraordinary storm), which is unlikely to occur more often than once in 100 or more years. Since the effects and routing of storm waters for the major storm may not be the same as for the initial storm, all storm drainage plans submitted for acceptance will detail two separate systems; one indicating the effects of the initial storm and the other showing the effects of the major storm.

- A. *Initial storm provisions:* The initial storm will be considered the 5-year storm. The objectives of such drainage system planning are to minimize inconvenience, to protect against recurring minor damage, to reduce rising maintenance costs, and to create an orderly drainage system. The initial storm drainage system may include such facilities as curb and gutter, storm sewer, swales, and other open drainageways and detention facilities.
- B. *Major storm provisions:* The major storm will be considered the 100-year storm. The objectives of the major storm planning are to eliminate substantial property damage or loss of life and will be as directed and accepted by the Town Engineer. Major drainage systems may include storm sewers, open drainageways and detention facilities. The correlation between the initial and major storm system will be analyzed to insure a well-coordinated drainage system.

813.02 Storm Return Periods

The initial and major storm design return periods will not be less than those found in section 813.01.

813.03 Runoff Computations, Colorado Urban Hydrograph Procedure (CUHP)

The CUHP method is generally applicable to drainage basins greater than 90 acres. However, the CUHP is required for watershed areas larger than 160-acres. The procedures for the CUHP, as explained in the USDCM, shall be followed in the preparation of drainage reports and storm drainage facility designs in the Town. The CUHP program requires the input of a design storm, either as a detailed hyetograph or as a 1-hour rainfall depth. The program for the latter using the 2-hour storm distribution recommended in the USDCM generates a detailed hyetograph distribution.

The hydrograph from the CUHP program must be routed through any proposed conveyance facility using the Storm Water Management Model (SWMM) or a similar method approved by the Town Engineer.

813.04 Runoff Computations, Rational Method

The Rational Method will be utilized for sizing storm sewers and for determining runoff magnitude from un-sewered areas. The limit of application of the Rational Method is approximately 160 acres. When the drainage basin exceeds 160 acres, the CUHP method shall be used. The procedures for the Rational Method, as explained in the Urban Storm Drainage Criteria Manual, shall be followed in the preparation of drainage reports in the Town.

813.05 Runoff Coefficients

Rational method runoff coefficients: The runoff coefficient (C) to be used in conjunction with the Rational Method will be calculated using the percent imperviousness shown in Table 800-3 as explained in the Urban Storm Drainage Criteria Manual Volume 1 Table 6-3 (refer to manual for current edition).

**TABLE 800-3
PERCENT IMPERVIOUS FOR RATIONAL METHOD**

SURFACE TYPES	IMPERVIOUS
Roadway and Paved Streets	95%
Concrete Driveways and Walks	95%
Roofs	95%
<u>Gravel</u>	
No Traffic (Pedestrian Use)	40%
Low-traffic Areas (Maintenance Paths and Substations)	60%
High-traffic Areas (Roadways and Parking)	80%
Disturbed Soil (Including Lawns, Managed/Active Turf, Landscaped areas with Water-Wise Vegetation, and Uncompacted Garvel/Mulch Planting Beds)	20%
Undisturbed or Decompacted Soil (Native Grasses and Open Space Areas)	5%
<u>Artificial Turfs¹</u>	
Landscape Applications (without Subgrade Drainage Layer)	25% - 45%
Sport Fields (with Underdrain Pipe System)	60% - 80%
Water Surfaces (Lakes/Reservoirs/Irrigation Ponds)	100%
<u>Solar Fields²</u>	
Grass Cover (Varies with Panel Orientation Relative to Ground Contours)	10% - 45%
Gravel Cover (Varies with Panel Orientation Relative to Ground Contours)	50% - 75%
Historic Flow Analysis, Greenbelts, Agricultural	5%
Newly Graded Areas	65%
<u>Stormwater Control Measures³</u>	
Retention Ponds & Constructed Wetland Ponds	100%
Rooftop Systems – Blue Roofs	95%
Rooftop Systems – Green Roofs (extensive)	65%
Rooftop Systems – Green Roofs (intensive)	50%
Permeable Pavement – CGP/PGP/RGP	55%

¹ Consult with the manufacturer to get a recommended value.

² Assumes 1:1 ratio of panels to aisles. See MHFD's technical memorandum regarding Determination of Solar Panel Runoff Coefficients and Imperviousness Values for additional information on procedures for determining percent imperviousness based on panel width, panel spacing, and panel orientation relative to ground contours and how to reflect other impervious areas such as roads and pads that may be part of a solar filed and layouts with wider inter-panel spacing.

³ See MHFD's technical memorandum regarding Evaluation of Percent Imperviousness for Stormwater Control Measures for background information.

SURFACE TYPES	IMPERVIOUS
Permeable Pavement – PICP	45%
Extended Detention Basins	25%
Receiving Pervious Areas (incl. Grass Buffers & Grass Swales)	20%
Bioretention & Sand Filters	10%

813.06 Rainfall Intensities

The rainfall intensities to be used in the computation of runoff using the Rational Method shall be obtained from Chapter 5, Volume 1 of the USDCM.

814.00 Detention

814.01 General

Onsite detention is required for all new development, expansion, and redevelopment. The required minimum detention volume and maximum release rates at these volumes shall be determined in accordance with the procedure and data set forth in these criteria.

For lands where the Town has adopted a Master Drainage Plan or Outfall Systems Plan, detention facilities identified in the Master Drainage Plan or Outfall Systems Plan shall be constructed. For lands where there is no Master Drainage Plan or Outfall Systems Plan, detention is required for all development as discussed in this section. Detention facilities should be designed using hydrograph and routing methods where possible.

Full Spectrum Detention design guidelines as described in Chapter 12, Volume 2 of the USDCM shall be used for all detention facilities. For detention facilities with tributary areas less than 10 acres, the Simplified Equations for Full Spectrum Detention may be used. Hydrograph routing using CUHP and SWMM shall be used when multiple detention facilities in parallel or series are proposed. The Rational Formula-based FAA detention method shall not be used.

Offsite drainage shall be routed around the detention facility or the tributary drainage area must be included in the pond volume and release rate sizing analysis.

More stringent detention volumes and release rates may be required by the Town Engineer to avoid negatively impacting the downstream properties.

Extended Detention Basins with stormwater quality storage as defined in the Urban Storm Drainage Criteria Manual shall typically be provided.

Exemptions from the detention requirement may be granted if it can be demonstrated that the developed area does not adversely affect the downstream major drainageways (assuming the entire tributary drainage area is fully developed). This condition can typically occur for development located adjacent to a major drainageway. If an exemption is granted, a water quality only storage facility must be provided.

Parking lots that serve as detention storage facilities must not have a storage depth of more than 1 foot. Parking lots that serve as detention storage facilities must place notification signs that ponding will occur during a rainfall event. The signs shall be permanent and high quality, meeting both the Town’s specifications for traffic signs and the Manual on Uniform Traffic Control Devices (MUTCD).

Parking lot detention shall not be used at critical facilities as determined by the Town Engineer. Critical facilities may include, but are not limited to, hospitals, fire stations, police stations, schools, and potential gathering places that may be used in the event of an emergency.

814.02 State Engineer's Office

Any dam constructed for the purpose of storing water, with a surface area, volume, and/or dam height as specified in Colorado Revised Statutes 37-87-105, shall require the approval of the plans by the State Engineer's Office. Current legislation may revise these statutes. All detention storage areas shall be designed and constructed in compliance with current state statutes and/or criteria presented herein.

814.03 Grading Requirements

Slopes on earthen embankments shall not be steeper than 4 (horizontal) to 1 (vertical). The geotechnical engineer for the project shall verify slope stability. All earthen slopes shall be covered with topsoil and re-vegetated. For irrigated grassed detention facilities the minimum bottom slope shall be 2% measured perpendicular to the trickle channel. Wet bottom detention facilities shall be reviewed on a case-by-case basis.

When proposed lot grading has three or more lots draining to a shared lot line swale to a roadway, a sidewalk chase drain shall be installed to convey drainage through the sidewalk to the gutter. In areas with detached sidewalk and trees lawns, the sidewalk chase shall continue through the tree lawn and curb to the gutter.

814.04 Freeboard Requirements

The minimum required freeboard for grassed and parking lot detention facilities is one (1) foot above the computed 100-year water surface.

814.05 Trickle Flow Control

All grassed detention ponds shall include a trickle channel.

The base flow shall be carried in a trickle channel. The minimum capacity shall be one (1) percent to three (3) percent of the 100-year flow, but not less than one (1) cfs. Trickle channels may be constructed of concrete or other approved materials to minimize erosion and to facilitate maintenance. Trickle channels that aesthetically blend with the adjacent vegetation and are designed to be stable based on the soil conditions are preferred..

814.06 Outlet Configuration

Refer to the Urban Storm Drainage Criteria Manual for outlet configuration and sizing methods.

814.07 Embankment Protection

Whenever a detention facility uses an embankment to contain water, the embankment shall be protected from catastrophic failure due to overtopping. Overtopping can occur when the pond outlets become obstructed or when a larger than 100-year storm event occurs. Failure protection

for the embankment may be provided in the form of a heavy buried riprap layer (Type M or larger) on the entire downstream face of the embankment or a separate stable emergency spillway having a minimum capacity of twice the maximum release rate for the 100-year storm event. For either case, the pond overflow velocity down the face of the embankment must be analyzed and adequate erosion protection must be provided. Structures shall not be permitted in the path of the emergency spillway or overflow. The invert of the emergency spillway should be set equal to or above the 100-year water surface elevation.

814.08 Release Rates

Refer to Chapter 12, Volume 2 of the USDCD for release rate sizing.

815.00 Design Standards

815.01 Open Channels

Except as modified herein, open channels will be designed for the 100-year frequency storm and will conform to the criteria set forth in the Urban Storm Drainage Criteria Manual. However, the channel design will also be analyzed with respect to initial storm runoff and its effect made known. Whenever practical, the channel should have slow flow characteristics, be wide and shallow, and be natural in its appearance and functioning.

Where appropriate or required by the Town Engineer, such as for major drainageways, natural stream corridors shall be preserved and stabilized or naturalized channels shall be created in accordance with the Urban Storm Drainage Criteria Manual, Chapter 8 Open Channels.

Channels shall be designed in such a manner that critical depth and super-critical flows are avoided. Capacities for small channels may be computed from Manning's Formula for uniform flow, except at crossings and transitions where backwater effects will need to be accounted for and the Town Engineer may require the channel capacity be calculated using different methods.

The channel cross section may be almost any type suitable to the location. However, the limitations for design for the major storm and initial storm design flows shall include:

- A. The channel and overbank areas shall have adequate capacity for the 100-year storm runoff.
- B. Side slopes: Side slopes will be as flat as practical. Side slopes of 4:1 will be considered a normal minimum. Under special conditions, slopes of 3:1 may be utilized with written approval of the Town Engineer. However, a slope of no steeper than 4:1 is the practical limit for mowing equipment.
- C. Depth: The maximum design depth of flow for the major storm shall be limited to five (5) feet, not including freeboard. Any design variation exceeding the maximum depth of flow must be submitted in writing for approval by the Town Engineer. Critical depths and velocities will be investigated for both the major and initial storm runoffs and these values made available to the Town Engineer.
- D. Freeboard: Except where localized overflow in certain areas is desirable for additional ponding benefits or other reasons, the minimum allowable freeboard will be one (1) foot
- E. Bottom width: The bottom width should be designed to satisfy the hydraulic capacity of the cross-section recognizing the limitations on velocity, depth and Froude number.
- F. Slope of channel: Grass lined channel slopes are dictated by velocity and Froude number requirements. Grass-lined channels normally will have slopes of 0.2% to

- 0.6%. Where the natural topography is steeper than desirable, drops may have to be utilized.
- G. Curvature: The centerline curvature will not have a radius less than twice the design flow top width, but not less than one hundred (100) feet.
- H. Trickle channels: Trickle channels to carry low flows will be required for all new channels. The capacity of a trickle channel will be approximately 2.0% of the major design flow. Where 2.0% of the major design flow exceeds 90 cfs, a low flow channel will be required. Low flow channels shall be in accordance with the UDFCD Urban Storm Drainage Criteria Manual.
- I. Design velocity: The maximum velocity for the major storm design runoff will not exceed seven (7) feet per second for grass lined channels, except in sandy soil where the maximum velocity shall not exceed five (5) feet per second.
- J. Erosion: All channels will be designed with the proper and adequate erosion control features.
- K. Grass lining: The grass lining for channels shall be in accordance with the UDFCD Urban Storm Drainage Criteria Manual.
- L. Water surface profile: A water surface profile for the major storm runoff will be computed for all channels and clearly shown on the final drawings submitted for acceptance. Computations of the water surface profile will utilize standard backwater methods such as HEC-RAS taking into consideration all losses due to velocity changes, drops, bridge and culvert openings, and other obstructions. A Computations Report shall be submitted along with the final design plan.
- M. Roughness coefficient (n): The value of the roughness coefficient (n) to be used in Manning's Formula, HEC-RAS, and for any other hydraulic calculation will not be less than those listed in Table 800-5:
- N. Froude number (turbulence factor) shall be less than 0.8 for grass-lined channels. Grass lined channels having a Froude number greater than 0.8 will not be permitted. Minimum velocities for all channels will not be less than two (2) feet per second for the initial storm runoff.

TABLE 800-5
MINIMUM VALUES OF ROUGHNESS COEFFICIENT (n)

Type of Channel and Description Closed Conduits:		Minimum
Closed Conduits:		
	Concrete pipe and box culvert (new)	0.013
	Concrete pipe and box culvert (old)	0.015
	PVC pipe	0.011
	CMP pipe	0.024
	HDPE pipe	0.010
Channels and Swales:		
	Grass-lined (native grasses)	0.035
	Grass-lined (turfgrass sod)	0.030
	Riprap-lined	0.042
	Concrete trickle channel	0.013
Major Drainageways:		
	Natural channel preservation	See USDCM
	Naturalized channel	See USDCM
	Wetlands channel	See USDCM
Streets:		
	Asphalt street with concrete gutter	0.016
	Concrete street and gutter	0.013
	Concrete pavement and crosspans	0.013

815.02 Street Flow Capacities

Except as modified herein, the criteria set forth in the Urban Storm Drainage Criteria Manual will be used in analyzing and approving the adequacy of streets as a function of the drainage system. The Street Classifications for Drainage Purposes are listed in Table 800-6.

**Table 800-6
STREET CLASSIFICATION FOR DRAINAGE PURPOSES**

Street Classification	Function	Speed/Number of Lanes	Signalization at Intersections	Street Parking
Local	Provide access to residential and industrial areas	Low speed with 2 moving lanes	Stop signs	One or both sides of the street
Collector	Collect and convey traffic between local and arterial streets	Low to moderate speed with 2 or 4 moving lanes	Stop signs or traffic signals	One or both sides of the street
Arterial	Function as primary through traffic conduits in urban areas	Moderate to high speeds with 4 to 6 lanes	Traffic signals (controlled access)	Usually prohibited
Freeway	Provide rapid and efficient transport over long distances	High speed travel with 4 lanes or more	Cloverleaves, access ramps (limited access)	Always prohibited

Both the initial storm runoff and major storm runoff must be considered, and calculations showing such runoff at critical sections will be submitted. The following criteria will apply in the determination of allowable street flow capacities:

- A. Street, curb/gutter, walks, crosspans and curb cuts shall conform to all applicable Sections of these STANDARDS AND SPECIFICATIONS.
- B. In relation to street capacity for initial storm, pavement encroachment for the initial design storm shall not exceed the limitations set forth in Table 800-7:

**TABLE 800-7
ALLOWABLE PAVEMENT ENCROACHMENT AND DEPTH OF FLOW
FOR INITIAL STORM RUNOFF**

Street Classification	Maximum Encroachment*
Local	No curb overtopping; flow may spread to crown of street.
Collector	No curb overtopping; flow spread must leave the equivalent of one 10-foot driving lane clear of water.
Arterials	No curb overtopping; flow spread must leave the equivalent of two 10-foot driving lanes clear of water - one lane in each direction.
Freeways	No encroachment is allowed on any traffic lane.

* Where no curbing exists, encroachment will not extend past property lines.

The storm sewer system will commence at the point where the maximum allowable encroachment occurs.

C. In relation to street capacity for major storm, the allowable depth of flow and inundated area for the major design storm will not exceed the limitations set forth in Table 800-8:

**TABLE 800-8
ALLOWABLE DEPTH OF FLOW AND INUNDATED AREA FOR
MAJOR STORM RUNOFF**

Street Classification	Allowable Depth and Inundated Areas
Local & Collector	Residential dwellings and public, commercial, and industrial buildings shall be no less than 12 inches above the 100-year flood at the ground line or lowest water entry of the building. The depth of water over the gutter flow line must not exceed 12 inches.
Arterial & Freeway	Residential dwellings and public, commercial, and industrial buildings must be no less than 12 inches above the 100-year flood at the ground line or lowest water entry of the building. The depth of water must not exceed the street crown to allow operation of emergency vehicles. The depth of water over gutter flow line must not exceed twelve (12).inches

D. Cross street flow: Cross street flow will occur by one of the following methods. One method is runoff which has been flowing in a gutter and then flows across the street to the opposite gutter or inlet. The second case is flow from some external source, such as a drainageway or conduit, which will flow across the crown of the street when the conduit capacity is exceeded. Allowable Cross Street Flow is set forth in Table 800 -9.

**TABLE 800-9
ALLOWABLE CROSS STREET FLOW**

Street Classification	Initial Storm Flow	Major Storm Flow
Local	6 inches of depth in crossspan.	12 inches of depth above gutter flow line.
Collector	Where cross-spans allowed, depth of flow must not exceed 6 inches.	12 inches of depth above gutter flow line.
Arterial/Freeway	None.	No cross flow.

815.03 Storm Sewers and Storm Inlets

Except as subsequently modified, the design of storm sewers and inlets shall conform to the criteria set forth in the Urban Storm Drainage Criteria Manual. Both the initial and major storm events shall be considered to size the storm sewer system. Storm sewers and inlets shall be of sufficient capacity to adequately carry the expected runoff from the initial design storm, minimum. There are conditions when the storm sewer system needs to be sized to convey flows greater than the initial design storm (and as much as the major storm event). The storm sewer system and subsequent storm inlets will commence at all locations where the allowable street capacity is exceeded or wherever ponding of water is likely to occur. No bubblers will be allowed. The minimum allowable pipe size to be used in storm sewers and laterals will be as listed in Table 800-10:

**TABLE 800-10
MINIMUM ALLOWABLE PIPE SIZE**

Type of Conduit	Min. Inside Pipe Dia.
Main Trunk Sewer	18"
Short Laterals	15"

Arch pipes will be allowed where design conditions dictate, provided that the minimum cross-sectional areas will not be less than the equivalent pipe size specified above. All storm sewer conduits shall be of sufficient structural strength to withstand an H-20 design load.

The maximum allowable distance between manholes or other suitable appurtenances for cleanouts shall not exceed those listed in Table 800-11:

**TABLE 800-11
MAXIMUM ALLOWABLE MANHOLE SPACING**

Inside Diameter or Minimum Head Room	Maximum Allowable Distance Between Manholes
18" - 36"	400 feet
42" - 60"	500 feet
60" & Larger	750 feet

The capacities of conduits will be computed using the criteria set forth in the Urban Storm Drainage Manual, including a hydraulic grade line (HGL) analysis, for both the initial and major

storm events. Friction, lateral, bend, exit and entrance losses shall be included in the design. The storm sewer design shall include tailwater conditions. The value of the roughness coefficient (n) to be used will not be less than those specified in Section 815.01(l), Table 800-5 of these STANDARDS AND SPECIFICATIONS. The average flow velocity for the initial storm event shall not be less than two (2) feet per second and the maximum velocity for all storm events shall not exceed 18 feet per second. The HGL for the major storm event peak flow shall be at least 1 foot below the elevation of manhole covers, inlet grates, and the flowline at inlet curb openings. For storm sewer systems designed for the initial storm event, additional runoff can be intercepted by inlets during major storm events due to greater depths of flow in the streets. Surge created by conveyance of the additional runoff must be analyzed and the HGL must meet the maximum limit as described above for the major storm event.

Allowable storm inlets will be curb opening inlets, type "R" or combination curb/grate inlets, type "13", similar and equal to the Town's Standard Storm Water Inlets or as approved by the Town Engineer. Inlets will be utilized at all points where ponding or sump conditions exist. Refer to the Standard Drawings for details.

The allowable capacity and spacing of storm inlets shall be analyzed using the criteria set forth in the Urban Storm Drainage Criteria Manual. Reduction factors are applied to the theoretical inlet capacity to determine the allowable capacity. These reduction factors compensate for debris plugging, pavement overlaying, variations in design assumptions or other factors that decrease inlet capacities. Other methods, such as nomographs, may be used to design inlets as long as appropriate reduction factors are applied. The Town Engineer must approve other design methods.

The size of outlet pipes from storm water inlets shall be based on providing at least 1 foot of freeboard from the gutter flowline to the hydraulic inlet control depth for the outlet pipe or the storm sewer hydraulic grade line at the inlet, whichever is higher.

At sump inlets, an emergency overflow channel designed to convey the major storm runoff must be provided in case the inlet becomes clogged. The emergency overflow channel shall be contained within a drainage tract or easement. If the sump inlet is designed to intercept the major storm event, the emergency overflow channel does not need to meet maximum velocity requirements. If the sump inlet is not designed to intercept the major storm event, the emergency overflow channel must meet the requirements in Section 815.01 Open Channels of these STANDARDS and SPECIFICATIONS.

Computations for storm sewer design and storm inlet designs shall be submitted on forms similar to those included in these specifications for acceptance, or computer model or spreadsheet generated results tables. Adequate details of the proposed storm sewer system, including plan and profile, details of inlets, manholes and other appurtenances shall be included in the overall drainage plan submitted for acceptance.

The storm sewer outlet shall be protected for the major storm event. The protection shall be designed as set forth in the Urban Storm Drainage Criteria Manual.

815.04 Culverts

Culvert capacities shall be at least equal to the capacities of culverts designed in accordance with the procedures outlined in the Urban Drainage Storm Criteria Manual. Culverts may be of any shape and construction required by existing topographic features, provided, however, the size, shape, location, and type of construction of culverts shall be subject to acceptance by the Town Engineer.

Culverts installed under local and collector streets shall be designed to pass at least the 10-year storm event. Culverts installed under arterials shall pass at least the 100-year storm event.

Culverts under principal arterials shall have sufficient capacity to pass all of the runoff from the major storm considering a minimum of twenty percent (20%) of the inlet plugged. Higher percentages may be required based on site-specific considerations.

Overtopping of culvert installations due to plugging must be analyzed for the 100-year storm event. The overtopping depth due to plugging must be less than one foot.

The following design criteria shall be utilized for all culvert designs:

- A. The culvert, including inlet and outlet structures, will properly take care of water, bed load and debris at all stages of flow.
- B. Inlets: Culvert inlets shall be designed to minimize entrance and friction losses. Inlets shall be provided with either flared-end sections or head walls with wing walls. Projecting ends will not be acceptable. For large structures, provisions shall be made to resist possible structural failure due to hydrostatic uplift forces.
- C. Outlets: Culvert outlets shall be designed to avoid sedimentation, undermining of culvert, or erosion of downstream channels. Outlets shall be provided with either flare-end sections or headwalls, with wingwalls and riprap or grouted boulders. Projecting outlets will not be acceptable. Outlet protection shall be designed according to the Urban Storm Drainage Criteria Manual or a method acceptable to the Town Engineer.
- D. Slopes: Culvert slopes shall be such that neither silting nor excessive velocities nor scour occur.
- E. Excessive ponding above culvert entrances will not be acceptable if such ponding appears likely to cause property or roadway damage, culvert clogging, saturation of fills, detrimental upstream deposits of debris, or inundate existing or future utilities and structures.
- F. Tailwater: The height of tailwater at the outlet shall be considered by the culvert outlet control analysis and will be subject to acceptance by the Town Engineer.
- G. Hydraulic Design: Culverts shall be analyzed to determine whether discharge is controlled by inlet or outlet conditions for both the initial storm discharge and the major storm discharge. The value of the roughness coefficient (n) used shall not be less than those specified in Section 815.01, Table 800-5 of these STANDARDS AND SPECIFICATIONS. Computations for selected culvert sizes shall be submitted for approval on forms similar to those included in these specifications, or computer model or spreadsheet generated results tables.
- H. Minimum Allowable Size: The required size of the culvert shall be based on adequate hydraulic design analysis. In no case shall approval be made for round culverts with less than an eighteen (18) inch inside diameter.
- I. Multiple Culvert Installations: Where physical conditions dictate, multiple culvert installations will be acceptable, subject to approval by the Town Engineer. Headwalls shall be used with multiple culvert installations. The minimum size of any culvert shall not be less than the requirements set forth in Section 815.03, Table 800-10 of these STANDARDS AND SPECIFICATIONS.
- J. Structural Design: The structural design of culverts shall conform to those methods and criteria recommended by the manufacturer of a specific type of culvert for the specified embankment conditions. Where appropriate, the applicable provisions of Section 815.02 of these STANDARDS AND SPECIFICATIONS will also apply to the design of culverts.

815.05 Stormwater Quality

Applicable development projects are encouraged to approach water quality planning utilizing the four-step approach outlined in Volume 3 of the Urban Storm Drainage Criteria Manual. The four steps aim for a comprehensive approach to stormwater quality by 1) reducing the amount of site runoff by employing runoff reduction practices; 2) implementing permanent CMs that provide water quality capture volume (WQCV) with slow release; ; 3) stabilizing streams; and, 4) implementing site specific source control permanent CMs.

All applicable development projects subject to the requirements of these STANDARDS AND SPECIFICATIONS must provide for water quality, unless exempted by the Town's MS4 permit, through permanent CMs. Please refer to the Urban Storm Drainage Criteria Manual (Volume 3) for guidance on selection, use and design of BMPs. Justification for the selection of one of the allowed base design standards must be included in the Phase III Drainage Report, including any allowable exclusions.

Permanent CMs shall meet one of the following base design standards listed below:

- Water Quality Capture Volume (WQCV) – this standard can be achieved through the treatment or infiltration of the WQCV. When utilizing this standard, sites must provide treatment for the entire new development or redevelopment. Some areas may be excluded from treatment when justified that a portion of the site cannot practically drain to the permanent CM (such as driveway access, perimeter sidewalks, or tree lawns). In addition, the excluded area may not be more than 20% of the site, not to exceed one acre.
- Pollutant Removal Standard – this standard can be achieved through treating stormwater runoff in a manner expected to reduce the mean concentration of total suspended solids (TSS) to a median value of 30 mg/L or less for the 80th percentile storm event, at a minimum. When utilizing this standard, sites must provide treatment for the entire new development or redevelopment. Some areas may be excluded from treatment when justified that a portion of the site cannot practically drain to the permanent CM (such as driveway access, perimeter sidewalks, or tree lawns). In addition, the excluded area may not be more than 20% of the site, not to exceed one acre.
- Runoff Reduction Standard – this standard can be achieved through the infiltration, evaporation or evapotranspiration of 60% of the sites WQCV, with the WQCV assuming all of the impervious area for the site discharges to infiltration. When utilizing this standard, additional soils analysis and recommendations from a geotechnical engineer are required to demonstrate that site geology and other factors allow appropriate infiltration to occur.
- Regional WQCV Control measure – this standard can be achieved through the treatment or infiltration of the WQCV. Stormwater from the site must not discharge to a water of the state before being discharged to the regional WQCV control measure.
- Regional WQCV Facility – this standard can be achieved through the treatment or infiltration of the WQCV. Stormwater from the site may discharge to water of the state before being discharged to the regional WQCV facility. In order to utilize this treatment option, the following apply:
 - Before discharging to waters of the state, at least 20% of the upstream imperviousness of the applicable development site must be disconnected and drain through a receiving pervious area comprising at least 10% of the upstream disconnect impervious area.
 - The facility must be implemented, functional, and maintained following good engineering, hydrologic and pollution control practices.

- The facility must be designed and maintained for 100% WQCV for its entire drainage area and have the capacity to accommodate the drainage from the applicable development site.
- The facility must be designed and implemented with flood control or water quality as the primary use. Waterbodies listed by name in surface water quality classifications and standards regulations (5 CCR 1002-38) may not be considered regional WQCV facilities.
- Constrained Redevelopment Site – This standard may be utilized if the redevelopment is greater than 75% impervious AND the Town of Firestone has determined that is it not practicable to meet any of the previous listed base design standards. Constrained Redevelopment Site permanent CMs must be designed to meeting one of the following:
 - Provide WQCV for at least 50% of the impervious area of the site.
 - Provide treatment for the 80th percentile stormwater event, where the CM is designed to treat stormwater runoff in a manner expected to reduce the even mean concentration of TSS to a median value of 30 mg/L or less. Additionally, a minimum of 50% of the applicable development area including 50% or more of the impervious area shall drain to the CM. This standard does not require that 100% of the applicable development site be directed to the CM as long as the overall goal is met or exceeded, or
 - Provide Runoff Reduction through infiltration, evaporation, or evapotranspiration, for a quantity of water equal to 30% of what the calculated WQCV would be if all impervious area for the site discharged without infiltration.

820.00 GENERAL PROVISIONS**821.00 General**

All storm drainage construction in the Town rights-of-way shall be accomplished in accordance with these STANDARDS AND SPECIFICATIONS, and these standards will cover not only new storm drainage construction but also repairs and maintenance of the existing facilities within the Town.

Water, sanitary sewer and storm sewer lines shall have a minimum horizontal separation of ten (10) feet. When a ten (10) foot separation is not provided or when sewer and storm sewer lines cross water lines with less than one and one-half (1½) feet of vertical separation, sewer and storm sewer line joints shall be concrete encased. For perpendicular crossings, encased joints shall extend ten (10) feet, perpendicular to the water line in both directions.

822.00 Accepted Plans

All storm drainage construction shall be done in accordance with engineered construction plans for the work, prepared under the direction of a Registered Professional Engineer licensed to practice in Colorado. Plans will conform to the Town's Design Criteria and must be accepted by the Town Engineer. Storm drainage plans will include an Area Grading Plan and an Erosion Control plan as defined in Section 161.00 of these STANDARDS AND SPECIFICATIONS.

Where work is to be done on an irrigation ditch, the written approval of the ditch owner is required prior to acceptance by the Town Engineer.

823.00 Permits Required

The Town Engineer will require a public improvement permit. Refer to Section 622.00, Permits Required, of these STANDARDS AND SPECIFICATIONS for additional requirements.

824.00 Maintenance of Traffic

Maintenance of traffic shall comply with Section 623.00, Maintenance of Traffic, of these STANDARDS AND SPECIFICATIONS.

830.00 EROSION CONTROL**831.00 General**

Erosion and sedimentation are natural processes, the intensity of which are increased by land disturbing activities that reduce or destroy the aesthetic and practical values of neighboring properties, streams and lakes. The purpose of these erosion criteria is to reduce intensified erosion, caused by either wind or water, to an acceptable level without placing undue burdens on the landowner, builder or community.

832.00 Requirements

Erosion control measures shall be designed in conformance with Urban Storm Drainage Criteria Manual. All land-disturbing activities within the Town of Firestone shall be in compliance with applicable Colorado Discharge Permit System (CDPS) and Colorado Air Quality Control Commission regulations to protect stormwater.

833.00 Submittal

A discussion summarizing erosion control methods shall be submitted as part of the preliminary and final drainage reports as required in Section 162.00 of these STANDARDS AND SPECIFICATIONS. A detailed erosion control plan must accompany the Area Grading Plan and approved Drainage Plan as required in Section 161.09 of these STANDARDS AND SPECIFICATIONS. The erosion control plan must be submitted to, and accepted by the Town of Firestone Public Engineering Division prior to receiving a grading permit.

834.00 Erosion Control Measures

Detailed erosion control measures must be provided to protect the following:

- A. Inlets and culverts
- B. Drainageways
- C. Streams or other water bodies that are immediately adjacent to land disturbed by construction activity.
- D. Cut and fill areas where exposed soil exists.
- E. Properties and improved streets adjacent to construction activity.
- F. Other as required by the Town Engineer.

Temporary erosion control measures such as sediment traps, hay bales or silt fences must be properly placed in accordance with the accepted Stormwater Management Plan (SWMP) prior to any earthmoving on site. Erosion control measures shall be kept in good repair and fully functional until the erosion potential from the site no longer exists. Permanent erosion control (sod, seed, mulching, etc.) will be in place prior to the request for a Certificate of Occupancy.

A water truck shall be kept on-site at all times during land disturbing activities to control wind erosion and dust.

835.00 Erosion Control Structures

Standard details and specifications are provided in the Standard Drawings. When applicable, details of additional erosion control measures should be obtained from the Urban Storm Drainage Criteria Manual.

840.00 STORM DRAINAGE CONSTRUCTION**841.00 Site Work and Earthwork**

841.01 General

Site work and earthwork shall be performed in accordance with Section 300.00, Site Work and Earthwork, of these STANDARDS AND SPECIFICATIONS.

841.02 Trenching, Backfilling and Compacting

Trenching, backfilling and compacting shall be performed in accordance with Section 350.00, Trenching, Backfilling and Compacting, of these STANDARDS AND SPECIFICATIONS.

841.03 Preservation of Monuments

Refer to Section 141.00, Protection of Public and Utility Interests, of these STANDARDS AND SPECIFICATIONS.

842.00 Materials

842.01 Pipe

Reinforced concrete pipe (RCP): shall be manufactured in accordance with ASTM C-76. All applicable portions of Section 706, Concrete and Clay Pipe, of the CDOT Standard Specifications for Road and Bridge Construction shall apply. Rubber gasket joints shall be in accordance with ASTM C443.

Polyvinyl Chloride Pipe (PVC): shall be manufactured in accordance with ASTM F794. All applicable portions of Section 712.13, Plastic Pipe, of the CDOT Standard Specifications for Road and Construction shall apply. Use of PVC within the right-of-way is not allowed.

High-density polyethylene pipe (HDPE): shall be manufactured in accordance with ASTM D3350, ASTM D4976, ASTM F667, ASTM F894, ASTM F2306, and ASTM F2562. Requirements for test methods, dimensions and markings shall comply with AASHTO Designation M-294. Use of HDPE within the right-of-way is not allowed.

Couplings shall be corrugated to match the pipe corrugations (to be fabricated by the pipe manufacturer) and the width shall not be less than one-half (1/2) the nominal diameter of the pipe. Split couplings shall be manufactured to engage an equal number of corrugations on each side of the pipe joint. Where required by the Town Engineer, a mastic type gasket will be utilized. A manufacturer's certification that the product was manufactured, tested and supplied in accordance with this specification shall be furnished upon request of the Town Engineer.

Pipe class designation or gauge shall be as shown on the accepted plans or as designated by the Town Engineer for each individual project. Pipe material shall be chosen based on strength and soil conditions. At no time shall high-density polyethylene pipe (HDPE) be allowed under roadways.

All pipe shall be inspected by the Town Engineer to allow for rejection of pipe that fails to conform to the requirements of these STANDARDS AND SPECIFICATIONS. Defects will be marked so as not to disfigure the rejected pipe. Rejected pipe will be removed from the job site within 24 hours.

842.02 Pipe Joints

Pipe joints shall be constructed as designated on the accepted construction plans or as otherwise accepted by the Town Engineer. Rubber gasket joints for concrete pipe will conform to ASTM C-443. Corrugated metal pipe joints will be installed according to pipe manufacturer's recommendations. Cement mortar joints will be constructed with mortar mixture composed of one (1) part Portland cement to three (3) parts sand and enough water to produce a workable mix. Mortar that has started to set will be discarded and a new batch prepared.

842.03 Manholes, Inlets and Sidewalk Chases

Manholes and inlets may be constructed of cast-in-place or precast concrete. Concrete precast reinforced risers and tops must conform to ASTM Designation C-478 except that wall thickness may be either wall "A" or wall "B" as described in ASTM Designation C-76. Manholes shall conform to details shown on the Standard Drawings unless otherwise approved by the Town Engineer. Cones will be of the eccentric type.

The top of the manhole vault shall be a minimum of twelve (12) inches and a maximum of eighteen (18) inches below the finished street or ground surface elevation. Concrete extension risers or collars shall be used to bring the manhole ring and cover up to finished street or ground surface elevation.

Manhole rings and covers (all traffic covers shall be designed for H-20 traffic loading):

- A. Twenty-four (24) inch manhole rings and covers; cover weight = approximately one hundred sixty-five (165) pounds, ring weight = approximately two hundred forty (240) pounds.
- B. Twenty-four (24) inch by thirty-six (36) inch double ring and cover (36" cover with auxiliary 24" opening and cover);
36" cover weight = approximately two hundred fifty (250) pounds.
24" cover weight = approximately one hundred sixty five (165) pounds.
36" ring weight = approximately two hundred eighty (280) pounds.
- C. Manholes located in drainage ways, floodplains, near roadway sump conditions, or as otherwise directed shall be fitted with water tight lids with hinges and locking devices. Bolted manhole lids are not acceptable. A submittal detailing the water tight lid to be used must be accepted by the Town.

Steps shall have a minimum tensile strength of 38,000 psi, minimum yield strength of 35,000 psi, and have an elongation of not less than ten percent (10%) in two (2) inches. Without permanent deformation, steps must carry a load of one thousand (1,000) pounds when projected six (6) inches from the wall and fifteen hundred (1,500) pounds when projected four (4) inches from the wall. Steps shall be one-half (1/2) inch diameter steel-reinforcing rods completely encapsulated in Copolymer

Polypropylene as manufactured by M.A. Industries, Inc. or an approved equal. Steps shall be spaced as shown on the Standard Drawings. All manhole steps shall be cast into the manhole barrel when the manhole is poured. The maximum distance from the finished ground (street) surface to the first step shall be twenty-four (24) inches.

Mortar for manholes shall be mixed in the following proportions by volume: One (1) part Portland cement; one-half (1/2) part hydrated lime; and three (3) parts sand or masonry cement. The cement, lime, and sand will be thoroughly mixed dry and only enough water added to form a mortar of proper consistency. Mortar shall be used within one (1) hour after mixing with no retempering permitted. Mortar that has taken a partial set is prohibited from use.

Inlets shall conform to the Standard Drawings and to applicable Colorado Department of Transportation "M" Standards. All lids for inlets shall have the words "No Dumping – Drains to River" and "Storm Sewer".

Sidewalk chase drains are allowed and shall conform to the standard drawings.

842.04 Manhole Base Slabs & Base Beams

Manhole base slabs may be poured in place or precast. Where possible, inverts will be the PVC pipe with the top half cut out. The slab shall be designed to uniformly support the earth load and any other reasonable loads that may occur. The minimum slab thickness shall be six (6) inches. The minimum reinforcement will be #4 Rebar grid on one (1) foot centers.

If required, manhole base beams shall be precast, reinforced concrete. The beams shall be twelve (12) inches wide by nine (9) inches deep by eight (8) feet long.

The reinforcement shall consist of three (3) No. 5 bars longitudinally and No. 4 bars at twelve (12) inch centers transversely.

842.05 Concrete

Concrete shall conform to Section 400.00, Concrete Work, of these STANDARDS AND SPECIFICATIONS, for Portland cement concrete work. Type II cement will be used. Concrete encasement of pipe will conform to the details shown on the accepted plans.

842.06 Cast Iron Fittings

All cast iron manhole rings and covers, and other iron castings must be made of tough gray pig iron conforming to ASTM Designation A-48 and shall be free from cracks, holes, swells, and cold shuts, and will have a smooth workman-like finish. Fittings shall be hot dipped in asphalt varnish in such a manner as to form a firm and tenacious coating. Fittings shall conform to details shown on the Standard Drawings unless otherwise approved by the Town Engineer. Cast iron manhole rings and covers shall have a combined weight of between three hundred (300) and four hundred (400) pounds. All metal bearing surfaces between the ring and cover will be machined or fabricated to insure good seating. Manhole lids shall be provided with non-slip pattern in surface that lies flush with the elevation of the ring. Lids shall be furnished with the word "STORM" cast on top with a confined space warning in accordance with the Standard Drawings.

842.07 Bedding Material

Bedding for storm sewer mains shall meet the gradation of CDOT “No.67 Coarse Aggregate” as specified in Section 703.02 in the latest edition of the CDOT “Standard Specifications for Road and Bridge Construction”. Reference the Storm Sewer Trench Detail for further detail. All applicable portions of Section 352.00, Bedding for Pipelines and Service Lines, of these STANDARDS AND SPECIFICATIONS, shall apply.

842.08 Riprap and Filter Cloth

Riprap and filter cloth shall be installed at those locations noted on the accepted plans, or in locations designated by the Town Engineer. Riprap and bedding shall meet the standards set forth in the Urban Storm Drainage Criteria Manual.

842.08.01 Riprap

Rock used for riprap shall be hard, durable, angular in shape, and be free from cracks, overburden, shale and organic matter. Neither breadth nor thickness of single stone shall be less than one-third (1/3) its length and rounded stone will not be accepted except when used for mixing void-filled riprap per the USDCM requirements. The rock shall sustain abrasion test (Los Angeles machine - ASTM C0535-69) and shall sustain a loss of not more than ten percent (10%) after twelve (12) cycles of freezing and thawing (AASHTO test 103 for ledge rock procedure A). The rock shall have a minimum specific gravity of 2.50. Classification and gradation for riprap are shown in Table 800-14.

The riprap designation and total thickness of riprap shall be as shown on the accepted plans. The maximum stone size shall not be larger than the thickness of the riprap.

**TABLE 800-14
CLASSIFICATION AND GRADATION OF RIPRAP**

Riprap Designation	% Smaller Than Given Size By Weight	Intermediate Rock Dimension (Inches)	d(50)* (Inches)
Type VL	70-100	12	
	50-70	9	
	35-50	6	6**
	2-10	2	
Type L	70-100	15	
	50-70	12	
	35-50	9	9**
	2-10	3	
Type M	70-100	21	
	50-70	18	
	35-50	12	12
	2-10	4	
Type H	70-100	30	
	50-70	24	
	35-50	18	18
	2-10	6	
Type VH	70-100	42	
	50-70	33	

Riprap Designation	% Smaller Than Given Size By Weight	Intermediate Rock Dimension (Inches)	d(50)* (Inches)
	35-50	24	24
	2-10	9	

*d(50) = Mean rock size

** Bury Types VL and L with native topsoil and re-vegetate to protect from vandalism.

842.08.02 Filter Cloth

Filter cloth shall be manufactured especially for the stability of erosion control construction and made from polyethylene, polypropylene or polyester yarns in accordance with the following:

- | | | | |
|----|-------------------------|-------------------|------------|
| A. | Weight | 3.9 oz/yd | ASTM D1910 |
| B. | Thickness | 15 mils | ASTM D1777 |
| C. | Grab Strength | 130 lbs | ASTM D1682 |
| D. | Elongation Break | 60% | ASTM D1682 |
| E. | Mullen Burst Strength | 140 psi | ASTM D3786 |
| F. | Puncture Strength | 40 lb | ASTM D751 |
| G. | Trapezoid Tear Strength | 60 lb | ASTM D751 |
| H. | Equivalent Opening Size | 70-100 U.S. Sieve | CW 02215 |

842.08.03 Filter Material

The filter material that shall be placed on top of the filter cloth (at specified thickness) prior to placement of the riprap shall meet the requirements of "Stabilization Material" as defined in Section 340.01, Definitions, of these STANDARDS AND SPECIFICATIONS.

When requested by the Town Engineer, the Contractor shall furnish copies of tests from a certified and acceptable testing laboratory for the following:

- A. Gradation and soundness of rock for riprap and boulders
- B. Gradation of filter material
- C. Strength and characteristic tests for filter cloth

843.00 **Installation**

Refer to Section 733.01, General, of these STANDARDS AND SPECIFICATIONS.

843.01 Alignment and Grade

Storm sewers and structures appurtenances shall be constructed accurately to the line and grade as shown on the accepted plans. Construction stakes shall be placed by field parties under the direct supervision of a Registered Professional Land Surveyor licensed to practice in the State of Colorado.

The grade and alignment of the storm sewer will be determined and maintained by the use of a string line, parallel to the sewer supported above the ground on grade boards spaced not more than thirty (30) feet apart and rigidly anchored to and supported by substantial posts driven into the ground.

The boards will be straight and true with a minimum size of the boards of two (2) inch by six (6) inch. Where possible, not less than three (3) boards will be installed and maintained in proper position at any one time as a check on the accuracy of the grade line. If the Town Engineer approves double string lines, there will be a minimum of three (3) feet six (6) inches between strings.

The grade and alignment may also be determined by use of suitable surveying instruments (checking the invert of each piece of pipe) or laser equipment, operated continuously during the construction.

"As-built" drawings, as described in Section 161.00, Construction Plan Requirements, of these STANDARDS AND SPECIFICATIONS, shall be furnished to the Town Engineer.

843.02 Protection of Existing Underground Utilities

Refer to Section 733.03, Protection of Existing Underground Utilities, of these STANDARDS AND SPECIFICATIONS.

843.03 Wet Trench

Refer to Section 351.00, Trench Excavation for Pipelines and Service Lines, of these STANDARDS AND SPECIFICATIONS.

843.04 Handling Pipe and Fittings

Refer to Section 733.05, Handling Pipe and Fittings, of these STANDARDS AND SPECIFICATIONS.

843.05 Sewer Pipe Installation

Refer to Section 733.06, Sewer Pipe Installation, of these STANDARDS AND SPECIFICATIONS.

843.06 Connections to Existing Manholes

Refer to Section 733.07, Connections to Existing Manholes, of these STANDARDS AND SPECIFICATIONS.

843.07 Construction of Manholes, Inlets and Sidewalk Chases

Manholes and inlets shall be constructed in accordance with applicable portions of Section 733.08, Construction of Manholes, of these STANDARDS AND SPECIFICATIONS.

Refer to the Standard Drawings for manhole details, inlet details, and for sidewalk chase details. Inlets shall be per CDOT Construction Details or accepted by the Town of Firestone.

843.08 Construction of Open Channels and Special Structures

All work will conform to details shown on the accepted plans and whatever additional specifications are required. Construction will be accurately done to line and grade according to construction stakes as required by Section 843.01 of these STANDARDS AND SPECIFICATIONS.

When required, sidewalk chases will be constructed as detailed on the Standard Drawings.

843.09 Riprap and Filter Cloth

Excavation for riprap shall conform to all applicable portions of Section 300.00, Site Work and Earthwork, of these STANDARDS AND SPECIFICATIONS.

The Contractor shall complete the excavation in accordance with the accepted plans or as directed by the Town Engineer, then he shall place the filter cloth over the graded areas loosely enough so that any protrusions from underneath or applied bands to the cloth will not cause stretching of the cloth beyond elastic limits.

The outer edge of the filter cloth shall be folded vertically upward at the trench. All overlapping joints shall be a minimum of two (2) feet wide, with the upstream section overlapping the downstream portion. The overlapping joints shall be secured with staples at each edge of the adjoining sections of cloth, and spaced at two (2) foot intervals. The Contractor, at his expense, in accordance with the manufacturer's recommendations, shall repair any holes, rips or other damage to the filter cloth.

Stabilization material, as described in Section 340.01, Definitions, of these STANDARDS AND SPECIFICATIONS, shall be placed on top of the filter cloth (where filter cloth is used) to a thickness of six (6) inches. The material shall be placed using equipment, which will not rip, tear or otherwise damage the filter cloth. Any damaged areas shall be promptly repaired at the Contractor's expense. The material shall be screeded to give a finished surface, which is within one- (1) inch of the specified thickness.

Riprap shall be placed to conform to the details shown on the accepted plans. The larger size stones shall be placed first and roughly arranged in close contact. The toe trench and foundation course shall be closed first. The spaces between the larger stones shall then be filled with smaller stone of suitable size, so placed as to leave the surface evenly stepped, conforming to the contour required. The finished surface shall be even and tight and shall not vary from the planned surface by more than one-quarter (1/4) foot per foot of depth. The material may be machine placed with sufficient handwork to accomplish the requirements noted herein.

Where boulders are to be grouted, the boulders shall be laid with care to prevent earth and sand from filling the gaps between boulders. Grout must be removed from exposed rock for aesthetic purposes. Gaps shall be filled with grout and mechanical vibrators shall be used to insure all voids are filled. The surface shall be trowel finished. Concrete for the grout shall be an approved batch meeting the following requirements:

- a. All grout shall have a minimum 28-day compressive strength equal to 3,200 psi.
- b. One cubic yard of grout shall contain a minimum of six (6) sacks of Type II Portland cement.
- c. A maximum of 25% Type F Fly Ash may be substituted for the Portland cement.
- d. Aggregate for the grout shall consist of 70% natural sand (fines) and 30% 3/8-inch rock (coarse).
- e. Slump shall be four (4) inches to six (6) inches.
- f. Air entrainment shall be 5.5% - 7.5%.
- g. Grout shall contain one and one-half (1-1/2) pounds of Fibermesh, or approved equivalent, per cubic yard of grout.
- h. Color Additive in required amounts shall be used when so specified by contract.

Except when approved in writing by the Town Engineer, the Contractor shall not be permitted to grout boulders when the air temperature away from artificial heat falls below thirty-two degrees

Fahrenheit (32°F), and there is frost in the subgrade. When grouting is permitted during cold weather, the temperature of the mix shall not be less than fifty degrees Fahrenheit (50°F) at the time of placing. During hot weather conditions, the temperature of the mix shall not be more than ninety degrees Fahrenheit (90°F) at the time of placing. The Contractor shall not place filter cloth, stabilization material, or boulders on frozen ground. Blankets and heaters must be used to maintain a temperature between fifty degrees Fahrenheit (50°F) and seventy degrees Fahrenheit (70°F) for the required curing period. Concrete shall not be placed against forms exposed to heating unless the temperature of the forms is first cooled to less than or equal to ninety degrees Fahrenheit ($\leq 90^{\circ}\text{F}$).

843.10 Inspections

Initial Acceptance: Prior to initial acceptance the Contractor, at the Contractor's expense, will jet-vac the storm sewer and have the lines inspected with TV video equipment (a copy of the video tape and written report must be supplied to the Town). If, after visual inspection of the storm sewer system and video, the Town Engineer suspects that there is a problem, he may require that further tests shall be completed by the Contractor at the Contractor's expense. Should any inadequacies be found, the Contractor shall make repairs deemed necessary to correct the problem.

Final Acceptance: Prior to final acceptance the Contractor, at the Contractor's expense, will jet-vac the storm sewer and have the lines inspected with TV video equipment (a copy of the video tape and written report must be supplied to the Town). If, after visual inspection of the storm sewer system and video, the Town Engineer suspects that there is a problem, he may require that further tests shall be completed by the Contractor at the Contractor's expense. Should any inadequacies be found, the Contractor shall make repairs deemed necessary to correct the problem.

850.00 TRENCHING, BACKFILLING AND COMPACTING

Refer to Section 350.00, Trenching Backfilling and Compacting, of these STANDARDS AND SPECIFICATIONS.

860.00 RESTORATION AND CLEANUP

Refer to Section 360.00, Restoration and Cleanup, of these STANDARDS AND SPECIFICATIONS.

870.00 GRADING AND EXCAVATION

Refer to Section 330.00, Site Preparation, of these STANDARDS AND SPECIFICATIONS.

<u>DRAWING NO.</u>	<u>TITLE</u>
SW1	CURB AND GUTTER JOINT DETAIL
SW2	MONOLITHIC INTEGRAL CURBWALK
SW3	CONCRETE CROSS PAN
SW4A	DRIVE CUT – DETACHED WALK
SW4B	DRIVE CUT – ATTACHED WALK
SW5	CURB RAMP TYPE 1 ATTACHED WALK
SW6	CURB RAMP TYPE 2A ATTACHED WALK
SW7	CURB RAMP TYPE 4 DETACHED WALK
SW8	CURB RAMP TYPE 3 DETACHED WALK
SW9A	CURB RAMP MID BLOCK TYPE 1 DETACHED WALK
SW9B	CURB RAMP MID BLOCK TYPE 3 DETACHED WALK
SW9C	CURB RAMP MID BLOCK TYPE 2 ATTACHED WALK
SW10	MOUNTABLE CURB SECTION
SW11	VERTICAL CURB SECTION
SW12A	6" VERTICAL CURB, GUTTER AND DETACHED WALK
SW12B	6" MOUNTABLE CURB, GUTTER AND DETACHED WALK
SW13	SIDEWALK DESIGN STANDARDS

INDEX OF CURB, GUTTER AND SIDEWALK DETAILS



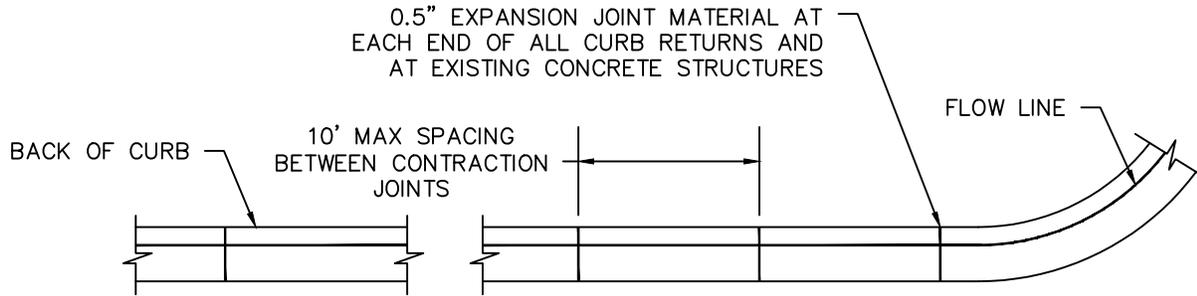
**CURB, GUTTER AND
SIDEWALK CONSTRUCTION
DRAWINGS**

BY: JME

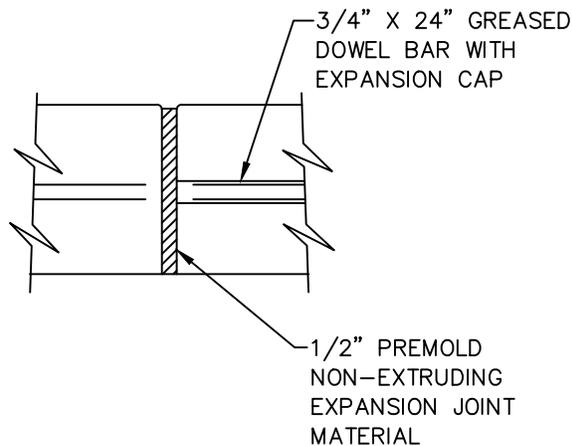
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DATE: 1/2020

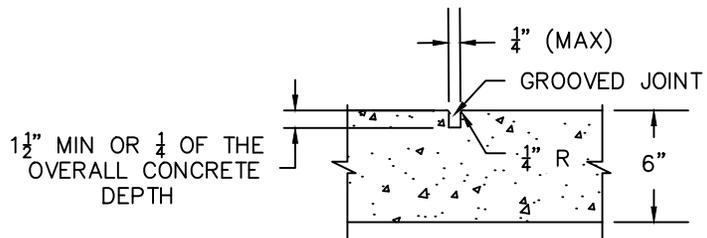
DRAWING:



LAYOUT



EXPANSION JOINT



JOINT SHALL BE TOOLED IN LIEU OF SAWCUTTING AT TIME OF RAMP INSTALLATION BEFORE CONCRETE HAS HARDENED.

CONTRACTION JOINT

NOTES:

1. EXPANSION JOINT MATERIAL SHALL BE NON-EXTRUDING AND RESILIENT TYPE TO MEET AASHTO SPEC. M-213.
2. ANY OVER-EXCAVATION SHALL BE REPLACED BY GRANULAR BACKFILL COMPACTED TO 95% MAXIMUM DRY DENSITY AS DETERMINED BY ASTM D-698.

CURB AND GUTTER JOINT DETAIL

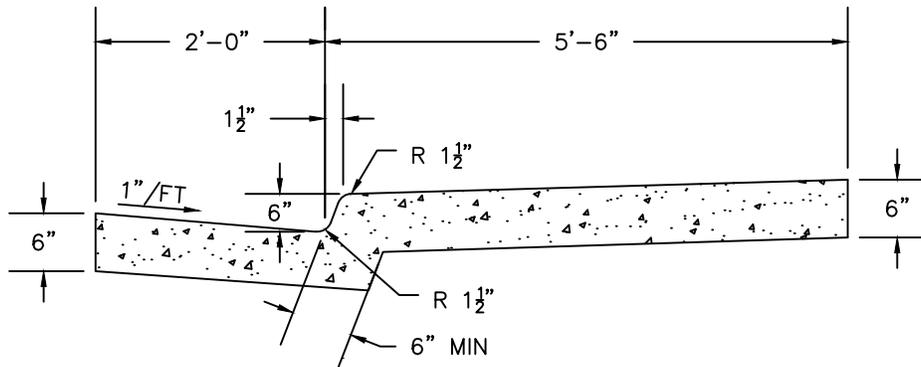


**CURB, GUTTER AND
SIDEWALK CONSTRUCTION
DRAWINGS**

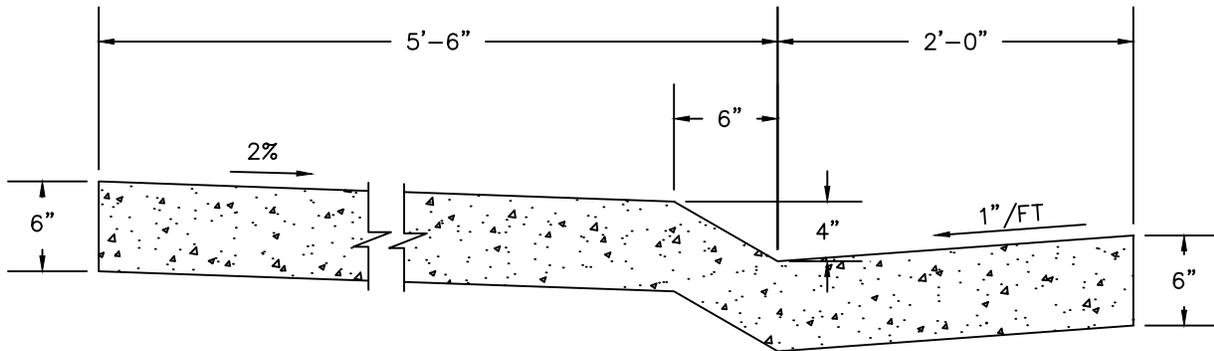
BY: JME
SCALE: NTS
DATE: 1/2020

DRAWING:

SW1



VERTICAL



ROLLOVER

NOTES:

1. EXPANSION JOINT MATERIAL SHALL BE NON-EXTRUDING AND RESILIENT TYPE TO MEET AASHO SPEC. M-213.
2. ANY OVER-EXCAVATION SHALL BE REPLACED BY GRANULAR BACKFILL COMPACTED TO 95% MAXIMUM DRY DENSITY AS DETERMINED BY ASTM D-698.
3. SEE DETAILS ON DRAWING SW1 FOR EXPANSION AND CONTRACTION JOINT DETAILS.
4. FOR USE IN RESIDENTIAL AREAS OR RESIDENTIAL COLLECTORS ONLY.

MONOLITHIC INTEGRAL CURBWALK

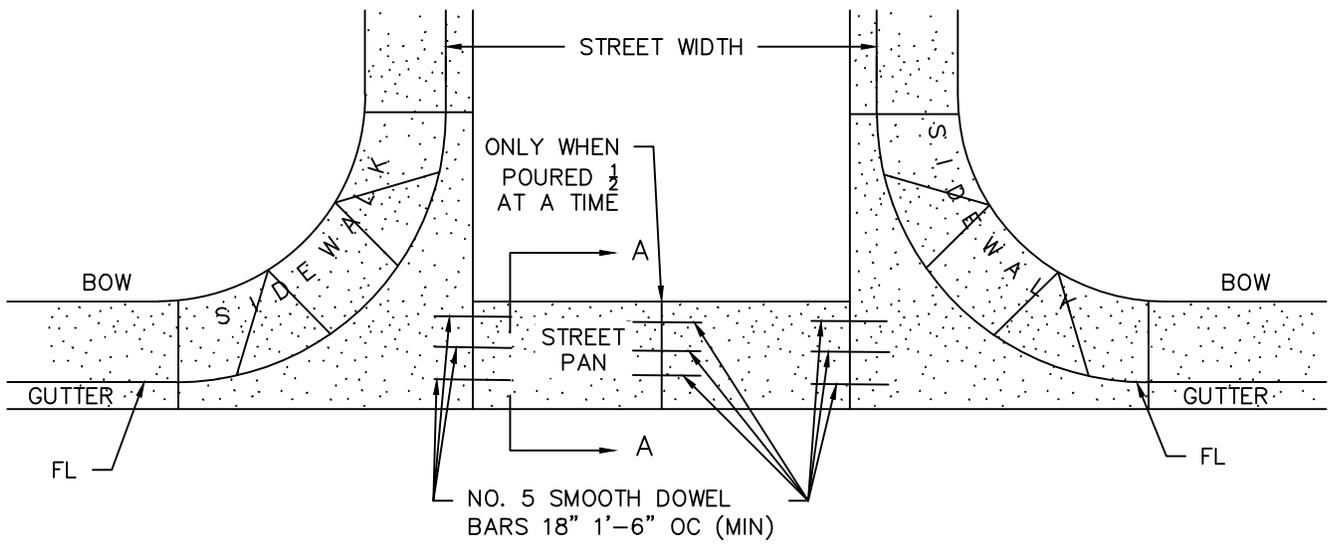


**CURB, GUTTER AND
SIDEWALK CONSTRUCTION
DRAWINGS**

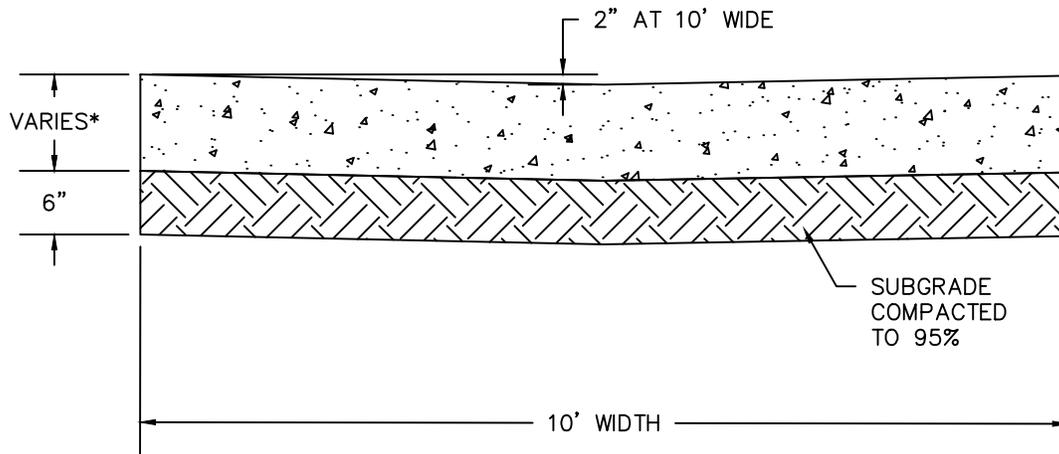
BY: JME
SCALE: NTS
DATE: 1/2020

DRAWING:

SW2



PLAN



SECTION A-A

VARIABLE*
8" - #4 @ 18" OC EACH WAY
10" - NO REBAR REQUIRED

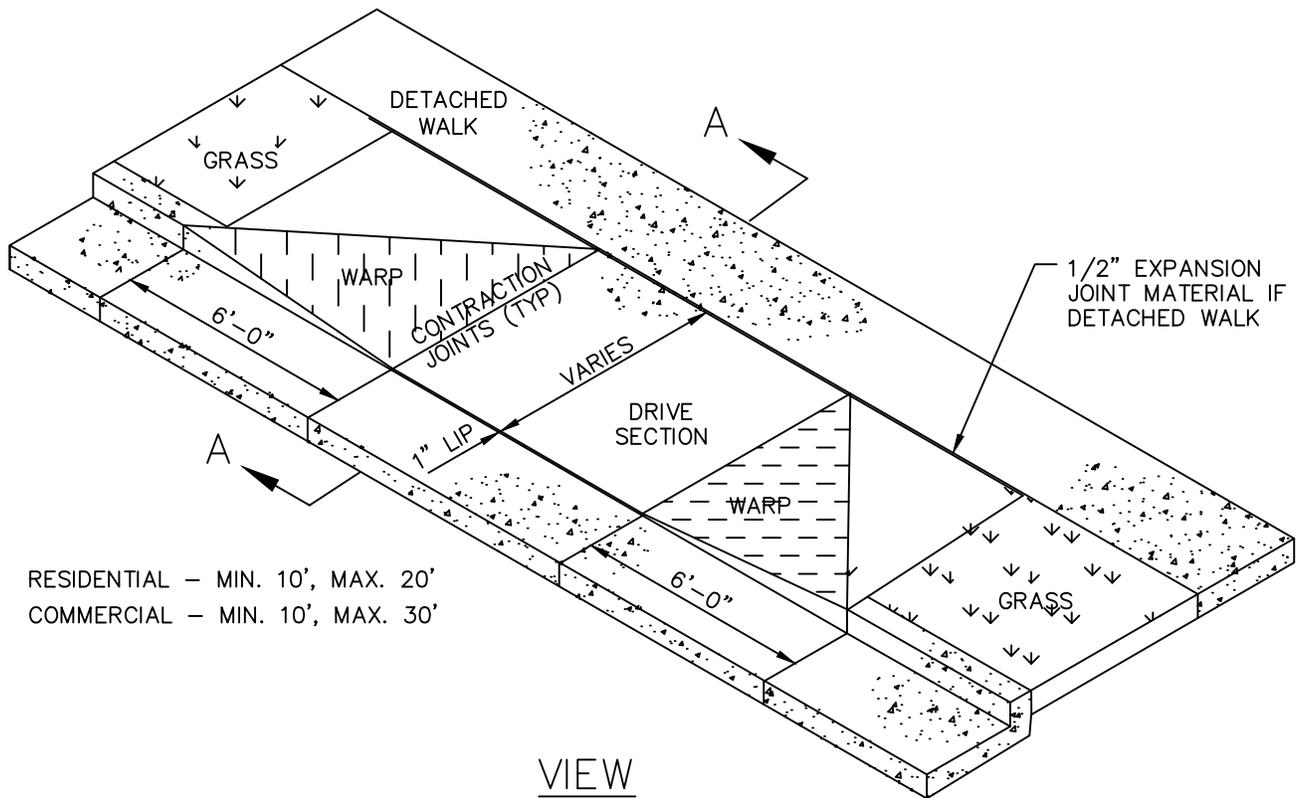
CONCRETE CROSS PAN



CURB, GUTTER AND
SIDEWALK CONSTRUCTION
DRAWINGS

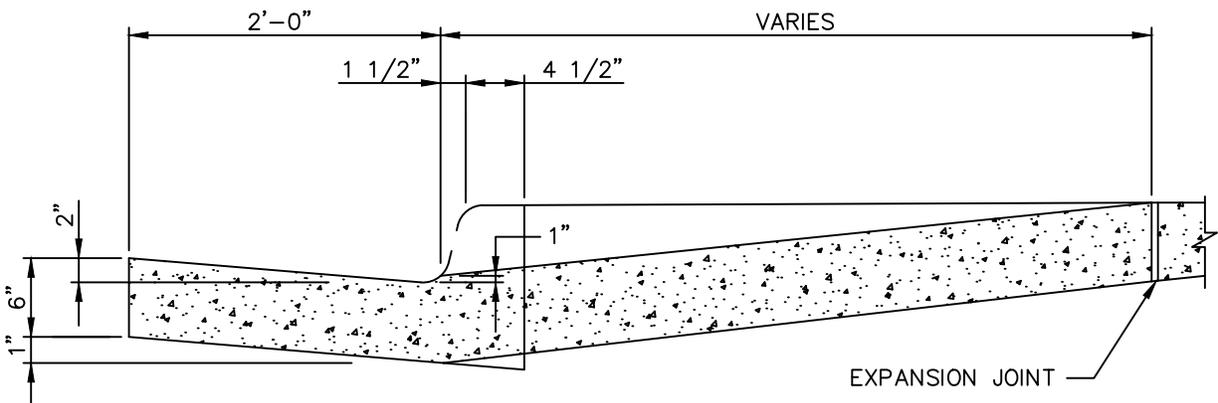
BY: NLH
SCALE: NTS
DATE: 07/2025

DRAWING:
SW3



RESIDENTIAL – MIN. 10', MAX. 20'
 COMMERCIAL – MIN. 10', MAX. 30'

VIEW



SECTION A-A

NOTES:

1. CONTRACTION JOINTS ARE REQUIRED AT EACH SIDE OF WARPED SECTION AND EVERY 10' ALONG THE DRIVE SECTION. SEE DETAILS ON DRAWING SW1 FOR CONSTRUCTION JOINT DETAILS.
2. CHAMFER FRONT EDGE OF CURB AND DRIVE SECTION AS SHOWN IN SECTION A-A.
3. SIDEWALK THICKNESS SHALL BE 6".

DRIVE CUT - DETACHED WALK

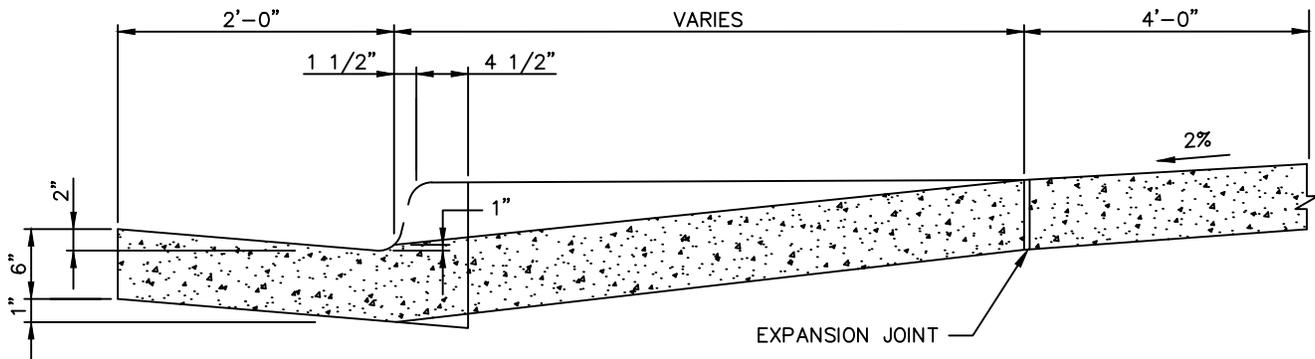
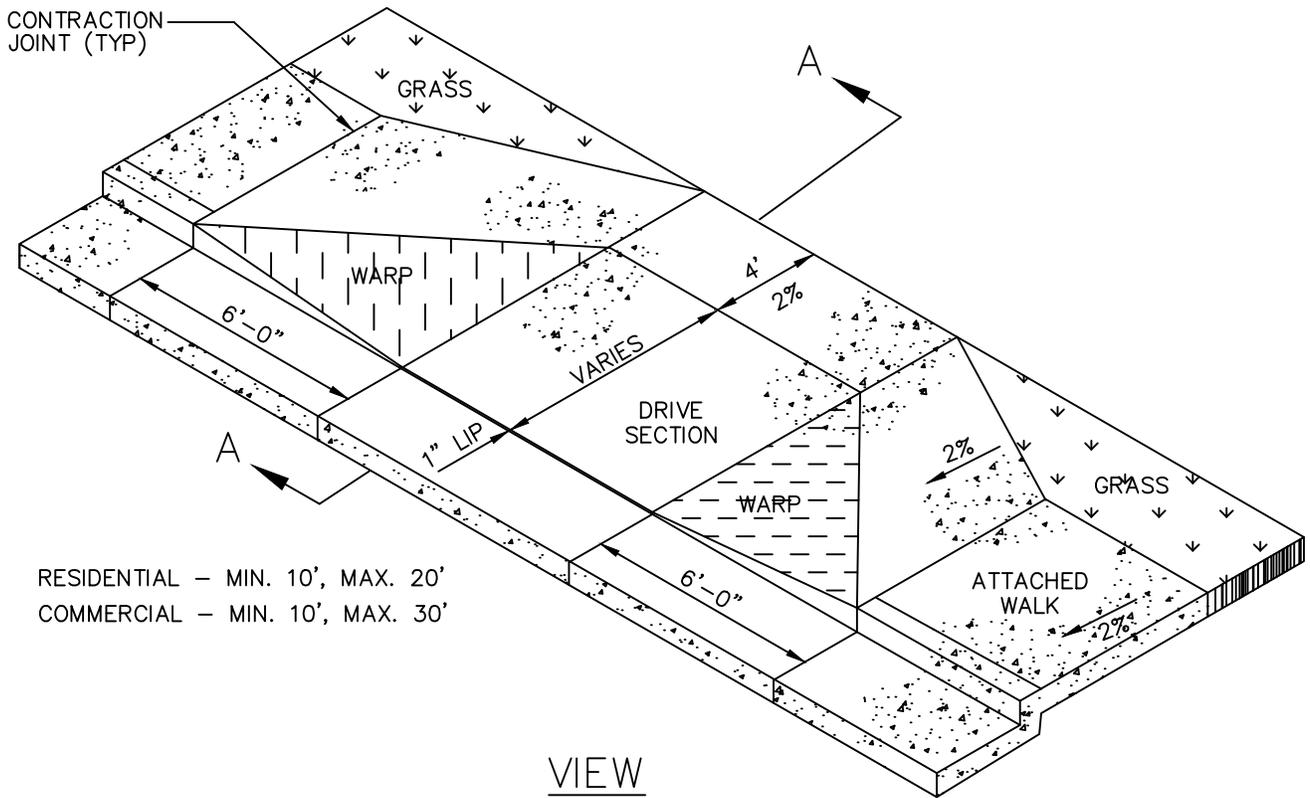


**CURB, GUTTER AND
 SIDEWALK CONSTRUCTION
 DRAWINGS**

BY: JME
 SCALE: NTS
 DATE: 1/2020

DRAWING:

SW4A



SECTION A-A

NOTES:

1. CONTRACTION JOINTS ARE REQUIRED AT EACH SIDE OF WARPED SECTION AND EVERY 10' ALONG THE DRIVE SECTION. SEE DETAILS ON DRAWING SW1 FOR CONSTRUCTION JOINT DETAILS.
2. CHAMFER FRONT EDGE OF CURB AND DRIVE SECTION AS SHOWN IN SECTION A-A.
3. SIDEWALK THICKNESS SHALL BE 6".

DRIVE CUT - ATTACHED WALK

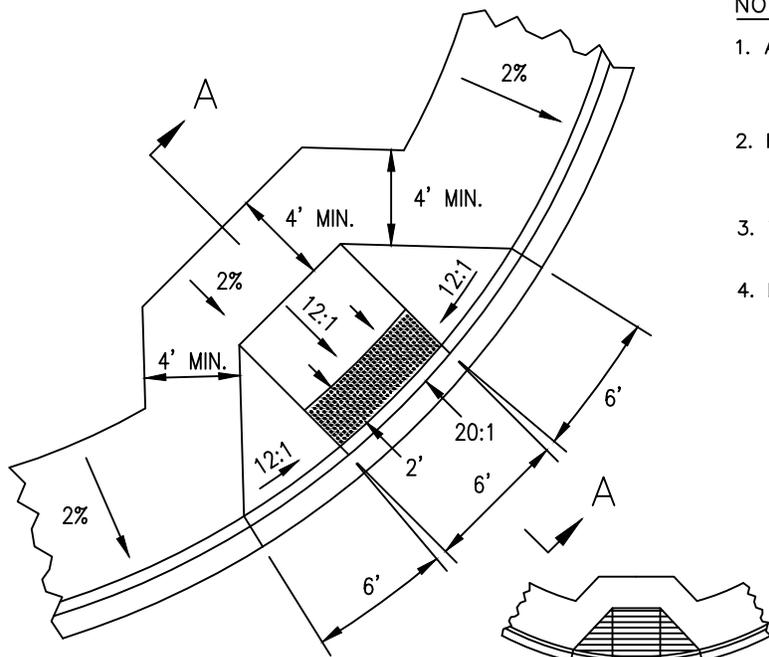


**CURB, GUTTER AND
SIDEWALK CONSTRUCTION
DRAWINGS**

BY: JME
SCALE: NTS
DATE: 1/2020

DRAWING:

SW4B

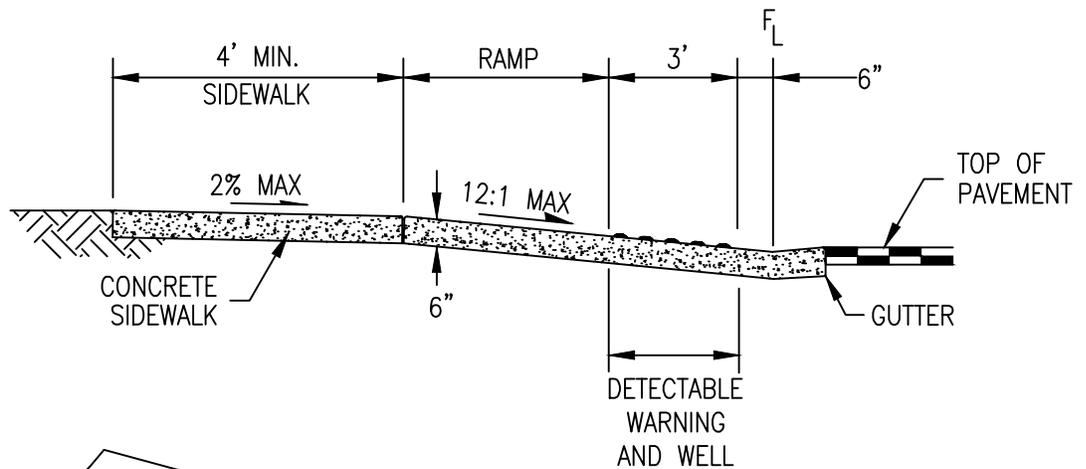


SIDEWALK RAMP TYPE 1A
PLAN

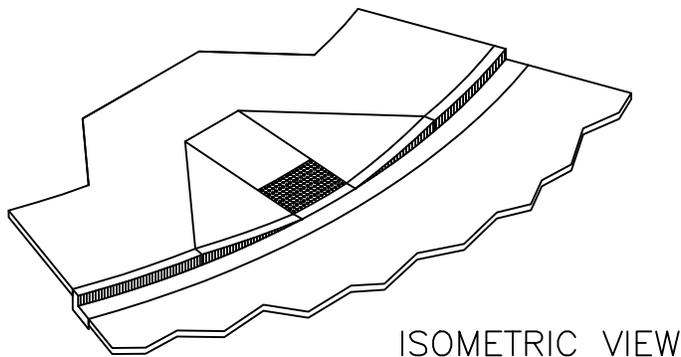
RAMP PAY AREA

NOTES:

1. AVOID PLACING DRAINAGE STRUCTURES, TRAFFIC SIGNAL EQUIPMENT, OR OTHER OBSTRUCTIONS IN FRONT OF RAMP ACCESS AREAS
2. RAMP SLOPES SHALL NOT BE STEEPER THAN 12:1. THE DETECTABLE WARNING AND WELL AREA SLOPES SHALL NOT BE STEEPER THAN 20:1.
3. THE RAMP AREA SHALL RECEIVE A COARSER BRUSH TREATMENT THAN THE SIDEWALK.
4. DETECTABLE WARNINGS SHALL BE EAST JORDON IRON WORKS 7005 SERIES DETECTABLE WARNING PLATES OR APPROVED EQUAL.



SECTION A-A



ISOMETRIC VIEW

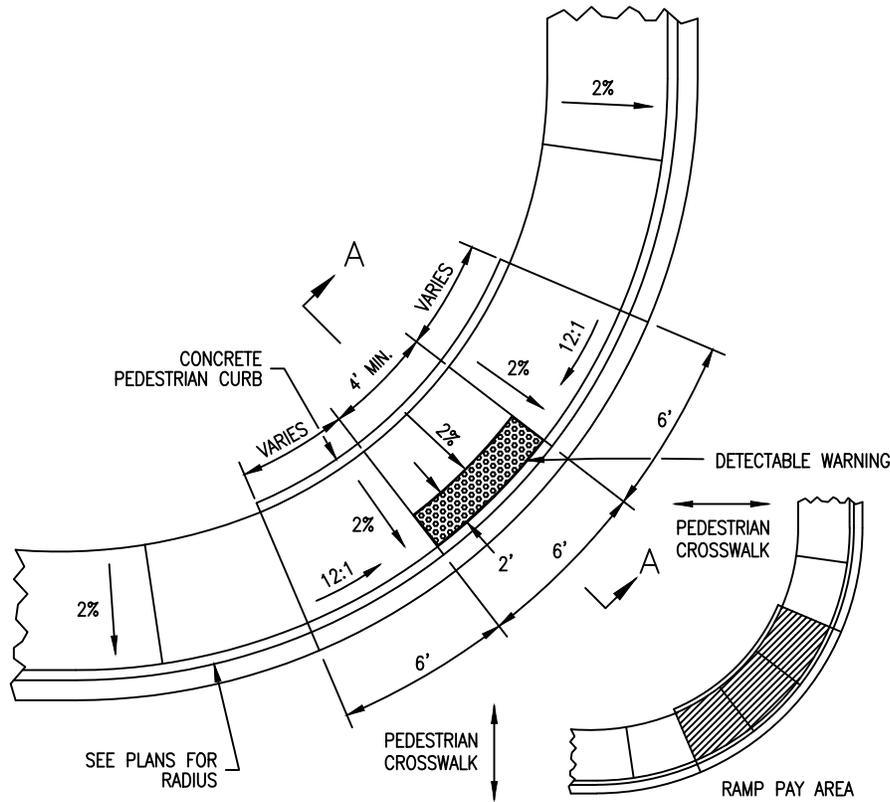
CURB RAMP TYPE 1 ATTACHED WALK



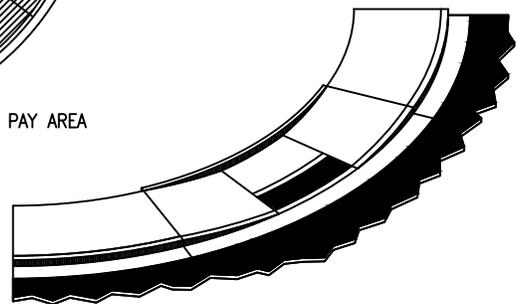
**CURB, GUTTER AND
SIDEWALK CONSTRUCTION
DRAWINGS**

BY: NLH
SCALE: NTS
DATE: 07/2025

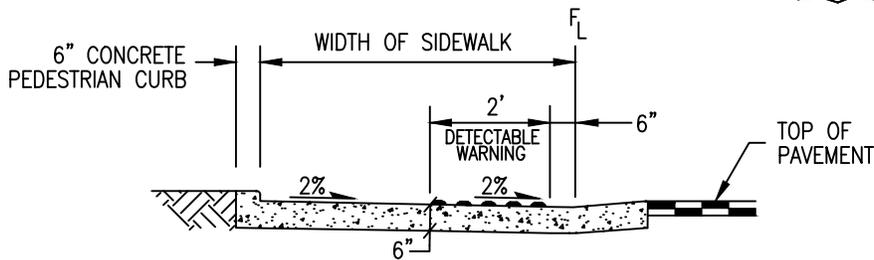
DRAWING:
SW5



SIDEWALK RAMP TYPE 2A
PLAN



ISOMETRIC VIEW



SECTION A-A

NOTES:

1. THE RAMP AREA SHALL RECEIVE A COARSER BRUSH TREATMENT THAN THE SIDEWALK.
2. AVOID PLACING DRAINAGE STRUCTURES, TRAFFIC SIGNAL EQUIPMENT, JUNCTION BOXES OR OTHER OBSTRUCTIONS IN FRONT OF RAMP ACCESS AREAS.
3. RAMP SLOPES SHALL NOT BE STEEPER THAN 12:1. THE DETECTABLE WARNING AREA SLOPE SHALL NOT BE STEEPER THAN 20:1.
4. CONSTRUCTION OF THE CONCRETE PEDESTRIAN CURB TO BE INCLUDED IN THE COST OF THE CURB RAMP.
5. DETECTABLE WARNINGS SHALL BE EAST JORDAN IRON WORKS 7005 SERIES DETECTABLE WARNING PLATES OR APPROVED EQUAL.

CURB RAMP TYPE 2A ATTACHED WALK

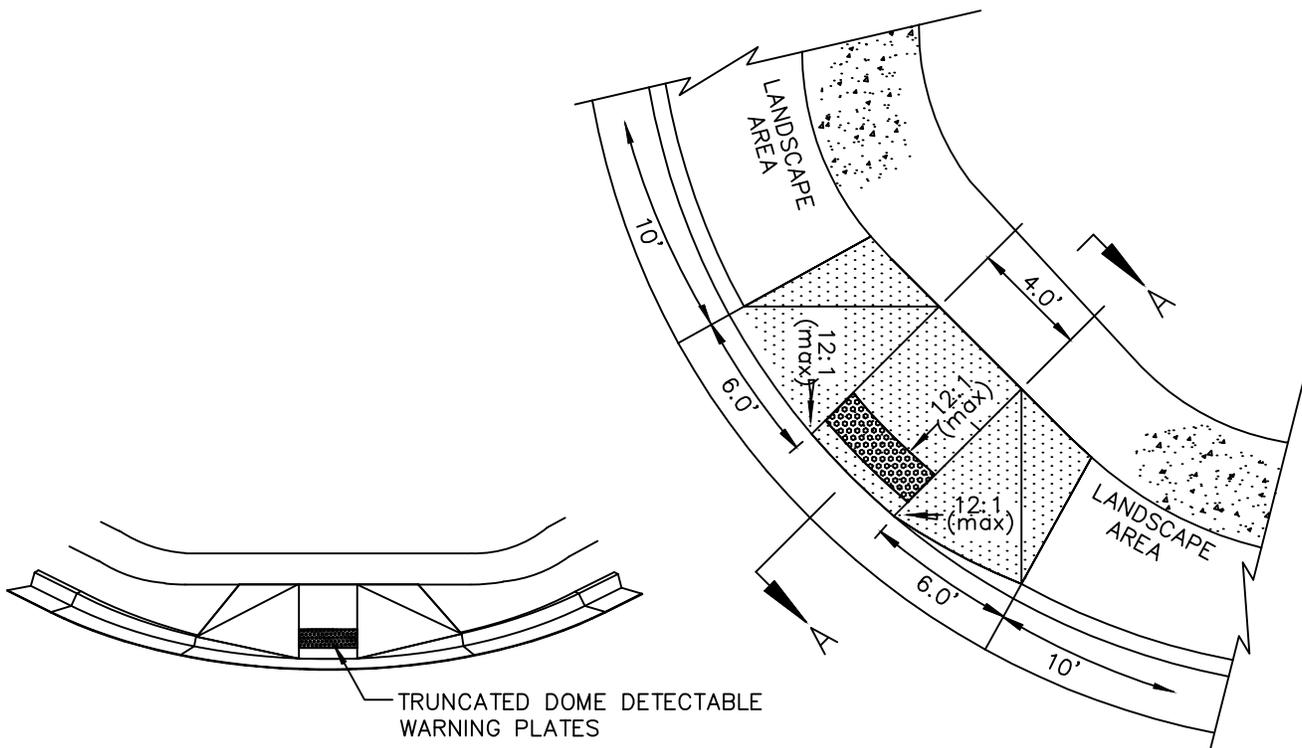


**CURB, GUTTER AND
SIDEWALK CONSTRUCTION
DRAWINGS**

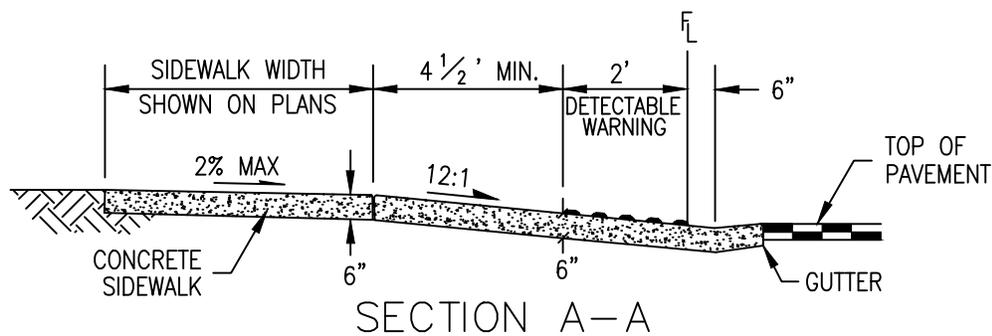
BY: JME
SCALE: NTS
DATE: 1/2020

DRAWING:

SW6



TRUNCATED DOME DETECTABLE WARNING PLATES



NOTES:

1. THERE SHALL BE NO LIP WHERE THE RAMP MEETS THE GUTTER.
2. CURB RAMPS SHALL BE PROVIDED AT ALL CORNERS OF STREET INTERSECTIONS AND AT "T" INTERSECTIONS WHERE THERE IS EXISTING OR PROPOSED SIDEWALK AND CURB.
3. RAMP SURFACE SHALL HAVE A COARSE BROOM FINISH.
4. CURB RAMPS SHALL BE POURED MONOLITHICALLY WITH THE CURB, GUTTER AND APRON.
5. RAMP DIMENSIONS SHALL BE SPECIFIED ON THE CONSTRUCTION PLANS.
6. RAMP AND WING SLOPES SHALL NOT BE STEEPER THAN 12:1.
7. THE DETECTABLE WARNING AREA SLOPE SHALL NOT BE STEEPER THAN 20:1.
8. DETECTABLE WARNINGS SHALL BE EAST JORDAN IRON WORKS 7005 SERIES DETECTABLE WARNING PLATES OR APPROVED EQUAL.

CURB RAMP TYPE 4 DETACHED WALK

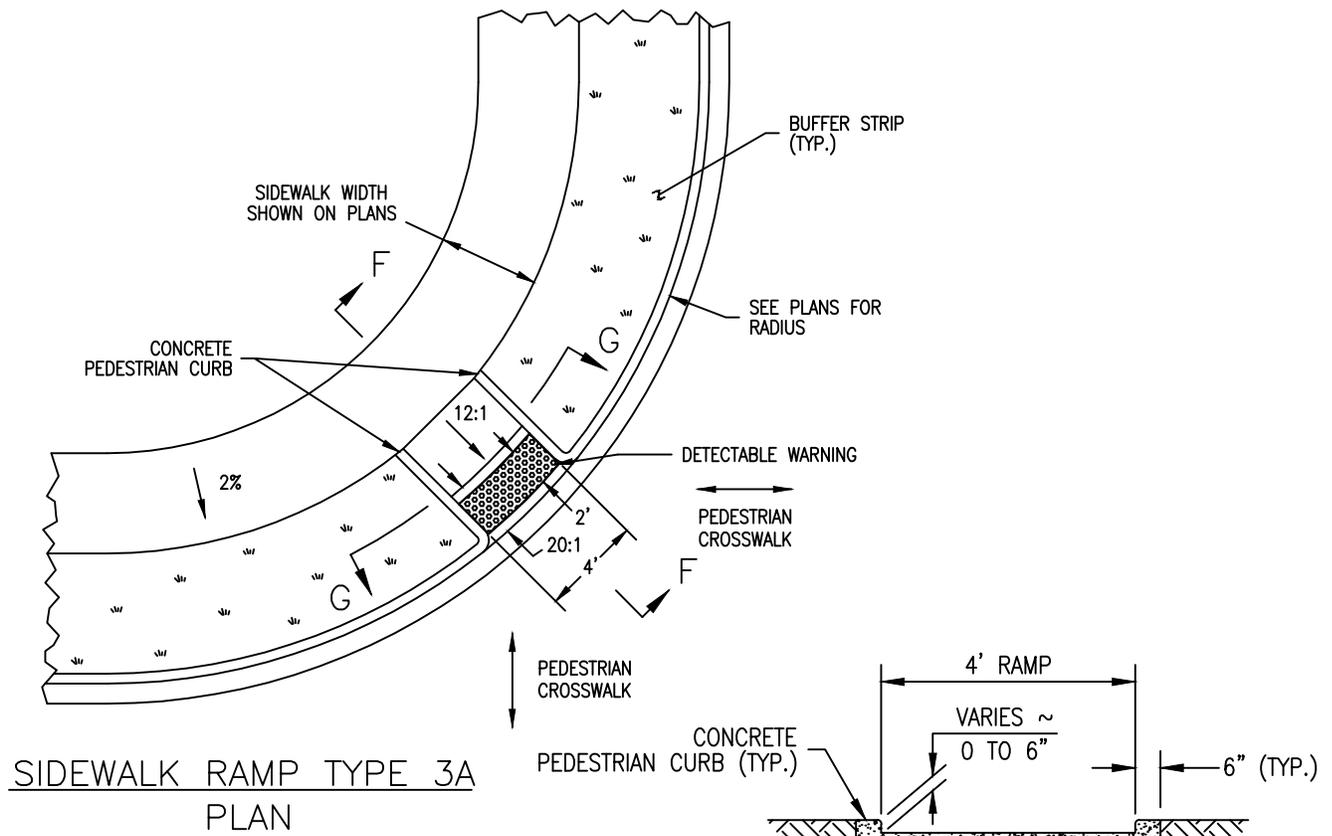


**CURB, GUTTER AND
SIDEWALK CONSTRUCTION
DRAWINGS**

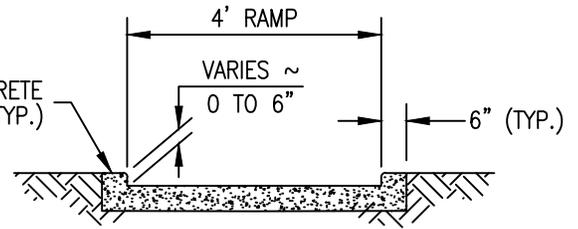
BY: NLH
SCALE: NTS
DATE: 07/2025

DRAWING:

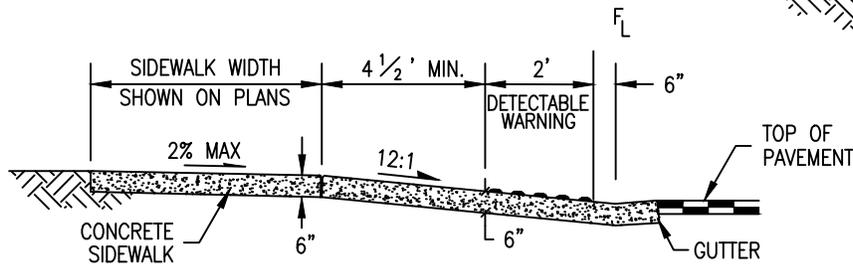
SW7



SIDEWALK RAMP TYPE 3A
PLAN



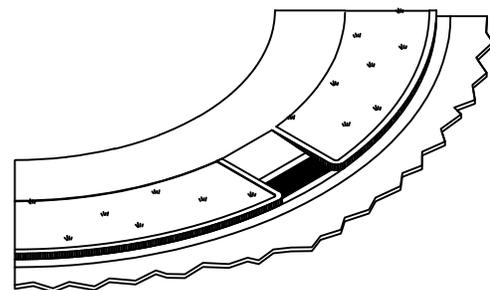
SECTION G-G



SECTION F-F

NOTES:

1. THE RAMP AREA SHALL RECEIVE A COARSER BRUSH TREATMENT THAN THE SIDEWALK.
2. AVOID PLACING DRAINAGE STRUCTURES, TRAFFIC SIGNAL EQUIPMENT, JUNCTION BOXES OR OTHER OBSTRUCTIONS IN FRONT OF RAMP ACCESS AREAS.
3. RAMP SLOPES SHALL NOT BE STEEPER THAN 12:1.
4. THE DETECTABLE WARNING AREA SLOPE SHALL NOT BE STEEPER THAN 20:1.
5. CONSTRUCTION OF THE CONCRETE PEDESTRIAN CURB TO BE INCLUDED IN THE COST OF THE CURB RAMP.
6. DETECTABLE WARNINGS SHALL BE EAST JORDAN IRON WORKS 7005 SERIES DETECTABLE WARNING PLATES OR APPROVED EQUAL.



ISOMETRIC VIEW

CURB RAMP TYPE 3 DETACHED WALK

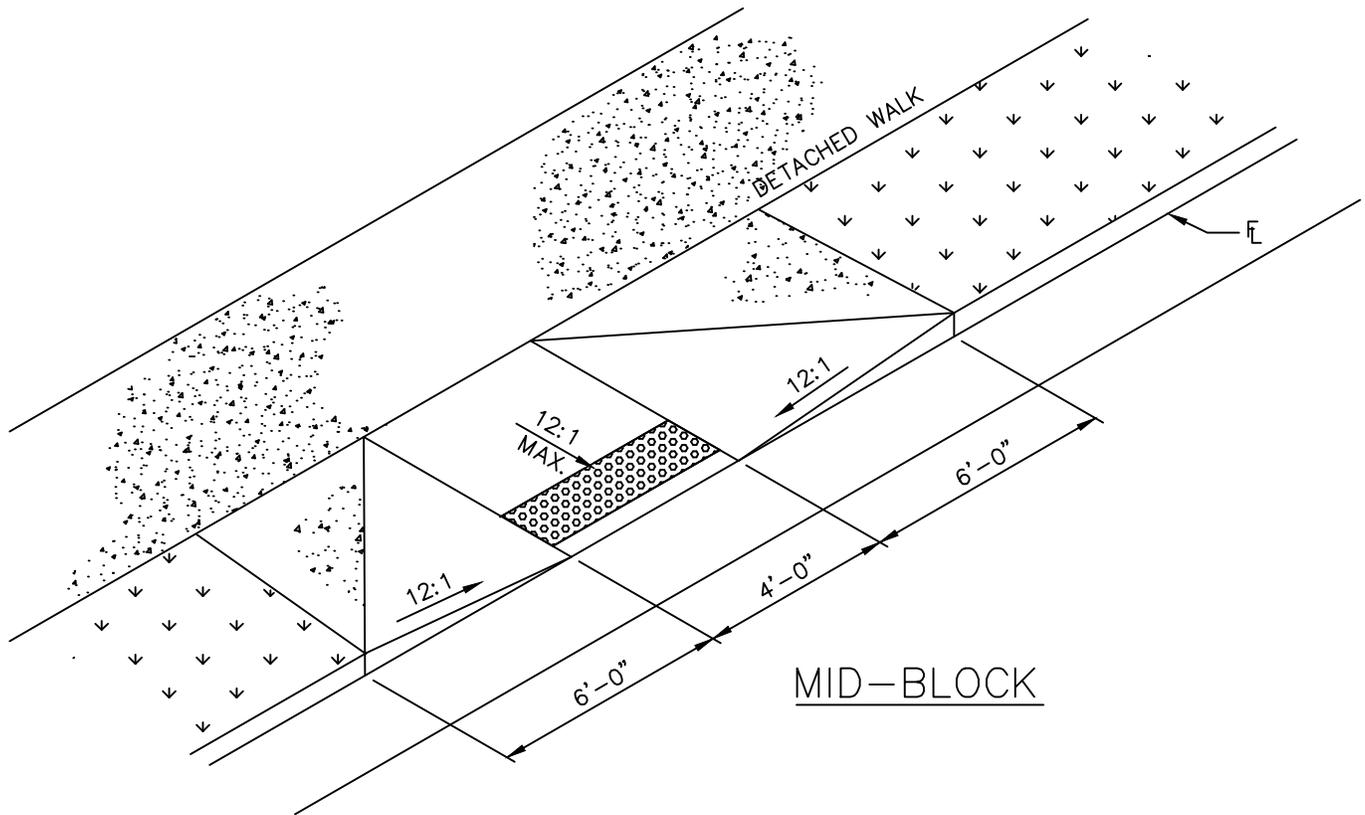


**CURB, GUTTER AND
SIDEWALK CONSTRUCTION
DRAWINGS**

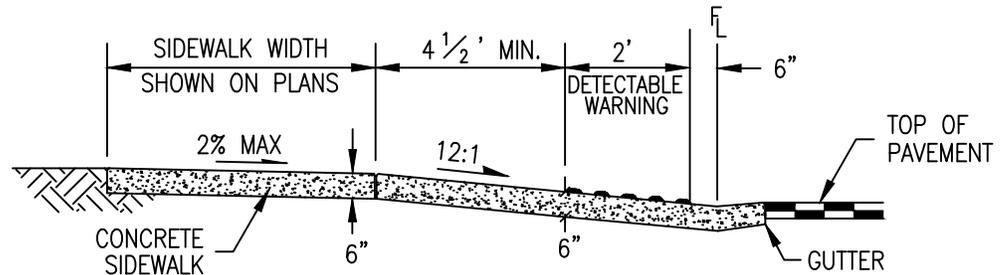
BY: NLH
SCALE: NTS
DATE: 07/2025

DRAWING:

SW8



MID-BLOCK



TYPICAL RAMP SECTION

NOTES:

1. THERE SHALL BE NO LIP WHERE THE RAMP MEETS THE GUTTER.
2. RAMP SURFACE SHALL HAVE A COARSE BROOM FINISH.
3. CURB RAMPS SHALL BE POURED MONOLITHICALLY WITH THE CURB, GUTTER AND APRON.
4. RAMP DIMENSIONS SHALL BE SPECIFIED ON THE CONSTRUCTION PLANS.
5. RAMP AND WING SLOPES SHALL NOT BE STEEPER THAN 12:1.
6. THE DETECTABLE WARNING AREA SLOPE SHALL NOT BE STEEPER THAN 20:1.
7. DETECTABLE WARNINGS SHALL BE EAST JORDAN IRON WORKS 7005 SERIES DETECTABLE WARNING PLATES OR APPROVED EQUAL.

CURB RAMP MID BLOCK TYPE 1 DETACHED WALK

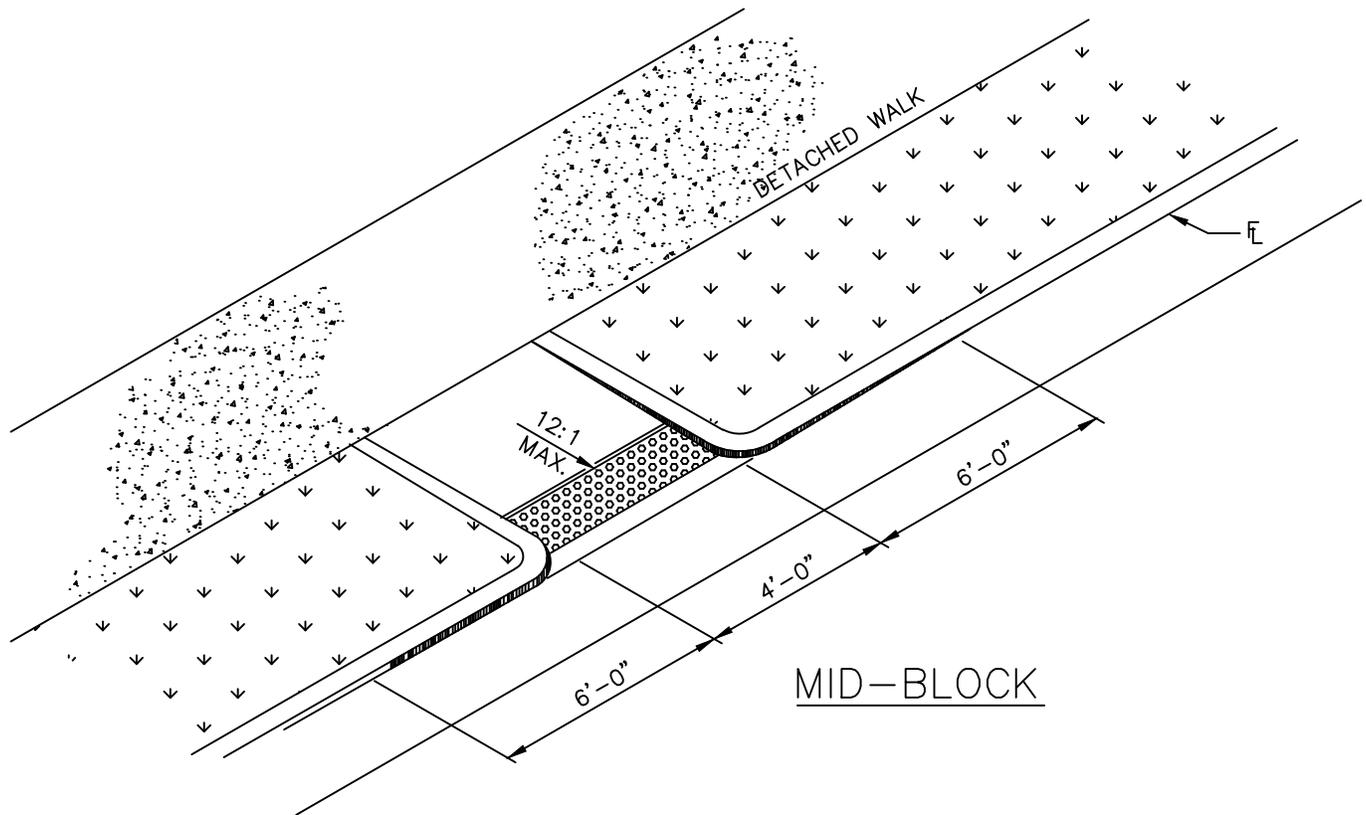


**CURB, GUTTER AND
SIDEWALK CONSTRUCTION
DRAWINGS**

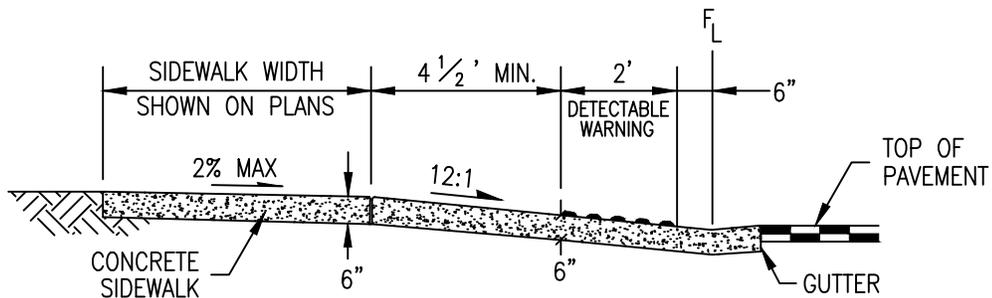
BY: NLH
SCALE: NTS
DATE: 07/2025

DRAWING:

SW9A



MID-BLOCK



TYPICAL RAMP SECTION

NOTES:

1. THERE SHALL BE NO LIP WHERE THE RAMP MEETS THE GUTTER.
2. RAMP SURFACE SHALL HAVE A COARSE BROOM FINISH.
3. CURB RAMPS SHALL BE POURED MONOLITHICALLY WITH THE CURB, GUTTER AND APRON.
4. RAMP DIMENSIONS SHALL BE SPECIFIED ON THE CONSTRUCTION PLANS.
5. RAMP AND WING SLOPES SHALL NOT BE STEEPER THAN 12:1.
6. THE DETECTABLE WARNING AREA SLOPE SHALL NOT BE STEEPER THAN 20:1.
7. DETECTABLE WARNINGS SHALL BE EAST JORDAN IRON WORKS 7005 SERIES DETECTABLE WARNING PLATES OR APPROVED EQUAL.

CURB RAMP MID BLOCK TYPE 3 DETACHED WALK

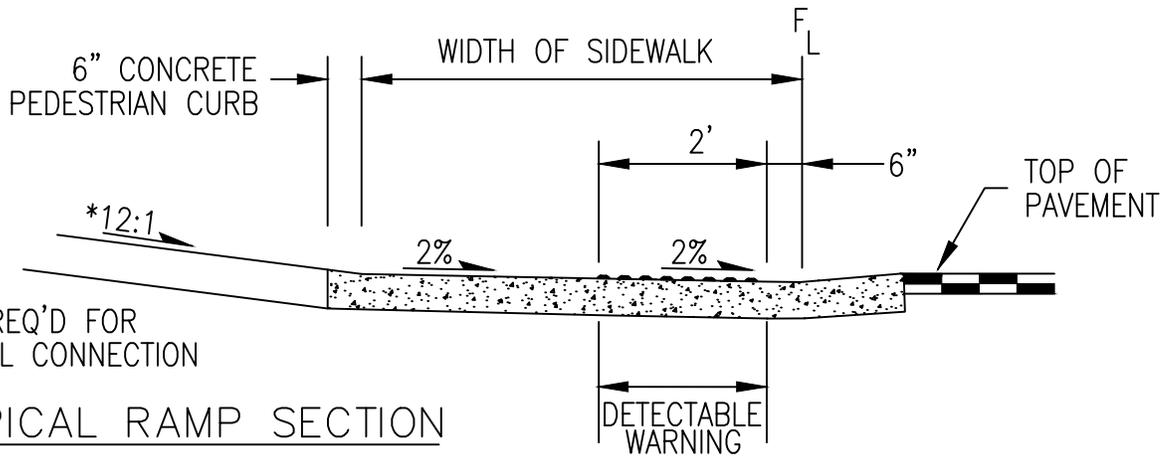
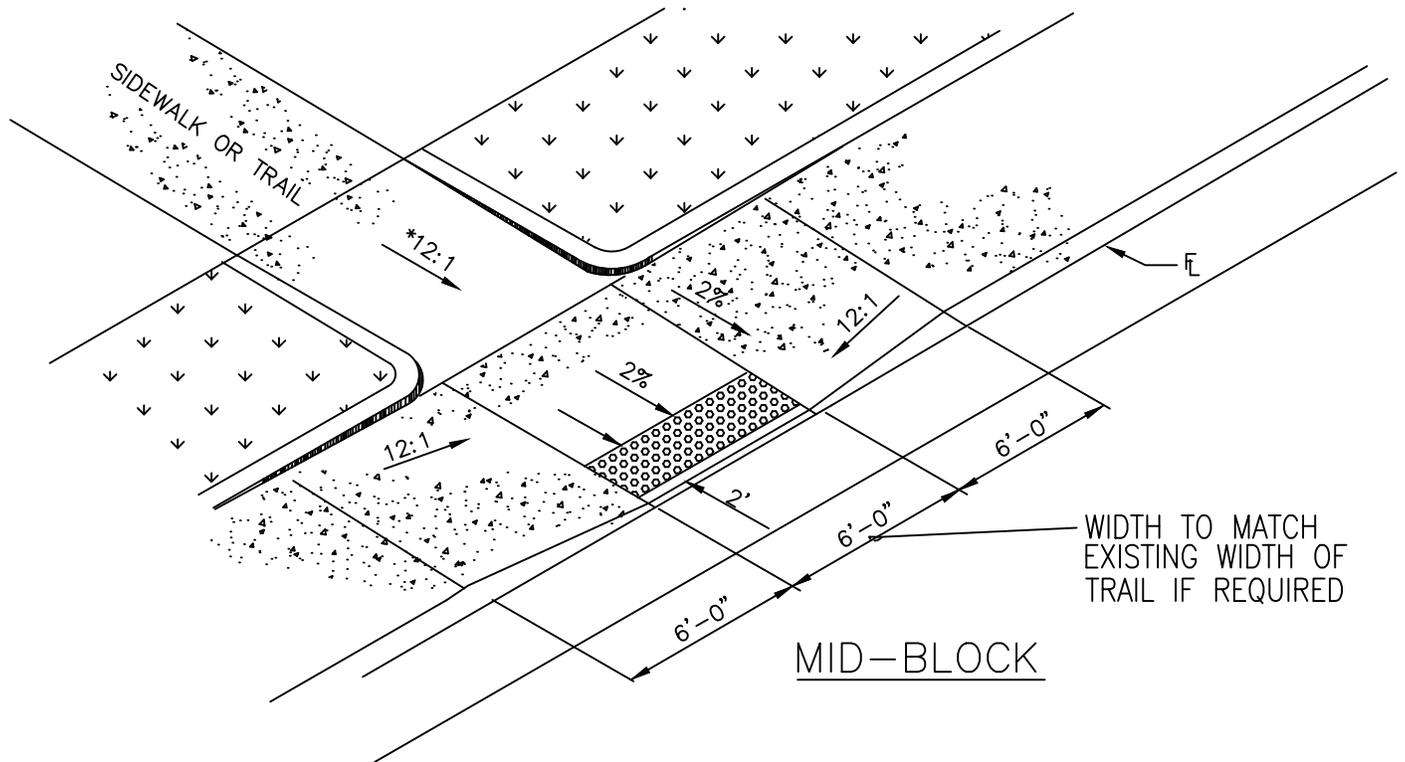


**CURB, GUTTER AND
SIDEWALK CONSTRUCTION
DRAWINGS**

BY: NLH
SCALE: NTS
DATE: 07/2025

DRAWING:

SW9B



NOTES:

1. THERE SHALL BE NO LOP WHERE THE RAMP MEETS THE GUTTER.
2. RAMP SURFACE SHALL HAVE A COARSE BROOM FINISH.
3. CURB RAMPS SHALL BE POURED MONOLITHICALLY WITH THE CURB, GUTTER AND APRON.
4. RAMP DIMENSIONS SHALL BE SPECIFIED ON THE CONSTRUCTION PLANS.
5. RAMP AND WING SLOPES SHALL NOT BE STEEPER THAN 12:1.
6. THE DETECTABLE WARNING AREA SLOPE SHALL NOT BE STEEPER THAN 20:1.
7. DETECTABLE WARNINGS SHALL BE EAST JORDAN IRON WORKS 7005 SERIES DETECTABLE WARNING PLATES OR APPROVED EQUAL.

CURB RAMP MID BLOCK TYPE 2 ATTACHED WALK

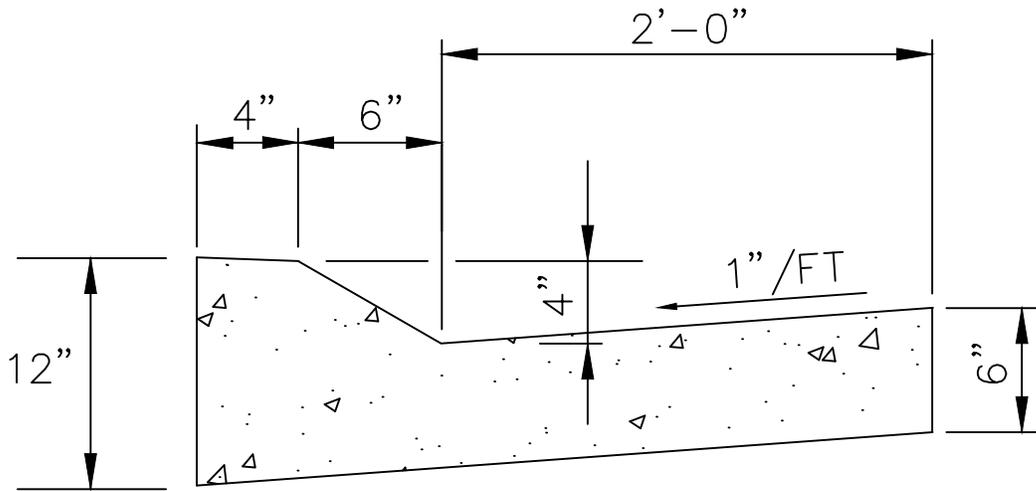


**CURB, GUTTER AND
SIDEWALK CONSTRUCTION
DRAWINGS**

BY: JME
SCALE: NTS
DATE: 1/2020

DRAWING:

SW9C



ROLLOVER

MOUNTABLE CURB & GUTTER CATCH

NOTE:

1. SUBGRADE TO BE COMPACTED TO 95% MODIFIED PROCTOR.

MOUNTABLE CURB SECTION



CURB, GUTTER AND
SIDEWALK CONSTRUCTION
DRAWINGS

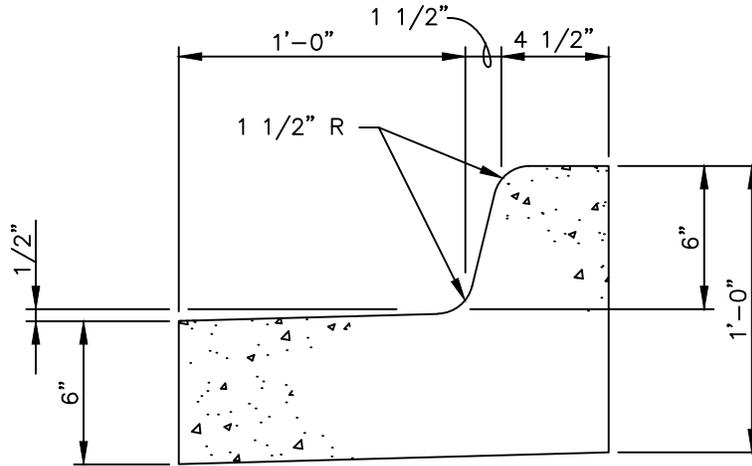
BY: JME

SCALE: NTS

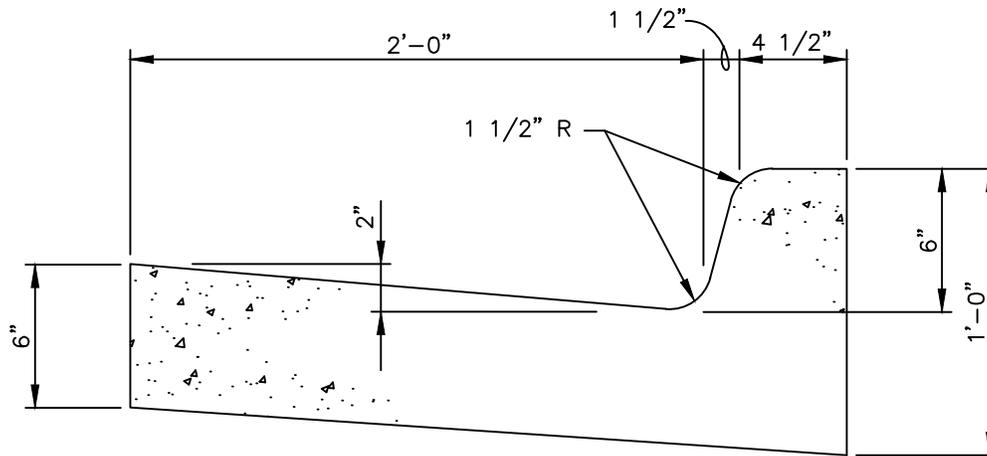
DATE: 1/2020

DRAWING:

SW10



MEDIAN CURB & GUTTER
SPILL



VERTICAL CURB & GUTTER
CATCH

NOTE:

1. SUBGRADE TO BE COMPACTED TO 95% MODIFIED PROCTOR.
2. INSTALL (3) #4 REBAR AT CURB RETURN FILLETS AND CURB PATCHES SPACED EQUIDISTANTLY OR AS REQUIRED.

VERTICAL CURB SECTION

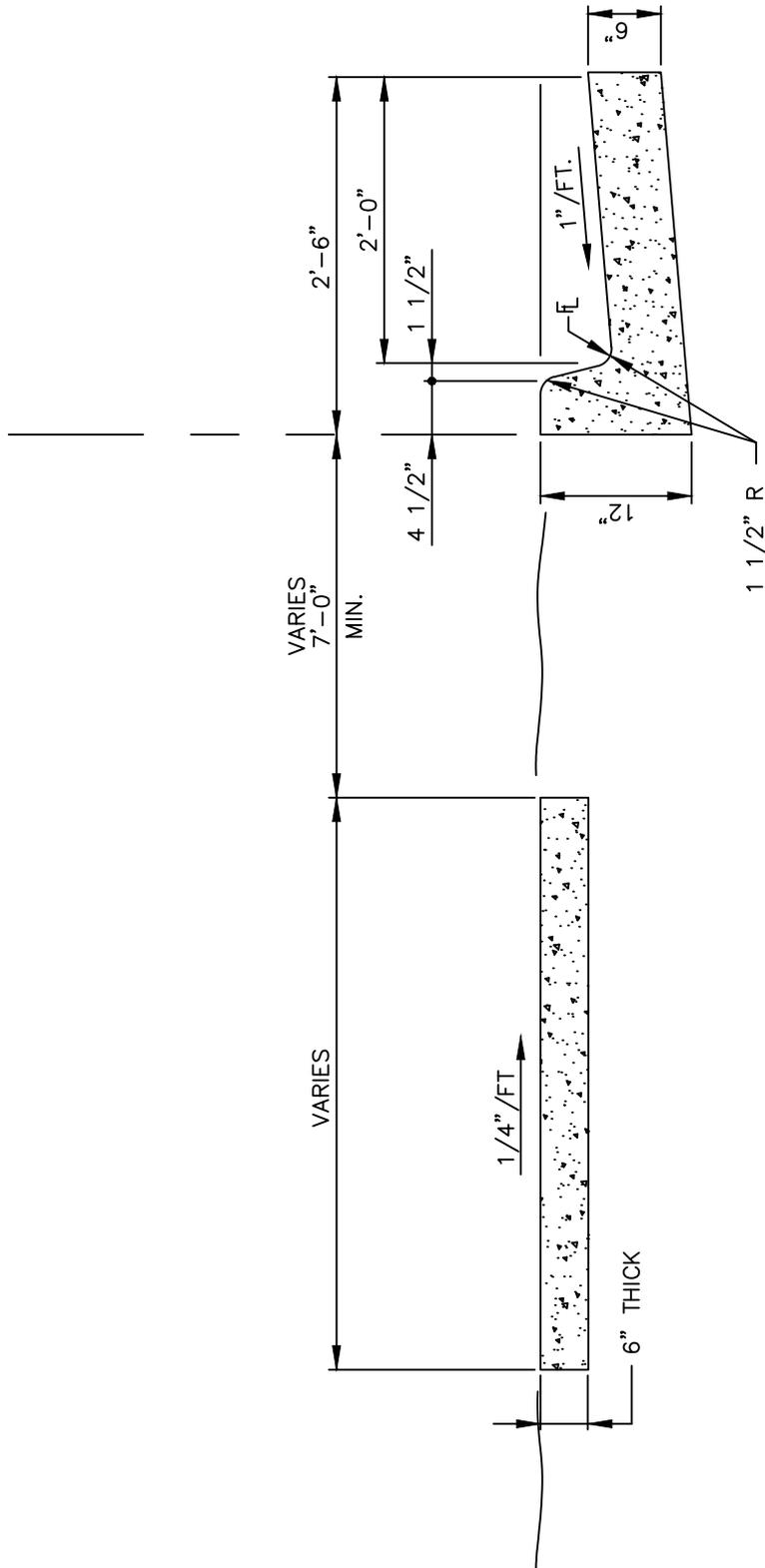


**CURB, GUTTER AND
SIDEWALK CONSTRUCTION
DRAWINGS**

BY: NLH
SCALE: NTS
DATE: 07/2025

DRAWING:

SW11



NOTES:

1. SIDEWALK WIDTH SHALL BE SPECIFIED ON THE CONSTRUCTION PLANS.
2. LANDSCAPE TREATMENT MUST BE SPECIFIED.
3. 6" VERTICAL CURB, GUTTER AND SIDEWALK IS REQUIRED FOR COLLECTOR AND ARTERIAL STREETS.

6" VERTICAL CURB, GUTTER AND DETACHED WALK

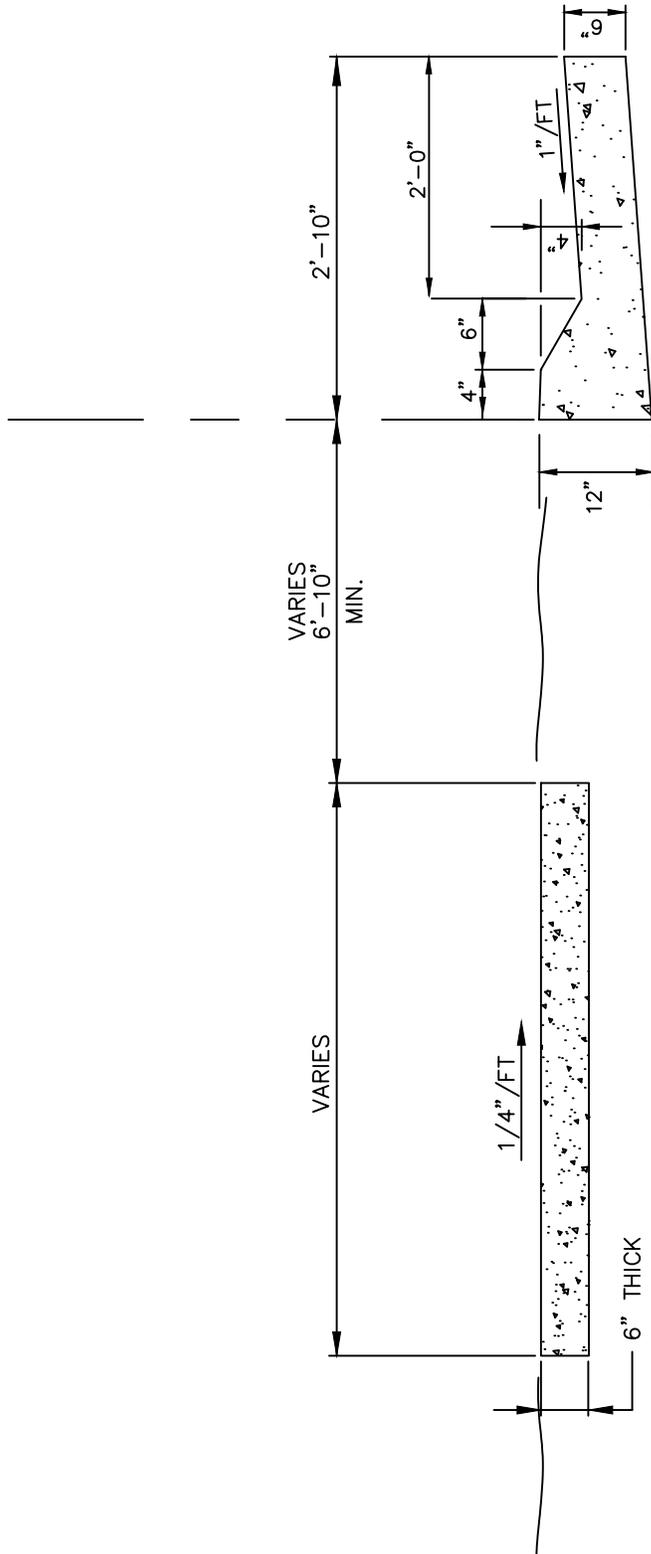


**CURB, GUTTER AND
SIDEWALK CONSTRUCTION
DRAWINGS**

BY: JME
SCALE: NTS
DATE: 1/2020

DRAWING:

SW12A



MOUNTABLE CURB & GUTTER
CATCH

NOTES:

1. SIDEWALK WIDTH SHALL BE SPECIFIED ON THE CONSTRUCTION PLANS.
2. LANDSCAPE TREATMENT MUST BE SPECIFIED.

6" MOUNTABLE CURB, GUTTER AND DETACHED WALK



CURB, GUTTER AND
SIDEWALK CONSTRUCTION
DRAWINGS

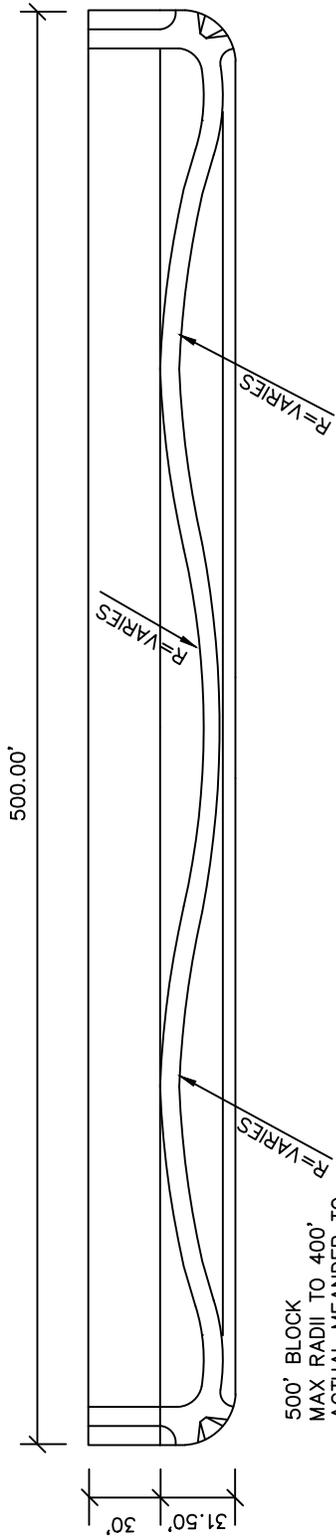
BY: JME

SCALE: NTS

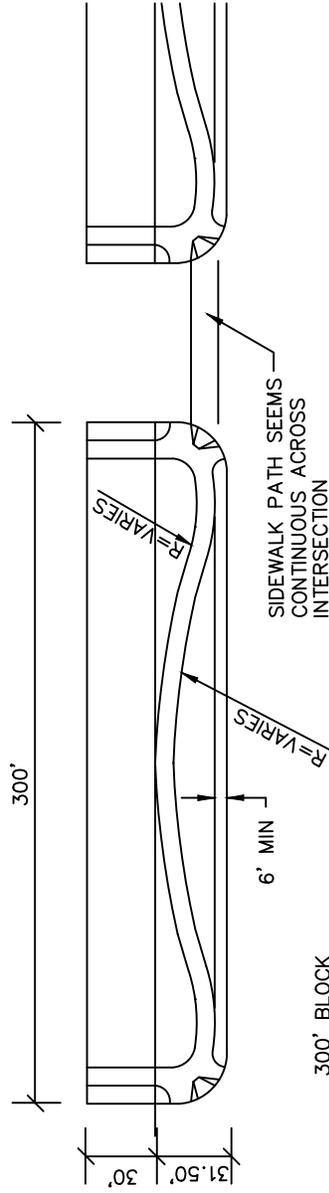
DATE: 1/2020

DRAWING:

SW12B



500' BLOCK
 MAX RADII TO 400'
 ACTUAL MEANDER TO
 BE DETERMINED IN
 THE FIELD



300' BLOCK
 MAX RADII TO 300'
 ACTUAL MEANDER TO
 BE DETERMINED IN
 THE FIELD

SIDEWALK OPTIONS

SIDEWALK DESIGN STANDARDS



**CURB, GUTTER AND
 SIDEWALK CONSTRUCTION
 DRAWINGS**

BY: JME
 SCALE: NTS
 DATE: 1/2020

DRAWING:

SW13

<u>DRAWING NO.</u>	<u>TITLE</u>
ST1A	PRINCIPAL ARTERIAL
ST1B	PRINCIPAL ARTERIAL
ST2A	MINOR ARTERIAL
ST2B	MINOR ARTERIAL
ST3	COLLECTORS
ST4	COLLECTORS
ST5	RURAL ARTERIAL
ST6	LOCAL STREETS
ST7	PAVEMENT PHASING – NEW ROADS
ST8	TRENCH & CURB PATCH
ST9	STRUCTURE PATCH
ST10A	GROUND MOUNT STREET NAME SIGN
ST10B	ROAD AND STREET NAME SIGNS
ST10C	PRIVATE STREET SIGN
ST11	CUL-DE-SAC
ST12	SIGHT DISTANCE
ST13	DRIVEWAY APPROACHES FOR ROADS
ST14	90 DEGREE TURN – LOCAL ACCESS STREETS
ST15A	4" PERFORATED UNDERDRAIN
ST15B	4" PERFORATED MEDIAN UNDERDRAIN FOR CENTER PLANTING
ST15C	4" PERFORATED MEDIAN UNDERDRAIN FOR EDGE PLANTING
ST16	UNDERDRAIN OUTLET TREATMENT
ST17	TYPICAL STREET UTILITY LOCATION

INDEX OF STREET DETAILS



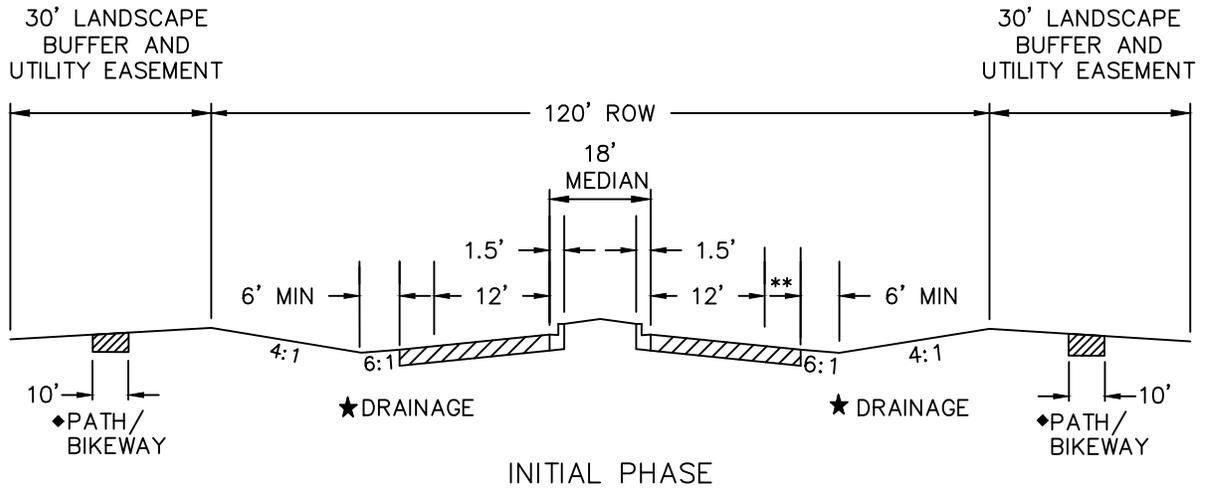
**STREET CONSTRUCTION
DRAWINGS**

BY: JME

SCALE: NTS

DATE: 11/2019

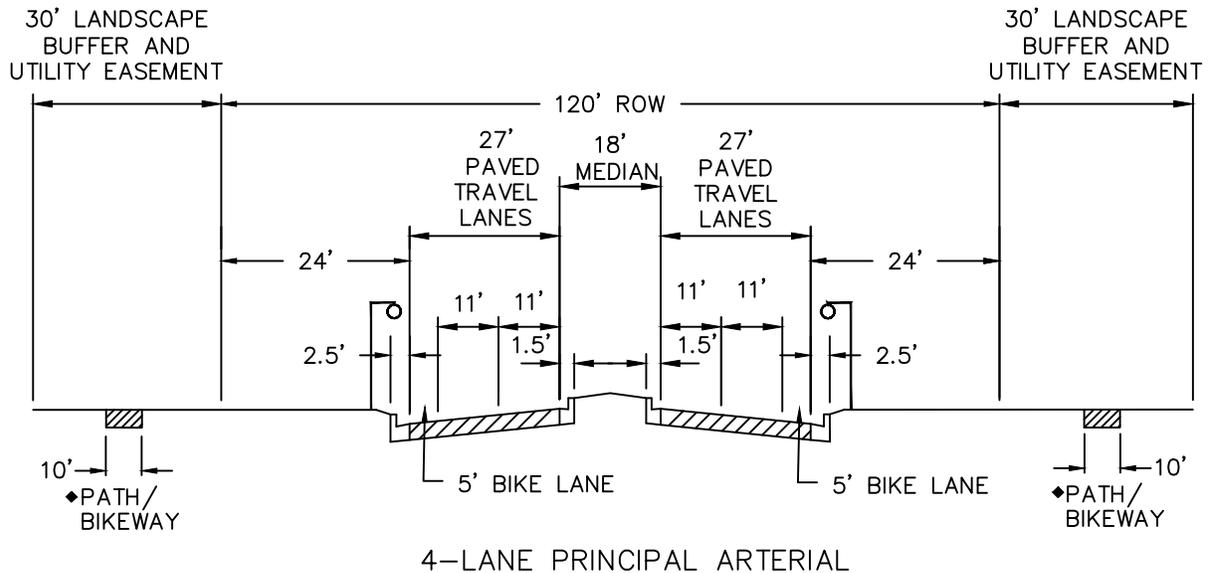
DRAWING:



** 6' SHOULDER TO ACCOMMODATE BICYCLES

★ DRAINAGE DITCH TO BE ENGINEERED AT CROSS STREETS AND DRIVEWAYS

◆ PATH MAY BE LOCATED IN LANDSCAPE BUFFER OR WITHIN ROW AND SHOULD MEANDER.



◆ PATH MAY BE LOCATED IN LANDSCAPE BUFFER OR WITHIN ROW AND SHOULD MEANDER.

PRINCIPAL ARTERIAL



STREET CONSTRUCTION
DRAWINGS

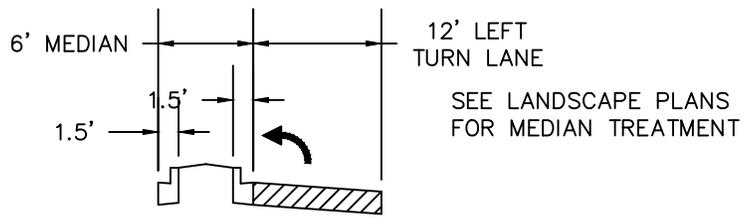
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SCALE: NTS

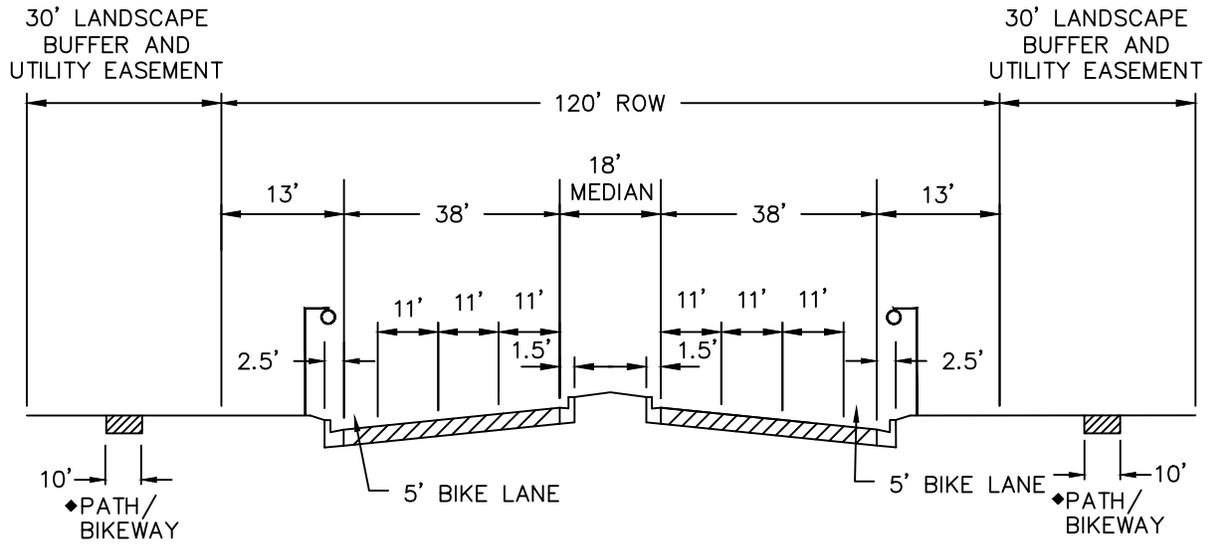
DATE: 11/2019

DRAWING:

ST1A



TYPICAL MEDIAN W/LEFT TURN LANE



6-LANE PRINCIPAL ARTERIAL

◆PATH MAY BE LOCATED IN LANDSCAPE BUFFER OR WITHIN ROW AND SHOULD MEANDER.

PRINCIPAL ARTERIAL

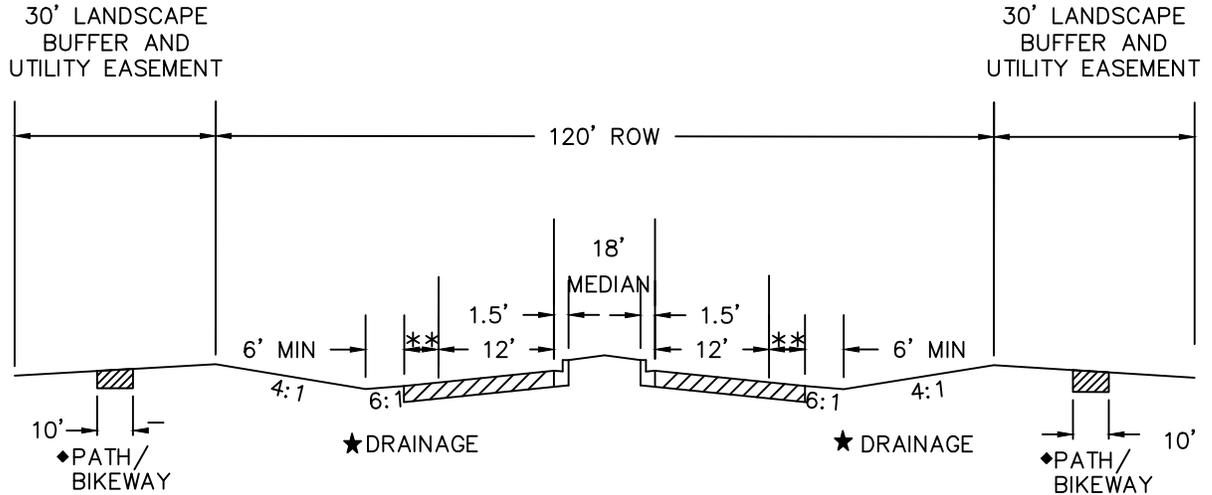


**STREET CONSTRUCTION
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BY: JME
SCALE: NTS
DATE: 11/2019

DRAWING:

ST1B

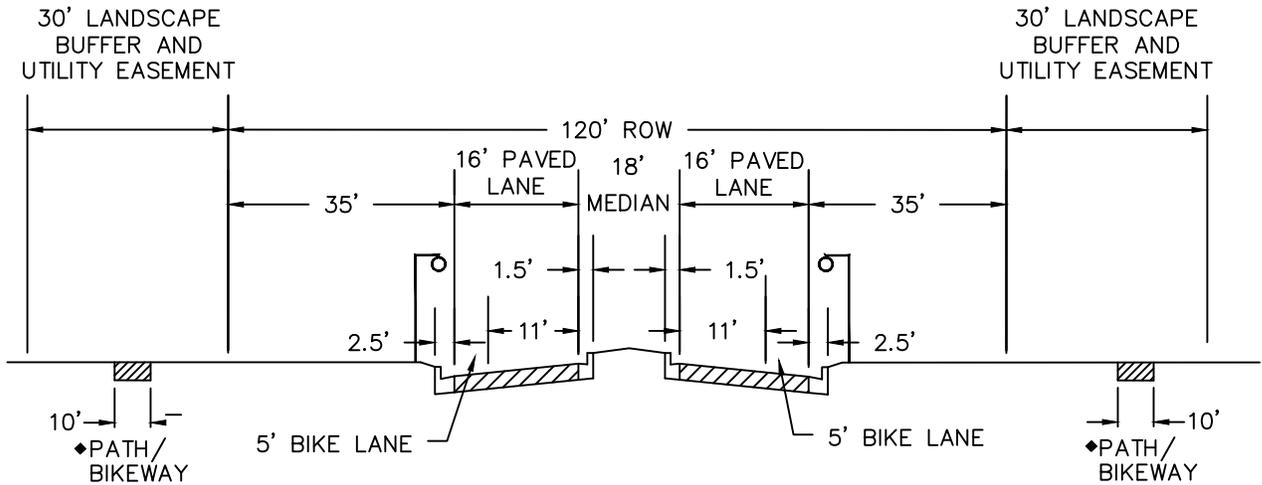


INITIAL PHASE

◆PATH MAY BE LOCATED IN LANDSCAPE BUFFER OR WITHIN ROW AND SHOULD MEANDER.

**6' SHOULDER TO ACCOMMODATE BICYCLES

★ DRAINAGE DITCH TO BE ENGINEERED AT CROSS STREETS AND DRIVEWAYS



2-LANE MINOR ARTERIAL

◆PATH MAY BE LOCATED IN LANDSCAPE BUFFER OR WITHIN ROW AND SHOULD MEANDER.

MINOR ARTERIAL

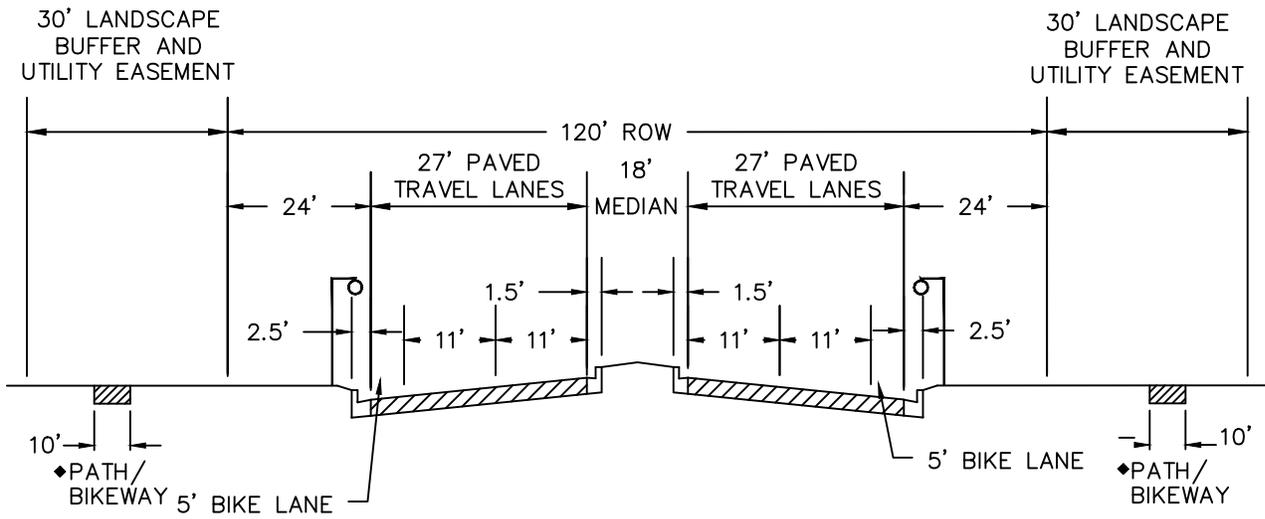


**STREET CONSTRUCTION
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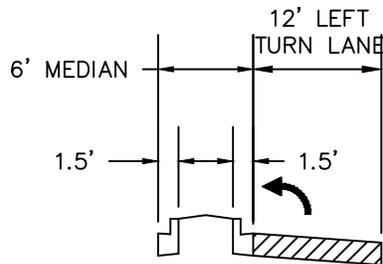
DRAWING:

ST2A



4-LANE MINOR ARTERIAL

◆PATH MAY BE LOCATED IN LANDSCAPE BUFFER OR WITHIN ROW AND SHOULD MEANDER.



TYPICAL MEDIAN W/LEFT TURN LANE

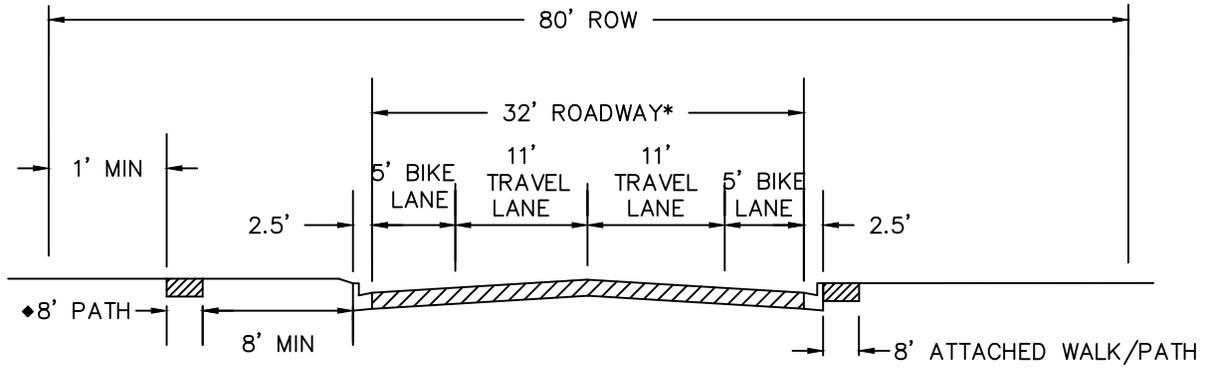
MINOR ARTERIAL



**STREET CONSTRUCTION
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BY: JME
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DATE: 11/2019

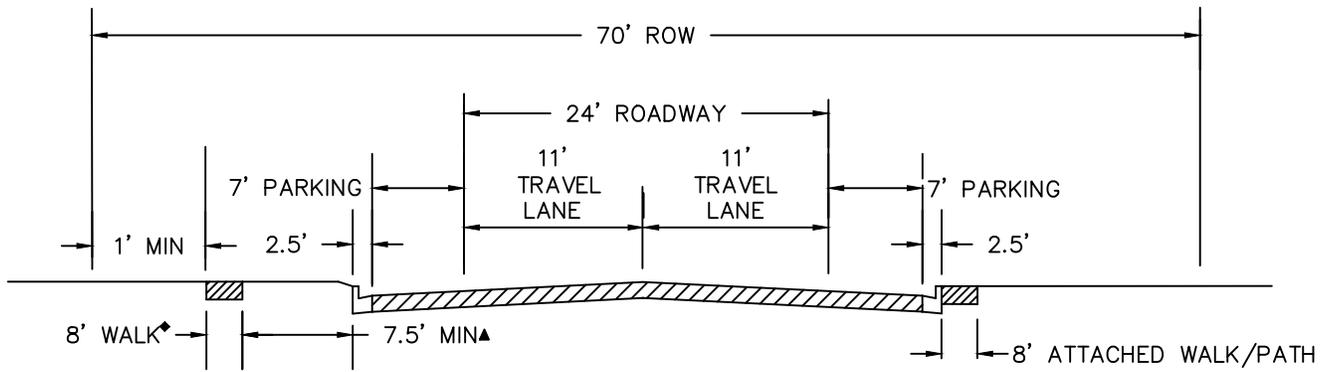
DRAWING:
ST2B



COLLECTOR WITHOUT PARKING OR MEDIAN

NOTE:

- PRIVATE UTILITIES TO BE PLACED OUTSIDE OF THE PUBLIC RIGHT-OF-WAY
- *TURN LANES WILL BE REQUIRED AS DETERMINED BY A TRAFFIC STUDY
- ◆PATH SHOULD MEANDER.



RESIDENTIAL COLLECTOR WITH ON-STREET PARKING
(TYPICAL VOLUME: UP TO 2,000 VPD)

- ▲ 8' MINIMUM IN MULTI-FAMILY DEVELOPMENT
- ◆PATH SHOULD MEANDER.

COLLECTORS

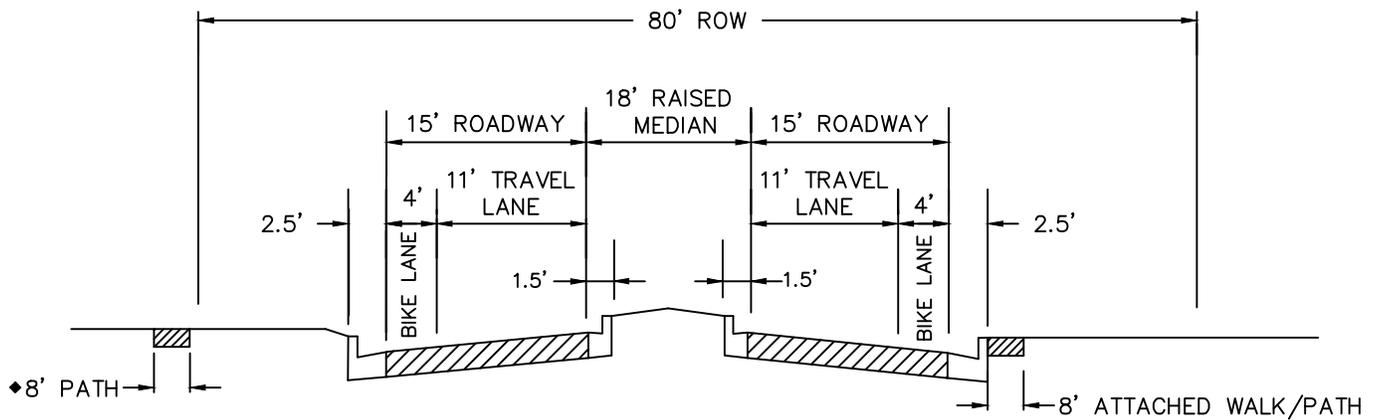


STREET CONSTRUCTION
DRAWINGS

BY: JME
SCALE: NTS
DATE: 11/2019

DRAWING:

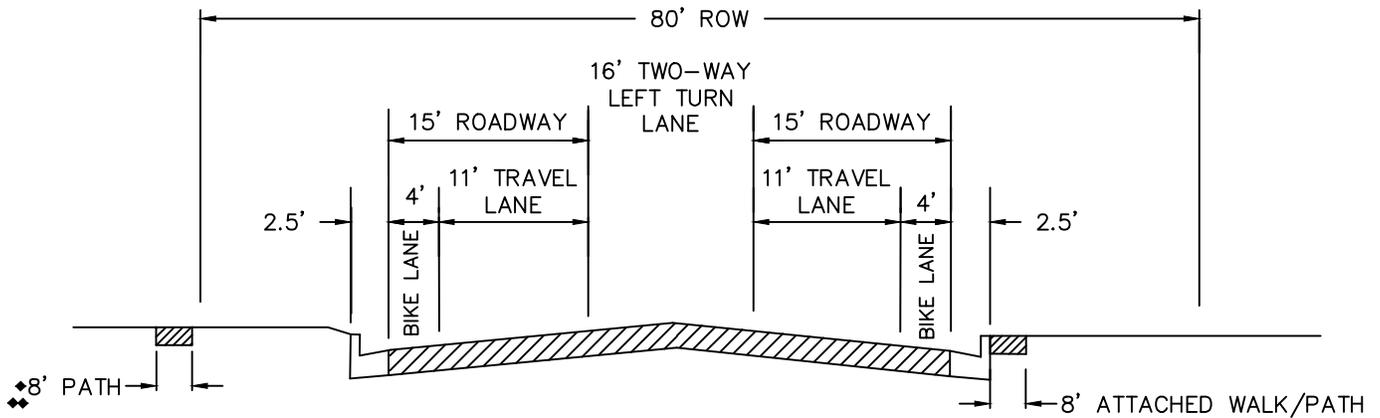
ST3



COLLECTOR WITH RAISED MEDIAN

NOTE:

- ◆ PRIVATE UTILITIES TO BE PLACED OUTSIDE OF THE PUBLIC RIGHT-OF-WAY
- ◆ PATH SHOULD MEANDER.



COLLECTOR WITH FLUSH MEDIAN

NOTE:

- ◆ PRIVATE UTILITIES TO BE PLACED OUTSIDE OF THE PUBLIC RIGHT-OF-WAY
- ◆ PATH SHOULD MEANDER.
- ◆ IF COLLECTOR ROADWAY FALLS ON SECTION LINE, TRAILS ARE TO BE TEN (10) FEET WIDE.

COLLECTORS

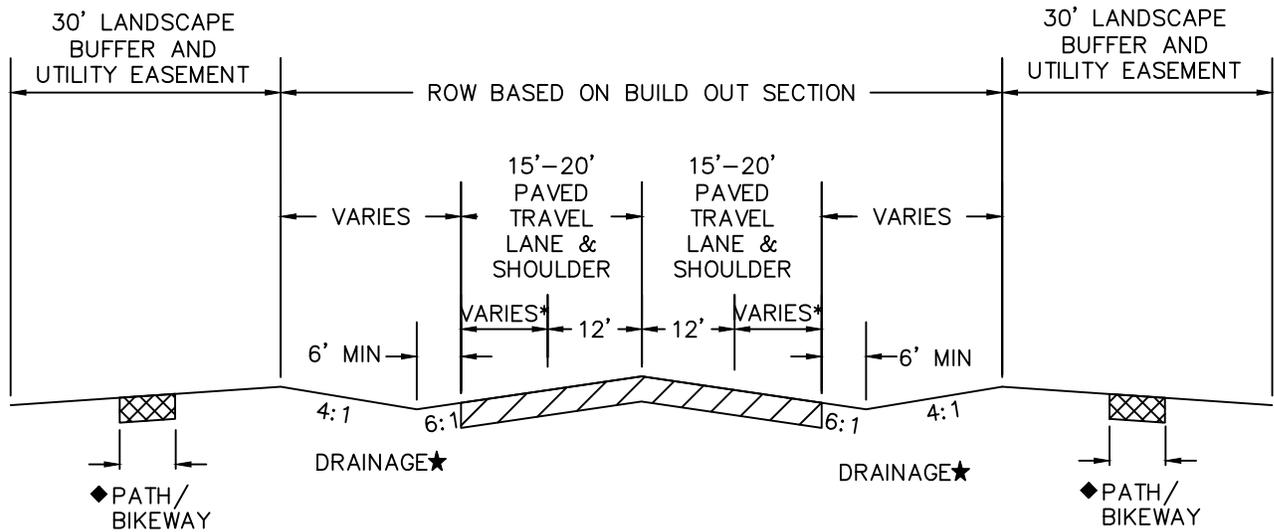


**STREET CONSTRUCTION
DRAWINGS**

BY: NLH
SCALE: NTS
DATE: 07/2025

DRAWING:

ST4



RURAL ARTERIAL

*BIKES CAN USE PAVED SHOULDERS

SHOULDER WIDTH VARIES DEPENDING ON DESIGN VOLUME:

- 4' WIDTH - UP TO 5,000 VPD
- 6' WIDTH - 5,000 TO 10,000 VPD
- 8' WIDTH - OVER 10,000 VPD

◆ PATH (5' TO 10') AT THE DISCRETION OF THE TOWN OF FIRESTONE. PATH SHOULD MEANDER.

★ DRAINAGE DITCH TO BE ENGINEERED AT CROSS STREETS AND DRIVEWAYS

RURAL ARTERIAL



STREET CONSTRUCTION
DRAWINGS

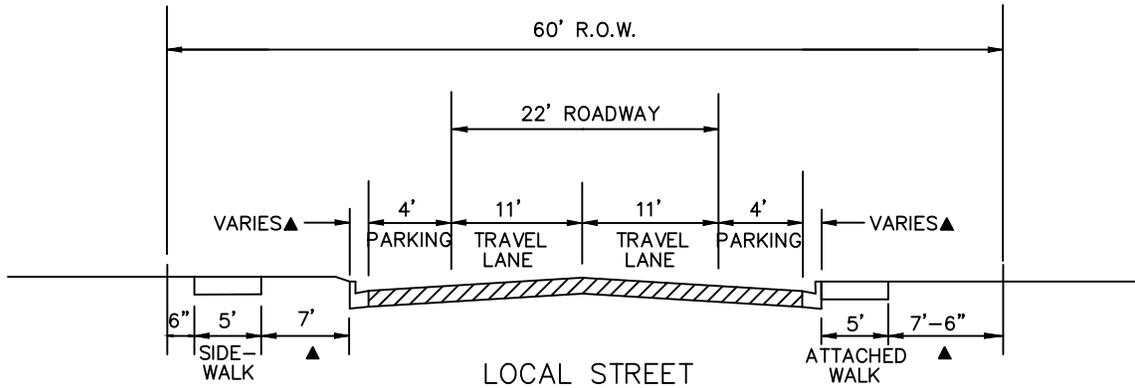
BY: JME

SCALE: NTS

DATE: 11/2019

DRAWING:

ST5



▲ WIDTH DEPENDS ON VERTICAL OR ROLLOVER CURB

NOTE:

1. PRIVATE UTILITY LINES TO BE OUTSIDE OF PUBLIC RIGHT-OF-WAY.

LOCAL STREETS

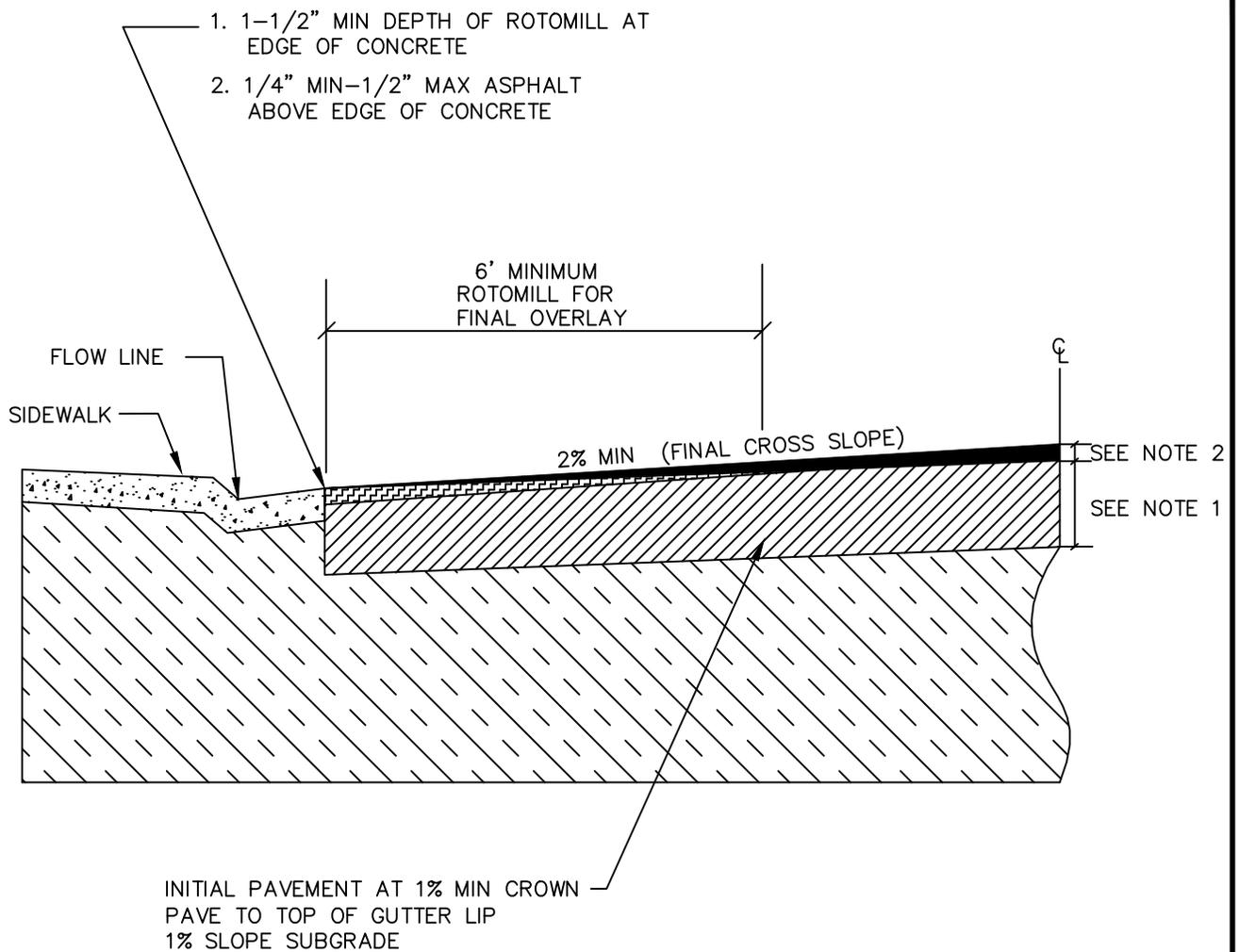


**STREET CONSTRUCTION
DRAWINGS**

BY: PCB
SCALE: NTS
DATE: 12/2021

DRAWING:

ST6



NOTES:

1. INITIAL PAVEMENT DEPTH AT CONSTRUCTION ACCEPTANCE SHALL BE FULL DESIGN DEPTH FOR THE ENTIRE WIDTH OF THE ROAD SECTION.
2. FINAL OVERLAY DEPTH AT FINAL ACCEPTANCE IS IN ADDITION TO THE DESIGN DEPTH. THE DEPTH WILL VARY DEPENDING UPON THE PAVEMENT WIDTH TO ENSURE A MINIMUM OF A 2% PAVEMENT CROSS SLOPE.
3. THE FINAL OVERLAY SHALL BE COMPLETED AT FINAL ACCEPTANCE WHICH IS AFTER THE END OF THE 2 YEAR WARRANTY PERIOD WHEN ALL FINAL PUNCH LIST REPAIRS ARE COMPLETE.
4. THE FINAL OVERLAY MUST BE SX MIX.
5. DETERMINATION OF CROWN FOR CUL DE SAC PAVING SHALL BE EVALUATED ON A CASE BY CASE BASIS.

PAVEMENT PHASING - NEW ROADS

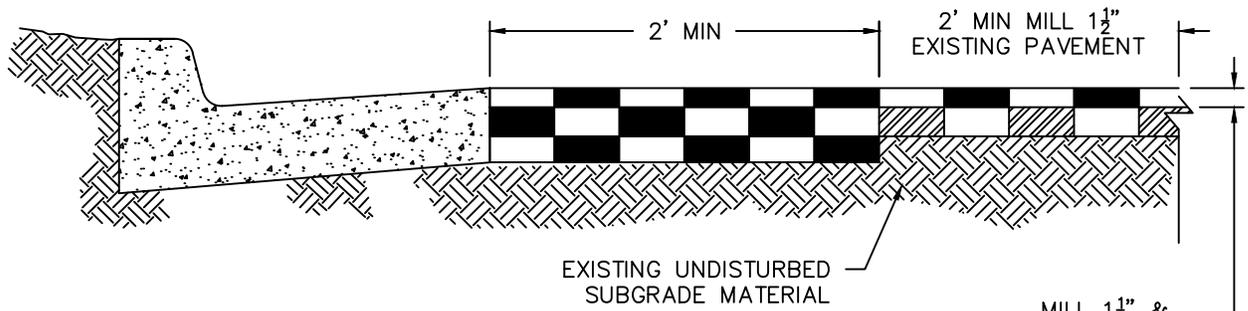


**STREET CONSTRUCTION
DRAWINGS**

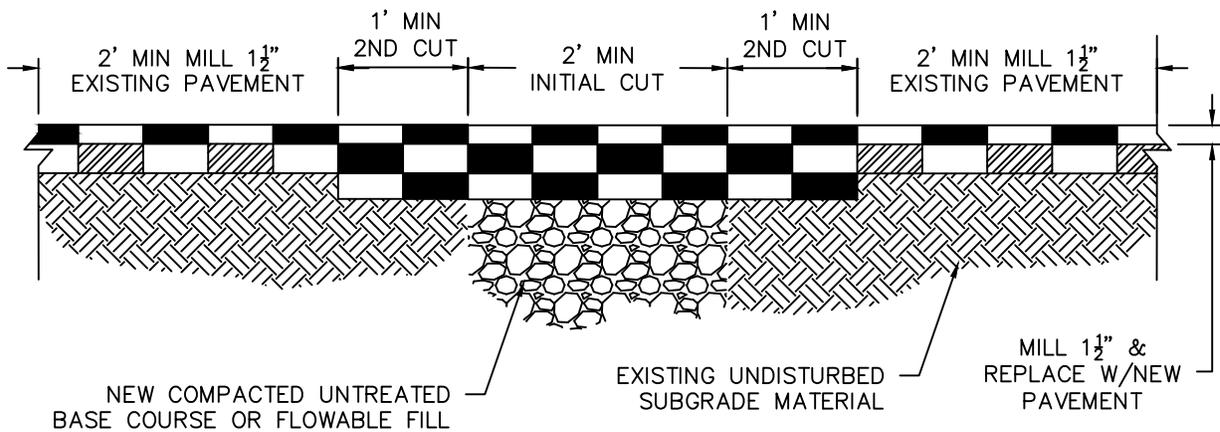
BY: JME
SCALE: NTS
DATE: 11/2019

DRAWING:

ST7



PATCHBACK ADJACENT TO CURB



PATCHBACK FOR UTILITY AND SERVICE TRENCHES

NOTE:

1. IF ASPHALT PATCH THICKNESS IS NOT IDENTIFIED ON PLANS USE 6½" MIN ASPHALT PATCH OR EXISTING THICKNESS PLUS 1", WHICH EVER THICKNESS IS GREATER.
2. MINIMUM DEPTH OF WEARING COURSE SHALL BE 1½" AND SHALL BE GRADING SX ASPHALT.
3. MINIMUM DEPTH OF INTERMEDIATE COURSE SHALL BE 5" AND BE INSTALLED IN 2 LIFTS. INTERMEDIATE COURSE SHALL BE GRADING S OR G ASPHALT.
4. PATCH SHALL BE PLACED AND COMPACTED IN LIFTS A MAXIMUM OF 3" IN DEPTH.
5. APPLY SS-I TACK COAT TO EXISTING ASPHALT AND/OR CONCRETE VERTICAL SURFACES.
6. TRENCHES LESS THAN 2' IN WIDTH MUST RECEIVE PRIOR APPROVAL FROM THE TOWN OF FIRESTONE ENGINEERING DEPARTMENT AND SHALL BE FLOW-FILLED.
7. PROVIDE 28 DAY 60 PSI CONTROLLED LOW STRENGTH FLOWABLE FILL AS SPECIFIED. USE FILL THAT FLOWS EASILY AND VIBRATION IS NOT REQUIRED. CURE TO INITIAL SET BEFORE PLACING NEW UNTREATED BASE COURSE OR NEW ASPHALT PAVEMENT. USE FLOWABLE FILL IN EXCAVATIONS THAT ARE TOO NARROW TO RECEIVE COMPACTION EQUIPMENT.
8. REMOVE ADDITIONAL PAVEMENT TO A PAINTED LANE STRIPE, A LIP OF GUTTER, A CURB, AN EXISTING PAVEMENT PATCH, OR AN EDGE OF THE PAVEMENT IF SUCH STREET FEATURE IS WITHIN TWO FEET OF THE SECOND SAW CUT.
9. PROVIDE UNTREATED BASE COURSE MATERIAL. DO NOT USE GRAVEL OR WASHED ROCK. PLACE NEW MATERIAL IN LIFTS NOT EXCEEDING 8" AFTER COMPACTION. COMPACT TO A MODIFIED PROCTOR DENSITY OF 95% OR GREATER.
10. STRAIGHT SAWCUT OR BLADECUT THE EXISTING ASPHALT PAVEMENT WHEN JOINING WITH NEW ASPHALT PAVEMENT.

TRENCH & CURB PATCH

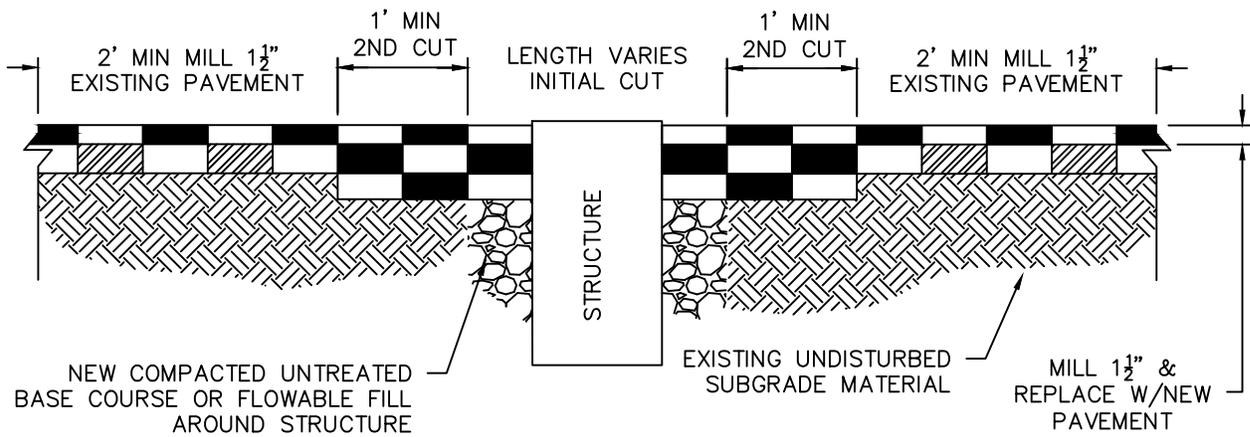


**STREET CONSTRUCTION
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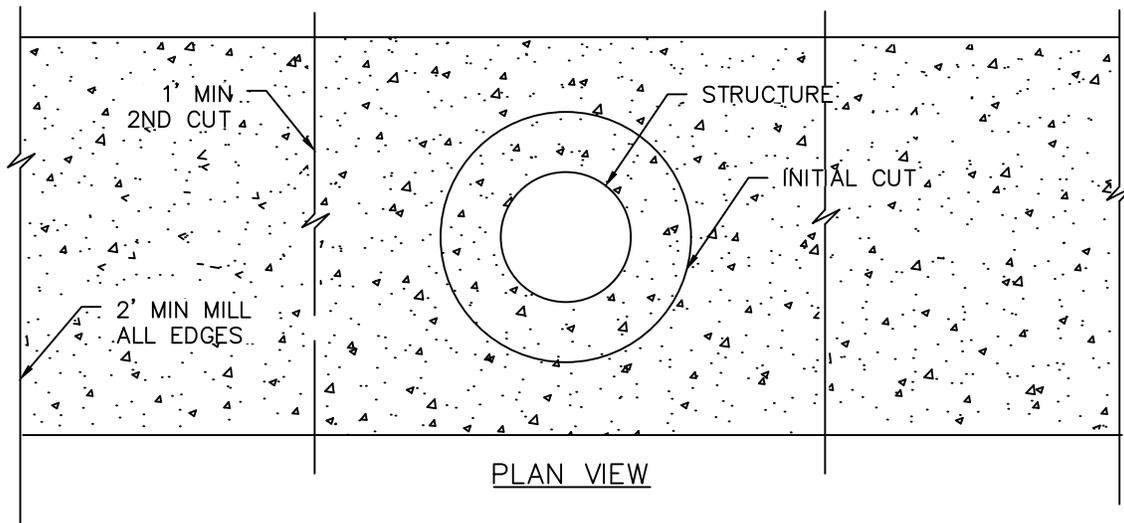
BY: JME
SCALE: NTS
DATE: 11/2019

DRAWING:

ST8



PATCHBACK FOR STRUCTURES (MANHOLES, VALVES ETC)



NOTE:

1. IF ASPHALT PATCH THICKNESS IS NOT IDENTIFIED ON PLANS USE 6½" MIN ASPHALT PATCH OR EXISTING THICKNESS PLUS 1", WHICH EVER THICKNESS IS GREATER.
2. MINIMUM DEPTH OF WEARING COURSE SHALL BE 1½" AND SHALL BE GRADING SX ASPHALT.
3. MINIMUM DEPTH OF INTERMEDIATE COURSE SHALL BE 5" AND BE INSTALLED IN 2 LIFTS. INTERMEDIATE COURSE SHALL BE GRADING S OR G ASPHALT.
4. PATCH SHALL BE PLACED AND COMPACTED IN LIFTS A MAXIMUM OF 3" IN DEPTH.
5. APPLY SS-I TACK COAT TO EXISTING ASPHALT AND/OR CONCRETE VERTICAL SURFACES.
6. TRENCHES LESS THAN 2' IN WIDTH MUST RECEIVE PRIOR APPROVAL FROM THE TOWN OF FIRESTONE ENGINEERING DEPARTMENT AND SHALL BE FLOW-FILLED.
7. PROVIDE 28 DAY 60 PSI CONTROLLED LOW STRENGTH FLOWABLE FILL AS SPECIFIED. USE FILL THAT FLOWS EASILY AND VIBRATION IS NOT REQUIRED. CURE TO INITIAL SET BEFORE PLACING NEW UNTREATED BASE COURSE OR NEW ASPHALT PAVEMENT. USE FLOWABLE FILL IN EXCAVATIONS THAT ARE TOO NARROW TO RECEIVE COMPACTION EQUIPMENT.
8. REMOVE ADDITIONAL PAVEMENT TO A PAINTED LANE STRIPE, A LIP OF GUTTER, A CURB, AN EXISTING PAVEMENT PATCH, OR AN EDGE OF THE PAVEMENT IF SUCH STREET FEATURE IS WITHIN TWO FEET OF THE SECOND SAW CUT.
9. PROVIDE UNTREATED BASE COURSE MATERIAL. DO NOT USE GRAVEL OR WASHED ROCK. PLACE NEW MATERIAL IN LIFTS NOT EXCEEDING 8" AFTER COMPACTION. COMPACT TO A MODIFIED PROCTOR DENSITY OF 95% OR GREATER.
10. STRAIGHT SAWCUT OR BLADECUT THE EXISTING ASPHALT PAVEMENT WHEN JOINING WITH NEW ASPHALT PAVEMENT.

STRUCTURE PATCH



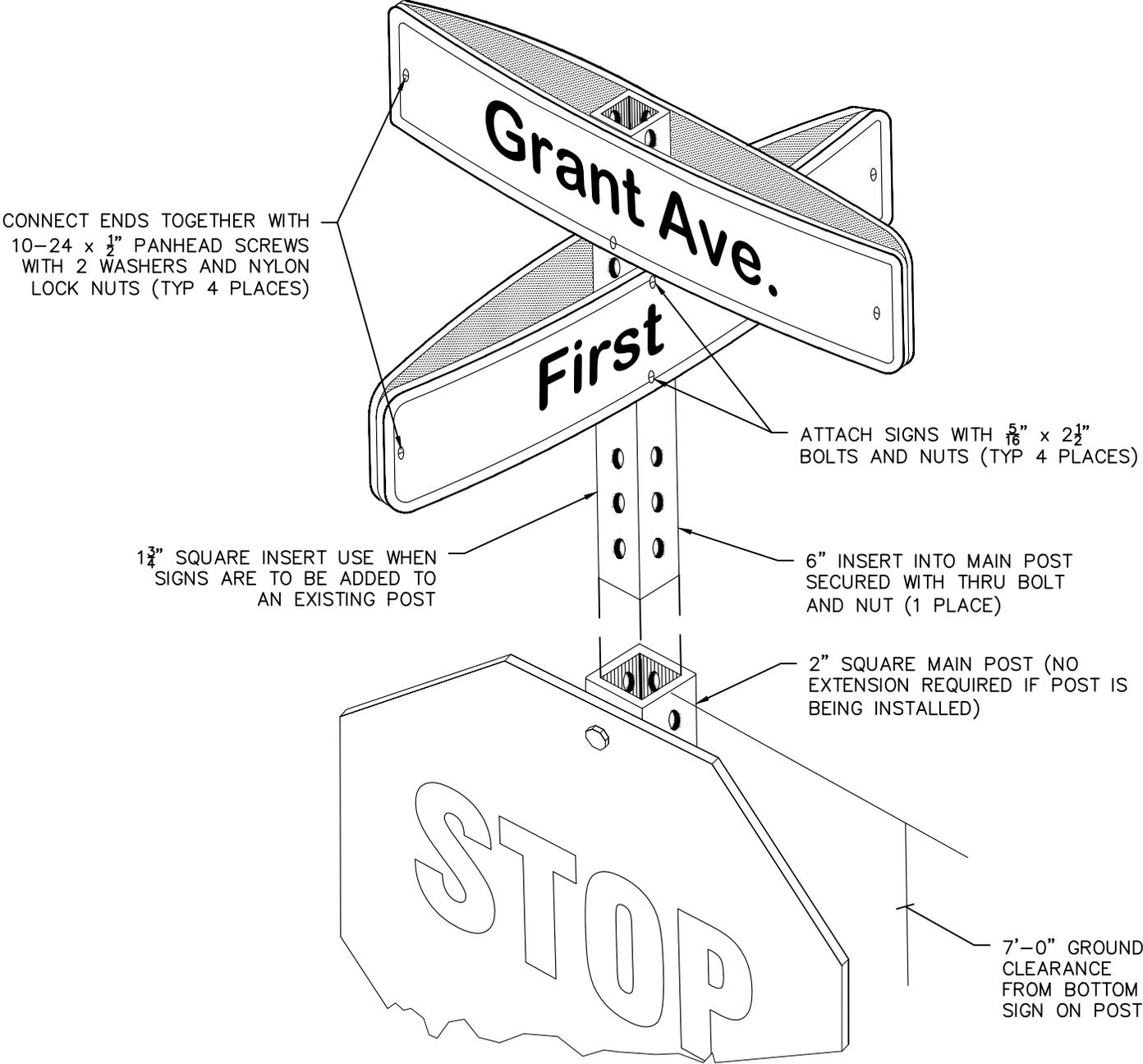
**STREET CONSTRUCTION
DRAWINGS**

BY: JME
SCALE: NTS
DATE: 11/2019

DRAWING:

ST9

STANDARD ORIENTATION:
NORTH-SOUTH STREETS ON TOP
EAST-WEST STREETS ON BOTTOM



GROUND MOUNT STREET NAME SIGN

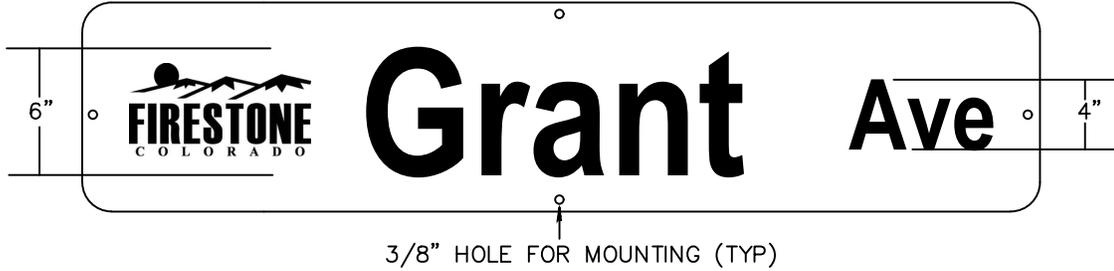


STREET CONSTRUCTION
DRAWINGS

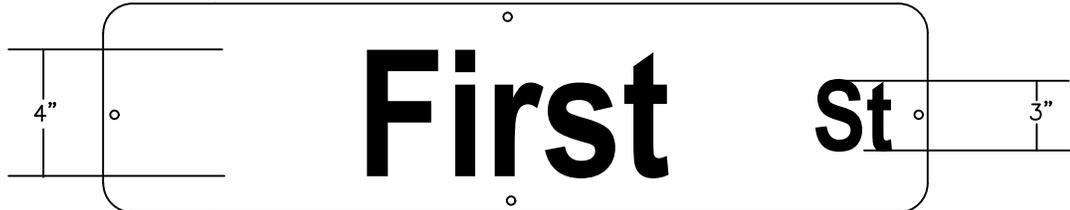
BY: JME
SCALE: NTS
DATE: 11/2019

DRAWING:
ST10A

9" STREET SIGN WITH TOWN OF FIRESTONE LOGO



6" STREET SIGN WITHOUT TOWN OF FIRESTONE LOGO



INTERSECTION TYPE	SIGN BLANK SIZE (30" MINIMUM ON ALL LENGTHS)	MOUNTING	RECOMMENDED MINIMUM			
			LETTER HEIGHT		SUFFIX (ST, AVE, CT ETC)	
			INITIAL UPPER CASE	LOWER CASE	INITIAL UPPER CASE	LOWER CASE
ARTERIALS AT SIGNAL LIGHTS WITH LOGO		OVERHEAD	12 INCHES	9 INCHES	6 INCHES	4.5 INCHES
MULTI LANE ARTERIALS AND ALL OTHERS DIRECTED BY PUBLIC WORKS DEPT WITH LOGO	10" X AS NEEDED	POST MOUNTED	8 INCHES	6 INCHES	4.5 INCHES	3.5 INCHES
ARTERIALS & COLLECTORS AND ALL OTHERS DIRECTED BY PUBLIC WORKS DEPT WITH LOGO	9" X AS NEEDED	POST MOUNTED	6 INCHES	4.5 INCHES	4 INCHES	3 INCHES
LOCAL/NO LOGO	9" X AS NEEDED	POST MOUNTED	6 INCHES	4.5 INCHES	4 INCHES	3 INCHES
*LOCAL/NO LOGO	6" X AS NEEDED	POST MOUNTED	4 INCHES	3 INCHES	3 INCHES	2.25 INCHES
*ON LOCAL TWO-LANE STREETS WITH SPEED LIMITS OF 25 MPH OR LESS, 4 INCH INITIAL UPPER-CASE LETTERS WITH 3 INCH LOWER CASE LETTERS MAY BE USED						
NO BORDERS EXCEPT ON OVERHEAD LIGHTED STREET SIGNS AT SIGNALIZED INTERSECTIONS						
WHEN LOGO IS DISPLAYED, THE HEIGHT AND WIDTH OF THE LOGO SHALL NOT EXCEED THE UPPER CASE LETTER HEIGHT OF THE PRINCIPAL LEGEND OF THE SIGN AND LOCATED LEFT OF THE STREET NAME						

NOTES:

1. SIGN BLANKS SHALL BE 6061 OR 5052-H38 ALUMINUM ALLOY MIN 0.080" THICK.
2. FACING SHALL BE GREEN HI-INTENSITY RETROREFLECTIVE SHEETING.
3. LETTERS AND NUMBERS SHALL BE WHITE RETROREFLECTIVE SHEETING.
4. TOWN OF FIRESTONE COLOR LOGO IS TO BE USED FOR COLLECTOR AND ARTERIAL STREET BLADES ONLY.
5. 30" MIN. LENGTH ON ALL STREET SIGNS, SINGLE FACE FOR BACK TO BACK INSTALLATION AND 1/4" HOLES FOR PINNING ENDS OF SIGNS TOGETHER.
6. THE SIZING OF ALL SIGNS AT AN INTERSECTION SHALL BE UNIFORM AND BE DETERMINED BY THE HIGHEST CLASSIFICATION ROAD AT AN INTERSECTION.

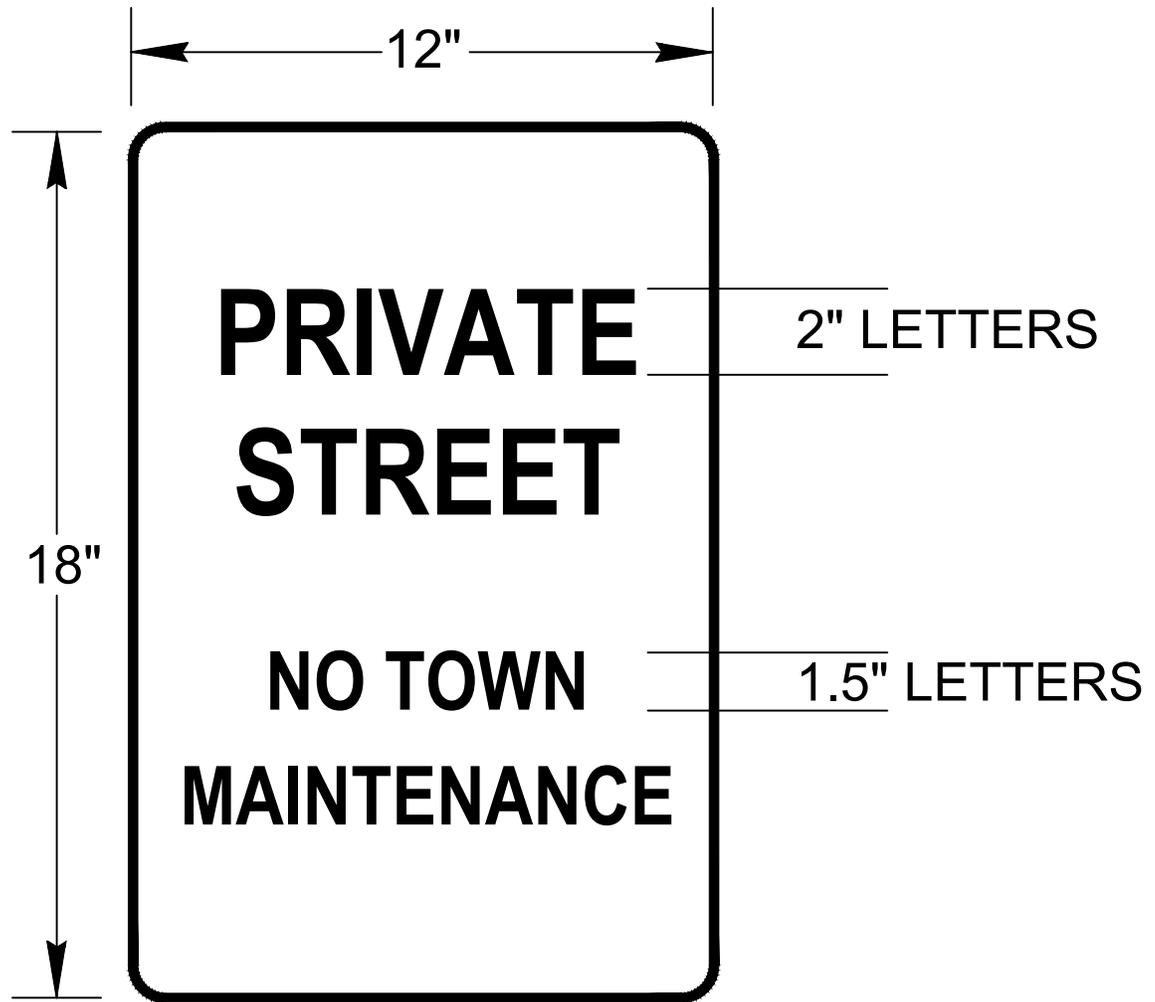
ROAD AND STREET NAME SIGNS



**STREET CONSTRUCTION
DRAWINGS**

BY: JME
SCALE: NTS
DATE: 11/2019

**DRAWING:
ST10B**



NOTES:

1. SIGN BLANKS SHALL BE 6061 OR 5052-H38 ALUMINUM ALLOY MIN. 0.080" THICK.
2. FACING SHALL BE WHITE RETROREFLECTIVE.
3. LETTERS SHALL BE BLACK.

PRIVATE STREET SIGN



**STREET CONSTRUCTION
DRAWINGS**

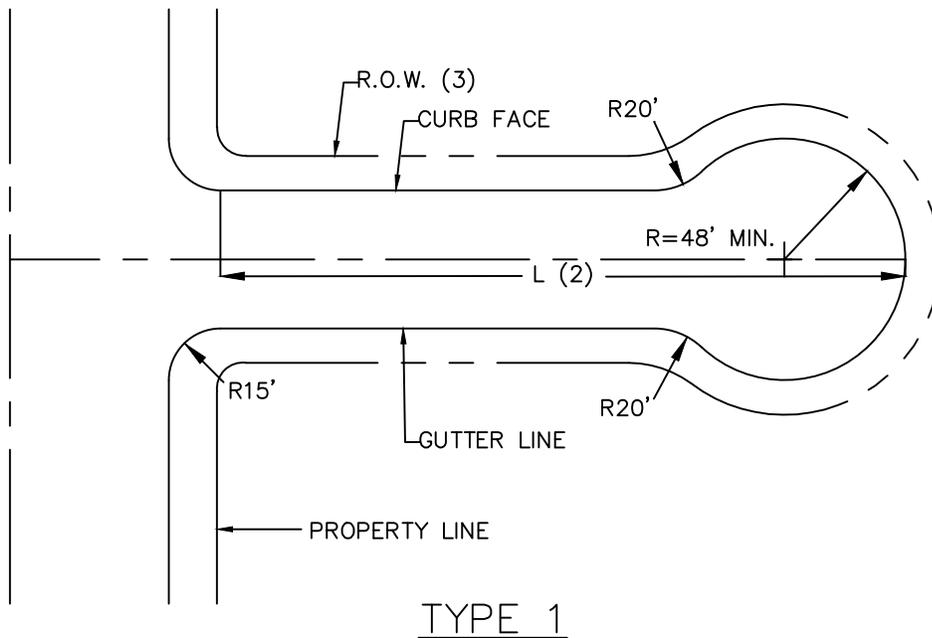
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SCALE: NTS

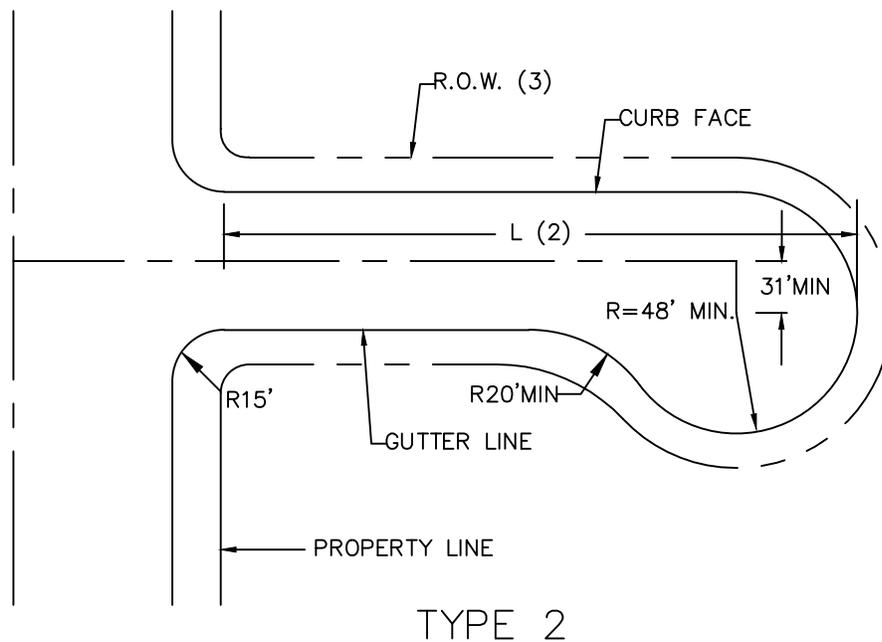
DATE: 11/2019

DRAWING:

ST10C



TYPE 1



TYPE 2

NOTES:

- (1) WIDTH OF TYPE 1 & 2 CUL-DE-SACS TO CONFORM TO APPLICABLE TYPICAL STREET CROSS SECTIONS.
- (2) SEE SECTION 526.00 CUL-DE-SACS FOR LENGTH (L) REQUIREMENTS.
- (3) R.O.W. LINES ARE TO BE PARALLEL TO AND OFFSET FROM THE CURB FACE AND THE DISTANCE SHALL MATCH THE STREET SECTION DETAIL.

CUL-DE-SAC



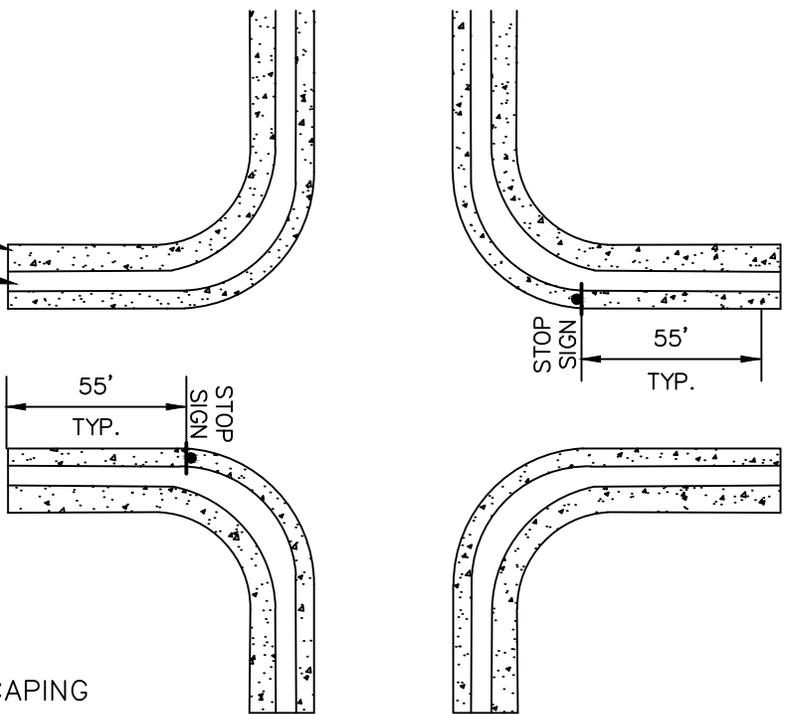
**STREET CONSTRUCTION
DRAWINGS**

BY: NLH
SCALE: NTS
DATE: 07/2025

DRAWING:

ST11

DETACHED WALK
TREE LAWN (TYP)

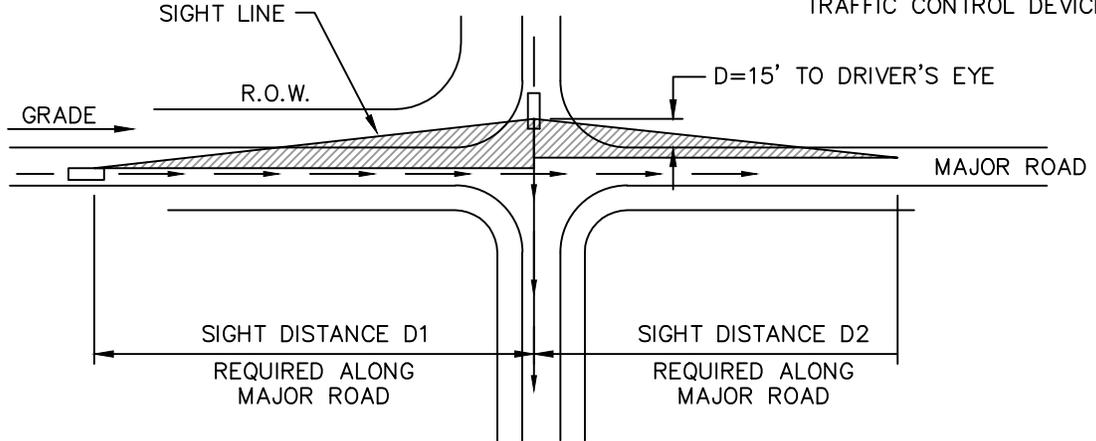


NO TREES IN TREE LAWN WITHIN 55 FEET OF SIGN. ANY OTHER PLANTS AND LANDSCAPING MUST BE APPROVED BY THE PUBLIC WORKS DIRECTOR OR DESIGNEE.

INTERSECTION LANDSCAPING

STOPPED APPROACH

SIGHT DISTANCE REQUIREMENT FOR INTERSECTIONS WITH TRAFFIC CONTROL DEVICES



DESIGN SPEED OF THRU ROADWAY (MPH)	MINIMUM D1 SIGHT DISTANCE FOR STOPPED VEHICLE (FEET)	DESIGN SPEED OF THRU ROADWAY (MPH)	MINIMUM D2 SIGHT DISTANCE FOR STOPPED VEHICLE (FEET)
25	280	25	240
30	280	30	290
35	390	35	335
40	445	40	385
45	500	45	430

*NOTE: SIGHT DISTANCES SHOWN ARE FOR MINOR ROAD APPROACHES AT GRADE WHERE THE MAJOR ROAD IS AN UNDIVIDED TWO-WAY, TWO-LANE ROADWAY WITH NO TURNS. ADDITIONAL CONSIDERATION SHOULD BE USED FOR SIGHT DISTANCES NOT MEETING THESE ASSUMPTIONS.

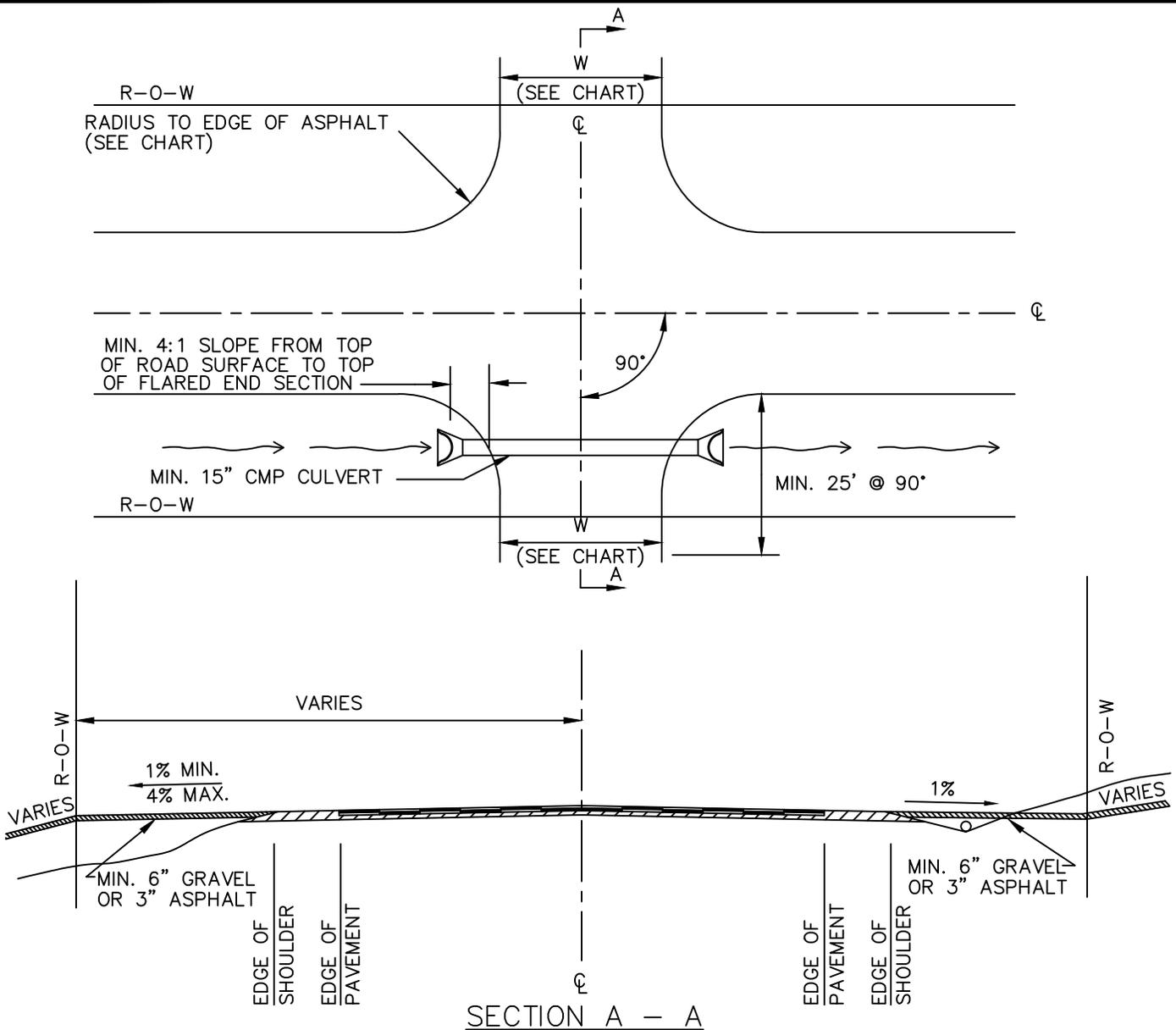
SIGHT DISTANCE



STREET CONSTRUCTION DRAWINGS

BY: NLH
SCALE: NTS
DATE: 07/2025

DRAWING:
ST12



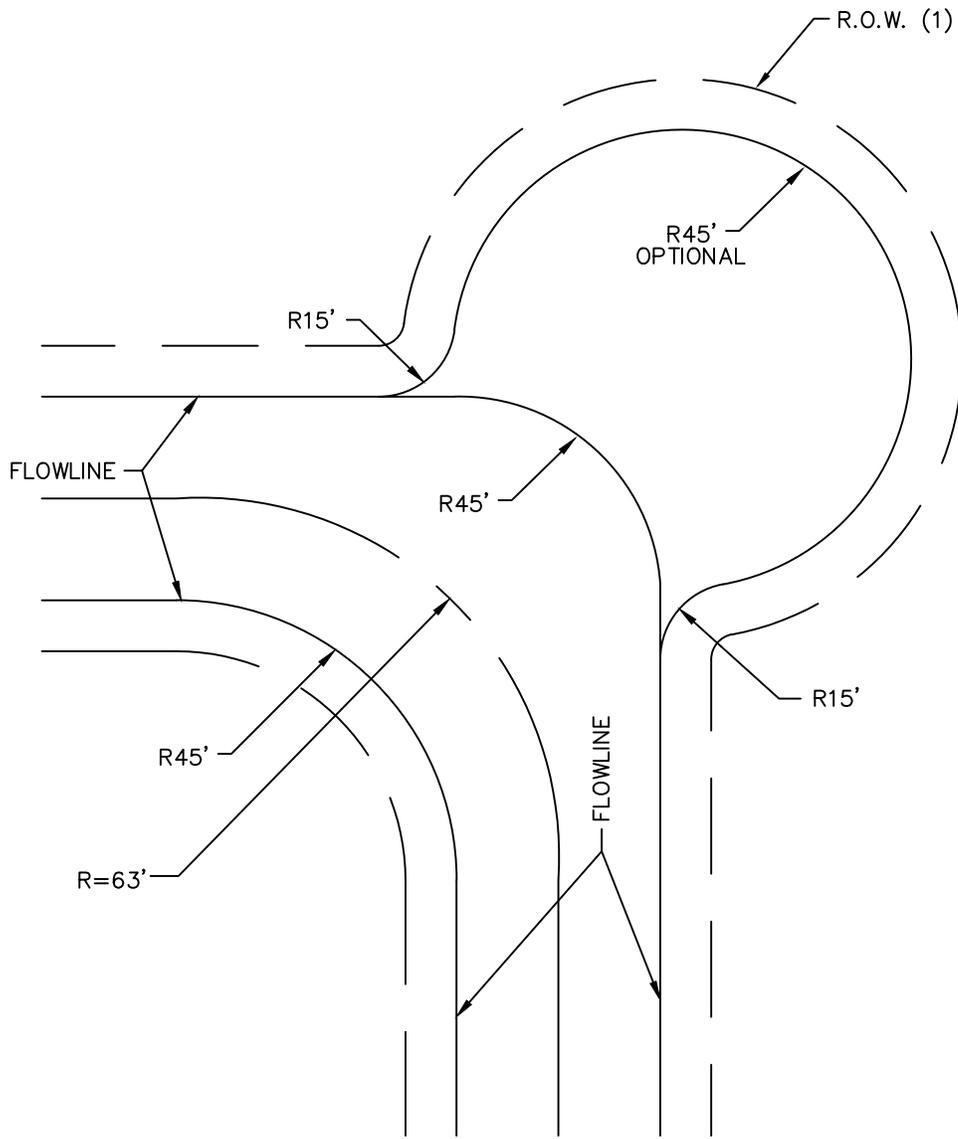
	DRIVEWAY WIDTH (FEET)	PAVEMENT RADIUS (FEET)
RESIDENTIAL	10-25	10
NON-RESIDENTIAL	15-35	15

NOTES:

1. THE TOWN OF FIRESTONE ENGINEERING DEPARTMENT WILL DETERMINE THE REQUIRED CULVERT SIZE. FLARED END SECTIONS ARE REQUIRED FOR CULVERTS 24" IN DIAMETER OR LARGER.
2. DRIVEWAY PERMITS ARE REQUIRED FROM THE TOWN OF FIRESTONE ENGINEERING DEPARTMENT.
3. THE TOWN OF FIRESTONE ENGINEERING DEPARTMENT MUST REVIEW DRIVEWAY LOCATIONS ONTO COLLECTOR AND ARTERIAL ROADS PRIOR TO A PERMIT BEING ISSUED.

DRIVEWAY APPROACHES FOR ROADS

	<p align="center">STREET CONSTRUCTION DRAWINGS</p>	<p>BY: JME</p>	<p>DRAWING: ST13</p>
		<p>SCALE: NTS</p>	
		<p>DATE: 11/2019</p>	



NOTE:

1. 20MPH ADVISORY SIGNS REQUIRED ON CURVE APPROACHES

90 DEGREE TURN - LOCAL ACCESS STREETS



**STREET CONSTRUCTION
DRAWINGS**

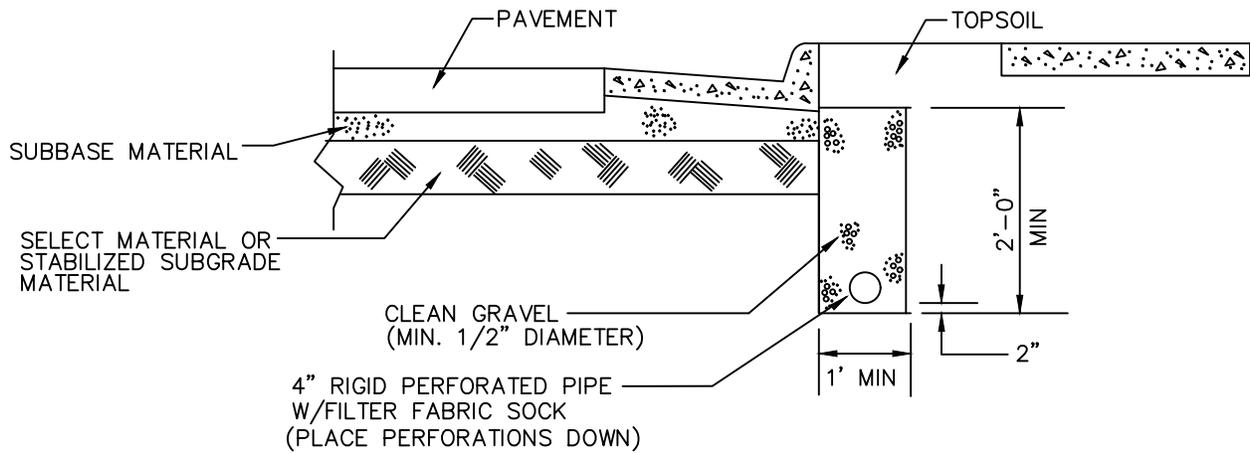
BY: JME

SCALE: NTS

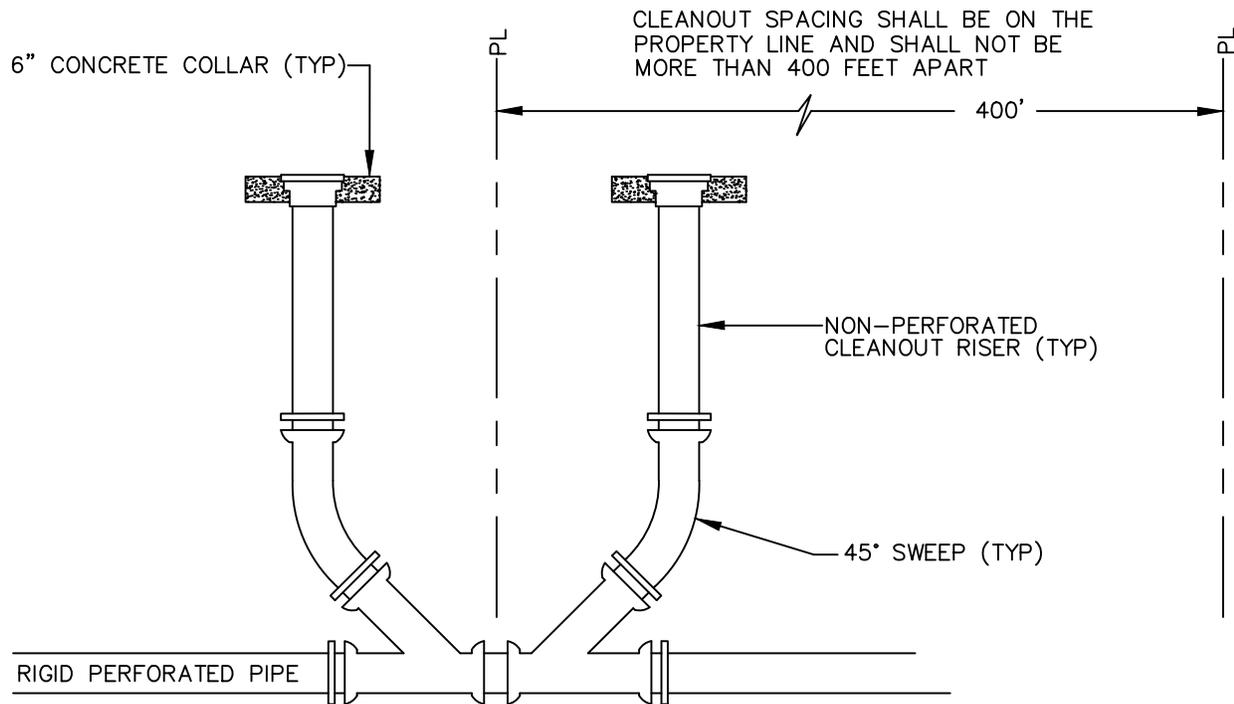
DATE: 11/2019

DRAWING:

ST14



4" PERFORATED UNDERDRAIN DETAIL



NOTES:

1. CURB STOP TO BE A MIN. OF 1' BEHIND TRENCH.
2. PERFORATED DRAIN NEEDS TO DAYLIGHT INTO DRAINAGE SYSTEM.
3. PROVIDE PLUG ON UPSTREAM END OF PIPE.
4. PERFORATED PIPE SHALL FOLLOW ESTABLISHED GRADE AND HAVE POSITIVE FLOW.
5. UNDERDRAINS WILL BE ON ALL ROADS WITH DETACHED SIDEWALKS AND IRRIGATED TREE LAWNS.
6. WHERE THE BOTTOM OF SELECT MATERIAL IS GREATER THAN 4' BELOW PAVEMENT, THE UNDERDRAIN PIPE IS TO BE COINCIDENT WITH THE BOTTOM OF SELECT MATERIAL AND THE TRENCH DEPTH AND BACKFILL QUANTITY INCREASED ACCORDINGLY.
7. PLACE A VALVE BOX TOP WITH LID AND 6" THICK CONCRETE COLLAR AT ALL 4" PERFORATED UNDERDRAIN CLEANOUTS.
8. WHEN CURB AND GUTTER IS IN PLACE, THE CLEANOUTS SHALL BE MARKED ON THE CONCRETE CURB FACE WITH A "+".

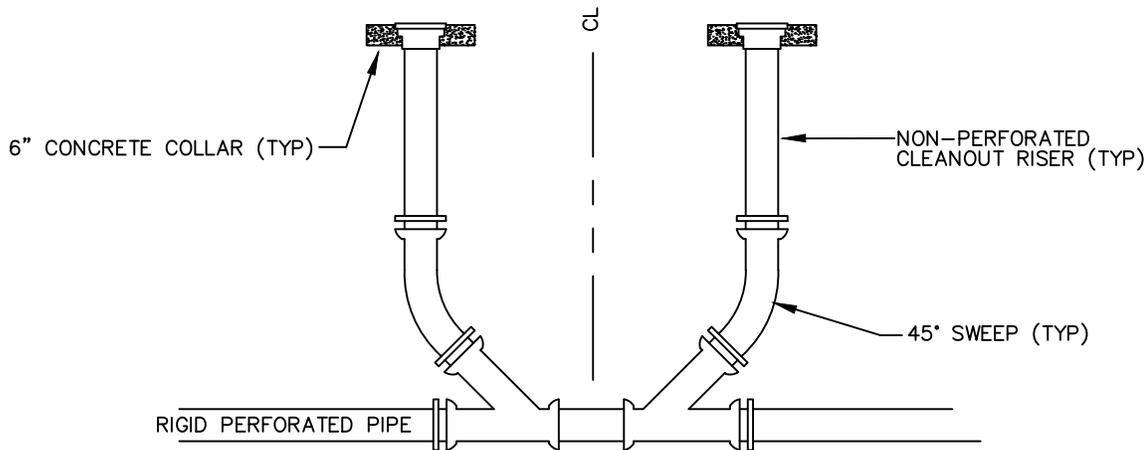
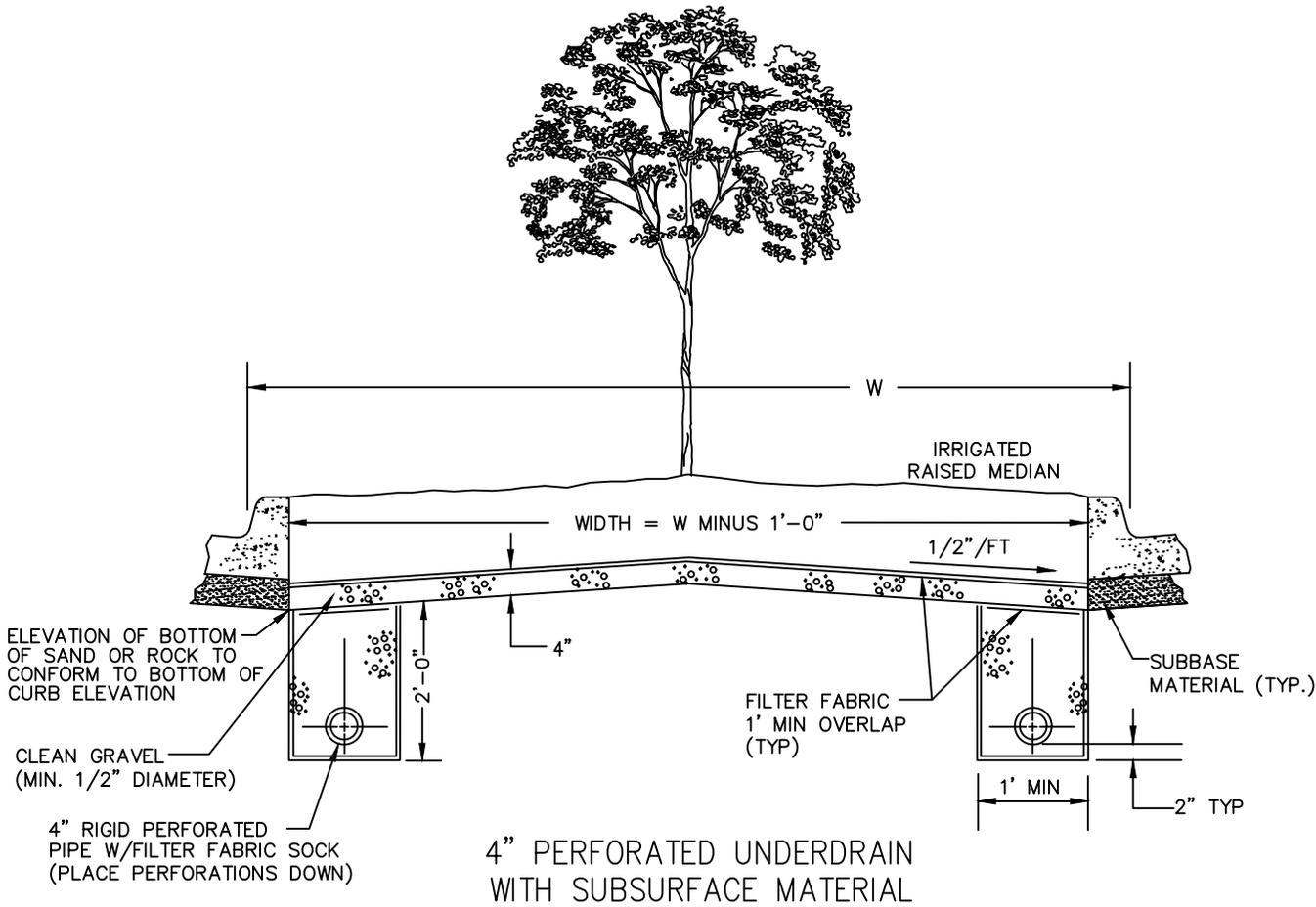
4" PERFORATED UNDERDRAIN



STREET CONSTRUCTION
DRAWINGS

BY: JME
SCALE: NTS
DATE: 11/2019

DRAWING:
ST15A



NOTES:

1. PERFORATED DRAIN NEEDS TO DAYLIGHT INTO DRAINAGE SYSTEM.
2. CLEANOUTS SHALL BE SPACED A MAXIMUM OF 400'.
3. PERFORATED PIPE SHALL FOLLOW ESTABLISHED GRADE AND HAVE POSITIVE FLOW.
4. PLACE A VALVE BOX TOP WITH LID AND 6" THICK CONCRETE COLLAR AT ALL 4" PERFORATED UNDERDRAIN CLEANOUTS.
5. WHEN CURB AND GUTTER IS IN PLACE, THE CLEANOUTS SHALL BE MARKED ON THE CONCRETE CURB FACE WITH A "+".

4" PERFORATED MEDIAN UNDERDRAIN FOR CENTER PLANTING

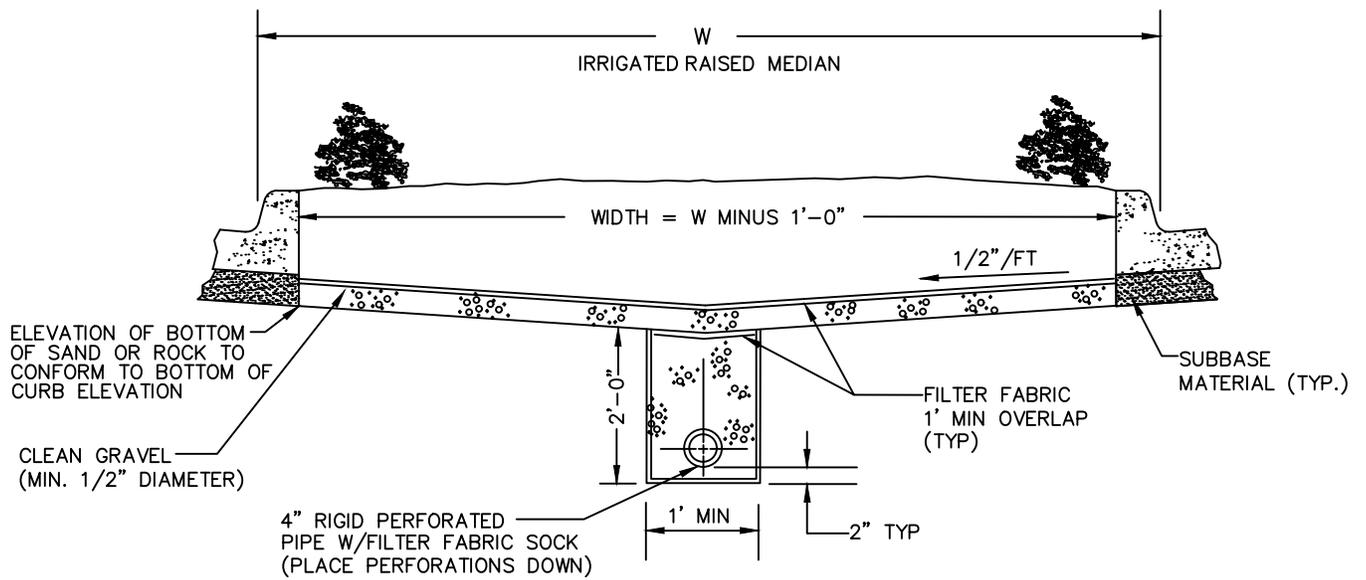


**STREET CONSTRUCTION
DRAWINGS**

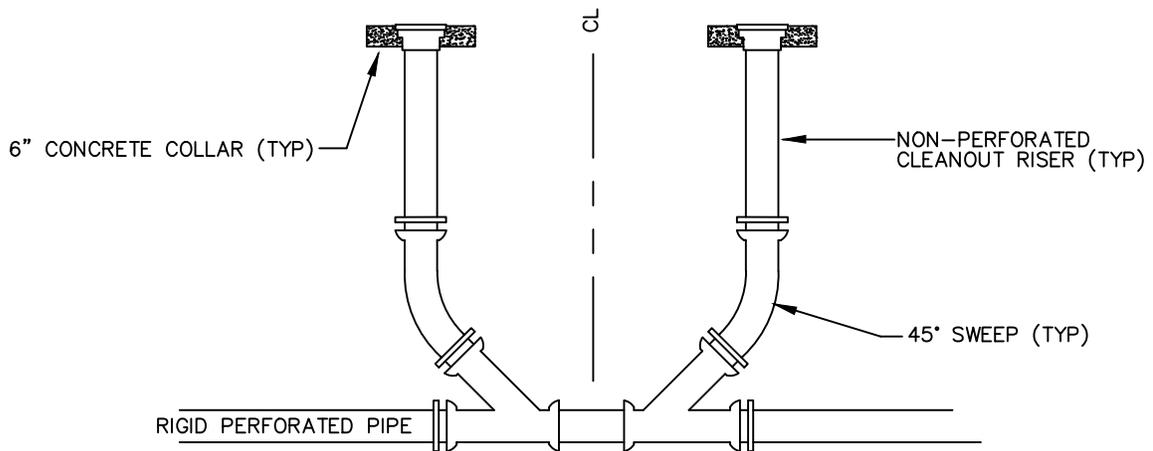
BY: JME
SCALE: NTS
DATE: 11/2019

DRAWING:

ST15B



**4" PERFORATED UNDERDRAIN
WITH SUBSURFACE MATERIAL**



NOTES:

1. PERFORATED DRAIN NEEDS TO DAYLIGHT INTO DRAINAGE SYSTEM.
2. CLEANOUTS SHALL BE SPACED A MAXIMUM OF 400'.
3. PERFORATED PIPE SHALL FOLLOW ESTABLISHED GRADE AND HAVE POSITIVE FLOW.
4. PLACE A VALVE BOX TOP WITH LID AND 6" THICK CONCRETE COLLAR AT ALL 4" PERFORATED UNDERDRAIN CLEANOUTS.
5. WHEN CURB AND GUTTER IS IN PLACE, THE CLEANOUTS SHALL BE MARKED ON THE CONCRETE CURB FACE WITH A "+".

4" PERFORATED MEDIAN UNDERDRAIN FOR EDGE PLANTING

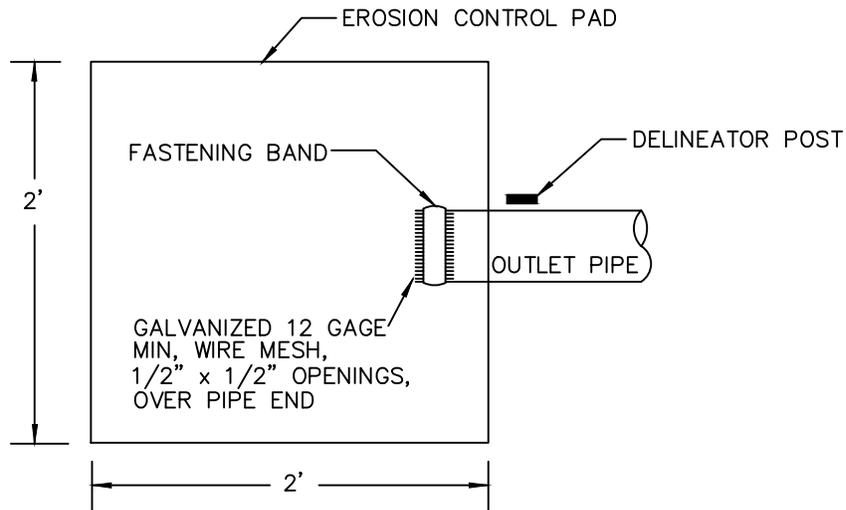


**STREET CONSTRUCTION
DRAWINGS**

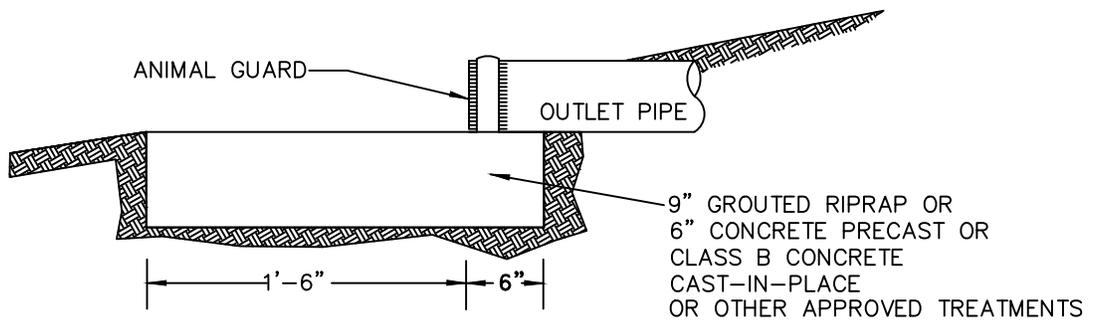
BY: JME
SCALE: NTS
DATE: 11/2019

DRAWING:

ST15C



PLAN



PROFILE

OUTLET PIPE
END TREATMENT

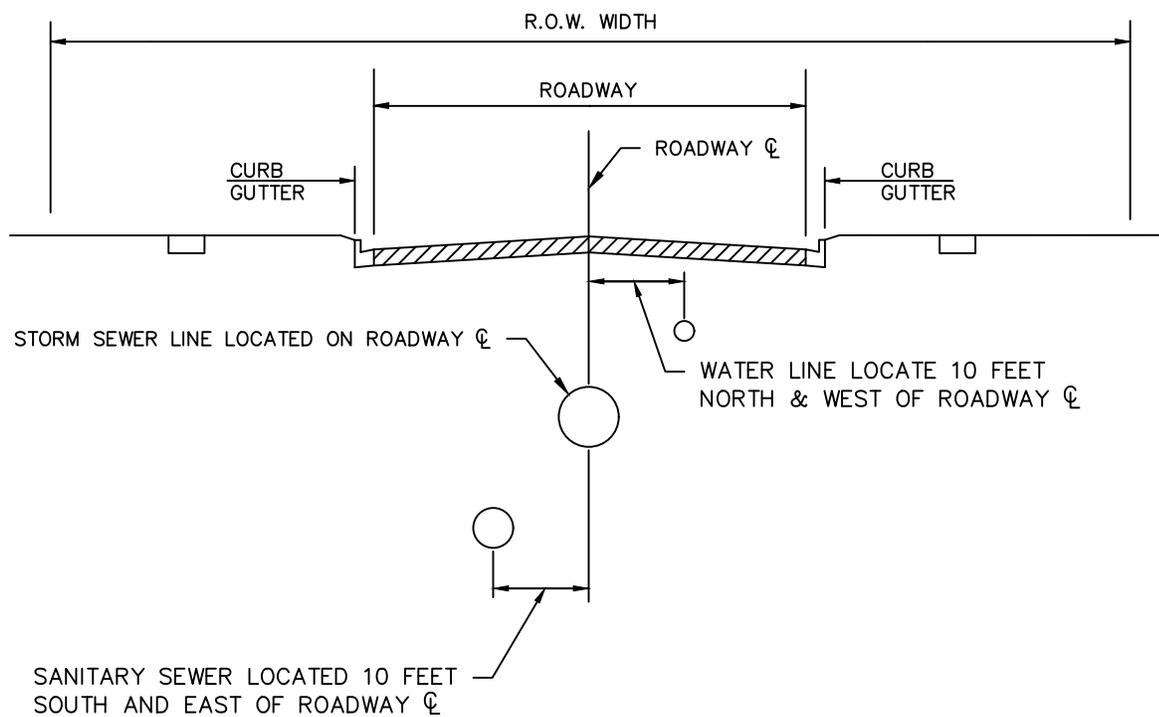
UNDERDRAIN OUTLET TREATMENT



**STREET CONSTRUCTION
DRAWINGS**

BY: JME
SCALE: NTS
DATE: 11/2019

DRAWING:
ST16



TYPICAL UTILITY LOCATIONS ON NORMAL ROADWAY

NOTES:

1. VERTICAL DEPTH LOCATION OF UTILITIES VARIES (REFER TO LATEST TOWN OF FIRESTONE STANDARDS AND SPECIFICATIONS FOR ALLOWABLE DEPTHS)
2. HORIZONTAL DIMENSIONS BASED ON CL TO CL OF VARIOUS PIPE UTILITIES.
3. UTILITY SEPARATION ALONG CL ROADWAY RADIAL ARC REVIEWED ON AN INDIVIDUAL PROJECT BASIS (MUST MAINTAIN 10 FEET OF HORIZONTAL SEPARATION).

TYPICAL STREET UTILITY LOCATION



**STREET CONSTRUCTION
DRAWINGS**

BY: JME
SCALE: NTS
DATE: 11/2019

**DRAWING:
ST17**

DRAWING NO.

TITLE

SS1	STANDARD MANHOLE
SS2	SANITARY MANHOLE WITH PRIVATE UNDERDRAIN
SS3	24" MANHOLE RING AND COVER
SS4	SANITARY SEWER TRENCH DETAIL
SS5	SANITARY SEWER TRENCH WITH PRIVATE UNDERDRAIN

INDEX OF SANITARY SEWER DETAILS



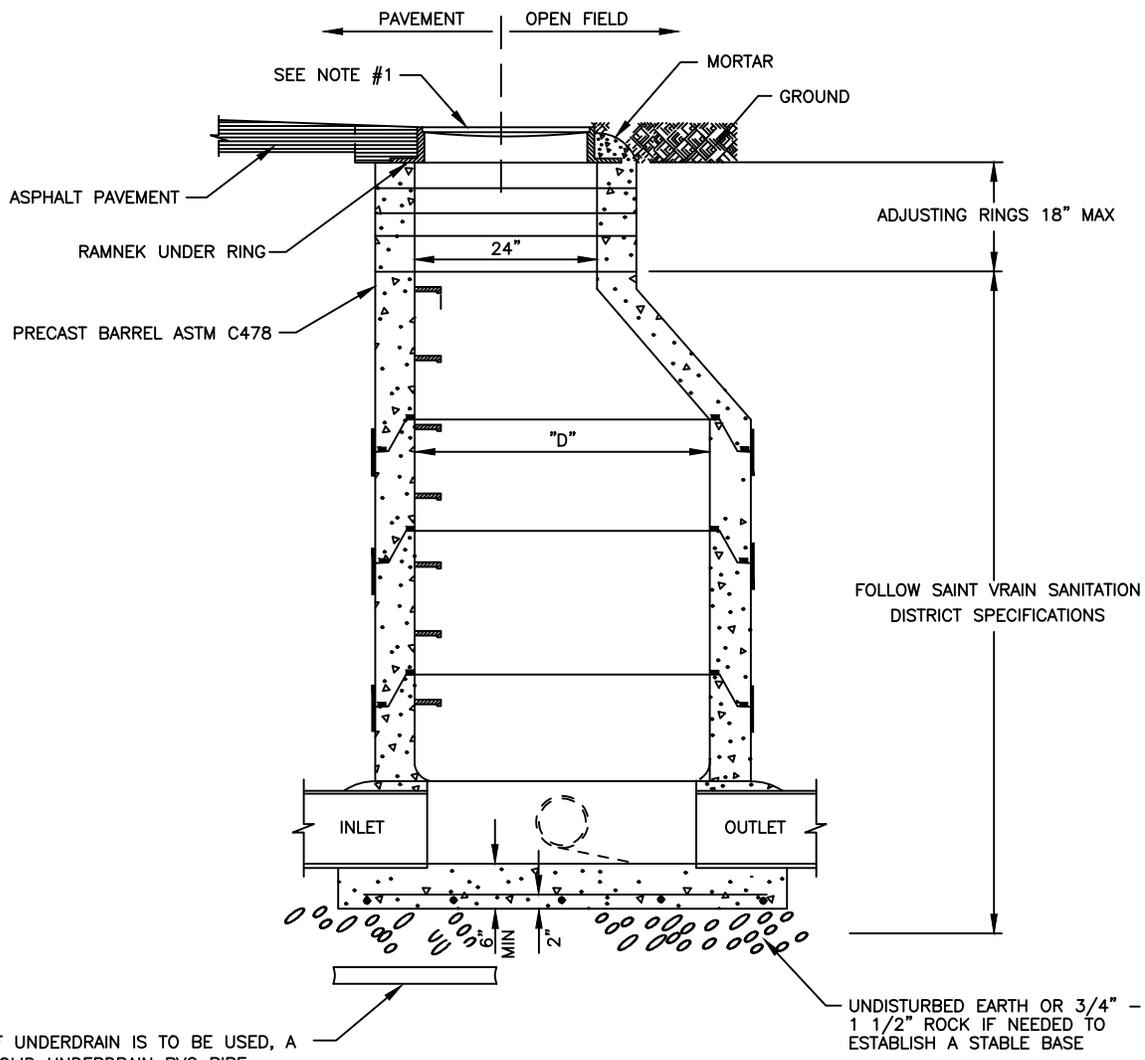
**SANITARY SEWER
CONSTRUCTION
DRAWINGS**

BY: JME

SCALE: NTS

DATE: 1/2020

DRAWING:



SECTION

NOTES:

1. FINAL GRADE OF MANHOLE COVERS SHALL BE 1/4" LOWER THAN FINAL STREET GRADE.
2. MANHOLES NOT IN ASPHALT OR CONCRETE SHALL BE RAISED 6" ABOVE FINAL GRADE AND A CONCRETE COLLAR INSTALLED WITH A GREEN CARSONITE POST.
3. BACKFILL TO BE HAND PLACED AND COMPACTED WITHIN FOUR FEET OF THE MANHOLE.

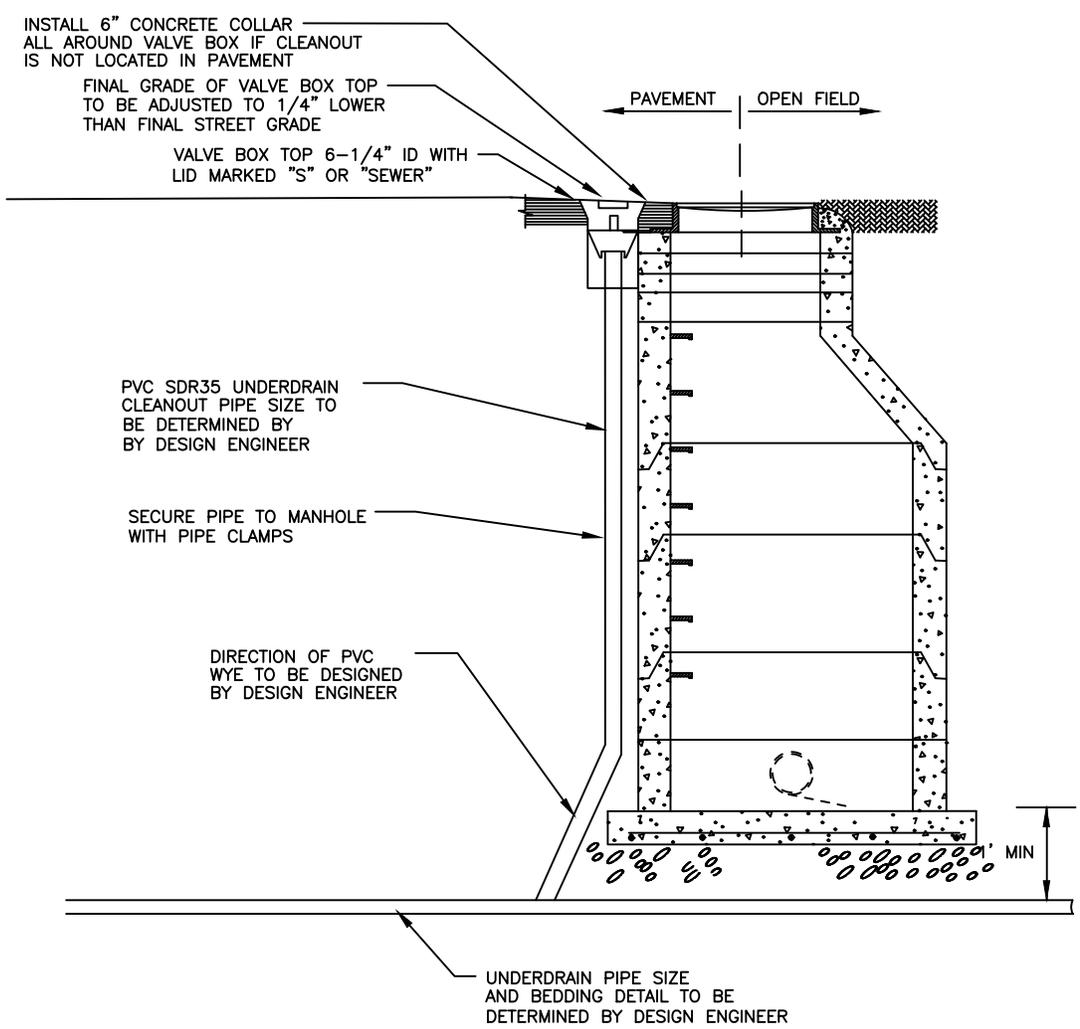
STANDARD MANHOLE



SANITARY SEWER
CONSTRUCTION
DRAWINGS

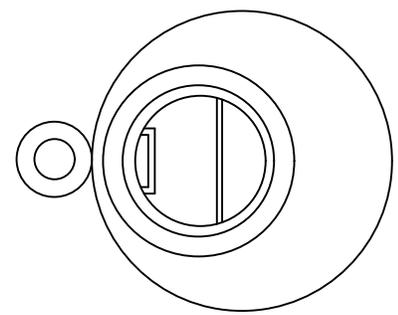
BY: JME
SCALE: NTS
DATE: 1/2020

DRAWING:
SS1



NOTES:

1. FALL UNDERDRAIN SYSTEMS SHALL BE PRIVATE AND NOT MAINTAINED BY THE TOWN OF FIRESTONE.
2. PLACE UNDERDRAIN COLLECTOR PIPE AROUND CONCRETE MANHOLE BASE.
3. CLEANOUT TO BE PLACED UPSTREAM/DOWNSTREAM OF SANITARY MANHOLE AS DETERMINED BY THE DESIGN ENGINEER.
4. SEE 'TRENCH DETAIL WITH PRIVATE UNDERDRAIN' DETAIL FOR VERTICAL LOCATION OF UNDERDRAIN.



PLAN VIEW

SANITARY MANHOLE WITH PRIVATE UNDERDRAIN

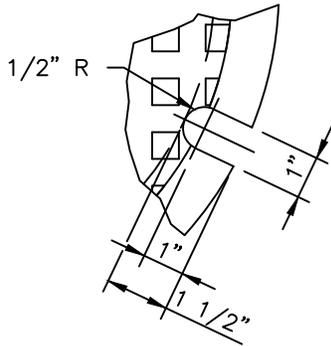
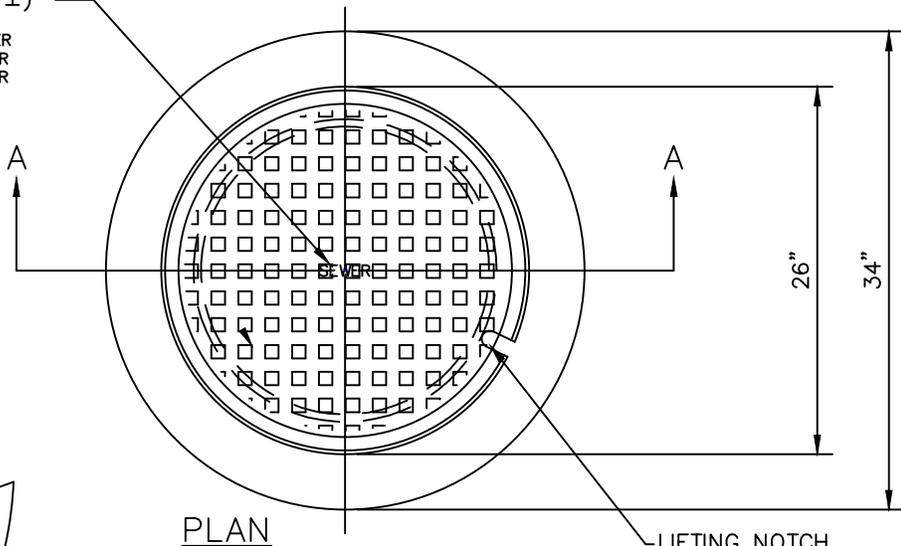
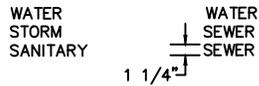


**SANITARY SEWER
CONSTRUCTION
DRAWINGS**

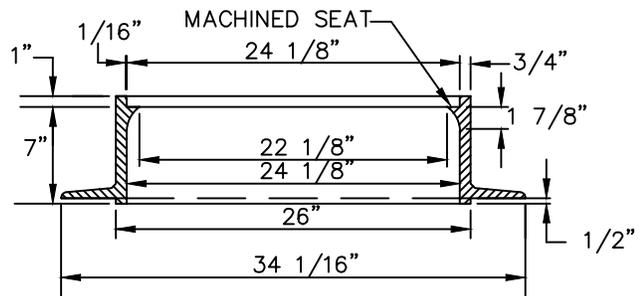
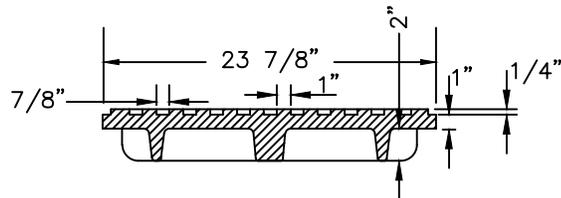
BY: JME
SCALE: NTS
DATE: 1/2020

DRAWING:
SS2

RAISED LETTERS ($1/8'' \pm$)



LIFTING NOTCH



SECTION A-A

1. CASTING SPECIFICATIONS: ASTM A-48 WITH A MINIMUM TENSILE STRENGTH OF 25 KSI (CLASS 25)
2. ALL CASTINGS TO BE DIPPED IN ASPHALT BASE PAINT (OR APPROVED EQUAL)
3. CASTINGS SHALL BE AS SPECIFIED BELOW OR APPROVED EQUAL:

MANUFACTURERS	CAT. #
NEENAH	R-1706
CASTINGS, INC.	MH-400-24 C.I.
HUTCHINSON FDRY. & STL. INC.	MH-400
EAST JORDAN	FRAME-2420Z

4. ALL NEW MANHOLES MUST INCLUDE A PLASTIC OR VINYL TAG ATTACHED TO THE TOP STEP STATING THE FOLLOWING "CAUTION CONFINED SPACE; ENTRY PERMIT REQUIRED.

24" MANHOLE RING AND COVER

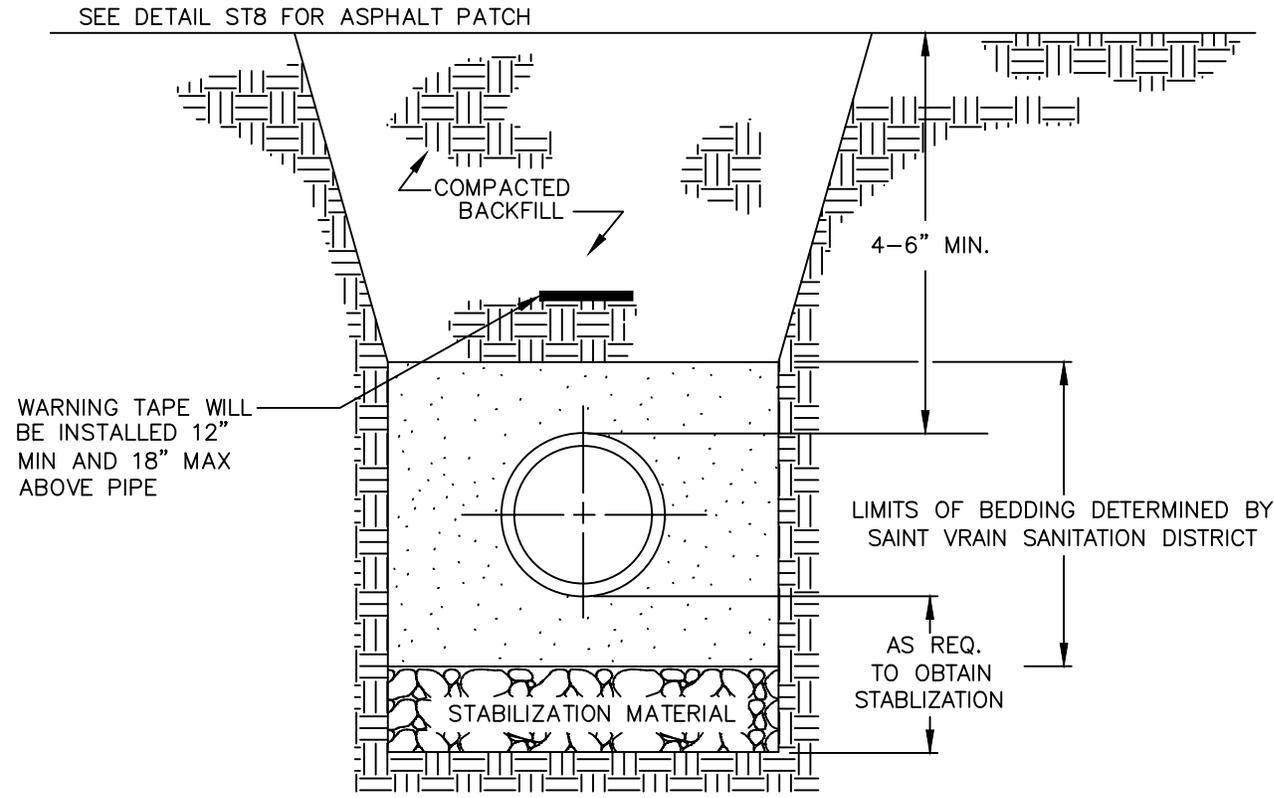


SANITARY SEWER
CONSTRUCTION
DRAWINGS

BY: PCB
SCALE: NTS
DATE: 12/2021

DRAWING:

SS3



NOTES:

1. COMPACTION SHALL BE AS FOLLOWS: PIPE ZONE BEDDING 6" UNDER AND 12" OVER PIPE WILL REQUIRE 90% S.P.D. TRENCH ZONE ABOVE BEDDING MATERIALS, FULL TRENCH SECTION IN ROADWAY OR STREET R.O.W. LIMITS WILL REQUIRE 95% S.P.D. TRENCH ZONE ABOVE BEDDING MATERIALS, OUTSIDE OF STREET R.O.W. WILL REQUIRE 90% S.P.D.
2. TRENCH TO 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.
3. TRENCH WIDTH SHALL NOT BE MORE THAN 24" NOR LESS THAN 12" WIDER THAN THE LARGEST OUTSIDE DIAMETER OF THE PIPE.

SANITARY SEWER TRENCH DETAIL

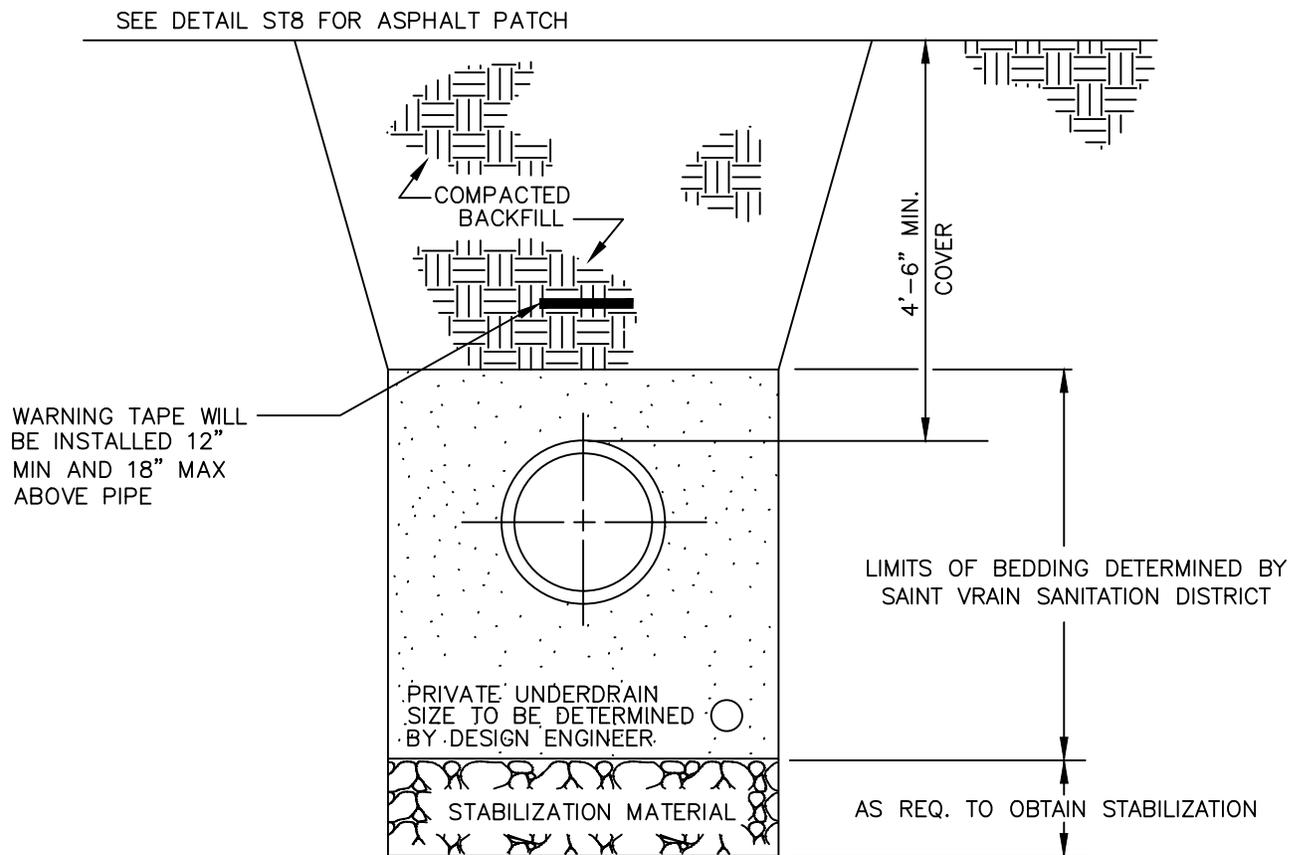


**SANITARY SEWER
CONSTRUCTION
DRAWINGS**

BY: JME
SCALE: NTS
DATE: 1/2020

DRAWING:

SS4



NOTES:

1. BACKFILL TO BE COMPACTED TO 95% ASTM D-698, OR 70% OF ASTM D-4253 AND 4254 RELATIVE DENSITY, IN ALL AREAS UNLESS OTHERWISE NOTED.
2. TRENCH TO 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.
3. TRENCH WIDTH SHALL NOT BE MORE THAN 16" NOR LESS THAN 12" WIDER THAN THE LARGEST OUTSIDE DIAMETER OF THE PIPE.
4. COMPACTION SHALL BE AS FOLLOWS: PIPE ZONE BEDDING 6" UNDER AND 12" OVER PIPE WILL REQUIRE 90% S.P.D. TRENCH ZONE ABOVE BEDDING MATERIALS, FULL TRENCH SECTION IN ROADWAY OR STREET R.O.W. LIMITS WILL REQUIRE 95% S.P.D. TRENCH ZONE ABOVE BEDDING MATERIALS, OUTSIDE OF STREET R.O.W. WILL REQUIRE 90% S.P.D.
5. ALL UNDERDRAIN SYSTEMS SHALL BE PRIVATE AND WILL NOT BE MAINTAINED BY THE TOWN OF FIRESTONE.

SANITARY SEWER TRENCH WITH PRIVATE UNDERDRAIN



**SANITARY SEWER
CONSTRUCTION
DRAWINGS**

BY: JME
SCALE: NTS
DATE: 1/2020

DRAWING:

SS5

<u>DRAWING NO.</u>	<u>TITLE</u>
STM1	SMALL CONSTRUCTION PROJECT EROSION CONTROL
STM2	FLARED END SECTION OUTLET
STM3	INLET PROTECTION
STM4	SILT FENCE EROSION BARRIER
STM5	(RESERVED FOR FUTURE USE)
STM6A	TRACKING CONTROL PAD – CRUSHED ROCK
STM6B	TRACKING CONTROL PAD – CATTLE GUARD
STM7	EROSION CONTROL SEQUENCE FOR SMALL CONSTRUCTION PROJECTS
STM8A	STANDARD MANHOLE
STM8B	24” MANHOLE RING AND COVER
STM9	MANHOLE STEPS
STM10	INLET AND INLET COVER
STM11A	CONCRETE PIPE JOINTS – SHIPLAP
STM11B	CONCRETE PIPE JOINTS – TYPE 'R'
STM12	STORM SEWER TRENCH DETAIL
STM13A	CONCRETE ENCASEMENT OF RIGID CONDUITS (1 OF 2)
STM13B	CONCRETE ENCASEMENT OF RIGID CONDUITS (2 OF 2)
STM14	FLARED END SECTION WITH TRICKLE CHANNEL
STM15A	TRASH GUARD FOR CONDUIT (1 OF 3)
STM15B	TRASH GUARD FOR CONDUIT (2 OF 3)
STM15C	TRASH GUARD FOR CONDUIT (3 OF 3)
STM16A	SIDEWALK CHASE DETAIL (1 OF 2)
STM16B	SIDEWALK CHASE DETAIL (2 OF 2)

INDEX OF STORM SEWER DETAILS



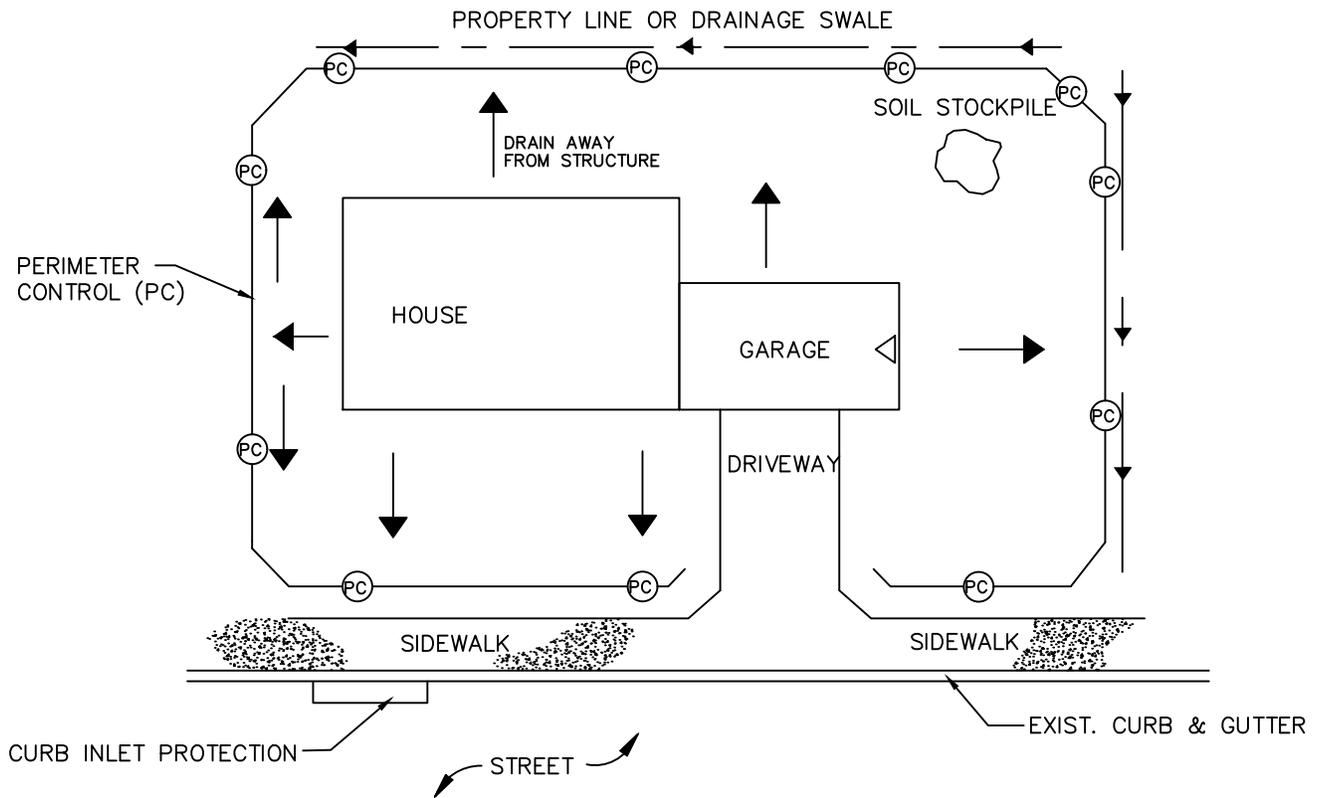
**STORM SEWER
CONSTRUCTION DRAWINGS**

BY: NLH

SCALE: NTS

DATE: 07/2025

DRAWING:



EVERY BUILDING SITE IS UNIQUE AND POSES ITS OWN POTENTIAL EROSION HAZARDS. IN MANY INSTANCES, ADDITIONAL OR ALTERNATIVE CONTROL METHODS ARE NECESSARY IF THE LOT IS ADJACENT TO A CREEK, LAKE, OR WETLAND; SLOPES ARE GREATER THAN 6%; RECEIVES RUNOFF FROM ADJACENT AREAS; AND/OR MORE THAN ONE ACRE OF GROUND IS DISTURBED.

NOTES:

1. IT IS THE RESPONSIBILITY OF THE PROPERTY OWNER AND CONTRACTOR TO COMPLY WITH STATE LAWS AND LOCAL AND COUNTY ORDINANCES REGARDING CONSTRUCTION SITE EROSION AND SEDIMENT CONTROL. IT IS THEIR RESPONSIBILITY TO APPLY FOR ALL APPROPRIATE PERMITS.
2. THIS PLAN IS ONLY A SAMPLE PLAN AND IS NOT INTENDED TO BE ALL INCLUSIVE OR ADDRESS EVERY SITUATION, ADDITIONAL OR MODIFIED PRACTICES MAY BE REQUIRED ON SOME SITES. THIS SHALL ONLY BE USED ON SMALL CONSTRUCTION PROJECTS THAT DO NOT NEED A STORMWATER QUALITY PERMIT.
3. EROSION OR SEDIMENT CONTROL MEASURES MUST BE FUNCTIONAL AND MAINTAINED THROUGHOUT CONSTRUCTION.
4. MAINTAIN POSITIVE DRAINAGE AWAY FROM THE STRUCTURE(S).
5. TRASH SHALL BE PROPERLY DISPOSED OF AND CONTAINED AT ALL TIMES.
6. PLEASE REPORT ANY ILLICIT DISCHARGE BY CALLING (303) 833-3291 OR EMAILING STORMWATER@FIRESTONECO.GOV.

PERIMETER CONTROL (PC)

1. INSTALL PC PARALLEL TO THE CONTOUR OF THE LAND.
2. ENSURE PC ARE INSTALLED PER DETAIL SPECIFICATION.
3. INSPECT AT LEAST WEEKLY AND AFTER EACH STORM EVENT, REPAIRING AS NEEDED AND REMOVING SEDIMENT DEPOSITS WHEN THEY REACH ONE-HALF THE PC HEIGHT.

CONSTRUCTION TRAFFIC ENTRANCES

PROVIDE A SINGLE CONSTRUCTION TRAFFIC ENTRANCE THAT IS MAINTAINED IN A STABLE MANNER TO MINIMIZE SEDIMENT TRACKING TO TOWN STREETS.

SMALL CONSTRUCTION PROJECT EROSION CONTROL

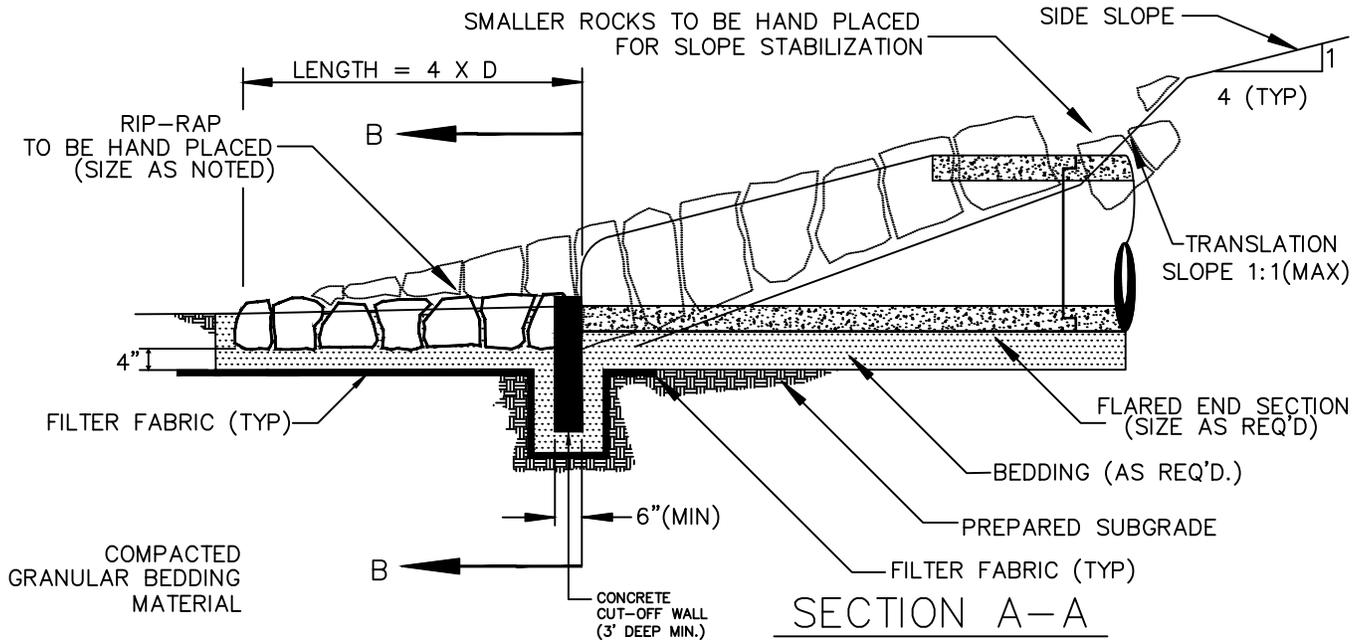


**STORM SEWER
CONSTRUCTION DRAWINGS**

BY: JME
SCALE: NTS
DATE: 1/2020

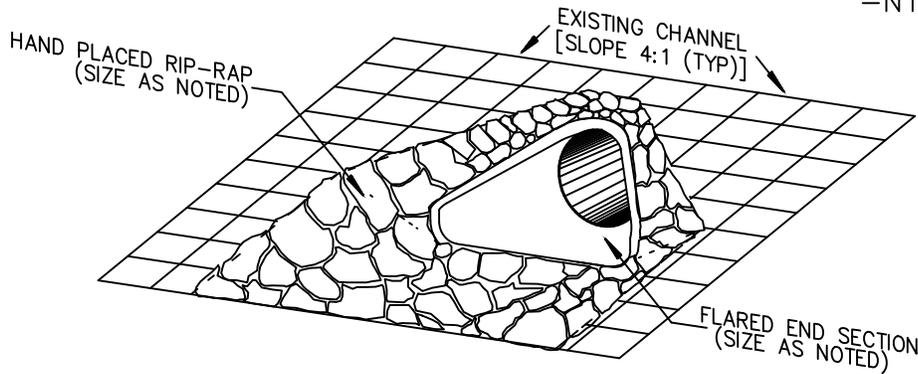
DRAWING:

STM1



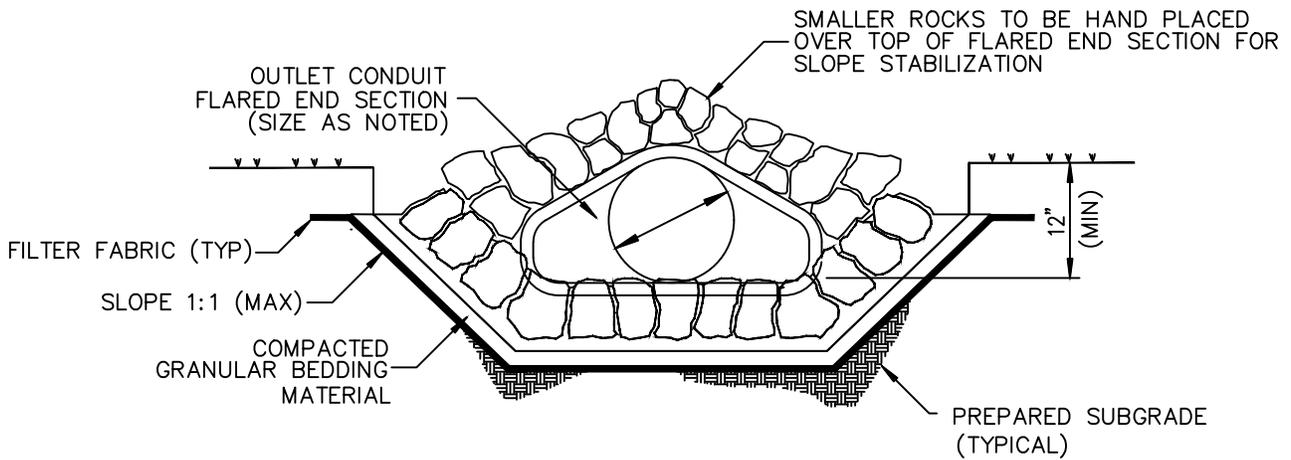
SECTION A-A

-NTS-



STORM SEWER OUTLET

ISOMETRIC VIEW



SECTION B-B

-NTS-

FLARED END SECTION OUTLET



STORM SEWER
CONSTRUCTION DRAWINGS

BY: JME
SCALE: NTS
DATE: 1/2020

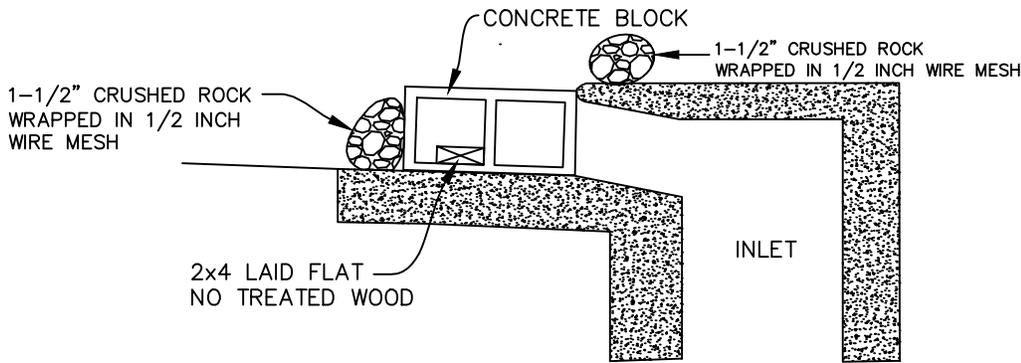
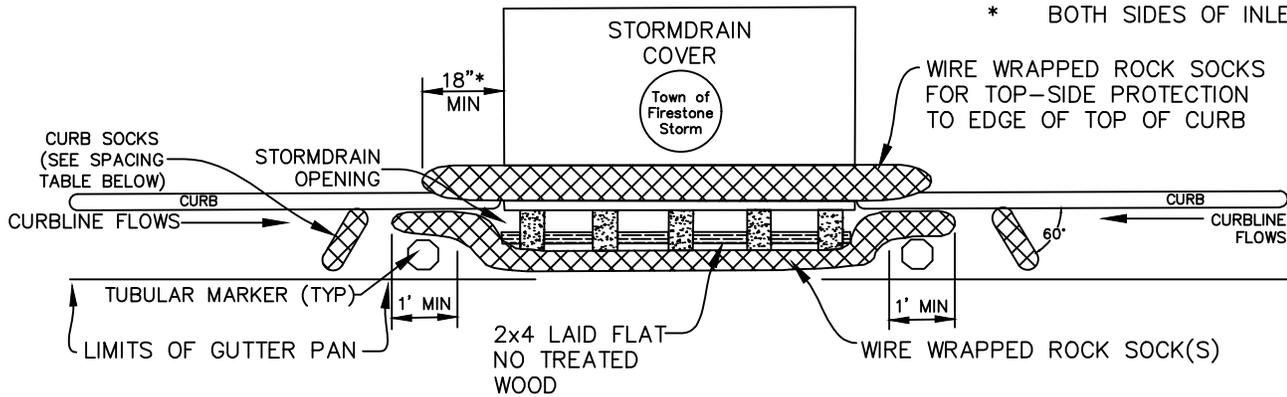
DRAWING:

STM2

NOTES:

- ROCK SOCK SHALL BE 1 1/2" CRUSHED ROCK FILL (RECYCLED CONCRETE NOT ACCEPTABLE)

* BOTH SIDES OF INLET



NOTES:

- INTERIM CONFIGURATION OF INLET PROTECTION IN STREETS SHALL BE INSTALLED WITHIN 72-HOURS OF POURING INLET.
- CRUSHED ROCK SHALL BE FRACTURED FACE (ALL SIDES) AND SHALL BE 1 1/2" CRUSHED ROCK.
- WIRE MESH SHALL BE FABRICATED OF MINIMUM 16-20 GAUGE WIRE TWISTED INTO A MESH WITH A MAXIMUM OPENING OF 1/2 INCH. ROLL WIDTH SHALL BE 48". 16-20 GAUGE CHICKEN WIRE MAY BE USED IF DOUBLE WRAPPED WITH NO MORE THAN 1/2" OPENING.
- WIRE MESH SHALL BE SECURED USING "HOG RINGS" OR WIRE TIES AT 6" CENTERS ALONG ALL JOINTS AND AT 2" CENTERS ON ENDS OF ROCK SOCKS.
- ROCK SOCK SHALL BE CONSTRUCTED IN ONE PIECE OR SHALL BE CONSTRUCTED USING ROCK SOCK JOINT DETAIL.
- TUBULAR MARKERS SHALL MEET REQUIREMENTS OF MANUAL ON UNIFORM TRAFFIC CONTROL DEVICES (MUTCD), AS AMENDED.
- THE TOP OF THE REINFORCED ROCK SOCK SHALL BE 1/2" - 1" BELOW TOP OF CURB.
- SEDIMENT ACCUMULATED UPSTREAM OF THE INLET PROTECTION SHALL BE REMOVED WHEN THE SEDIMENT DEPTH UPSTREAM OF ROCK SOCK IS WITHIN 5" OF THE CREST.
- INLET PROTECTION IS TO REMAIN IN PLACE UNTIL THE UPSTREAM DISTURBED AREA IS STABILIZED AND GRASS COVER IS APPROVED.
- THE LATEST EDITION OF THE MHFD CRITERIA MANUAL FOR INLET PROTECTION AND CURB SOCK DETAILS MAY BE USED.
- SEE STM10 FOR INLET AND INLET COVER DETAIL.

STREET SLOPE	CURB SOCK SPACING (ft)
0.5%	100
1.0%	100
2.0%	75
3.0%	50
4.0%	50
5.0%	50
6.0%	25
7.0%	25
8.0%	25

INLET PROTECTION



**STORM SEWER
CONSTRUCTION DRAWINGS**

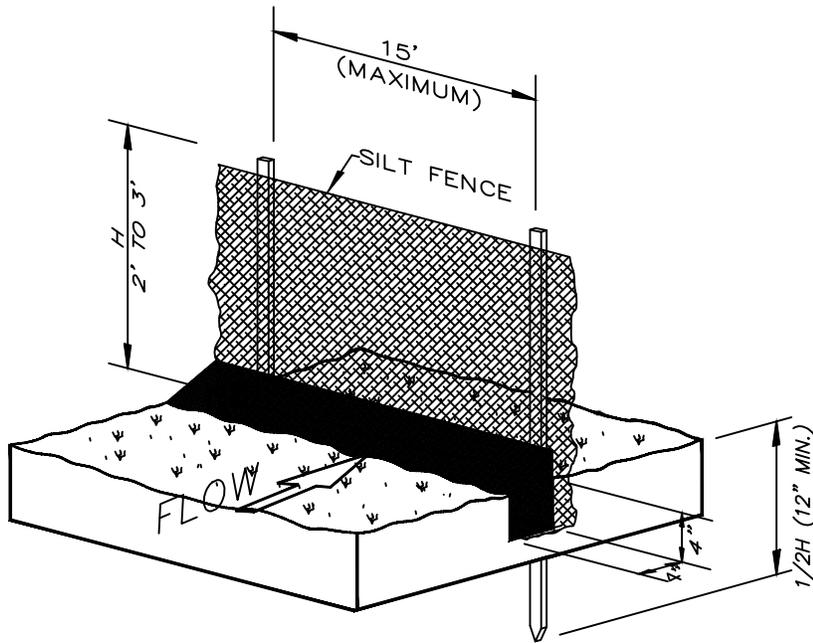
BY: NLH

SCALE: NTS

DATE: 07/2025

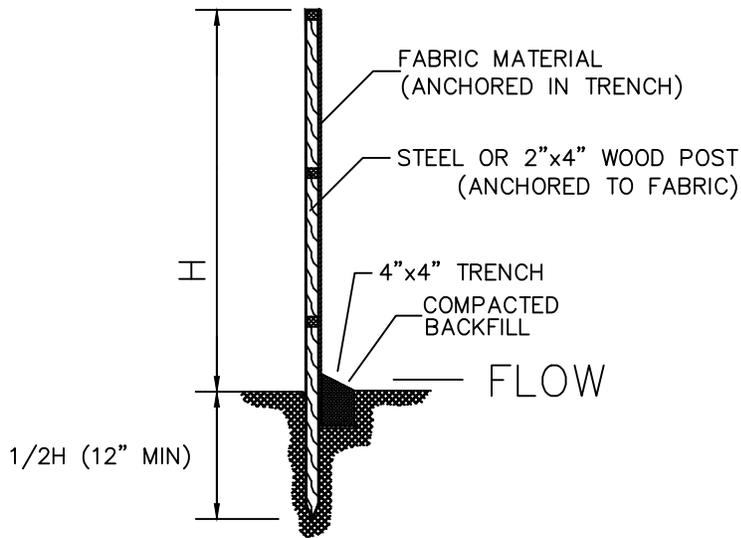
DRAWING:

STM3



SILT FENCE INSTALLATION

-NTS-



SECTION

-NTS-

NOTES:

1. INSTALL SILT FENCE PARALLEL TO THE CONTOUR OF THE LAND.
2. EXTEND ENDS UPSLOPE TO ALLOW WATER TO POND BEHIND FENCE.
3. EXCAVATE A TRENCH 4 INCHES WIDE AND 4 INCHES DEEP.
4. INSTALL FENCE WITH POSTS ON THE DOWNSLOPE SIDE.
5. PLACE 8 INCHES OF FABRIC IN THE TRENCH, EXTENDING THE BOTTOM 4 INCHES TOWARD THE UPSLOPE SIDE.
6. JOIN SILT FENCE SECTIONS BY USING A WRAP JOINT.
7. BACKFILL TRENCH WITH SOIL MATERIALS AND COMPACT.
8. INSPECT AT LEAST WEEKLY AND AFTER EACH STORM EVENT, REPAIRING AS NEEDED AND REMOVING SEDIMENT DEPOSITS WHEN THEY REACH ONE-HALF THE FENCE HEIGHT.

FOR SINGLE LOT EROSION CONTROL
SEE SHEET STM8

SILT FENCE EROSION BARRIER



STORM SEWER
CONSTRUCTION DRAWINGS

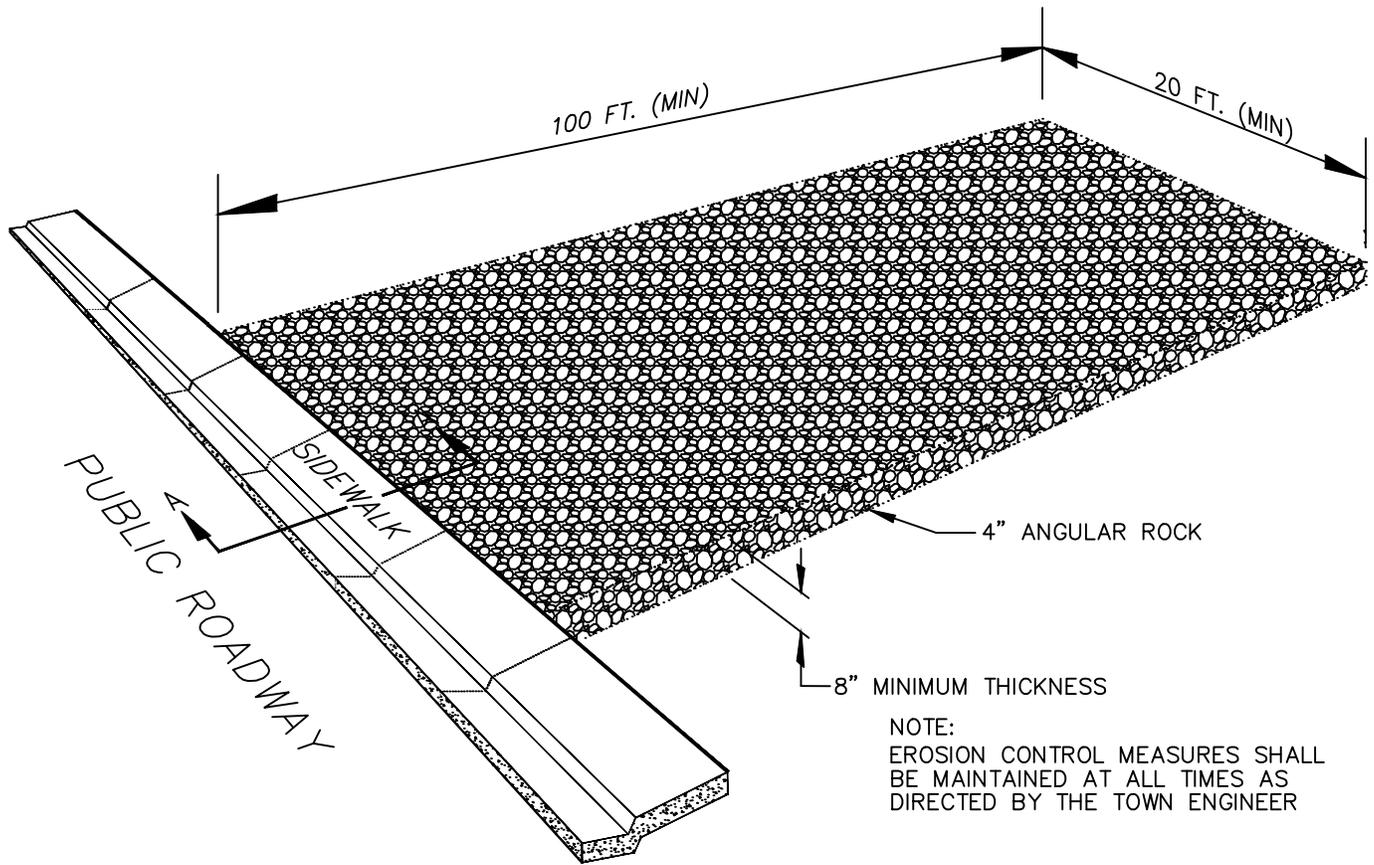
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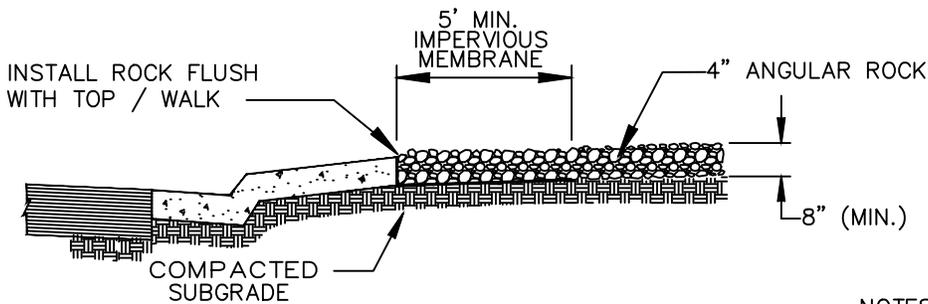
DATE: 1/2020

DRAWING:

STM4



NOTE:
 EROSION CONTROL MEASURES SHALL
 BE MAINTAINED AT ALL TIMES AS
 DIRECTED BY THE TOWN ENGINEER



SECTION A-A
 -NTS-

- NOTES:
1. ALL ROCK TO BE REMOVED UPON COMPLETION OF CONSTRUCTION
 2. PUBLIC ROADWAY TO BE KEPT CLEAN AND FREE OF MUD, DIRT AND DEBRIS AT ALL TIMES

TRACKING CONTROL PAD - CRUSHED ROCK



STORM SEWER
 CONSTRUCTION DRAWINGS

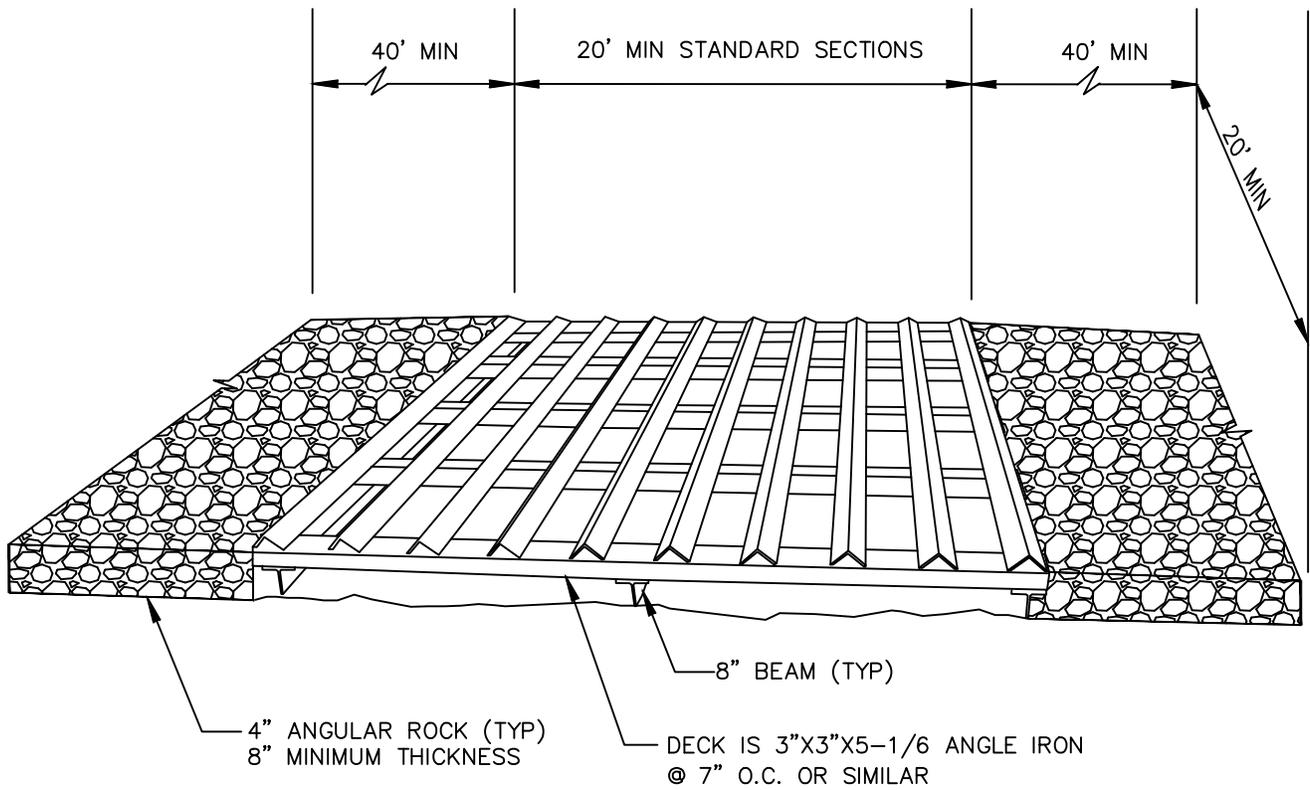
BY: JME
 SCALE: NTS
 DATE: 1/2020

DRAWING:

STM6A

NOTES:

1. ALL ROCK TO BE REMOVED UPON COMPLETION OF CONSTRUCTION
2. PUBLIC ROADWAY TO BE KEPT CLEAN AND FREE OF MUD, DIRT AND DEBRIS AT ALL TIMES



TRACKING CONTROL PAD - CATTLE GUARD



**STORM SEWER
CONSTRUCTION DRAWINGS**

BY: JME

SCALE: NTS

DATE: 1/2020

DRAWING:

STM6B

CONSTRUCTION SEQUENCE FOR EROSION & SEDIMENT CONTROL PRACTICES FOR SMALL CONSTRUCTION PROJECTS

1. INSTALL PERIMETER EROSION AND SEDIMENT CONTROLS

IDENTIFY THE AREAS WHERE SEDIMENT LADEN RUNOFF COULD LEAVE THE CONSTRUCTION SITE, AND INSTALL PERIMETER CONTROLS TO MINIMIZE THE POTENTIAL FOR OFF-SITE SEDIMENTATION. IT'S IMPORTANT THAT PERIMETER CONTROLS ARE IN PLACE BEFORE ANY LOT EXCAVATION ACTIVITIES BEGIN.

PREFERRED METHODS

- PROTECT DOWN-SLOPE AREAS WITH VEGETATIVE FILTER STRIPS
- PROTECT DOWN-SLOPE AREAS WITH SILT FENCES AND OTHER APPROPRIATE PRACTICES
- INSTALL STABLE CONSTRUCTION TRAFFIC ENTRANCE

2. PREPARE THE SITE FOR CONSTRUCTION

PREPARE THE SITE FOR CONSTRUCTION AND FOR INSTALLATION OF UTILITIES. NOTIFY ALL CONTRACTORS (ESPECIALLY THE EXCAVATION CONTRACTOR) OF AREAS TO BE PROTECTED.

PREFERRED METHOD

- SALVAGE AND STOCKPILE TOPSOIL OR SUBSOIL

3. BUILD STRUCTURE(S) AND CONNECT UTILITIES

CONSTRUCT THE STRUCTURE AND CONNECT THE UTILITIES.

4. MAINTAIN CONTROL PRACTICES

MAINTAIN ALL EROSION AND SEDIMENT CONTROL PRACTICES UNTIL CONSTRUCTION IS COMPLETED AND THE LOT IS STABILIZED.

5. RE-VEGETATE BUILDING SITE

IMMEDIATELY AFTER ALL OUTSIDE CONSTRUCTION ACTIVITIES ARE COMPLETED, STABILIZE THE LOT WITH LANDSCAPING, SEED AND/OR MULCH.

METHODS

- REDISTRIBUTE THE STOCKPILED SUBSOIL AND TOPSOIL
- SEED OR LANDSCAPE BARE AREAS
- MULCH NEWLY SEEDED AREAS

6. REMOVE REMAINING TEMPORARY CONTROL MEASURES

ONCE THE SOD AND/OR VEGETATION IS WELL ESTABLISHED, REMOVE ANY REMAINING TEMPORARY EROSION AND SEDIMENT CONTROL PRACTICES.

EROSION CONTROL SEQUENCE FOR SMALL CONSTRUCTION PROJECTS



STORM SEWER
CONSTRUCTION DRAWINGS

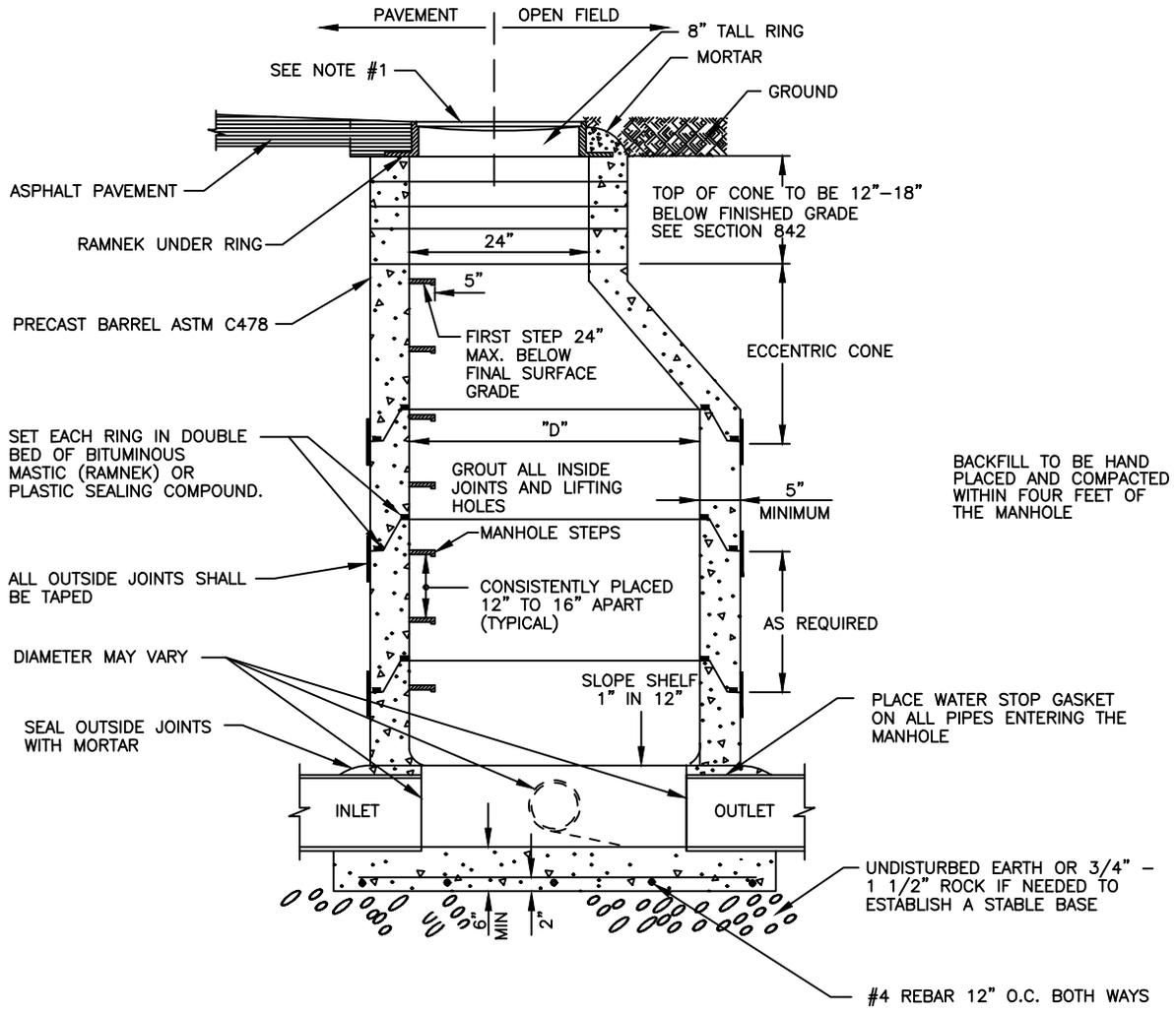
BY: JME

SCALE: NTS

DATE: 1/2020

DRAWING:

STM7



SECTION

NOTES:

1. FINAL GRADE OF MANHOLE COVERS SHALL BE 1/4" LOWER THAN FINAL STREET.
2. NO STEPS ALLOWED IN THE ADJUSTING RING AREA.
3. PRECAST CONCRETE SECTIONS SHALL CONFORM TO ASTM C-478.
4. BLOCK-OUTS, WHEN APPROVED, SHALL EXTEND A MAX. OF 6" PAST MANHOLE O.D. AND BE SATISFACTORILY PLUGGED AND SEALED.
5. MANHOLES NOT IN ASPHALT OR CONCRETE SHALL BE RAISED 6" ABOVE FINAL GRADE AND A CONCRETE COLLAR INSTALLED WITH A GREEN CARSONITE POST

STANDARD MANHOLE

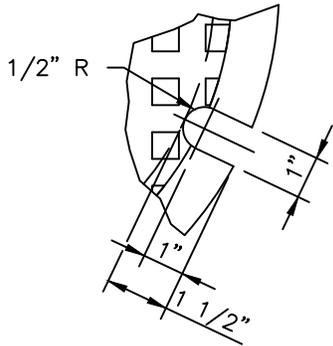
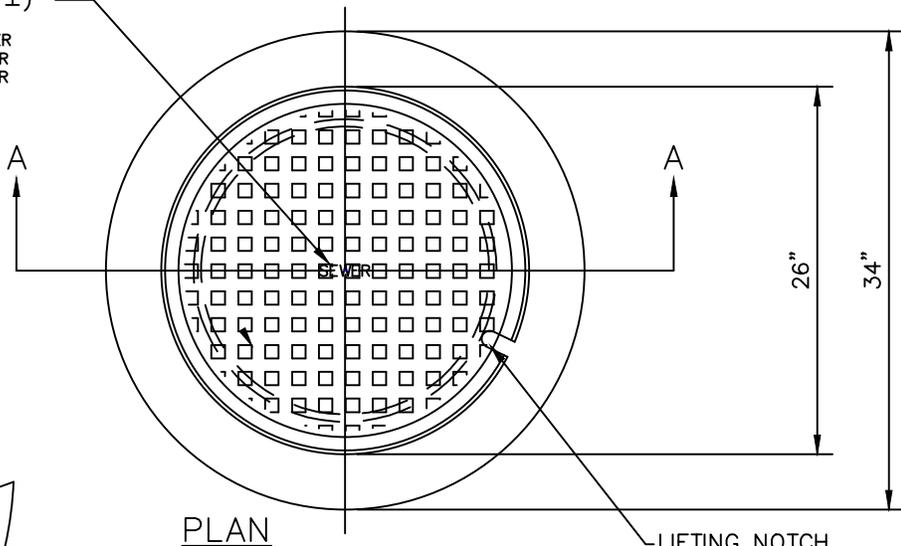
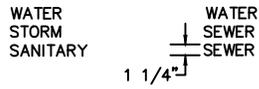


STORM SEWER
CONSTRUCTION DRAWINGS

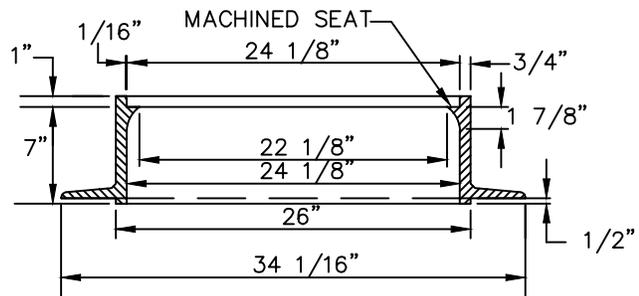
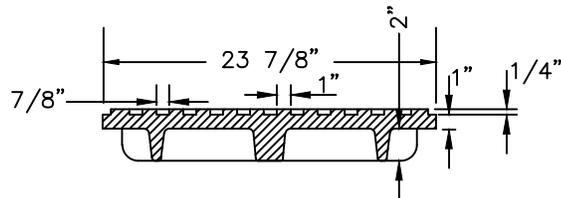
BY: NLH
SCALE: NTS
DATE: 07/2025

DRAWING:
STM8A

RAISED LETTERS ($1/8" \pm$)



LIFTING NOTCH



SECTION A-A

1. CASTING SPECIFICATIONS: ASTM A-48 WITH A MINIMUM TENSILE STRENGTH OF 25 KSI (CLASS 25)
2. ALL CASTINGS TO BE DIPPED IN ASPHALT BASE PAINT (OR APPROVED EQUAL)
3. CASTINGS SHALL BE AS SPECIFIED BELOW OR APPROVED EQUAL:

MANUFACTURERS	CAT. #
NEENAH	R-1706
CASTINGS, INC.	MH-400-24 C.I.
HUTCHINSON FDRY. & STL. INC.	MH-400
EAST JORDAN	FRAME-2420Z

5. SEE STM10 FOR MANHOLE RING AND COVER FOR INLETS.

24" MANHOLE RING AND COVER

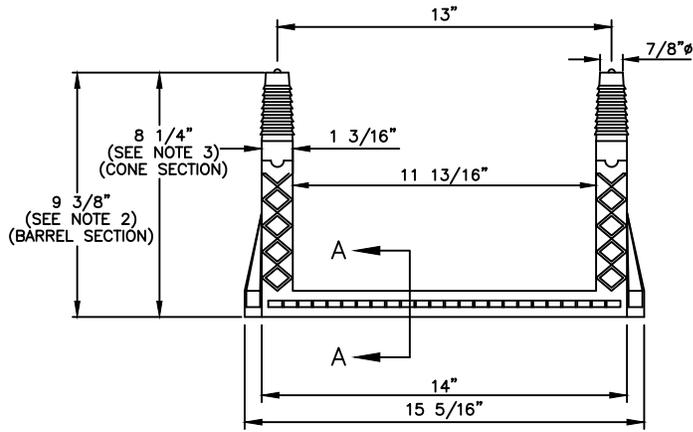


STORM SEWER
CONSTRUCTION DRAWINGS

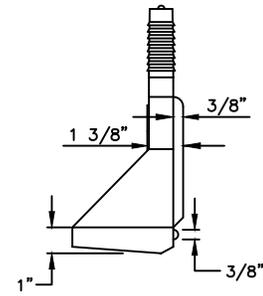
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DATE: 12/2021

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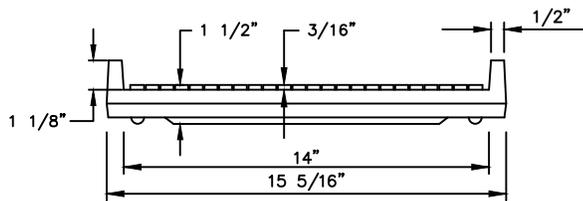
STM8B



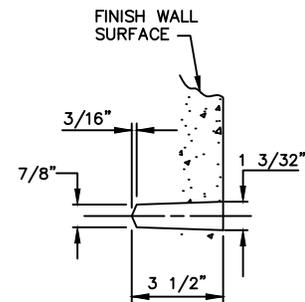
PLAN



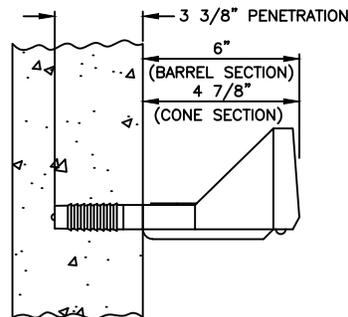
END VIEW



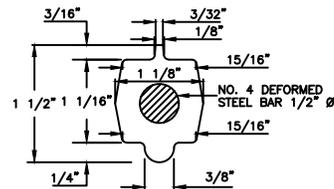
ELEVATION



DETAIL
PIN BLOCK OUT



DETAIL



SECTION A-A

POLYPROPYLENE REINFORCED PLASTIC STEP

NOTES:

1. ASTM SPECIFICATIONS:
 - A. ASTM C-478
 - B. ASTM A-615 GRADE 60 (STEEL REBAR).
 - C. ASTM 2146-69, TYPE III, GRADE 16906 (POLYPROPYLENE).
2. STEPS INSTALLED IN MANHOLE BARREL SECTIONS OR VERTICAL WALLS OF STRUCTURES SHALL HAVE A 9 3/8 INCH LEG AND SHALL PROJECT FROM THE WALL 6 INCHES.
3. STEPS INSTALLED IN MANHOLE CONE SECTIONS SHALL HAVE AN 8 1/4 INCH LEG AND SHALL PROJECT FROM THE WALL 4 7/8 INCHES.
4. ALL STEPS SHALL HAVE A PENETRATION DEPTH INTO THE WALL OF 3 3/8 INCHES.
5. STEPS SHALL BE INSTALLED BY THE "PRESS-FIT" METHOD UTILIZING A SPECIALLY TAPERED PIN TO FORM THE INSERT HOLE AS SHOWN, FOLLOWING MANUFACTURER'S RECOMMENDED PROCEDURE AND SHALL NOT BE GROUTED IN PLACE.
6. INSTALLED STEPS SHALL BE CAPABLE OF WITHSTANDING A PULL OUT FORCE OF 2500 LB. PER LEG FOR A MINIMUM PERIOD OF TWO MINUTES.
7. PINS MUST BE SMOOTH AND CONTINUOUSLY TAPERED. DIMENSIONS OF THE PIN AND THE INSERTED PORTION OF THE MANHOLE STEP ARE TYPICAL ONLY. W.M.D. INSTALLATIONS REQUIRE A MATCHED COMBINATION OF A TAPERED INSERT PIN AND MANHOLE STEP, AS RECOMMENDED OR REQUIRED BY SPECIFIC MANUFACTURER OF THE STEP TO BE USED.
8. THIS STEP CAN ALSO BE USED IN TOE POCKET INSTALLATIONS PROVIDED 5" TOE CLEARANCE IS ALLOWED.

MANHOLE STEPS



**STORM SEWER
CONSTRUCTION DRAWINGS**

BY: JME

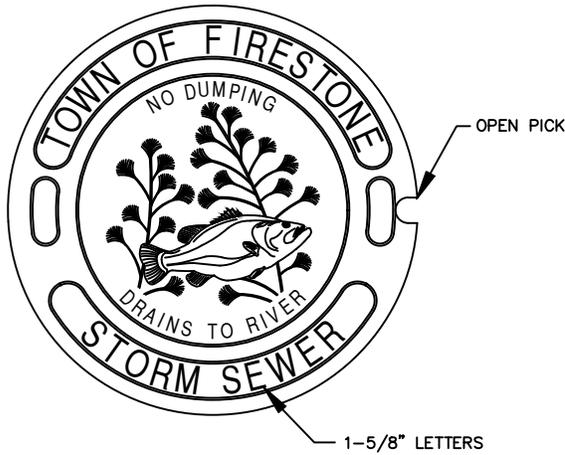
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DATE: 1/2020

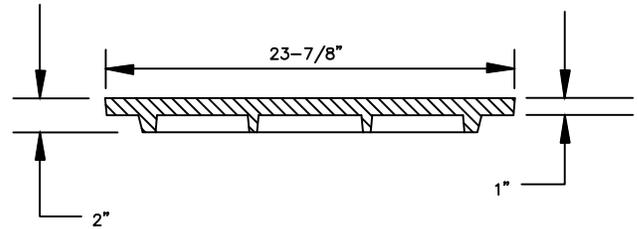
DRAWING:

STM9

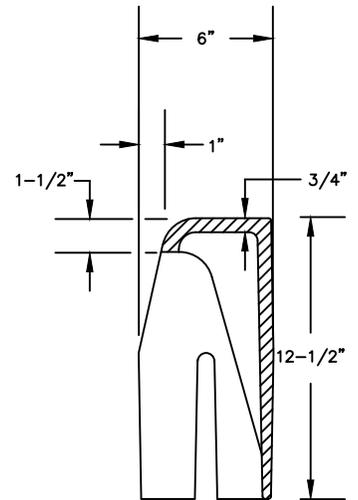
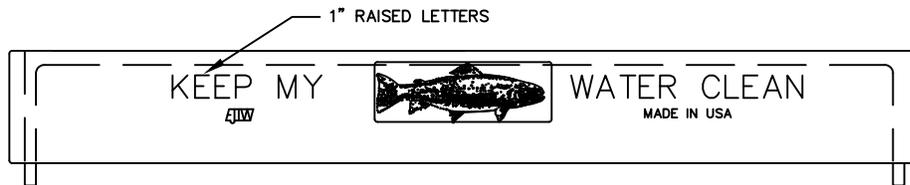
TYPE R INLET COVER



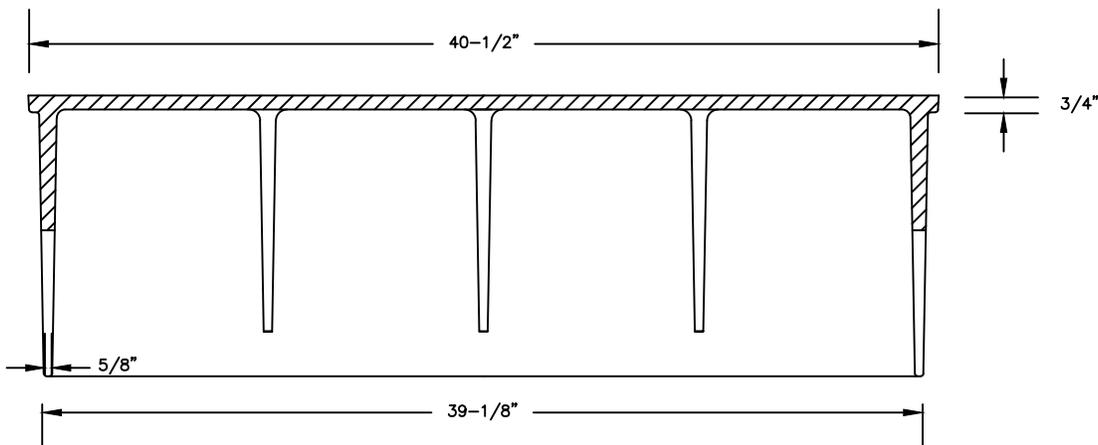
NOTE:
MATERIAL TO BE CAST GRAY IRON
ASTM A-48 CLASS 35B, NO PAINT



TYPE 13 INLET



SECTION



SECTION

INLET AND INLET COVER

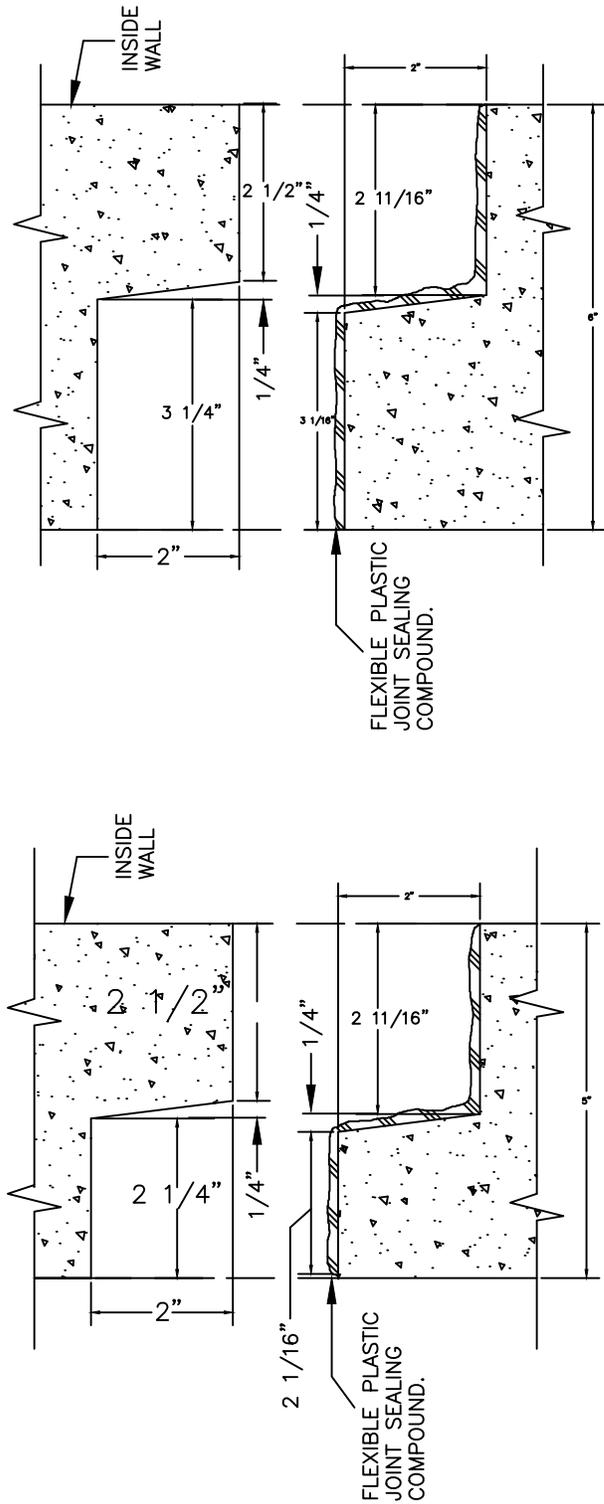


STORM SEWER
CONSTRUCTION DRAWINGS

BY: JME
SCALE: NTS
DATE: 1/2020

DRAWING:

STM10



5" WALL
 SHIPLAP JOINTS FOR
 REINFORCED CONCRETE M.H. SECTIONS
 NO SCALE

- NOTES:**
1. T= WALL THICKNESS OF PIPE FURNISHED.
 2. THE CONTRACTOR SHALL SUBMIT ALL TOLERANCES AND DIMENSIONS, REQUIRED BY THE SPECIFIC PIPE JOINT DETAILS SHOWN, TO THE ENGINEER PRIOR TO FABRICATION.
 3. ALL DIMENSIONS SHALL BE GIVEN IN INCHES, UNLESS OTHERWISE NOTED, AND ARE FOR BELL AND SPIGOT IN CONCENTRIC POSITION. DEFLECTED PIPE JOINT TOLERANCES & DIMENSIONS SHALL ALSO BE FURNISHED.
 4. JOINT CLEARANCE DIMENSION K IS AT CLOSEST POINT WITHIN DISTANCE A.
 5. THESE JOINT CONFIGURATIONS ARE IN ACCORDANCE WITH BUREAU OF RECLAMATION'S "TYPE R" JOINT DETAILS.
 6. RUBBER "O" RING GASKET SHALL BE IN CONFORMANCE W/ASTM C-443 OR C-361.
 7. APPLICABLE CONCRETE PIPE JOINT SPECIFICATIONS:
 - A. ASTM C-76
 - B. ASTM C-361
 8. STEEL REINFORCEMENT SHALL BE IN ACCORDANCE WITH THE APPROPRIATE ASTM SPECIFICATION FOR THE PIPE SIZE AND STRENGTH CLASS AS SPECIFIED ON PLAN/PROFILE DRAWINGS.

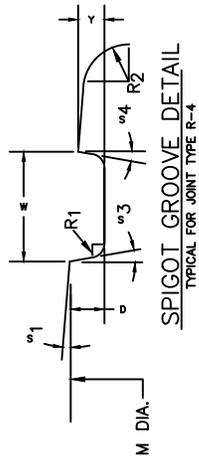
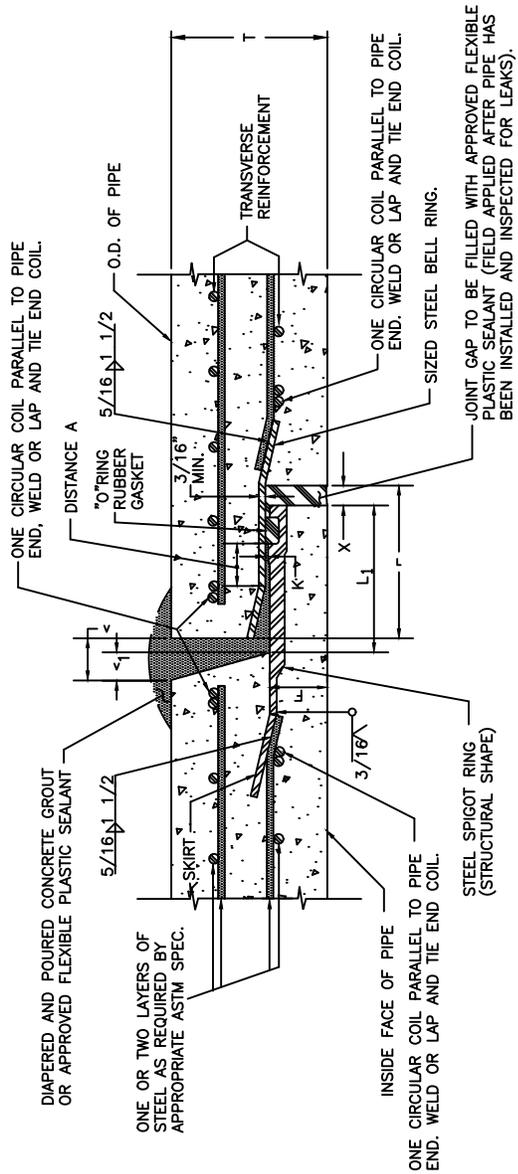
CONCRETE PIPE JOINTS - SHIPLAP



STORM SEWER
 CONSTRUCTION DRAWINGS

BY: JME
 SCALE: NTS
 DATE: 1/2020

DRAWING:
STM11A

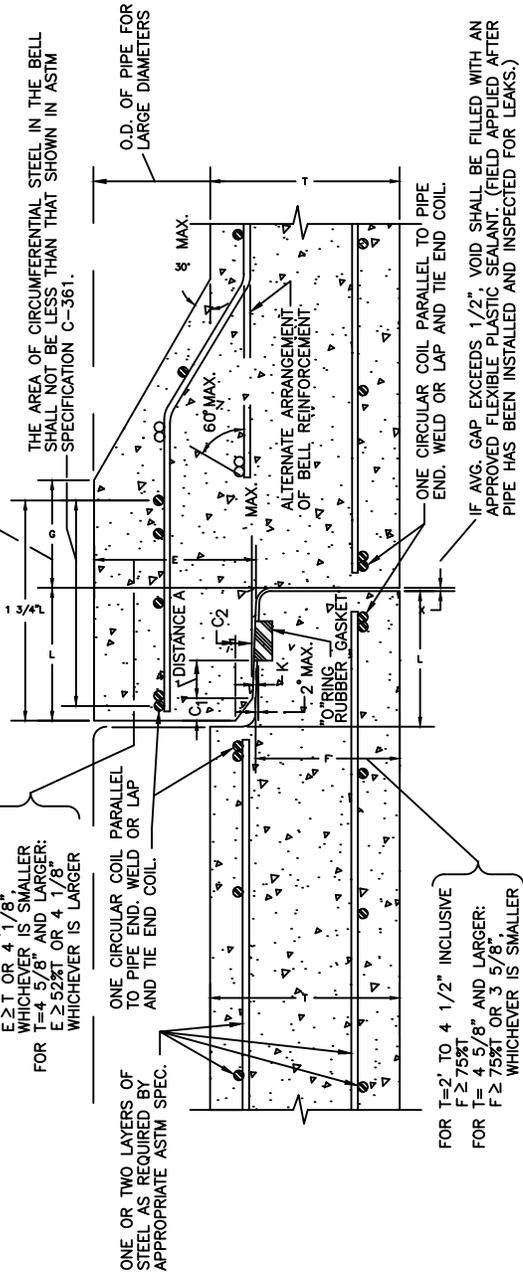


JOINT TYPE R-2

FOR T=2' TO 4 1/2" INCLUSIVE:
 G=NOT LESS THAN $\sqrt{1.44T^2-E^2}$
 FOR T=4 5/8" AND LARGER:
 G=2 1/2" MIN.

FOR T=2' TO 4 1/2" INCLUSIVE:
 E ≥ T OR 4 1/8"
 WHICHEVER IS SMALLER
 FOR T=4 5/8" AND LARGER:
 E ≥ 5/8" T OR 4 1/8"
 WHICHEVER IS LARGER

THE AREA OF CIRCUMFERENTIAL STEEL IN THE BELL SHALL NOT BE LESS THAN THAT SHOWN IN ASTM SPECIFICATION C-361.



FOR T=2' TO 4 1/2" INCLUSIVE:
 F ≥ 75% T
 FOR T=4 5/8" AND LARGER:
 F ≥ 75% T OR 3 5/8"
 WHICHEVER IS SMALLER

JOINT TYPE R-4, O-RING

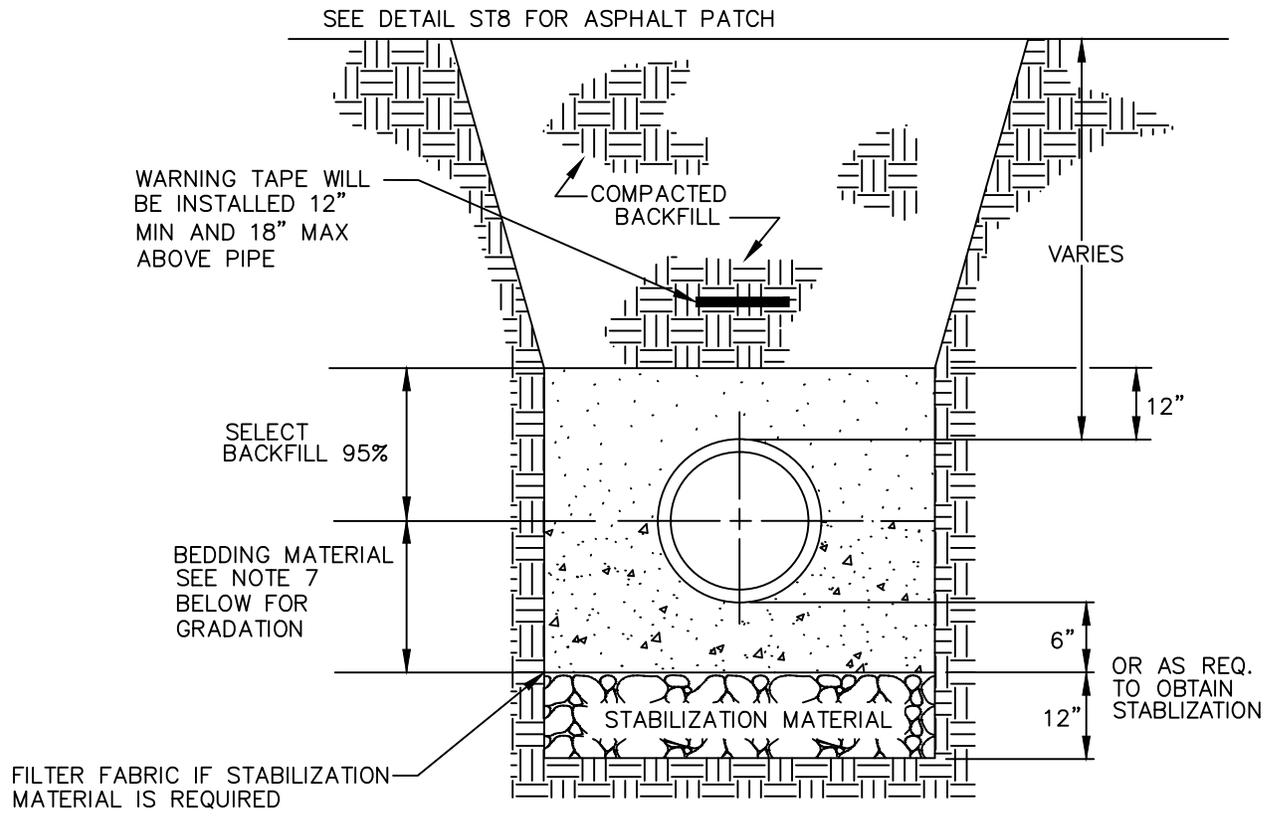
CONCRETE PIPE JOINTS - TYPE 'R'



STORM SEWER
 CONSTRUCTION DRAWINGS

BY: JME
 SCALE: NTS
 DATE: 1/2020

DRAWING:
STM11B

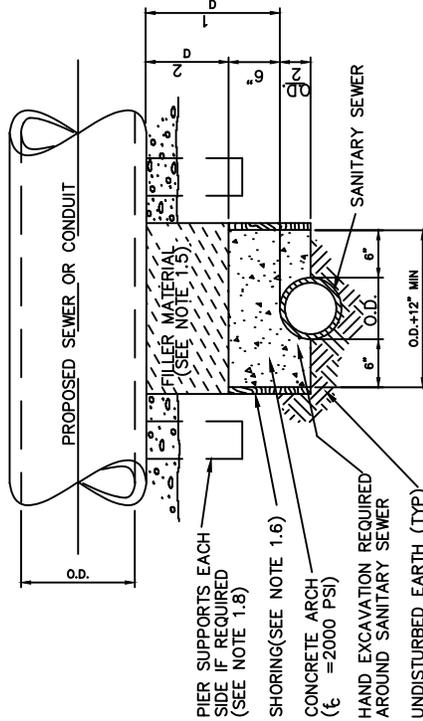


NOTES:

1. FULL TRENCH SECTION IN ROADWAY OR STREET R.O.W. LIMITS WILL REQUIRE 95% S.P.D. TRENCH ZONE ABOVE BEDDING MATERIALS, OUTSIDE OF STREET R.O.W. WILL REQUIRE 90% S.P.D.
2. FILTER FABRIC IS REQUIRED IF STABILIZATION MATERIAL IS USED. THE FABRIC SHALL BE INSTALLED AS SHOWN IN THE DETAIL.
3. TRENCH TO 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.
4. PIPE SHALL BE BEDDED FROM 6" BELOW THE BOTTOM OF THE PIPE TO THE HORIZONTAL CENTERLINE OF THE PIPE. SEE NOTE 7 FOR BEDDING MATERIAL GRADATION.
5. TRENCH WIDTH SHALL NOT BE MORE THAN 24" NOR LESS THAN 12" WIDER THAN THE LARGEST OUTSIDE DIAMETER OF THE PIPE.
6. SHOULD THE TRENCH BE EXCAVATED WIDER THAN ALLOWED, A CONCRETE CRADLE SHALL BE PLACED WITH 2500 P.S.I. CONCRETE FROM TRENCH BOTTOM TO PIPE SPRINGLINE.
7. BEDDING MATERIAL SHALL MEET THE GRADATION OF CDOT "NO.67 COARSE AGGREGATE" AS SPECIFIED IN SECTION 703.02 IN THE LATEST EDITION OF THE CDOT "STANDARD SPECIFICATIONS FOR ROAD AND BRIDGE CONSTRUCTION".

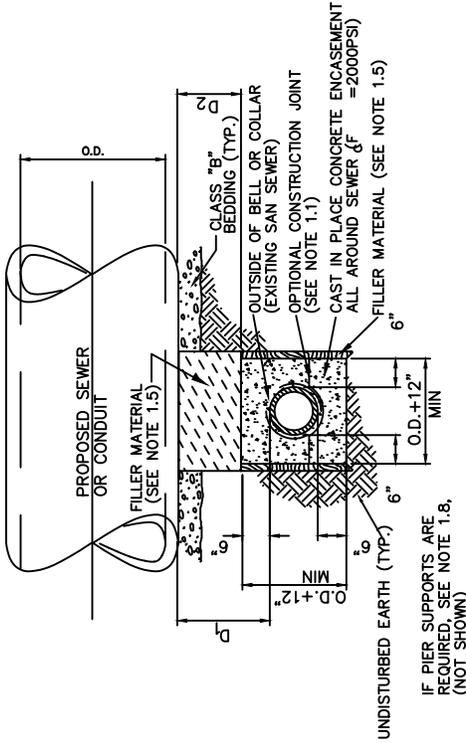
STORM SEWER TRENCH DETAIL

	<p align="center">STORM SEWER CONSTRUCTION DRAWINGS</p>	<p>BY: JME</p>	<p>DRAWING: STM12</p>
		<p>SCALE: NTS</p>	
		<p>DATE: 1/2020</p>	



TYPE I

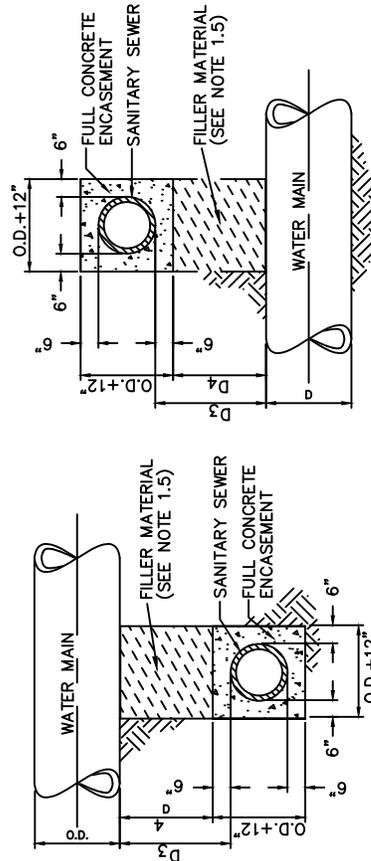
CONCRETE ENCASMENT FOR SANITARY SEWERS
(CONCRETE ARCH) NO SCALE (RIGID CONDUITS ONLY)



TYPE III

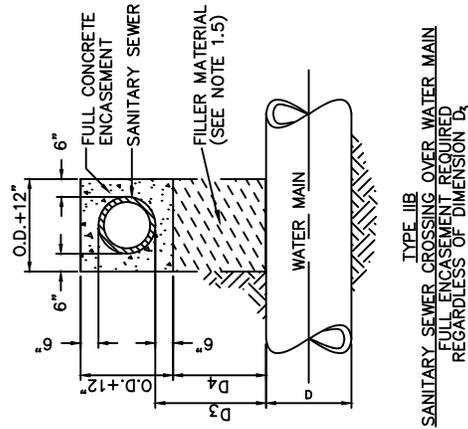
CONCRETE ENCASMENT FOR SANITARY SEWERS
(FULL ENCASMENT) NO SCALE (RIGID CONDUITS ONLY)

IF PIER SUPPORTS ARE REQUIRED, SEE NOTE 1.8, (NOT SHOWN)



TYPE IIA

SANITARY SEWER CROSSING UNDER WATER MAIN
IF D > 2FT, ENCASMENT NOT REQUIRED



TYPE IIB

SANITARY SEWER CROSSING OVER WATER MAIN
FULL ENCASMENT REQUIRED REGARDLESS OF DIMENSION D₃

TYPE II

CONCRETE ENCASMENT FOR SANITARY SEWERS
CROSSING OVER OR UNDER WATER MAIN
NO SCALE (RIGID CONDUITS ONLY)

CONCRETE ENCASMENT OF RIGID CONDUITS (1 OF 2)

GENERAL NOTES FOR TYPE I, II & III ENCASMENT

- 1.1 CONCRETE TO BE CAST AGAINST UNDISTURBED SOIL OR SHORING. IF OPTIONAL CONSTRUCTION JOINT IS USED & BOTTOM HALF OF ENCASMENT IS POURED SEPARATELY, A ONE INCH LAYER OF SAND OR MORTAR SHALL BE PLACED BETWEEN BOTTOM OF SANITARY SEWER AND TOP OF CONCRETE.
- 1.2 LENGTH OF ENCASMENT FOR :
(A) TYPE I & III ENCASMENT SHALL EXTEND FULL TRENCH WIDTH EXCAVATED FOR PROPOSED SEWER OR CONDUIT.
(B) TYPE II ENCASMENT SHALL EXTEND AT LEAST 10 FEET EACH SIDE OF WATER MAIN.
- 1.3 UNLESS OTHERWISE NOTED ON PLAN/PROFILE DRAWINGS, TYPE I, II & III ENCASMENTS NEED NOT BE REINFORCED. REINFORCEMENT, IF REQUIRED, TO BE SPECIFIED AND DETAILED SEPARATELY ON PLAN & PROFILE DRAWINGS.
- 1.4 TYPE I, II OR III ENCASMENT REQUIRED UNDER FOLLOWING CONDITIONS :
(A) TYPE I OR TYPE III IF D₁ ≤ 18" (D₂ ≤ 24") EXCEPT FOR SANITARY SEWERS CROSSING OVER OR UNDER WATER MAINS.
(B) TYPE IIA REQUIRED FOR SANITARY SEWERS CROSSING UNDER WATER MAINS AND D₃ ≥ 24" (D₄ ≤ 18").
(C) TYPE IIB REQUIRED FOR SANITARY SEWERS CROSSING OVER TOP OF WATER MAINS, REGARDLESS OF DIMENSION D₃.
(D) EXCEPT FOR UNUSUAL CIRCUMSTANCES, WATER MAIN CROSSINGS, OR WHERE UNSTABLE SOIL CONDITIONS ARE ENCOUNTERED, TYPE I ENCASMENT WILL NORMALLY BE SATISFACTORY.
(E) IF THE SANITARY SEWER IS REPLACED OR CONSTRUCTED OF CAST IRON PIPE (AWWA C-106 OR C-108) OR DUCTILE IRON PIPE (AWWA C-150 OR C-151), CONCRETE ENCASMENT MAY NOT BE REQUIRED.
- 1.5 FILLER MATERIAL BETWEEN CONDUITS TO BE :
(A) APPROVED COMPRESSIBLE MATERIAL SUCH AS STYROFOAM, ETC., IF D₂ & D₄ ≤ 6".
(B) COMPACTED CLASS 'B' BEDDING IF D₂ & D₄ > 6", (IF D₂ > 6" FOR TYPE IIB ENCASMENT FOUR CONDUITS ON UNDISTURBED SOIL).
- 1.6 SHORING OR SHEETING, IF USED, TO BE CUT OFF AT TOP OF ENCASMENT.
- 1.7 THESE ENCASMENT DETAILS MAY ALSO BE APPLICABLE FOR CONDUITS OTHER THAN STORM OR SANITARY SEWER INSTALLATIONS.
- 1.8 IN CERTAIN SITUATIONS WHERE CONDUIT DIAMETER "D" IS EXTREMELY LARGE, PIER SUPPORTS EACH SIDE OF SANITARY SEWER MAY ALSO BE REQUIRED. IF REQUIRED, SUPPORTS TO BE SPECIFIED AND DETAILED SEPARATELY ON PLAN AND PROFILE DRAWINGS. NO PIPE JOINTS OVER TOP OF WATER MAIN.
- 1.9 DETAILS SHOWN CONSIDER RIGID CONDUITS ONLY. FLEXIBLE CONDUITS REQUIRE SPECIAL CONSIDERATION.



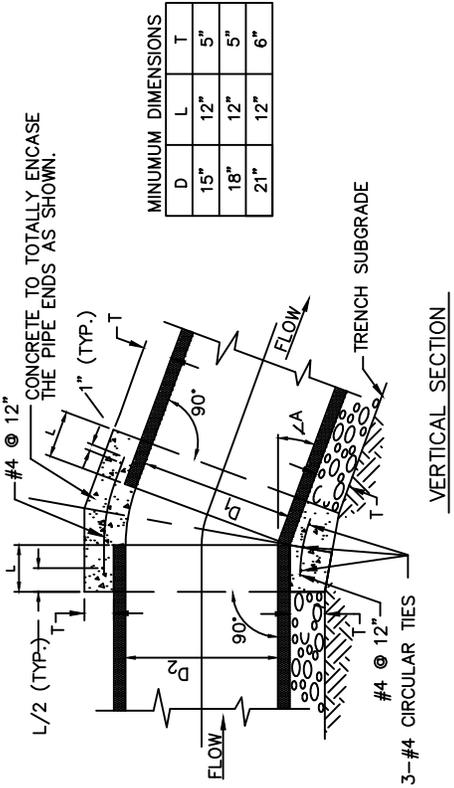
STORM SEWER
CONSTRUCTION DRAWINGS

BY: JME
SCALE: NTS
DATE: 1/2020

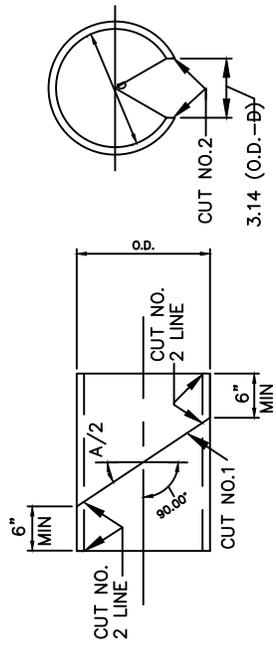
DRAWING:
STM13A

STORM CONNECTOR PIPE CLOSURE DETAIL

TO BE USED ONLY WHERE NECESSARY AND AS AUTHORIZED BY THE TOWN ENGINEER



VERTICAL SECTION



CUT NO.1: SAW THE TUBE AT AN ANGLE OF A/2 WITH THE TRANSVERSE PLANE. REVERSE ONE SECTION AND TAPE BOTH SECTIONS TOGETHER FORMING THE DEFLECTION ANGLE A.
 CUT NO.2: SAW THE TUBE LONGITUDINALLY REMOVING A STRIP 3.14 (D_o-D) INCHES WIDE ON THE SIDE OPPOSITE THE OPEN JOINT. BEND THE ENDS OF THE CUT TOGETHER AND INSERT THE TUBE IN THE PIPE.

NOTES: FOR STORM LINE CONNECTORS ONLY, NOT TO BE USED ON MAINLINE SEWERS.
 AN INTERIOR FORM OF UNSEALED SONO-TUBE OR EQUAL SHALL BE USED TO PROVIDE A SMOOTH INTERIOR JOINT. (SEE DETAIL A)

DETAIL "A"
 SONO-TUBE OR EQUAL INTERIOR FORM

GENERAL NOTES

1. A CONCRETE COLLAR IS REQUIRED WHERE THE CHANGE IN GRADE EXCEEDS 0.10 OF A FOOT PER FOOT.
2. GAP LIMITS

PIPE DIAMETER	COLUMN "A" (SEE A BELOW)	COLUMN "B" (SEE B BELOW)
21" OR LESS	1/2"	1"
3. IF THE "EXTREME OUTER ENDS" OF THE PIPE LEAVE A GAP THAT EXCEEDS VALUES IN COLUMN "A" OR COLUMN "B", A CONCRETE COLLAR IS REQUIRED.
4. IF THE GAP EXCEEDS 6 INCHES, A MANHOLE STRUCTURE IS REQUIRED.
5. CONCRETE COLLAR SHALL NOT BE USED FOR A SIZE CHANGE ON THE MAIN LINE.
6. FOR PIPE SIZE NOT LISTED USE NEXT SIZE LARGER.
7. WHERE REINFORCING IS REQUIRED THE DIAMETER OF THE CIRCULAR TIES SHALL BE D+(2X WALL THICKNESS)+T.
8. REINFORCING SHALL BE USED WHERE THE SPACES BETWEEN THE EXTREME OUTER ENDS IS 2 1/2" OR LARGER.

CIRCULAR TIES:	PIPE DIAMETER	SPACE BETWEEN EXTREME OUTER ENDS	NO. OF CIRCULAR TIES
	21" OR LESS	2 1/2"	3

WHERE THE SPACE BETWEEN PIPE LONGITUDINAL ENDS EXCEEDS 2 1/2", THE NUMBER OF CIRCULAR TIES SHALL BE INCREASED TO MAINTAIN AN APPROXIMATE SPACING OF 6" OC.

9. AN INTERIOR FORM OF UNSEALED SONO-TUBE OR EQUAL SHALL BE USED TO PROVIDE A SMOOTH INTERIOR JOINT. THE PAPER FORM MAY BE LEFT IN PLACE (SEE DETAIL A).
10. THIS DETAIL APPLIES "ONLY" TO PIPE 21" DIAMETER OR LESS.

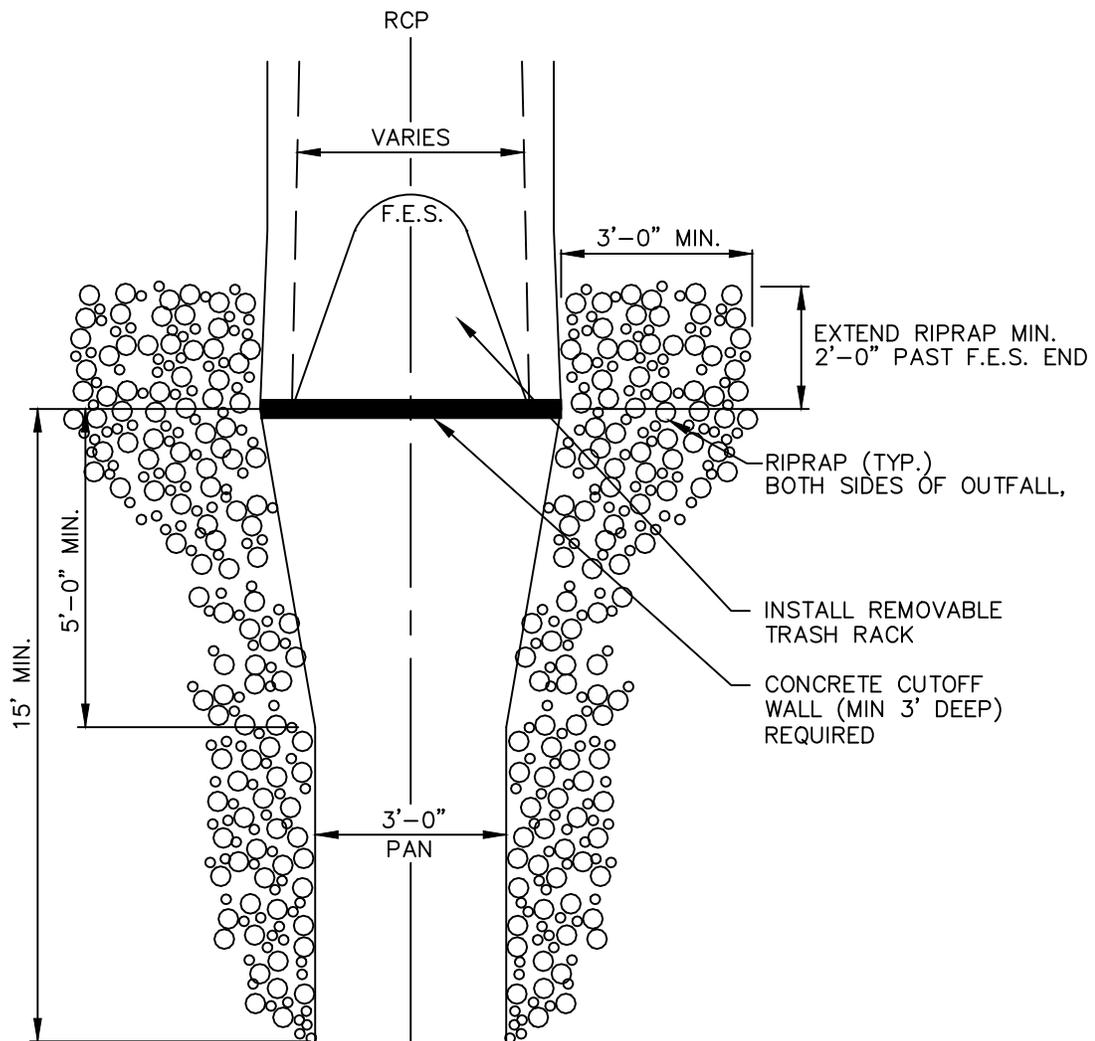
CONCRETE ENCASEMENT OF RIGID CONDUITS (2 OF 2)



**STORM SEWER
 CONSTRUCTION DRAWINGS**

BY: JME
 SCALE: NTS
 DATE: 1/2020

DRAWING:
STM13B



FLARED END SECTION WITH TRICKLE CHANNEL



**STORM SEWER
CONSTRUCTION DRAWINGS**

BY: JME

SCALE: NTS

DATE: 1/2020

DRAWING:

STM14

TRASH GUARD INSTALLED

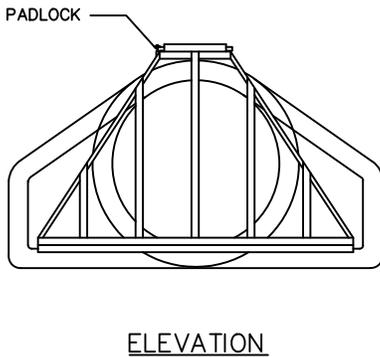
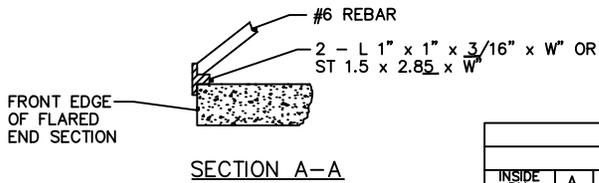
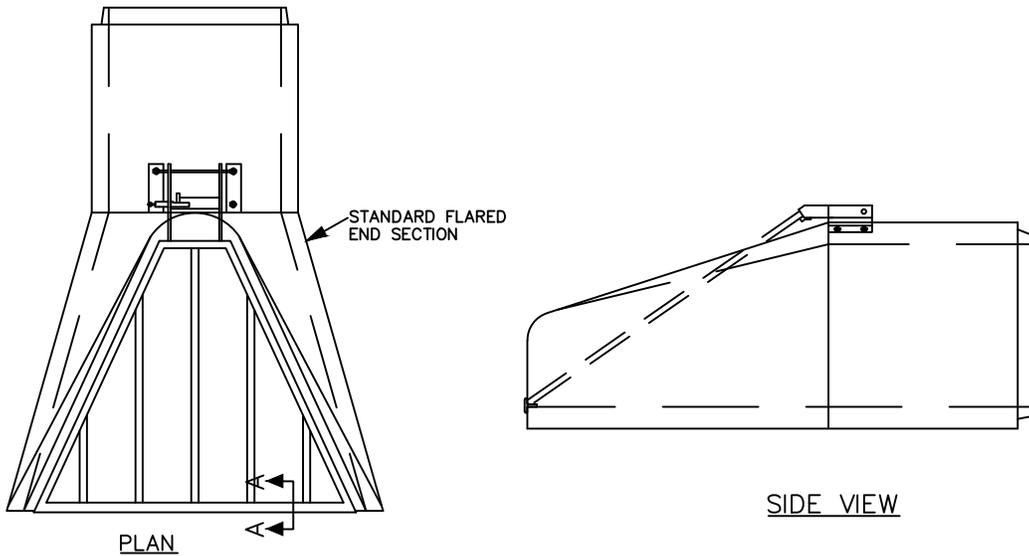


TABLE OF DIMENSIONS													
INSIDE DIA	TRASH GUARD							MOUNTING					
	A	B	D	G	L	W	C	H	J	R	S	T	
	(INCHES)							(EA)	(DEGREE)	(INCHES)			
18	10	6-1/2	8	3	31	28	3	45	45	11-1/2	5	5	
24	12	9-1/2	8	3	47-1/2	40	5	35	55	15	6-1/2	5-1/2	
30	15	12-1/2	9	3	59-3/4	52	5	35	55	18-1/2	8	6	
36	15	15-1/2	8-1/2	4	71-1/4	58	7	35	55	22	9-1/2	6-1/2	
42	21	18-1/2	9	4	75	64	7	40	50	25-1/2	11	7	
48	24	21-1/2	8	4	82-3/4	70	9	40	50	29	12-3/4	7-1/2	

NOTE: AN INDEPENDENT DESIGN AND DETAIL WILL BE REQUIRED FOR PIPE DIAMETERS GREATER THAN 48"

GENERAL NOTES

1. TRASH GUARDS SHALL BE INSTALLED AT LOCATIONS SHOWN IN THE PLANS OR SPECIFIED BY THE ENGINEER
2. PADLOCKS FOR LOCKING BAR WILL BE FURNISHED AND INSTALLED BY THE CONTRACTOR AND KEYS SUBMITTED TO THE PUBLIC WORKS DEPT.
3. THE TRASH GUARDS ARE NOT DESIGNED TO CARRY WHEEL LOADINGS AND SUCH ARE NOT TO BE USED AS SAFETY GRATES
4. IF THE FLARED END DIMENSIONS VARY FROM THOSE SHOWN IN THE STANDARD PLANS, NECESSARY ADJUSTMENTS SHALL BE MADE TO THE TRASH GUARD DIMENSIONS

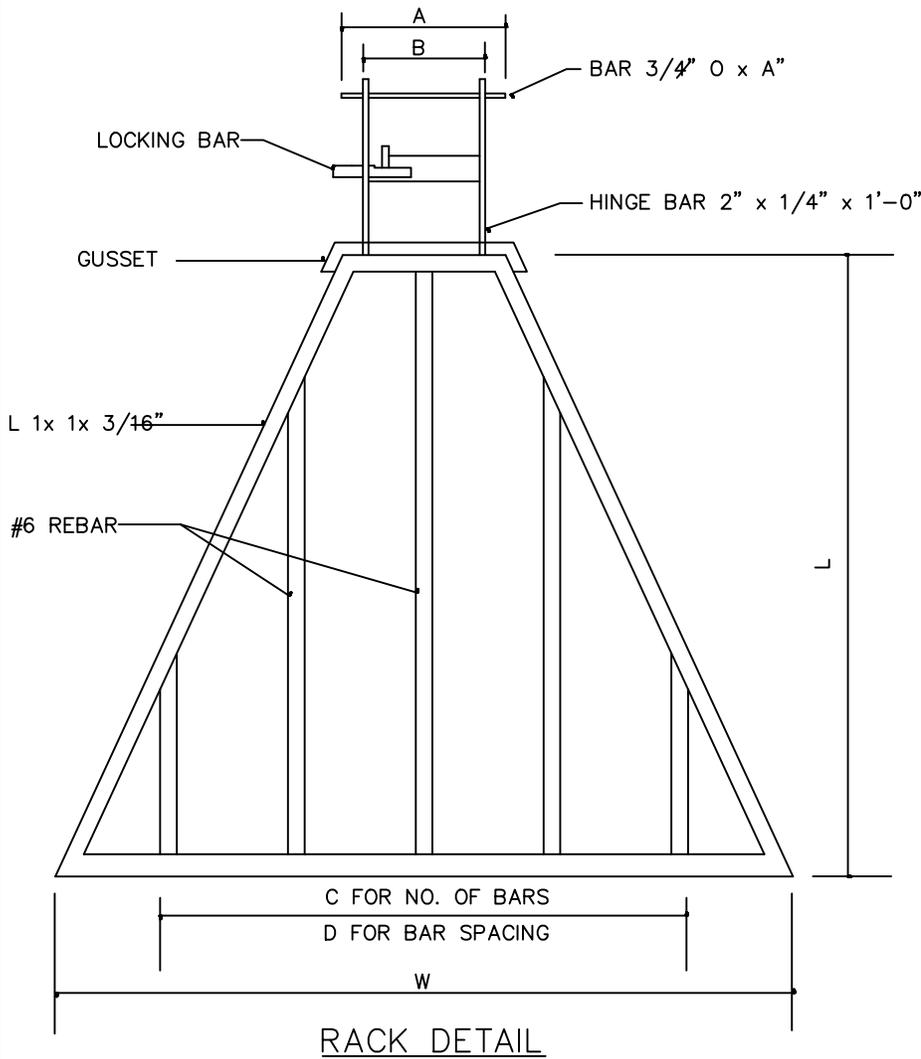
TRASH GUARD FOR CONDUIT (1 OF 3)



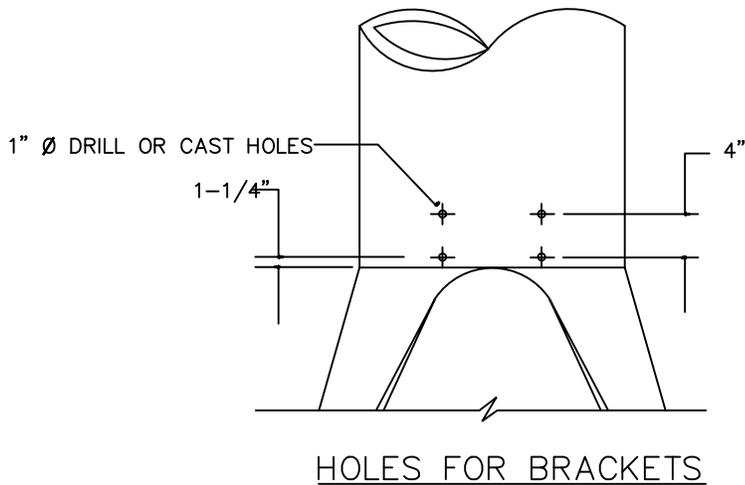
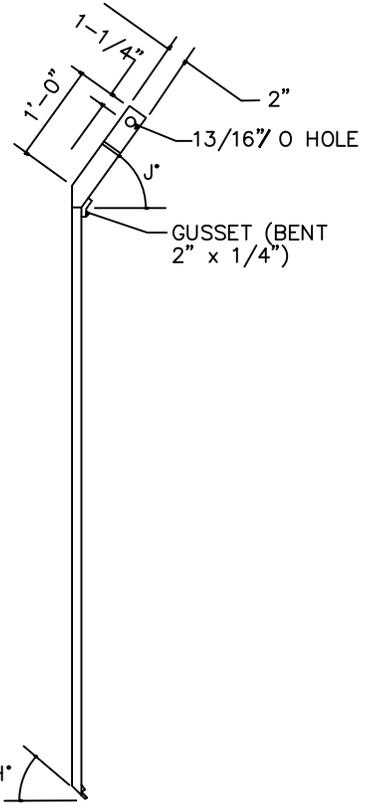
STORM SEWER
CONSTRUCTION DRAWINGS

BY: JME
SCALE: NTS
DATE: 1/2020

DRAWING:
STM15A



PLAN



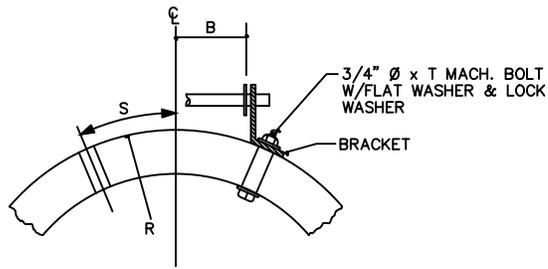
TRASH GUARD FOR CONDUIT (2 OF 3)



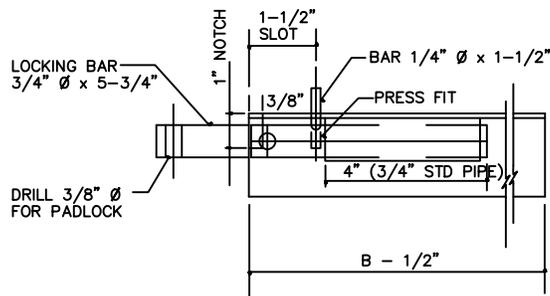
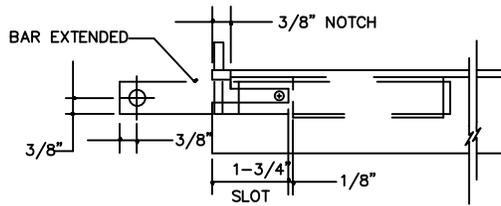
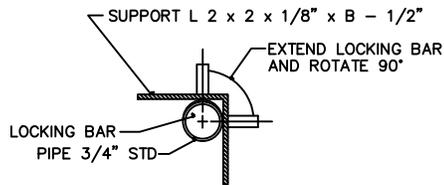
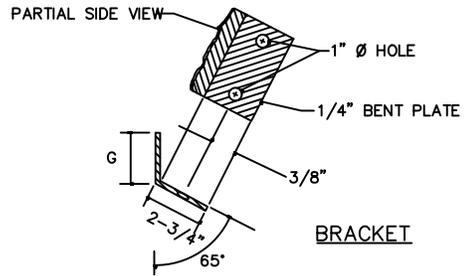
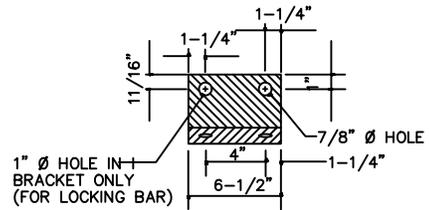
STORM SEWER
CONSTRUCTION DRAWINGS

BY: JME
SCALE: NTS
DATE: 1/2020

DRAWING:
STM15B



BRACKET & HINGE
DETAIL



LOCKING BAR &
SUPPORT

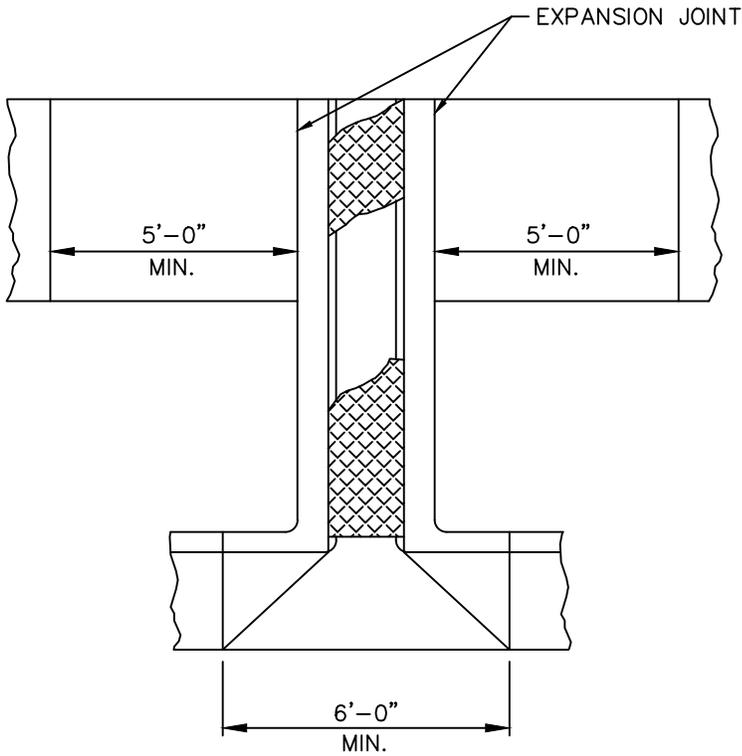
TRASH GUARD FOR CONDUIT (3 OF 3)



**STORM SEWER
CONSTRUCTION DRAWINGS**

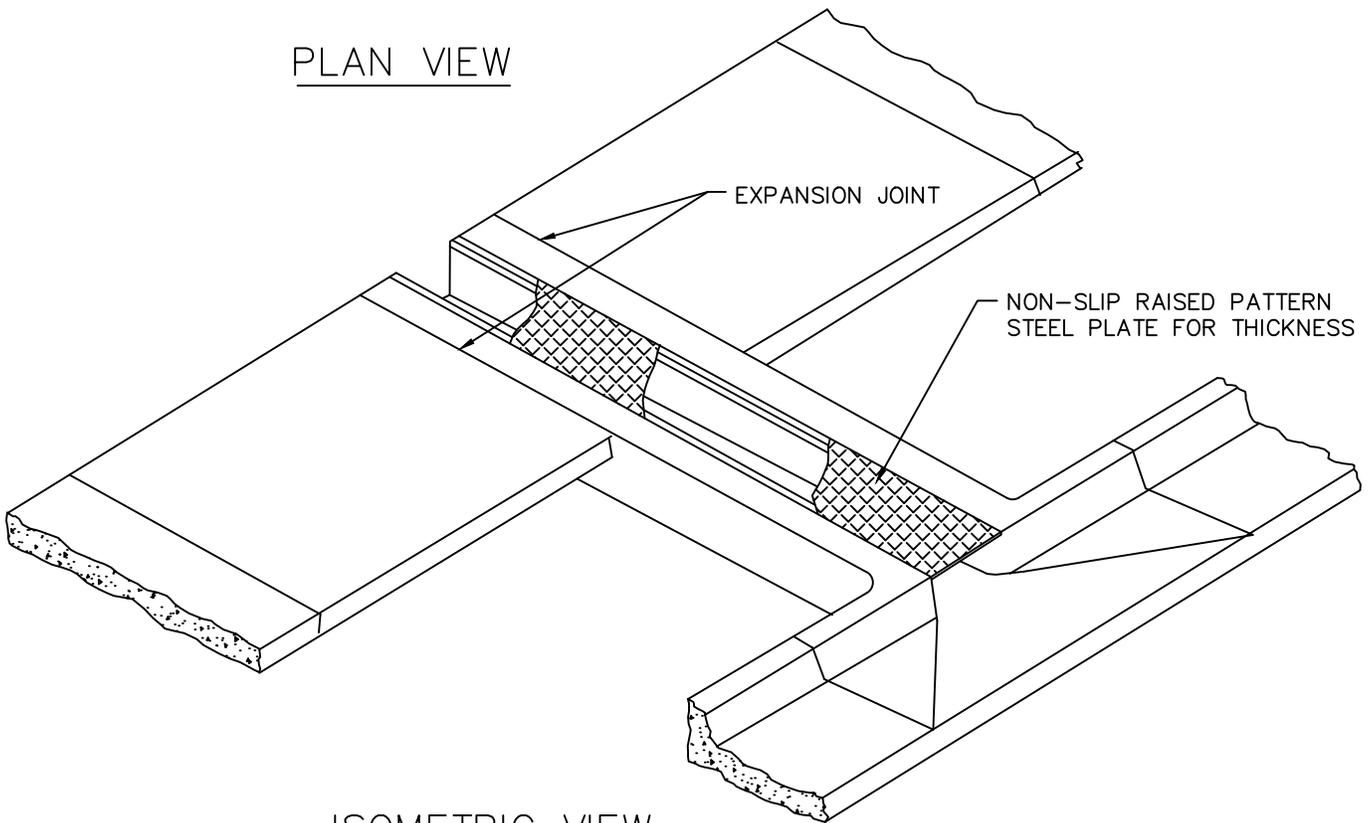
BY: JME
SCALE: NTS
DATE: 1/2020

**DRAWING:
STM15C**



PLAN VIEW

TYPE OF WALK	LENGTH OF PLATE
L ATTACHED	L + 3"
L DETACHED	VARIABLE



ISOMETRIC VIEW

SIDEWALK CHASE DETAIL (1 OF 2)



**STORM SEWER
CONSTRUCTION DRAWINGS**

BY: JME
SCALE: NTS
DATE: 1/2020

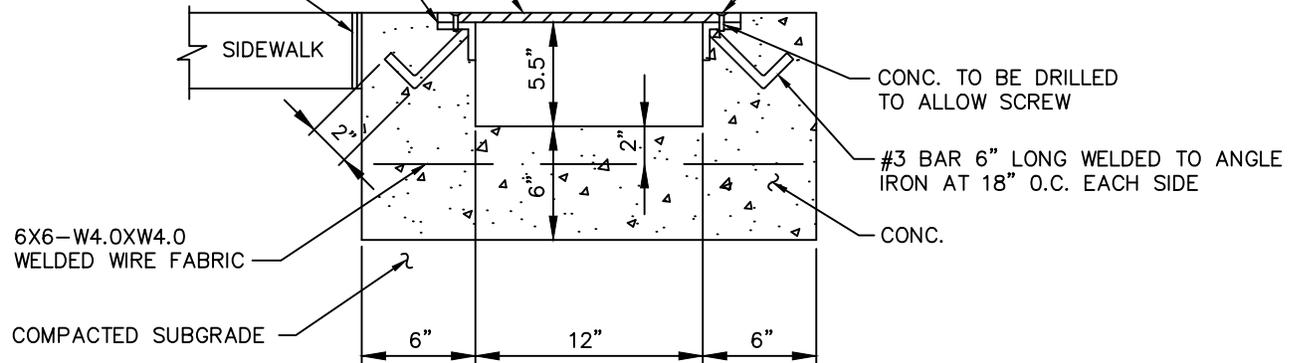
DRAWING:
STM16A

1/2" 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

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



SIDEWALK CHASE DETAIL

SIDEWALK CHASE DETAIL (2 OF 2)



**STORM SEWER
CONSTRUCTION DRAWINGS**

BY: JME

SCALE: NTS

DATE: 1/2020

DRAWING:

STM16B

<u>DRAWING NO.</u>	<u>TITLE</u>
TS1	ILLUMINATED STREET NAME SIGN
TS2	REGULATORY WARNING SIGN
TS3	SCHOOL FLASHING BEACON
TS4	POWER FEED FOR TRAFFIC SIGNALS
TS5	PULL BOX (PLASTIC/PREFAB)
TS6	PULL BOX (SPECIAL)
TS7	PEDESTRIAN POLE
TS8	POWER SOURCE SCHEMATIC
TS9	SIGNAL HEAD MOUNTING
TS10	CONTROLLER CABINET
TS11	CONDUIT DETAILS
TS12	FLASHING BEACON
TS13A	MASTARM POLES (MAX 55')
TS13B	MASTARM POLES (MAX 55')
TS13C	MASTARM POLES (MAX 55')
TS13D	MASTARM POLES (MAX 55')
TS14A	MASTARM POLES (>55' AND DOUBLES)
TS14B	MASTARM POLES (>55' AND DOUBLES)
TS14C	MASTARM POLES (>55' AND DOUBLES)
TS14D	MASTARM POLES (>55' AND DOUBLES)
TS14E	MASTARM POLES (>55' AND DOUBLES)

INDEX OF TRAFFIC SIGNAL DETAILS



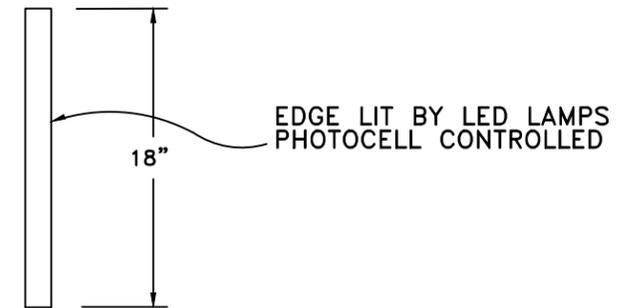
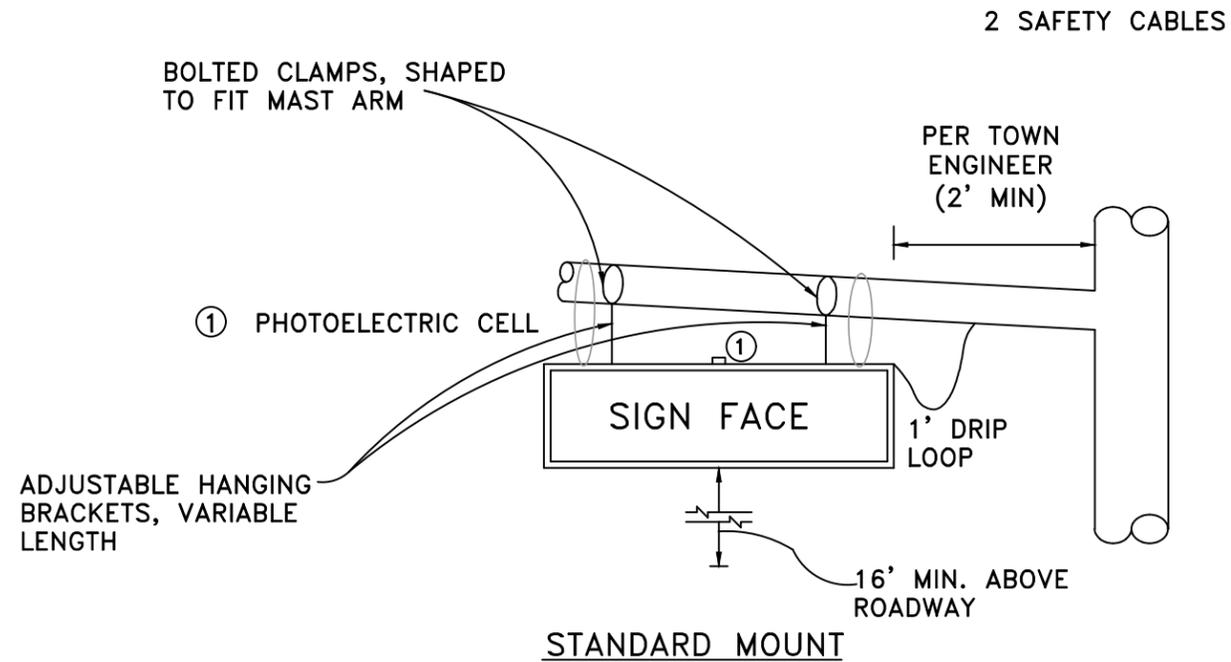
**TRAFFIC SIGNAL
CONSTRUCTION
DRAWINGS**

BY: JME

SCALE: NTS

DATE: 1/2020

DRAWING:



SIDE VIEW

NOTES

1. FOR DETAILS ON SIGN REFER TO DETAIL NO. 922-01, TYPICAL STREET SIGNS.
2. FINAL SIGN LAYOUT AND LETTERING DETAILS PER TOWN ENGINEER.
3. SIGN TO BE DOUBLE SIDED WITH WHITE PRINT ON GREEN BACKGROUND FOR STREET NAME AND LOGO.

GENERAL NOTES

1. STREET NAME SIGN TO BE FREE-SWINGING OR LIMITED-SWINGING. SIGN FIXTURE AND PANELS SHALL WITHSTAND 90 MPH WIND LOADING, WITH STRUCTURAL REQUIREMENTS MEETING AASHTO "STANDARD SPECIFICATIONS FOR STRUCTURAL SUPPORTS FOR HIGHWAY SIGNS, LUMINAIRES AND TRAFFIC SIGNALS," LATEST EDITION.
2. HOUSING TO BE CONSTRUCTED OF ALUMINUM.
3. NEOPRENE GASKETS SHALL BE INSTALLED BETWEEN THE SIGN PANEL FRAME AND FIXTURE HOUSING TO PREVENT WATER ENTRANCE. SCREENED WEEP HOLES SHALL BE PROVIDED ON HOUSING BOTTOM FOR DRAINAGE.
4. SAFETY CABLES (2) CONSISTING OF WIRE CABLE AND 2 CABLE CLAMPS FOR EACH SIDE INSTALLED ON EITHER END OF THE ILLUMINATED STREET NAME SIGN.



LIGHTED SIGN TYPICAL LAYOUT

ILLUMINATED STREET NAME SIGN



TRAFFIC SIGNAL CONSTRUCTION DRAWINGS

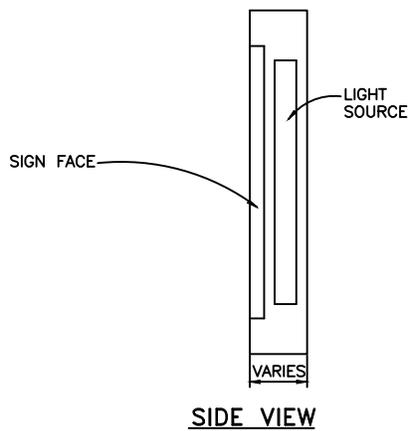
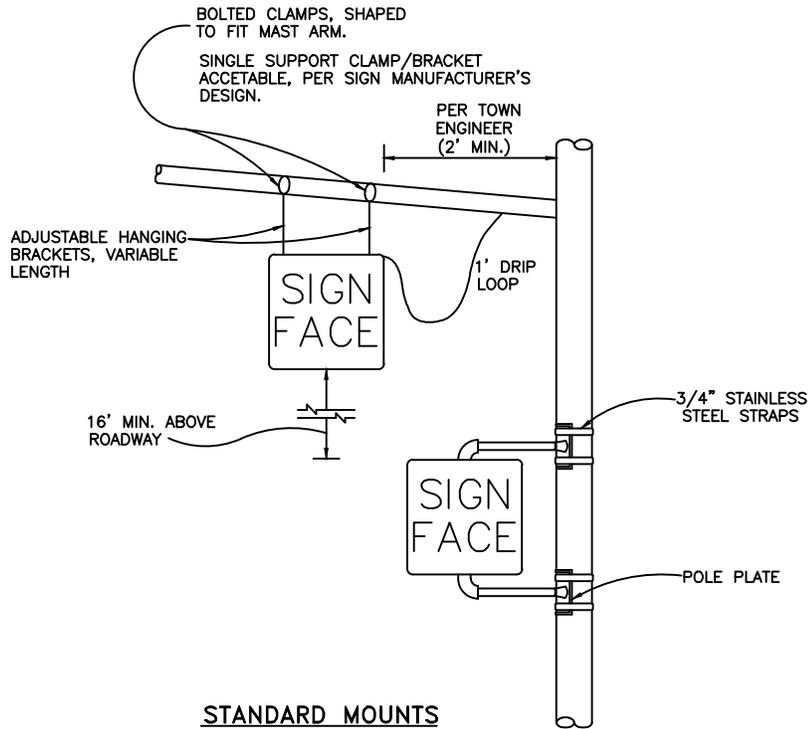
BY: JME

SCALE: NTS

DATE: 1/2020

DRAWING:

TS1

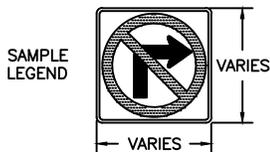


NOTES

1. LIGHT SOURCE SHALL BE LED, SIGN FACE SHALL COMPLETELY BLANK OUT WHEN NOT ENERGIZED.
2. CABINET INTERIOR AND CIRCUIT CONNECTIONS SHALL BE READILY ACCESSIBLE VIA HINGED DOORS OR REMOVABLE PANELS. THE LENS PANEL SHALL BE REMOVABLE WITHOUT THE USE OF TOOLS.

NOTES

1. SIGN MAY BE SINGLE-SIDED OR DOUBLE SIDED PER ENGINEER'S DIRECTION.
2. SIGN COLOR, LEGEND AND SIZE PER PUBLIC WORKS DIRECTOR.



TYPICAL SIGN LAYOUT

GENERAL NOTES

1. SIGN FIXTURE AND PANELS SHALL WITHSTAND 90 MPH WIND LOADING, WITH STRUCTURAL REQUIREMENTS MEETING AASHTO "STANDARD SPECIFICATIONS FOR STRUCTURAL SUPPORTS FOR HIGHWAY SIGNS, LUMINAIRES AND TRAFFIC SIGNALS," LATEST EDITION.
2. HOUSING SHALL BE CONSTRUCTED OF ALUMINUM UNLESS OTHERWISE DIRECTED BY ENGINEER.
3. NEOPRENE GASKETS SHALL BE INSTALLED BETWEEN THE SIGN PANEL AND FIXTURE HOUSING TO PREVENT WATER ENTRANCE. SCREENED WEEP HOLES SHALL BE PROVIDED ON HOUSING BOTTOM FOR DRAINAGE.

REGULATORY WARNING SIGN

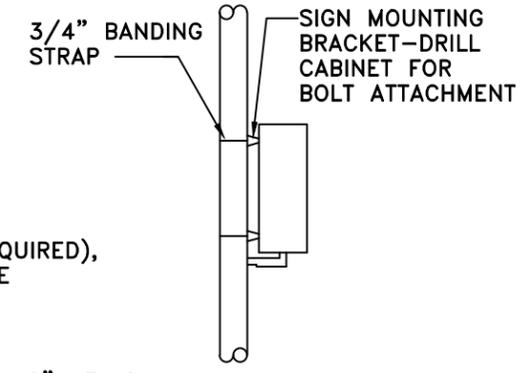
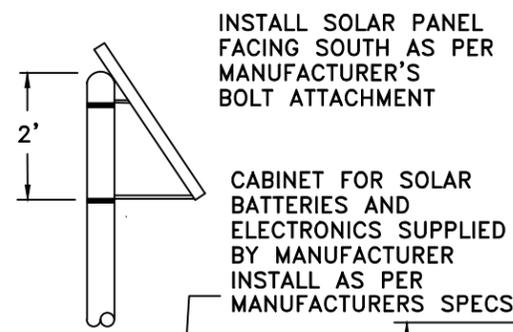


**TRAFFIC SIGNAL
CONSTRUCTION
DRAWINGS**

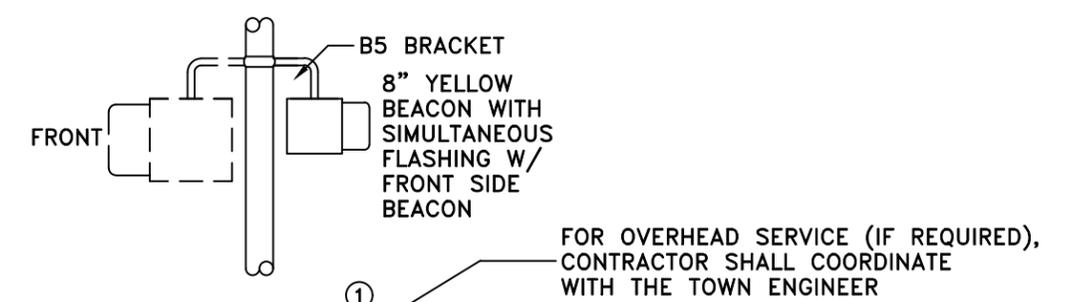
BY: JME
SCALE: NTS
DATE: 1/2020

DRAWING:
TS2

OPTIONAL SOLAR PANEL

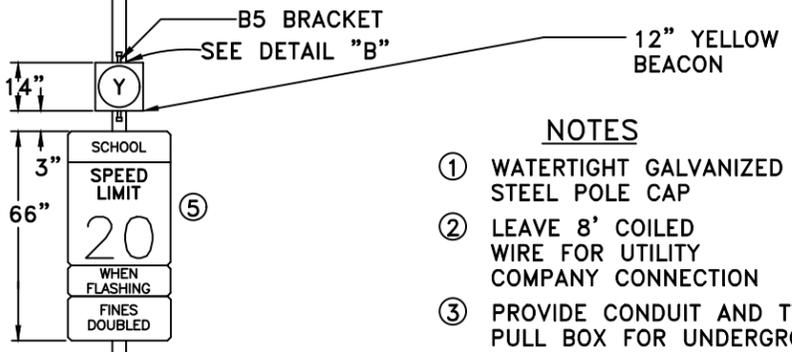


DETAIL "B"
OPPOSITE DIRECTION 8" FLASHER



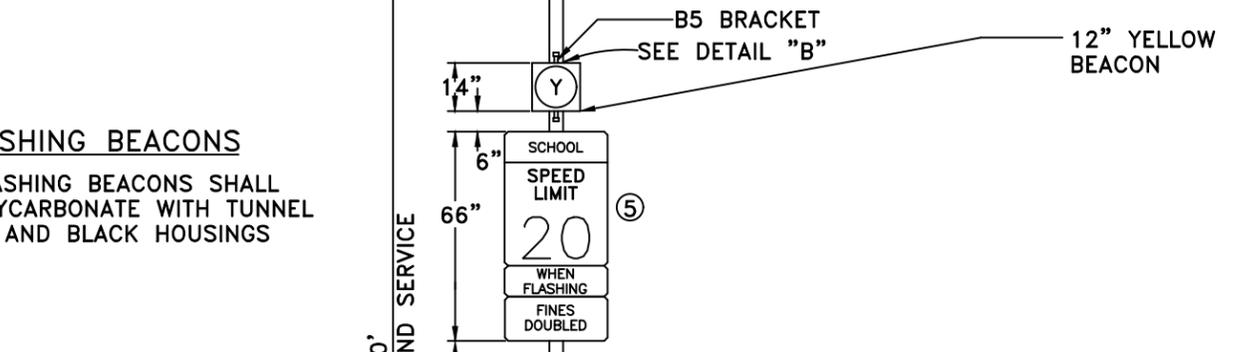
FOR OVERHEAD SERVICE (IF REQUIRED), CONTRACTOR SHALL COORDINATE WITH THE TOWN ENGINEER

FOR OVERHEAD SERVICE (IF REQUIRED), CONTRACTOR SHALL COORDINATE WITH THE TOWN ENGINEER



- NOTES**
- ① WATERTIGHT GALVANIZED STEEL POLE CAP
 - ② LEAVE 8' COILED WIRE FOR UTILITY COMPANY CONNECTION
 - ③ PROVIDE CONDUIT AND TYPE III PULL BOX FOR UNDERGROUND SERVICE ONLY
 - ④ BONDING STRAP IN BACKFILL
 - ⑤ SIGN ASSEMBLY LAYOUT TO BE APPROVED BY THE TOWN.
 - ⑥ SHOWN RADAR SPEED DISPLAY SIGN IS MODEL RU2 FAST 350 MAY BE SUBSTITUTED BY A TOWN APPROVED ALTERNATIVE.
 - ⑦ FLASHERS SHALL BE LED
 - ⑧ SEAL ALL PENETRATIONS IN POLE AND CABINET/WATER TIGHT

FLASHING BEACONS
ALL FLASHING BEACONS SHALL BE POLYCARBONATE WITH TUNNEL VISORS AND BLACK HOUSINGS



SCHOOL FLASHING BEACON ASSEMBLY
SIDE OF ROAD, TYPE 1

SCHOOL FLASHING BEACON ASSEMBLY
SIDE OF ROAD, TYPE 2

SCHOOL FLASHING BEACON



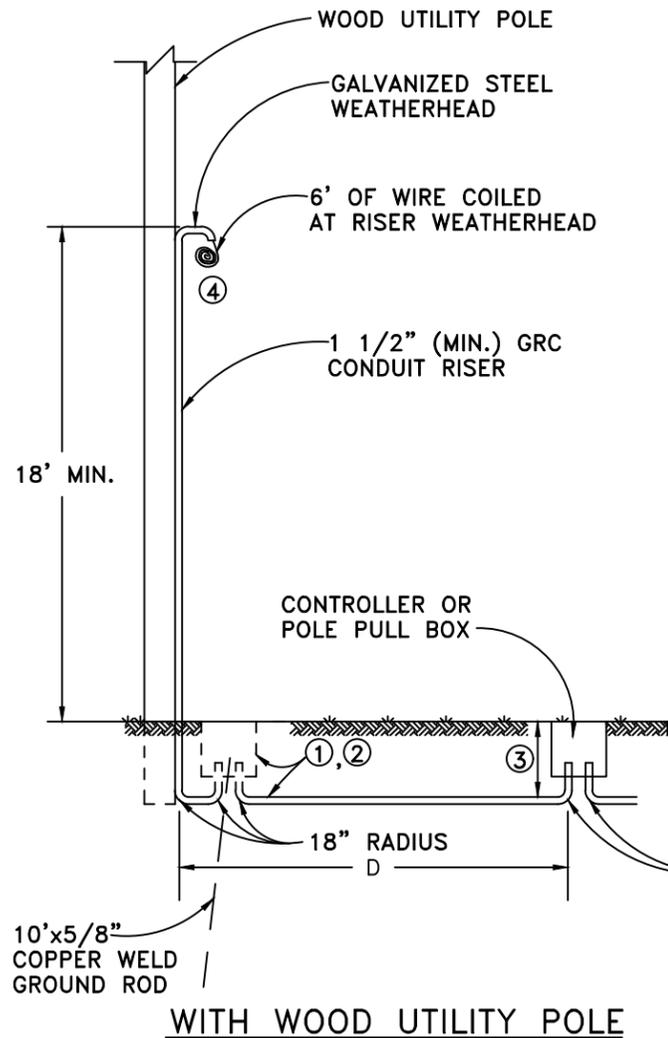
TRAFFIC SIGNAL CONSTRUCTION DRAWINGS

BY: JME
SCALE: NTS
DATE: 1/2020

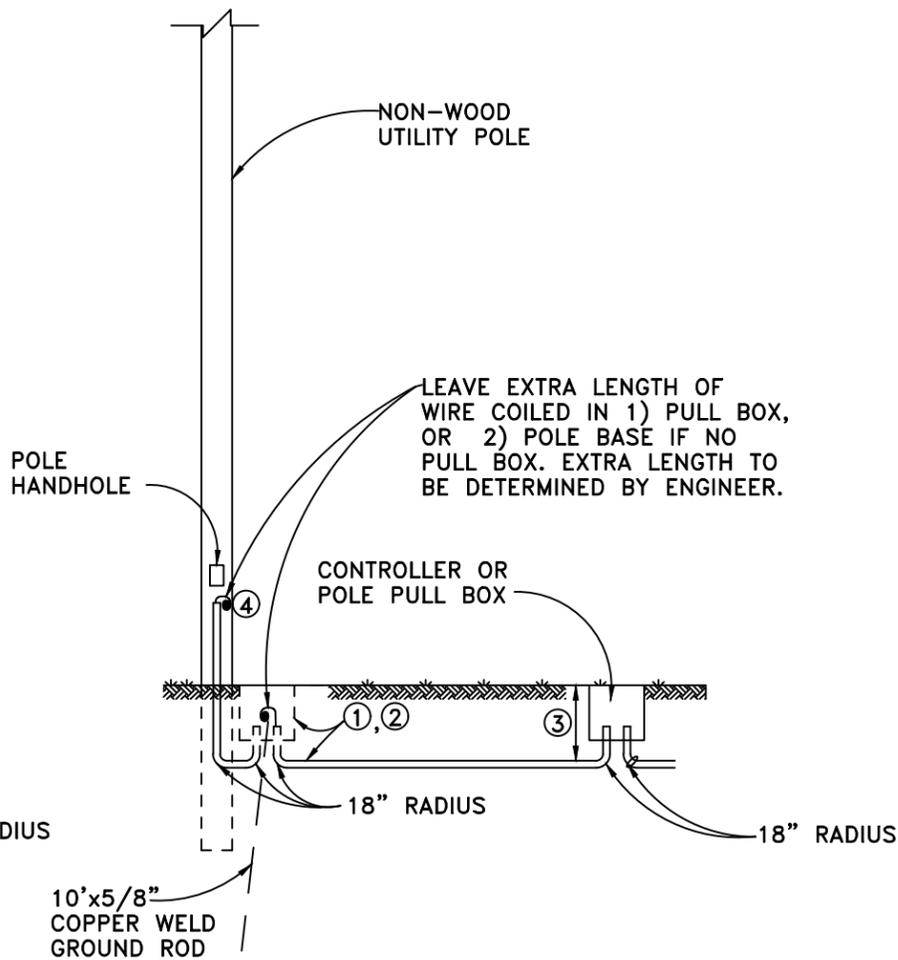
DRAWING:
TS3

NOTES

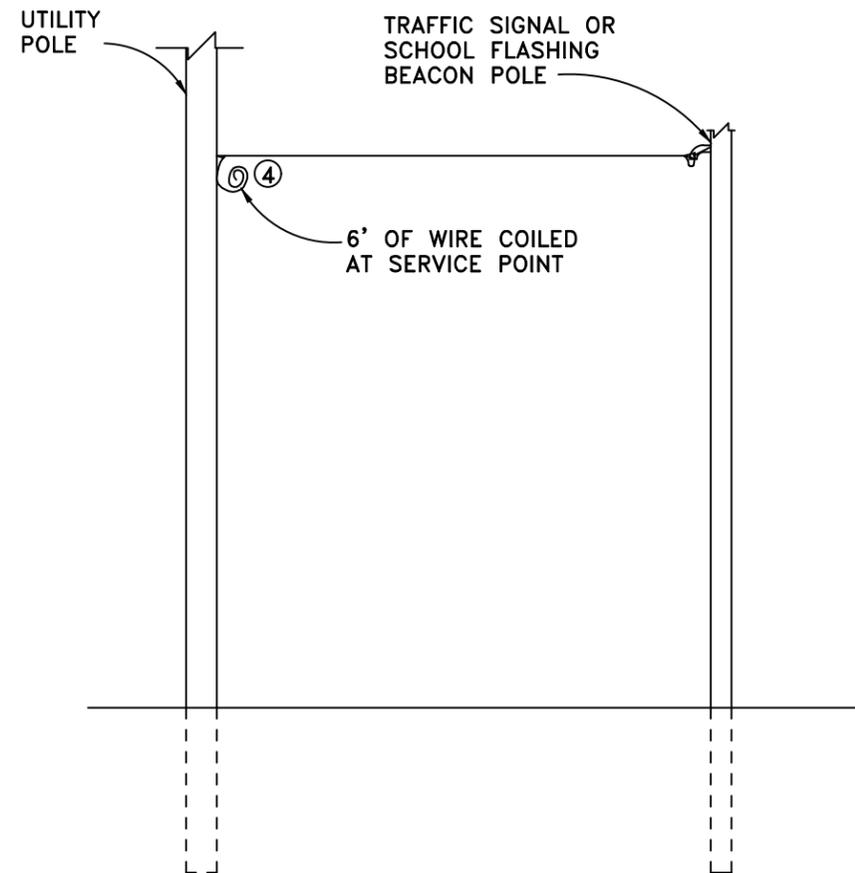
- ① PROVIDE TYPE III PULL BOX/GROUND ROD AND 2" PVC CONDUIT ONLY IF D EXCEEDS 10'
- ② PROVIDE 2" GRC CONDUIT WITHOUT PULL BOX/GROUND ROD IF D IS LESS THAN 10'
- ③ MINIMUM CONDUIT DEPTHS:
UNDERGROUND 24"
UNDER PAVEMENT 30"
- ④ WHERE REQUIRED BY UTILITY COMPANY, CONTRACTOR SHALL BE RESPONSIBLE FOR OBTAINING PERMIT AND INSPECTION FROM THE STATE ELECTRICAL BOARD.



WITH WOOD UTILITY POLE



WITH NON-WOOD UTILITY POLE



TYPICAL OVERHEAD POWER FEED FOR TRAFFIC SIGNAL AND SCHOOL FLASHING BEACON ASSEMBLIES

TYPICAL UNDERGROUND POWER FEED FOR TRAFFIC SIGNALS AND SCHOOL FLASHING BEACON ASSEMBLIES

POWER FEED FOR TRAFFIC SIGNALS



TRAFFIC SIGNAL CONSTRUCTION DRAWINGS

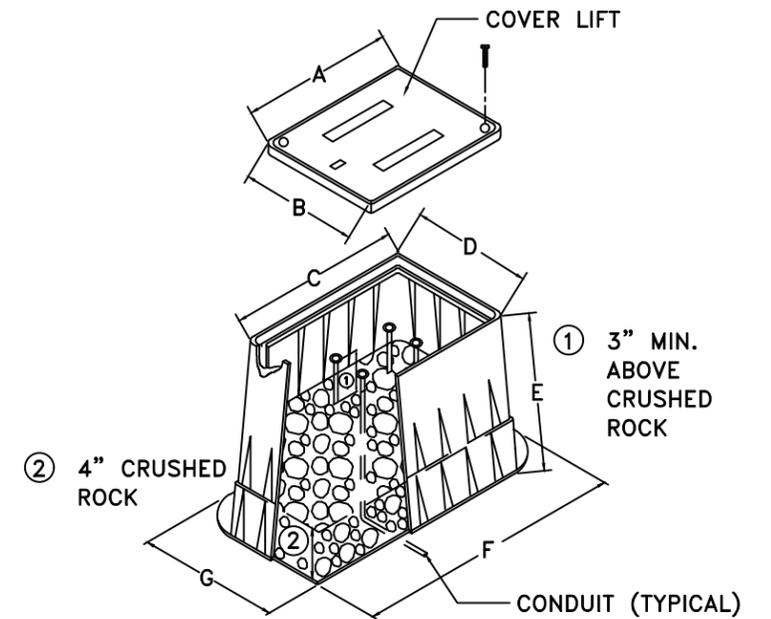
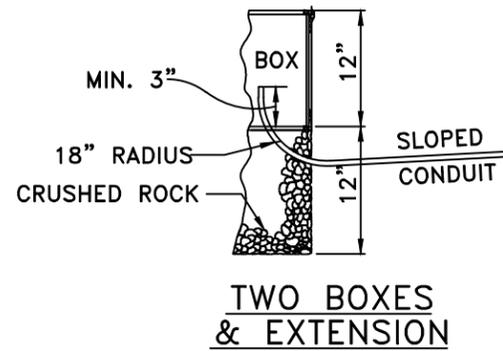
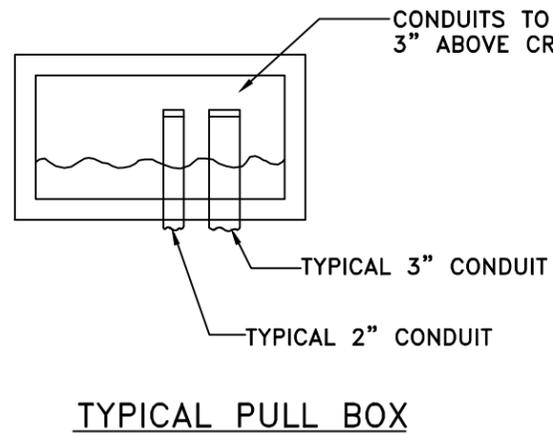
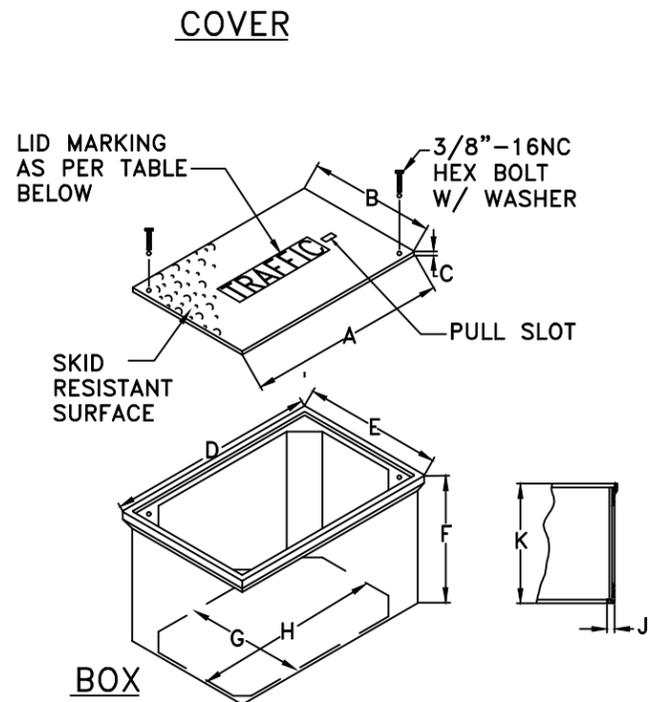
BY: JME

SCALE: NTS

DATE: 1/2020

DRAWING:

TS4



FIBERGLASS REINFORCED POLYMER CONCRETE DESIGNED FOR SERVICE LOAD (MINIMUM) OF 15,000 LBS. OVER A 10" SQUARE

PULLBOXES

PULL BOX USAGE	SIZE	PULL BOX LID MARKING
CABINET HOME RUN PULLBOX	24"x36"x18"	TRAFFIC
SIGNAL POLE PULL BOX	17"x30"x12"	TRAFFIC
DETECTOR PULL BOX (SIDE OF ROAD)	12"x12"x12"	TRAFFIC
DETECTOR WATER VALVE	WATER VALVE	TRAFFIC
COMMUNICATION VAULT (T/S CABINET)	30"x48"x18"	TRAFFIC COMM
COMMUNICATION VAULT (INTERMEDIATE LOCATIONS)	24"x36"x18"	TRAFFIC COMM
TELEPHONE DEMARCATION	13"x24"x12"	TRAFFIC COMM
ELECTRICAL DEMARCATION	13"x24"x12"	ELECTRIC

PULL BOX (PLASTIC/PREFAB)



TRAFFIC SIGNAL CONSTRUCTION DRAWINGS

BY: JME

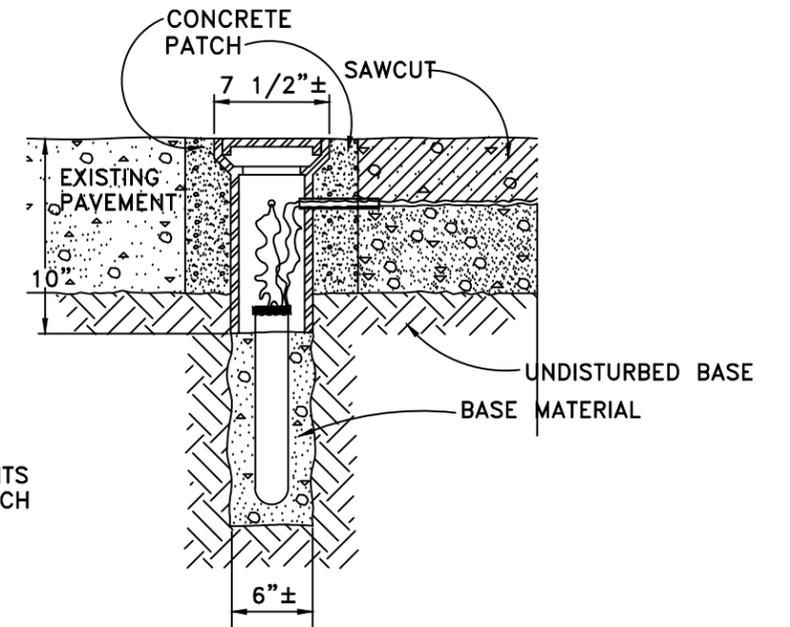
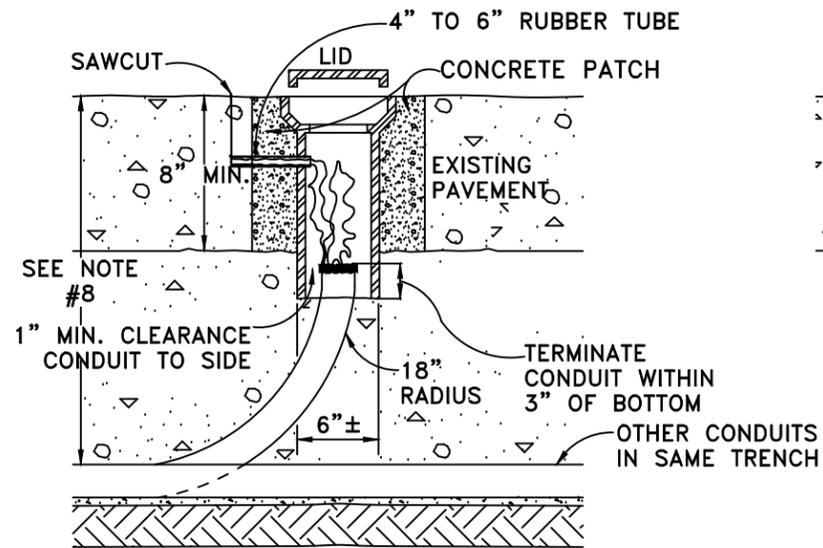
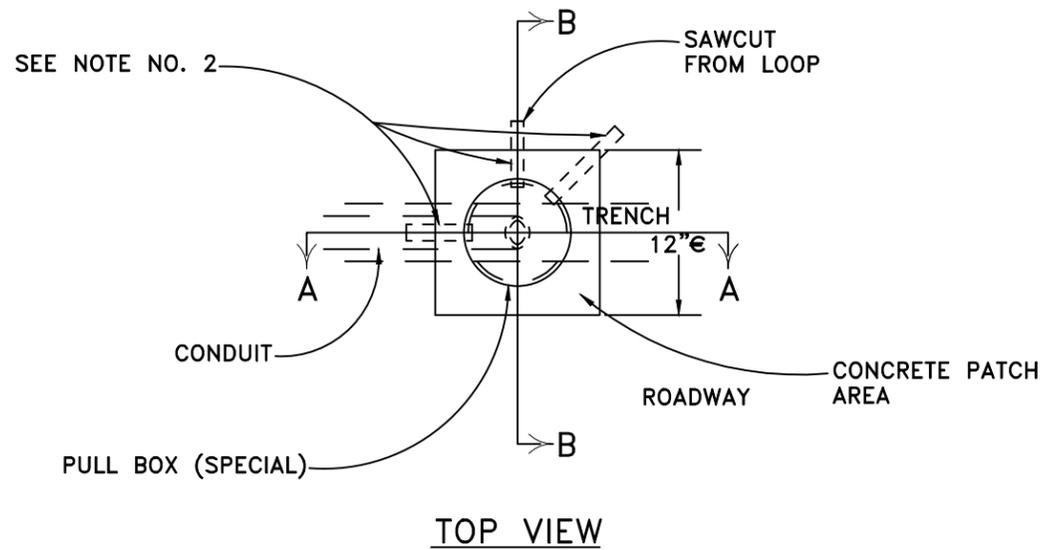
SCALE: NTS

DATE: 1/2020

DRAWING:

TS5

PULL BOX (SPECIAL)



SECTION A-A

SECTION B-B

GENERAL NOTES

1. PULL BOX (SPECIAL) SHALL BE A WATER VALVE STEM TYPE PULL BOX MADE OF ALUMINUM WITH A CAST IRON LID. THE PULL BOX SHALL HAVE THE CAPABILITY OF ACCEPTING RISER RINGS FOR FUTURE OVERLAYS. THE LID SHALL HAVE THE WORD "TRAFFIC" PRINTED ON IT.
2. PULL BOXES SHALL HAVE 3/4" TO 1" DIAMETER HOLES DRILLED OR TORCHED 3" FROM TOP TO ACCEPT A 4" TO 6" RUBBER TUBE (3/4" GARDEN HOSE). THE NUMBER OF HOLES SHALL BE AS PER PLANS OR AS DIRECTED BY THE TOWN ENGINEER.
3. CARE SHALL BE TAKEN DURING BACKFILL COMPACTION TO PREVENT COLLAPSE OF THE TUBES.
4. 2' MINIMUM SLACK OF BOTH FEED AND LOOP WIRES IS TO BE PROVIDED SO THAT ALL TESTING AND SPLICING CAN BE DONE OUTSIDE OF THE PULL BOX.
6. PULL BOX IS TO BE LOCATED IN AN AREA OF THE STREET NOT HEAVILY TRAVELED IF POSSIBLE AND CENTERED A MINIMUM OF 12" FROM THE CONCRETE GUTTER PAN.
7. ALL WORK LISTED ABOVE FOR INSTALLATION OF PULL BOXES SHALL NOT BE PAID FOR SEPARATELY, BUT SHALL BE INCLUDED IN THE PRICE OF THE CONDUIT.
8. CONDUIT UNDER ROADWAY SHALL BE LOCATED AT A DEPTH OF NOT LESS THAN 30 INCHES.

PULLBOX (SPECIAL)



TRAFFIC SIGNAL CONSTRUCTION DRAWINGS

BY: JME

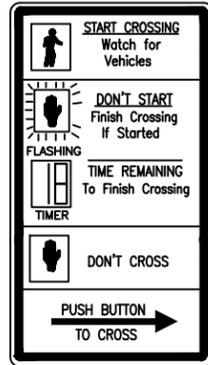
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DATE: 1/2020

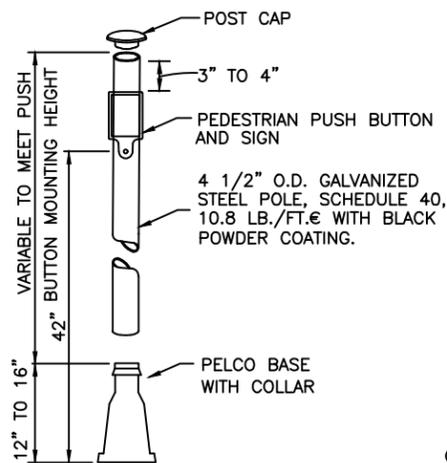
DRAWING:

TS6

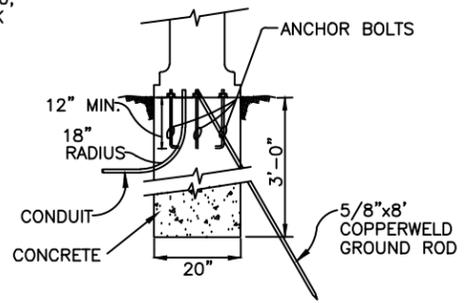
TYPICAL PEDESTRIAN PUSH-BUTTON SIGN
SIGN SHALL BE LABEL (STICK-ON) TYPE



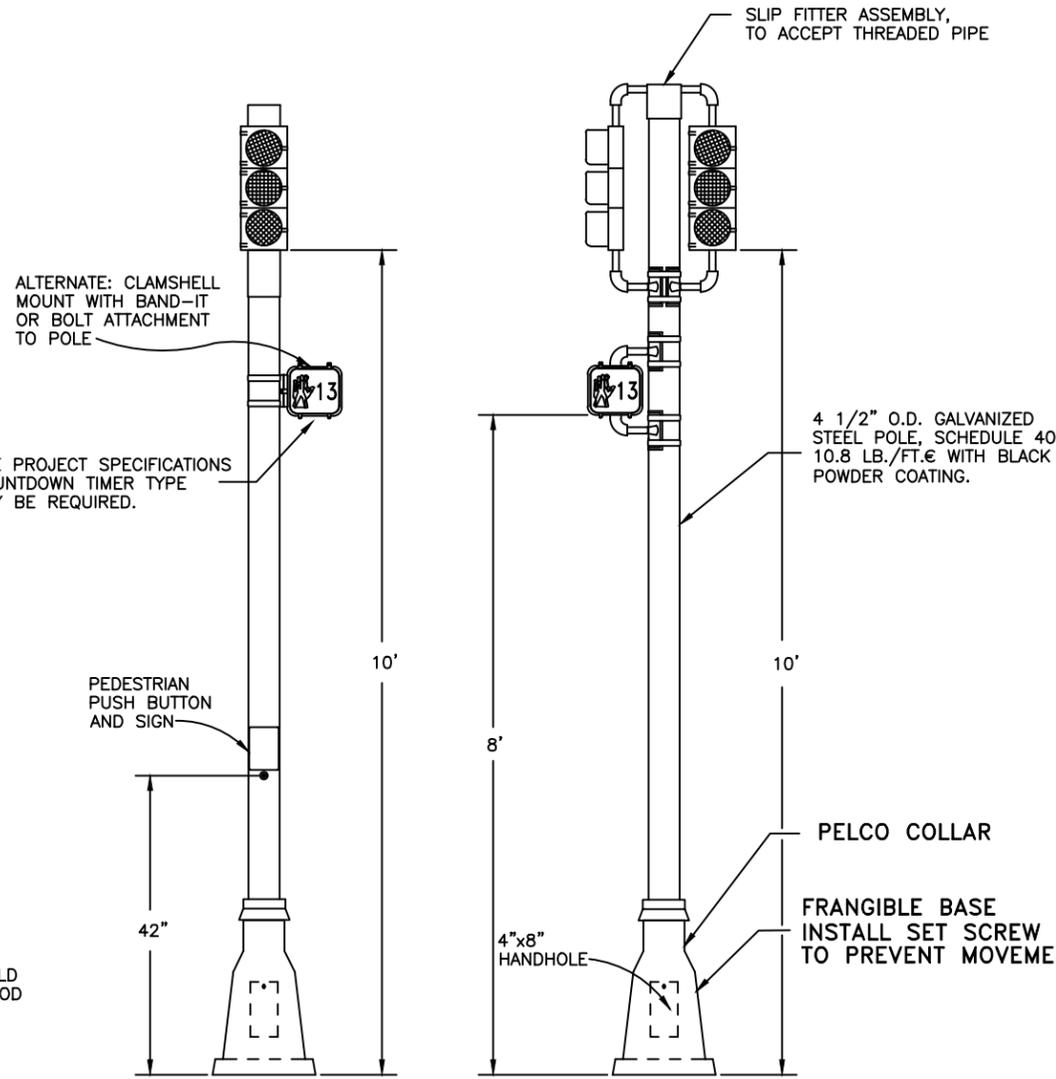
R10-3e
9"x15"
COUNTDOWN



PEDESTRIAN PUSH BUTTON POLE



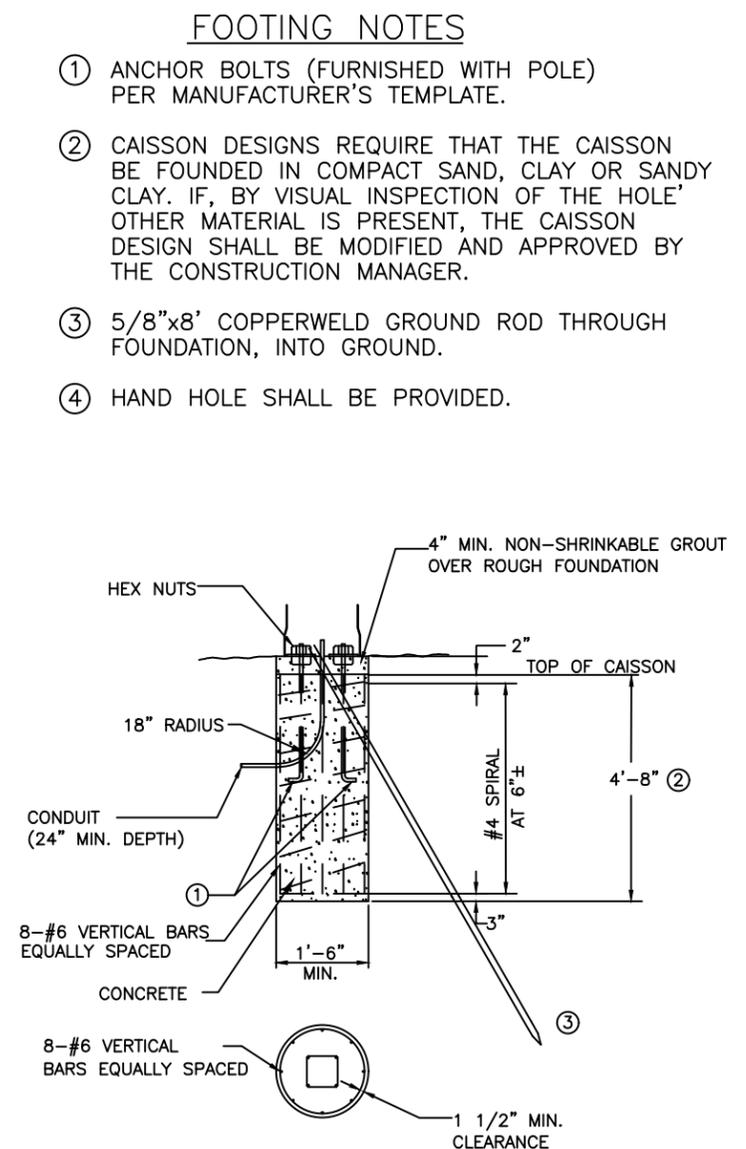
FOUNDATION
DETAIL



PEDESTAL POLE SHALL BE HOT DIPPED GALVANIZED PER ASTM A123,
EQUIVALENT TO 2 OZ. PER SQUARE FOOT, INSIDE AND OUT

TYPICAL PEDESTAL POLE DETAIL

1/4" SPLIT PIN SHALL BE INSTALLED IN THE UPPER
PORTION OF THE ALUMINUM BASE AND SHALL COMPLETELY
PENETRATE BASE AND POLE TO SECURE POLE TO PREVENT
MOVEMENT OR TWISTING. PELCO COLLAR TO BE INSTALLED.



FOOTING NOTES

- ① ANCHOR BOLTS (FURNISHED WITH POLE) PER MANUFACTURER'S TEMPLATE.
- ② CAISSON DESIGNS REQUIRE THAT THE CAISSON BE FOUNDED IN COMPACT SAND, CLAY OR SANDY CLAY. IF, BY VISUAL INSPECTION OF THE HOLE OTHER MATERIAL IS PRESENT, THE CAISSON DESIGN SHALL BE MODIFIED AND APPROVED BY THE CONSTRUCTION MANAGER.
- ③ 5/8"x8' COPPERWELD GROUND ROD THROUGH FOUNDATION, INTO GROUND.
- ④ HAND HOLE SHALL BE PROVIDED.

TYPICAL PEDESTAL POLE FOUNDATION

(CAST IN PLACE)

PEDESTRIAN POLE



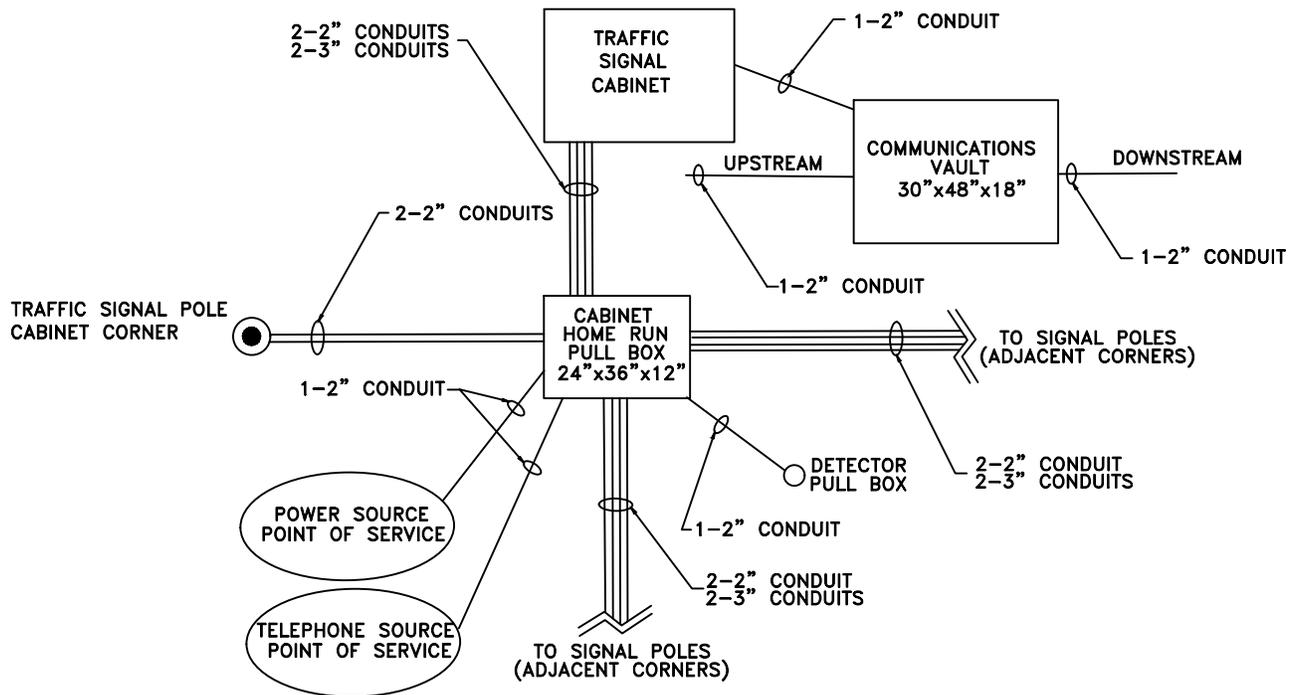
TRAFFIC SIGNAL CONSTRUCTION DRAWINGS

BY: JME
SCALE: NTS
DATE: 1/2020

DRAWING:
TS7

UNDERGROUND POWER SOURCE SCHEMATIC FOR SIGNALS WITH LUMINAIRES

NOT TO SCALE



RECOMMENDED CONDUIT/CABLE RELATIONSHIPS

"CABINET HOME RUN PULL BOX" TO "TRAFFIC SIGNAL CABINET"

- 1 OF 2 - 2" CONDUITS: POWER FROM POINT-OF-SERVICE
- 2 OF 2 - 2" CONDUITS: LOW VOLTAGE & VIDEO
- 1 OF 2 - 3" CONDUITS: FIELD WIRING (120 VAC)
- 2 OF 2 - 3" CONDUITS: SPARE

"CABINET HOME RUN PULL BOX" TO "SIGNAL POLE PULLBOX"/

"SIGNAL POLE PULL BOX" TO "SIGNAL POLE PULL BOX" ON ADJACENT CORNERS

- 1 OF 2 - 2" CONDUIT: LUMINAIRE POWER
- 2 OF 2 - 2" CONDUITS: LOW VOLTAGE & VIDEO
- 1 OF 2 - 3" CONDUITS: FIELD WIRING (120 VAC)
- 2 OF 2 - 3" CONDUITS: SPARE

"SIGNAL POLE PULL BOX" TO "SIGNAL POLE"

- 1 OF 1 - 2" CONDUIT: LUMINAIRE POWER
- 2 OF 2 - 2" CONDUITS: FIELD WIRING

"CABINET HOME RUN PULL BOX" TO "POINTS OF SERVICE"

- 1 OF 2 - 2" CONDUITS: POWER FROM POINT OF SERVICE
- 2 OF 2 - 2" CONDUITS: TELEPHONE FROM POINT OF SERVICE

"COMMUNICATIONS VAULT" TO "TRAFFIC SIGNAL CABINET":

- 1 OF 1 - 2" CONDUIT: INTERCONNECT

"COMMUNICATIONS VAULT" UPSTREAM/DOWNSTREAM:

- 1 OF 1 - 2" CONDUIT: INTERCONNECT

"SIGNALPOLE PULL BOX" TO "DECTOR PULL BOX"/"DETECTOR WATER VALVE"

- 1 OF 1 - 2" CONDUIT: INDUCTANCE DETECTOR WIRING

NOTE:

THE "TRAFFIC SIGNAL PULL BOX" ON THE CABINET CORNER IS TO BE SIZED AT 24"x36"x12" DUE TO THE NUMBER OF CONDUITS ENTERING IT. TRAFFIC SIGNAL PULL BOXES" ON REMAINING CORNERS ARE TO BE SIZED 17"x30"x12".

POWER SOURCE SCHEMATIC



**TRAFFIC SIGNAL
CONSTRUCTION
DRAWINGS**

BY: JME

SCALE: NTS

DATE: 1/2020

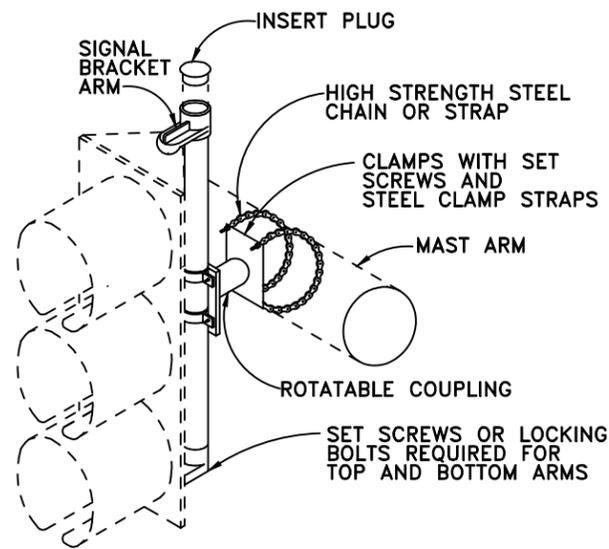
DRAWING:

TS8

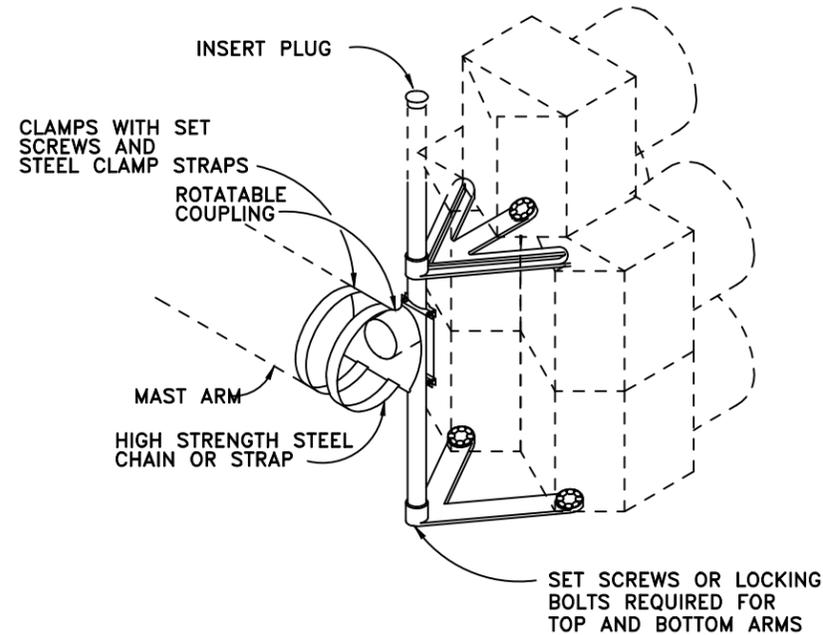
NOTES

ALL VEHICLE SIGNAL HEADS SHALL BE POLYCARBONATE WITH 12" SECTIONS AND TUNNEL VISORS.

ALL VEHICLE AND PEDESTRIAN SIGNAL HEADS SHALL BE LED TYPE, EXCEPT FOR ONE SIDE OF POLE RED WHICH SHALL BE INCANDESCENT. HEADS SHALL BE BLACK IN COLOR. PEDESTRIAN HEADS SHALL BE COUNTDOWN TYPE.



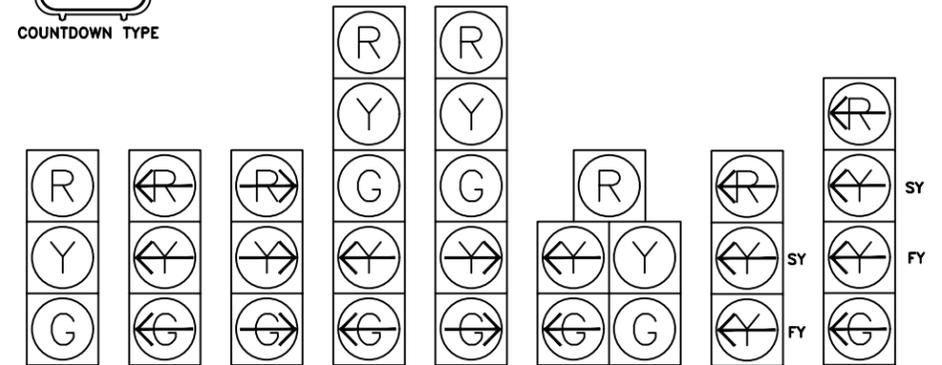
DETAIL OF MAST ARM MOUNTING FOR IN-LINE SIGNAL HEAD (3-SECTION OR 4-SECTION)



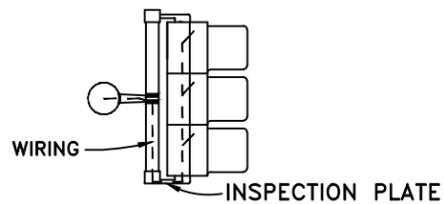
DETAIL OF MAST ARM MOUNTING FOR DOGHOUSE SIGNAL HEAD (5-SECTION)



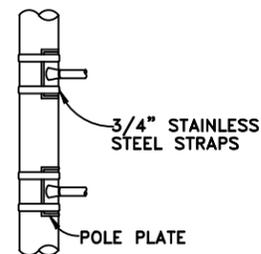
COUNTDOWN TYPE



PEDESTRIAN AND VEHICLE SIGNAL HEADS



WIRING DIAGRAM



TYPICAL SIDE OF POLE SIGNAL MOUNTING

MOUNTING NOTES

1. PIPE COUPLINGS FOR SIGNAL BRACKETS SHALL BE EITHER 1-1/2 OR 2 INCH DEPENDING UPON THE SIGNAL HEAD TO BE INSTALLED. SIGNAL BRACKETS SHALL BE FURNISHED BY THE MANUFACTURER OF THE SIGNAL HEADS.
2. UNLESS OTHERWISE SPECIFIED, ALL TRAFFIC SIGNALS MOUNTED ABOVE THE ROADWAY SHALL HAVE A HEIGHT OF 17' TO 19' ABOVE THE PAVEMENT GRADE AT THE ROADWAY CENTER, ALL SIDE-OF-POLE MOUNTED TRAFFIC SIGNALS SHALL HAVE A HEIGHT OF 10' ABOVE GROUND LINE AND PEDESTRIAN SIGNALS SHALL HAVE A HEIGHT OF 8' ABOVE GROUND LINE AS MEASURED TO THE BOTTOM OF THE SIGNAL HEAD HOUSING OR BRACKET.
3. MAST ARM MOUNTED SIGNAL HEADS SHALL USE ASTRO-BRAC'S OR SKY-BRACK. ALL SIGNAL HEADS SHALL BE MOUNTED IN SUCH A MANNER AS TO BE EASILY REMOVED FROM THEIR SUPPORTING STRUCTURE..
4. GASKET SEALING COMPOUND SHALL BE USED IN ADDITION TO ANY LEAD WASHERS REQUIRED FOR CREATING A WATER-TIGHT CONNECTION BETWEEN THE SIGNAL HEAD AND MOUNTING BRACKET.
5. SIGNAL HEADS SHALL BE SECURELY AFFIXED BY USE OF A SERRATED COUPLING OR OTHER ACCESSORIES RECOMMENDED BY THE SIGNAL MANUFACTURER.
6. WIRING FROM INSIDE MAST ARM THROUGH A 1" FIELD DRILLED HOLE IN ARM SHALL BE BROUGHT THROUGH THE MOUNTING SUPPORT TUBE AND LOWER ARM (AS SHOWN). FIELD DRILLED HOLES SHALL HAVE RUBBER GROMMETS INSTALLED.

GENERAL WIRING NOTES

1. TRAFFIC SIGNAL CONDUIT SHALL NOT CARRY WIRING OF OTHER UTILITIES.
2. EXCEPT FOR LOOP DETECTOR LEADS, ALL SPLICES SHALL BE IN HAND HOLES AT POLE BASES AND NOT IN PULL BOXES.
3. PEDESTRIAN AND VEHICLE SIGNAL HEADS SHALL BE INDIVIDUALLY WIRED FROM THE POLE BASE TO THE SIGNAL HEAD.
4. CONTRACTOR SHALL PROVIDE 2 WIRING DIAGRAMS OF THE SIGNAL INSTALLATION TO THE TOWN.
5. UNLESS ALLOWED BY THE TOWN ENGINEER, WIRE SHALL NOT OCCUPY MORE THAN 40% OF THE INSIDE AREA OF CONDUIT.

SIGNAL HEAD MOUNTING



TRAFFIC SIGNAL CONSTRUCTION DRAWINGS

BY: JME

SCALE: NTS

DATE: 1/2020

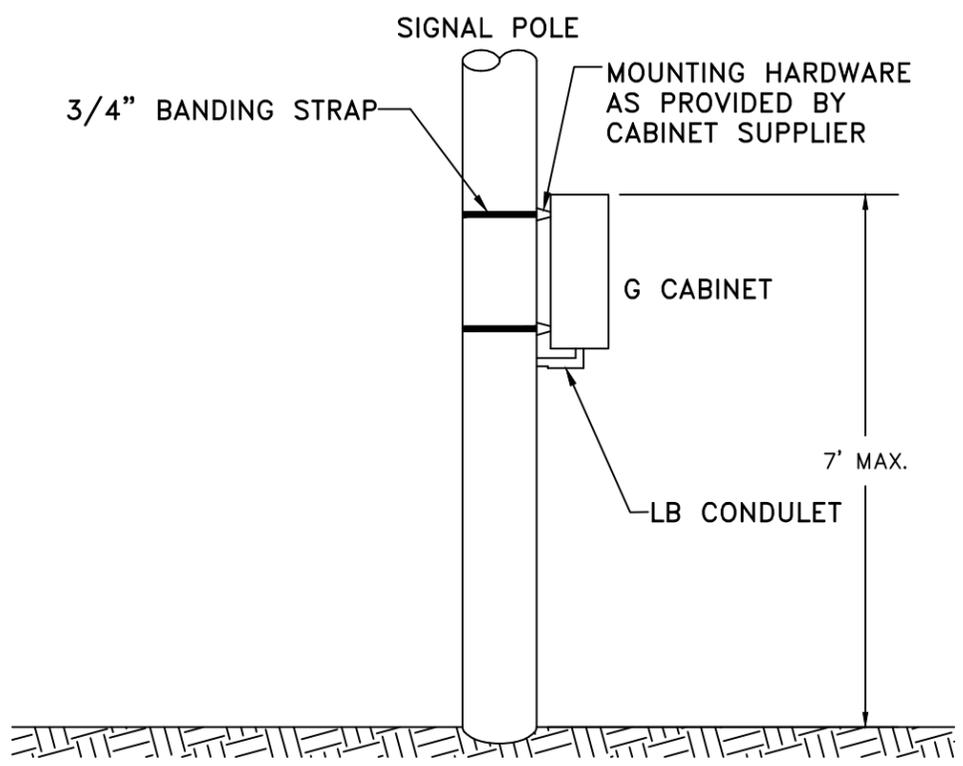
DRAWING:

TS9

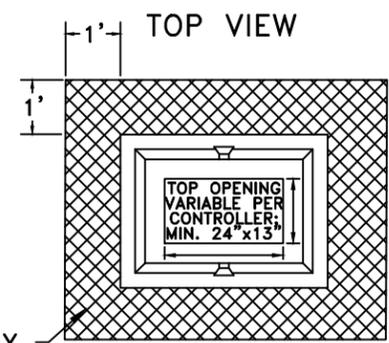
CABINET FOUNDATION

333 SD

L	D	H
44"	29"	24"

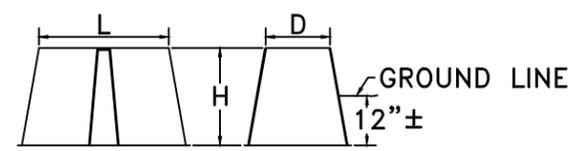


TYPICAL SIDE-OF-POLE MOUNTED
CONTROLLER CABINET

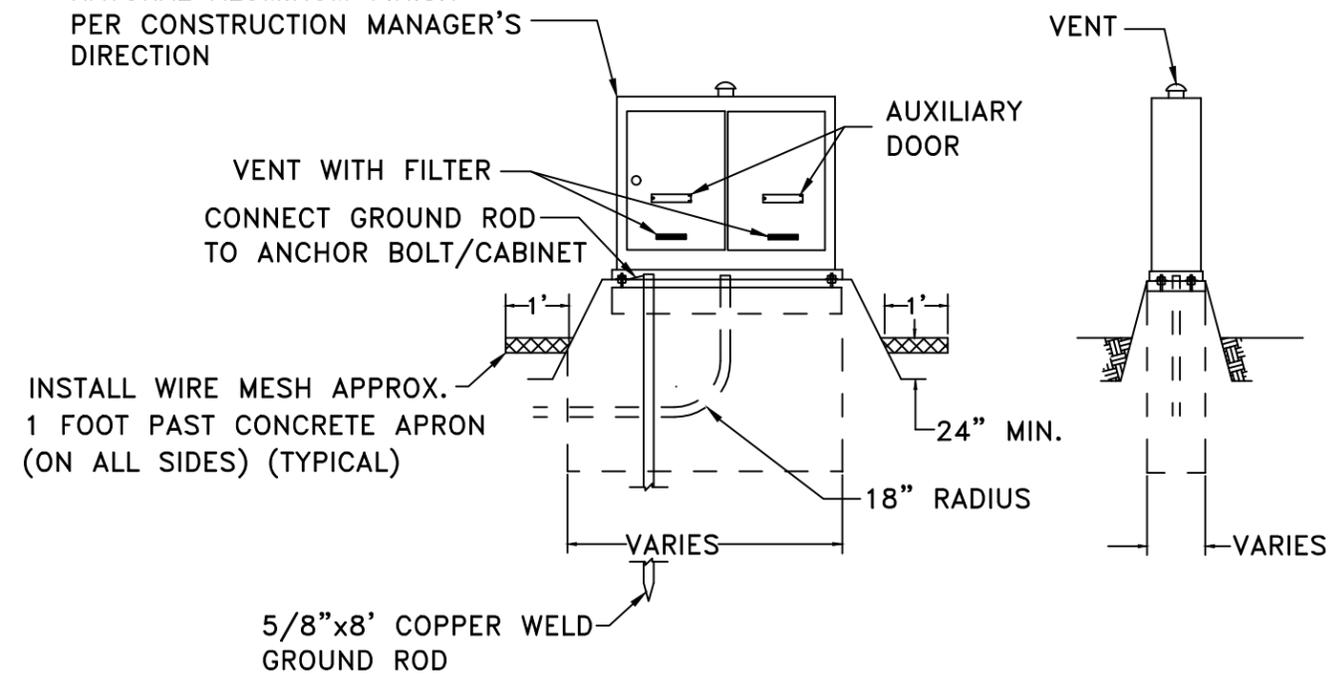


INSTALL WIRE MESH APPROX.
1 FOOT PAST CONCRETE APRON
(ON ALL SIDES) (TYPICAL)

CONTROLLER
FOUNDATION



NATURAL ALUMINUM FINISH
PER CONSTRUCTION MANAGER'S
DIRECTION



INSTALL WIRE MESH APPROX.
1 FOOT PAST CONCRETE APRON
(ON ALL SIDES) (TYPICAL)

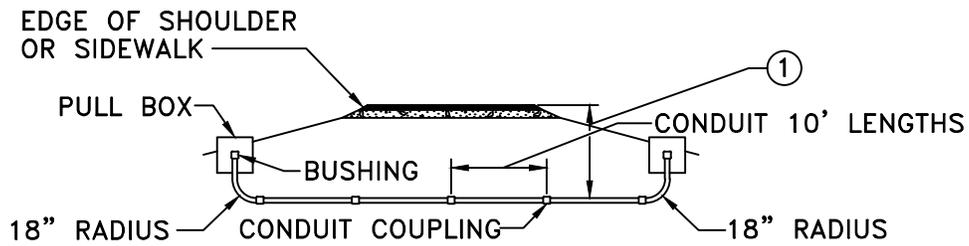
TYPICAL BASE MOUNTED CONTROLLER CABINET
INSTALLATION AND FIBERGLASS FOUNDATION

CONTROLLER CABINET



TRAFFIC SIGNAL CONSTRUCTION DRAWINGS

BY: JME	DRAWING: TS10
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DATE: 1/2020	



CONDUIT PLACEMENT UNDER PAVEMENT
OR SIDEWALK

NOTES

①	MINIMUM CONDUIT DEPTH:	UNDER PAVEMENT 30"	UNDER SIDEWALK 24"
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ALL PVC CONDUIT SHALL BE SCHEDULE 80

CONDUIT DETAILS



TRAFFIC SIGNAL
CONSTRUCTION
DRAWINGS

BY: JME
SCALE: NTS
DATE: 1/2020

DRAWING:

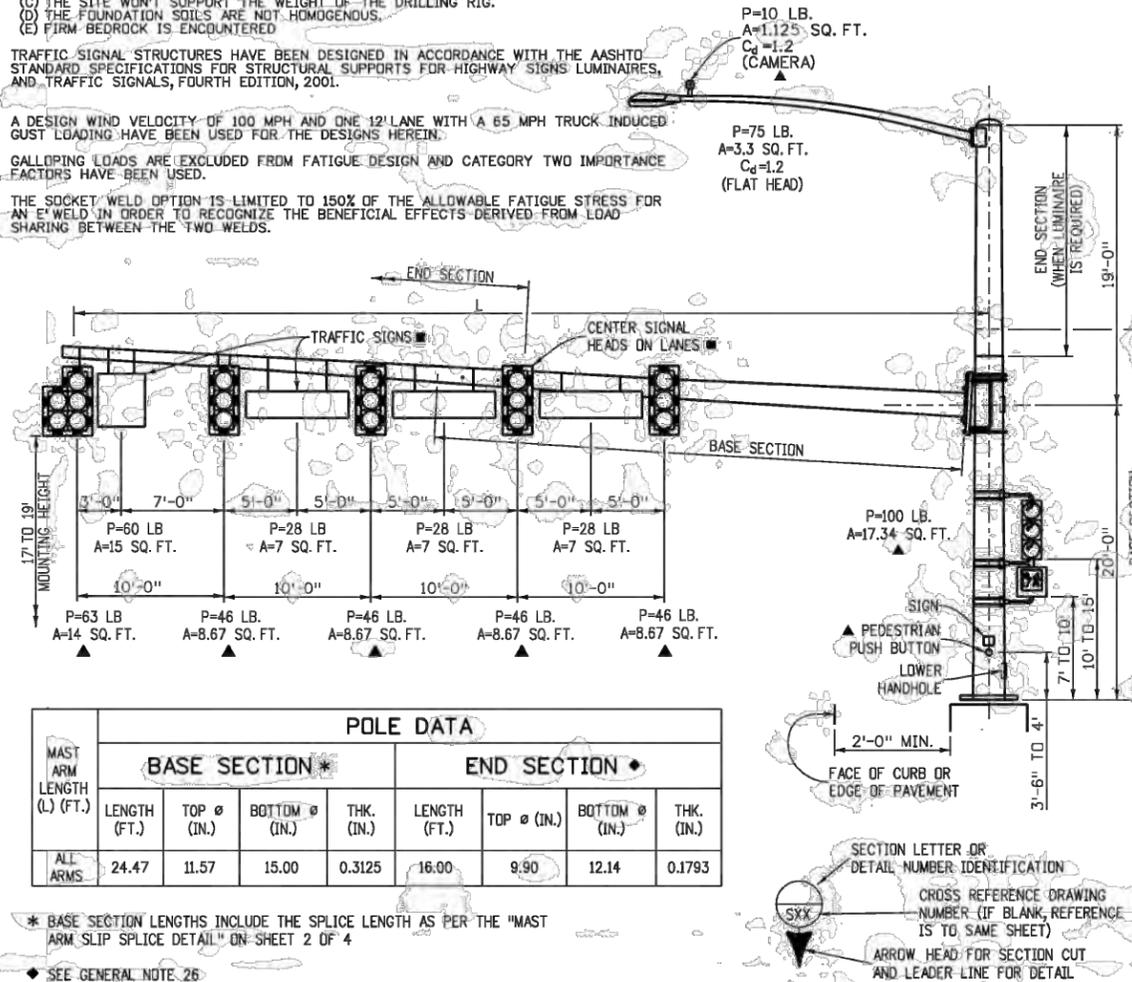
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GENERAL NOTES

- REFER TO THE ROADWAY PLANS FOR THE ACTUAL CONFIGURATION AND LOCATION OF TRAFFIC SIGNAL HEADS AND SIGNS MARKED WITH A ■.
- ALL POLES SHALL BE FABRICATED WITH ASTM A572 GRADE 65 STEEL.
- ALL ARMS SHALL BE FABRICATED WITH ASTM A572 GRADE 65 STEEL OR ASTM A595 GRADE A STEEL WITH A MINIMUM YIELD POINT OF 55 KSI.
- ALL POLES AND ARMS SHALL COMPLY WITH THE DIMENSIONAL TOLERANCES SPECIFIED IN ASTM A500, A501, OR A595.
- ALL POLES AND ARMS SHALL BE ROUND OR DODECAGONAL (12 SIDES) TUBES WITH A 0.14 IN/FT TAPER.
- HARDENED WASHERS SHALL CONFORM TO ASTM F436.
- ALL POLES AND ARMS SHALL BE GALVANIZED INSIDE AND OUTSIDE AFTER FABRICATION IN ACCORDANCE WITH ASTM A123, UNLESS PAINTING IS CALLED FOR ON THE PLANS. PAINTING SHALL CONFORM TO SECTION 522, DUPLEX COATING SYSTEM.
- POLE AND MAST ARM SPLICES SHALL BE MECHANICALLY FORCED TOGETHER FOR A SNUG FIT.
- ALL MAST ARMS MORE THAN 35 FT IN LENGTH SHALL BE TWO-PIECE CONSTRUCTION TO LIMIT ARM WEIGHTS.
- GALVANIZED ASTM A325 H.S. BOLTS SHALL BE USED FOR ATTACHING MAST ARMS. A LUBRICATED TIGHTENING TORQUE OF 178 FT-LBS FOR 3/4" DIAMETER BOLTS, AND 1300 FT-LBS FOR 1 1/2" INCH DIAMETER BOLTS SHALL BE USED TO TIGHTEN ALL H.S. BOLTS. MAST ARMS SHALL BE TEMPORARILY SUPPORTED TO TAKE LOAD OFF OF FIELD CONNECTIONS WHILE BOLTS ARE TIGHTENED IN ORDER TO FIRMLY SEAT THE FLANGE PLATE. BOLTS SHALL BE SEQUENTIALLY TIGHTENED.
- CAST POLE END CAP TO BE SECURED IN PLACE WITH 3 SET SCREWS.
- ALL SIGNAL HEADS, SIGNS, AND HARDWARE SHALL BE FIELD POSITIONED.
- ACCESSORIES TO BE HOT DIP GALVANIZED IN ACCORDANCE WITH ASTM A153.
- ALL PLATES SHALL BE FABRICATED WITH AASHTO M270 (ASTM A709) GRADE 36 STEEL AND SHALL COMPLY WITH THE DIMENSIONAL TOLERANCES SPECIFIED IN ASTM A6. ALL HANDHOLES SHALL BE FABRICATED WITH ASTM A572 GRADE 42 STEEL.
- LEVELING CONCRETE SHALL BE 3000 PSI AIR ENTRAINED CONCRETE VIBRATED IN PLACE BELOW THE POLE BASE PLATE.
- CAISSONS SHALL BE PLACED AGAINST UNDISTURBED EARTH. WET OR CAVING HOLES SHALL BE BACKFILLED WITH FLOW-FILL AND REDRILLED AFTER A THREE DAY CURING PERIOD WITHOUT THE USE OF A CASING.
- CAISSONS SHALL BE CONSTRUCTED WITH AIR ENTRAINED CLASS B2 CONCRETE IN ACCORDANCE WITH SECTION 503 OF THE STANDARD SPECIFICATIONS. REINFORCING STEEL SHALL BE GRADE 60.
- CAISSON CONCRETE MUST HAVE A MINIMUM COMPRESSIVE STRENGTH OF 2,700 PSI BEFORE INSTALLING THE SIGNAL STRUCTURE. VERIFY CONCRETE STRENGTH WITH MATURITY METER.
- U-BOLTS AND ANCHOR BOLTS SHALL BE FABRICATED WITH AASHTO M314-90 GRADE 55 STEEL.
- ANCHOR BOLTS SHALL BE FABRICATED WITH HEAVY HEX NUTS AND FLAT WASHERS, AND EXTENDED A MINIMUM OF 3/4" ABOVE THE NUT AFTER COMPLETING THE TIGHTENING PROCESS. THREAD UPPER 12 INCHES AND GALVANIZE UPPER 13 INCHES OF THE ANCHOR BOLTS. FIELD WELDING OF ANCHOR BOLTS TO REBAR DURING ERECTION WILL NOT BE ALLOWED. ANCHOR BOLTS SHALL BE SET WITH A STEEL TEMPLATE UNTIL THE CONCRETE HAS CURED AT LEAST TWO DAYS. THEY SHALL BE TIGHTENED USING THE TURN-OF-NUT METHOD BY FIRST TIGHTENING THEM TO SNUG TIGHT, WHICH IS DEFINED AS THE TIGHTNESS THAT EXISTS WHEN THE UPPER AND LOWER NUTS ARE IN FIRM CONTACT WITH THE BASE PLATE WITH MAST ARMS FREE TO DEFLECT. THE UPPER AND LOWER NUTS SHALL THEN EACH BE ROTATED AN ADDITIONAL 1/12 TURN (30° ± 5°) WITH A SLUGGING, HYDRAULIC OR AIR IMPACT WRENCH.
- WELDING OF STEEL SHALL CONFORM TO THE REQUIREMENTS OF ANSI/AWS D1.1. ALL AREAS TO BE WELDED SHALL BE GROUND TO BRIGHT METAL. ALL WELDING AND REQUIRED TESTING SHALL BE COMPLETE BEFORE ANY MATERIAL IS GALVANIZED. ALL CIRCUMFERENTIAL WELDS SHALL BE NON-DESTRUCTIVELY TESTED USING THE ENHANCED MAGNETIC PARTICLE METHOD IN ACCORDANCE WITH SUBSECTION 509.18 (d) OF THE STANDARD SPECIFICATIONS. THE ACCEPTANCE CRITERIA IS STATED IN TABLE 6.1 OF ANSI/AWS D1.1. ALL LONGITUDINAL WELDS WITHIN 6 INCHES OF FULL PENETRATION CIRCUMFERENTIAL GROOVE WELDS AND FULL PENETRATION GROOVE WELDS SHALL BE INSPECTED AS SPECIFIED ABOVE. MAXIMUM WELD UNDERCUT SHALL BE 0.01 INCHES.
- ALL ELECTRICAL CONNECTIONS TO THE SIGNALS SHALL BE GROUNDED IN ACCORDANCE WITH APPLICABLE ELECTRICAL CODES.
- CERTIFIED MILL TEST REPORTS INCLUDING CHARPY V-NOTCH (CVN) TEST RESULTS, WELD INSPECTION REPORTS AND ENHANCED MAGNETIC PARTICLE TEST REPORTS SHALL BE SUBMITTED TO CDOT STAFF BRIDGE, 4201 E. ARKANSAS AVE., DENVER COLORADO 80222 AS SOON AS THEY BECOME AVAILABLE. CVN TEST RESULTS FOR ASTM A572 GRADES 42, 55 AND 65 STEEL SHALL HAVE A MINIMUM VALUE OF 15 FT-LBS AT 40°F AS PER THE FREQUENCY TEST REQUIREMENTS IN AASHTO T243 (ASTM A673).
- SHOP DRAWINGS SHALL BE SUBMITTED TO THE ENGINEER FOR REVIEW IN ACCORDANCE WITH SUBSECTION 105.02 OF THE STANDARD SPECIFICATIONS.
- TRAFFIC SIGNALS MOUNTED ON MAST ARMS SHALL BE FURNISHED WITH ASTRO TYPE MOUNTING BRACKETS.
- END SECTION DIAMETERS MUST BE INCREASED TO ACCOMMODATE OUT-OF-ROUNDNESS, GALVANIZING THICKNESS AND SEAM WELD PROFILES TO PROVIDE THE MINIMUM REQUIRED ARM SLIP SPlice LENGTHS AND POLE MEMBER OVERLAPS.
- SECURE ARM FLANGE PLATE, POLE BASE PLATE, AND CONNECTION FACE PLATE DURING WELDING TO PREVENT DISTORTION.
- IF THE VERTICAL DEFLECTIONS DURING A 10 TO 20 MPH WIND EXCEED THE GALLOPING DEFLECTION LIMITS LISTED IN THE TABLE ON SHEET 2 OF 4, THE TOWER SHALL INSTALL AN ALUMINUM SIGN BLANK (18" X 66" OR LARGER) NEAR THE FREE END OF THE TRAFFIC SIGNAL MAST ARM. SAID SIGN BLANK SHALL BE ROTATED ABOUT THE LONGITUDINAL AXIS OF THE ARM WHILE THE WIND BLOWS TO MINIMIZE THE GALLOPING DEFLECTIONS. CONTACT STAFF BRIDGE FOR MORE INFORMATION.
- ONE DRILLED HOLE WITH A MAXIMUM DIAMETER OF 3/4" IS ALLOWED AT LOCATIONS MARKED WITH A ▲ TO ACCOMMODATE ELECTRICAL WIRING.
- SEE S-614-42 AND S-614-43 FOR "CABINET FOUNDATION DETAILS" AND "TRAFFIC LOOP AND MISC. SIGNAL DETAILS" RESPECTIVELY.

DESIGN DATA

- DRAWING SHOWN HAS 5 SIGNAL HEADS. SHORTER ARM LENGTHS MAY HAVE FEWER HEADS. THIS CONFIGURATION IS INTENDED TO REPRESENT A WORST CASE LOADING SITUATION.
 5 SIGNAL HEADS (55'), 50' 4 SIGNAL HEADS (45'), 40' 3 SIGNAL HEADS (35'), 30' 2 SIGNAL HEADS (25')
 THE DESIGN LENGTH "L" FOR EACH SERIES IS SHOWN IN PARENTHESIS.
- THE DESIGNS HEREIN ASSUME THAT SIGNALS ARE INSTALLED WITHIN THE ROADWAY EARTHWORK PRISM WITH THE FOLLOWING SOIL PARAMETERS:
 SOIL DENSITY γ = 110 LB./CU.FT.
 SOIL COHESION = 750 LB./SQ.FT. FOR MEDIUM STIFF COHESIVE SOIL
 SOIL φ ANGLE = 30° FOR MEDIUM DENSE COHESIONLESS SOIL
 SF = 1.25 FOR TORSIONAL RESISTANCE AND 3.0 FOR FLEXURAL RESISTANCE
- CONTACT THE ENGINEER IF ANY OF THE FOLLOWING SOIL CONDITIONS ARE ENCOUNTERED DURING DRILLING:
 (A) SIGNALS WILL NOT BE INSTALLED WITHIN THE ROADWAY EARTHWORK PRISM
 (B) THE SOIL HAS A HIGH ORGANIC CONTENT OR CONSISTS OF SATURATED SILT AND CLAY.
 (C) THE SITE WON'T SUPPORT THE WEIGHT OF THE DRILLING RIG.
 (D) THE FOUNDATION SOILS ARE NOT HOMOGENOUS.
 (E) FIRM BEDROCK IS ENCOUNTERED
- TRAFFIC SIGNAL STRUCTURES HAVE BEEN DESIGNED IN ACCORDANCE WITH THE AASHTO STANDARD SPECIFICATIONS FOR STRUCTURAL SUPPORTS FOR HIGHWAY SIGNS LUMINAIRES, AND TRAFFIC SIGNALS, FOURTH EDITION, 2001.
- A DESIGN WIND VELOCITY OF 100 MPH AND ONE 12' LANE WITH A 65 MPH TRUCK INDUCED GUST LOADING HAVE BEEN USED FOR THE DESIGNS HEREIN.
- GALLOPING LOADS ARE EXCLUDED FROM FATIGUE DESIGN AND CATEGORY TWO IMPORTANCE FACTORS HAVE BEEN USED.
- THE SOCKET WELD OPTION IS LIMITED TO 150% OF THE ALLOWABLE FATIGUE STRESS FOR AN E WELD IN ORDER TO RECOGNIZE THE BENEFICIAL EFFECTS DERIVED FROM LOAD SHARING BETWEEN THE TWO WELDS.



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ALTERNATE TRAFFIC SIGNAL
25' - 55' SINGLE MAST ARMS

Issued By: Traffic & Safety Engineering Branch July 31, 2019

STANDARD PLAN NO.
S-614-40A
Standard Sheet No. 1 of 4

Project Sheet Number:

MASTARM POLES (MAX 55')

WATER CONSTRUCTION DRAWINGS

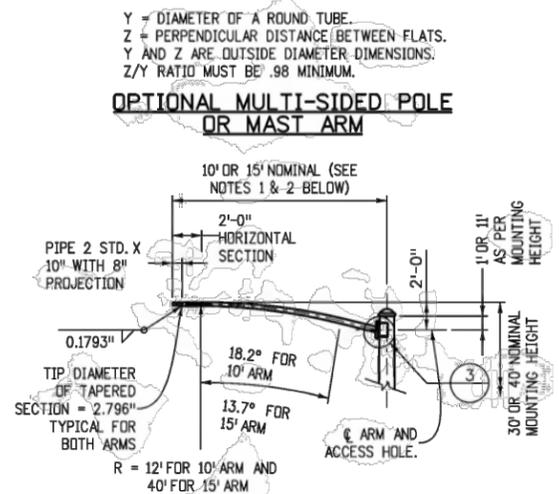
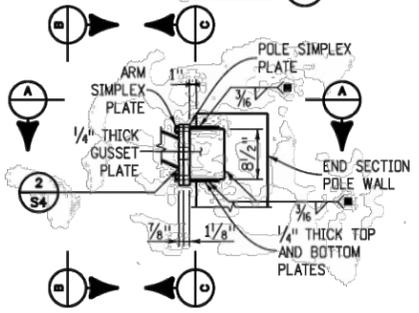
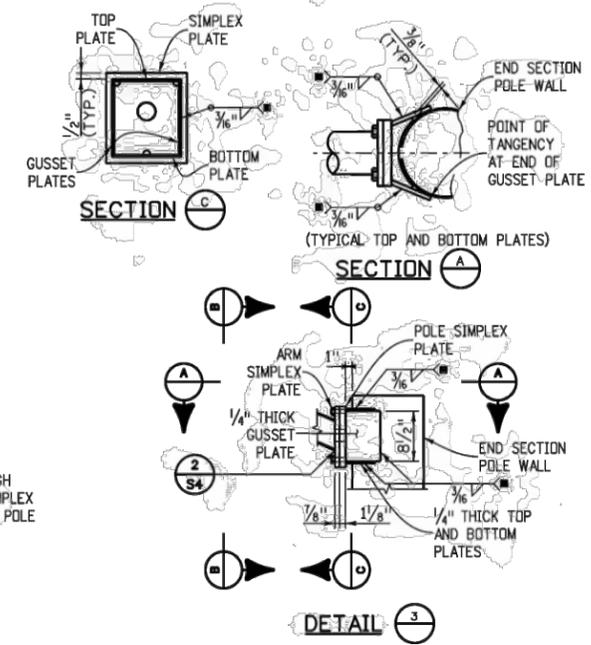
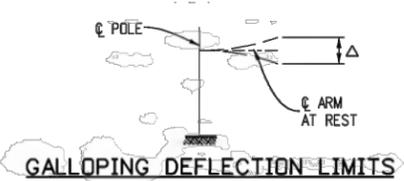
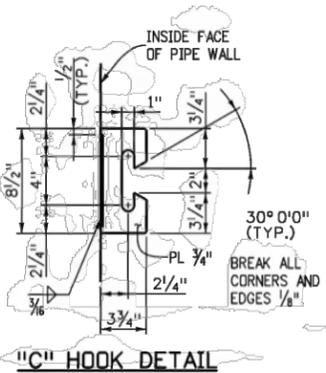
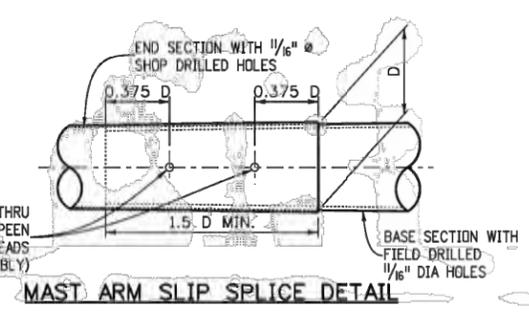
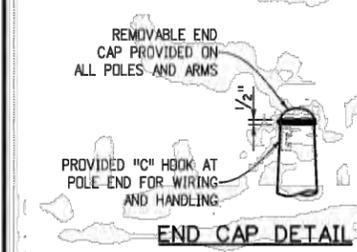
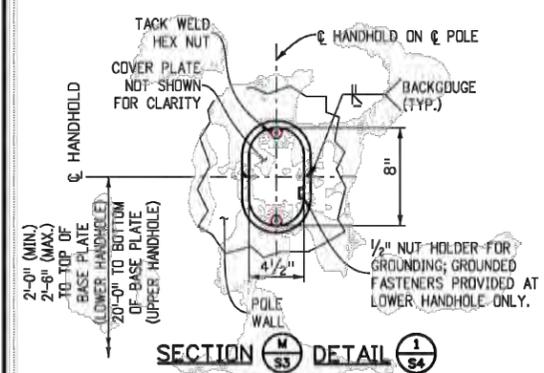
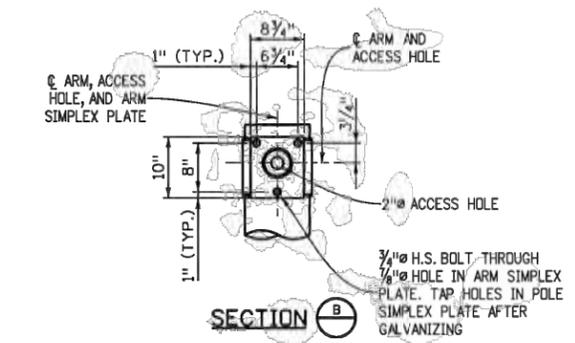
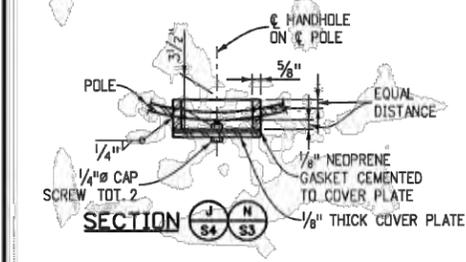


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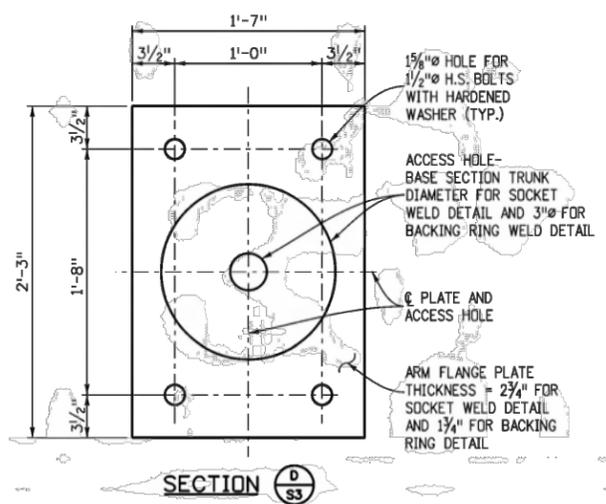
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TS13A

MAST ARM LENGTH (L) (FT.)	BASE SECTION *				END SECTION ♦				GALLOPING DEFLECTION LIMITS (Δ) (IN) ●
	LENGTH (FT.)	TIP Ø (IN.)	TRUNK Ø (IN.)	THK (IN.)	LENGTH (FT.)	TIP Ø (IN.)	TRUNK Ø (IN.)	THK (IN.)	
25	23.92	6.65	10.00	0.2391	N.A.	N.A.	N.A.	N.A.	+
35	33.92	7.50	12.25	0.2391	N.A.	N.A.	N.A.	N.A.	+
45	25.16	9.73	13.25	0.3125	20.00	7.46	10.26	0.1793	6"
55	25.34	11.20	14.75	0.3125	30.00	7.56	11.76	0.1793	11"

- * BASE SECTION LENGTH INCLUDES THE SPLICE LENGTH AS PER THE "MAST ARM SLIP SPLICE DETAIL" BELOW.
- ♦ SEE GENERAL NOTE 26 ON SHEET 1 OF 4.
- SEE GENERAL NOTE 28 ON SHEET 1 OF 4.
- † DEFLECTION TOO SMALL TO MEASURE.
- STOP ALL WELDS 1/2" SHORT OF PLATE EDGES AND BOLT HOLES.



- LUMINAIRE ARM NOTES
- 10' LUMINAIRE ARM SHAFT: WALL THICKNESS = 0.1793"; LINEAR TAPER = 0.14 IN./FT.; DIAMETER AT ARM SIMPLEX PLATE = 4.066".
 - 15' LUMINAIRE ARM SHAFT: WALL THICKNESS = 0.1793"; LINEAR TAPER = 0.14 IN./FT.; DIAMETER AT ARM SIMPLEX PLATE = 4.679".



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ALTERNATE TRAFFIC SIGNAL
 25' - 55' SINGLE MAST ARMS

Issued By: Traffic & Safety Engineering Branch July 31, 2019

STANDARD PLAN NO.
 S-614-40A
 Standard Sheet No. 2 of 4

Project Sheet Number:

MASTARM POLES (MAX 55')



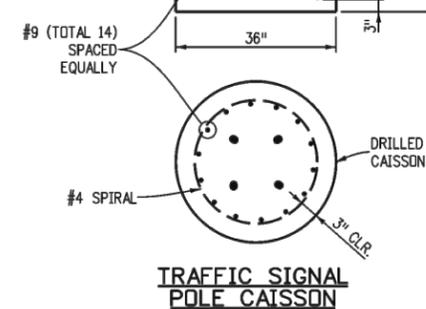
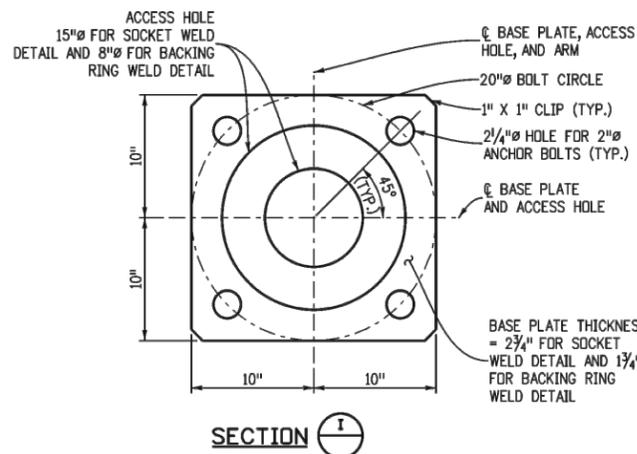
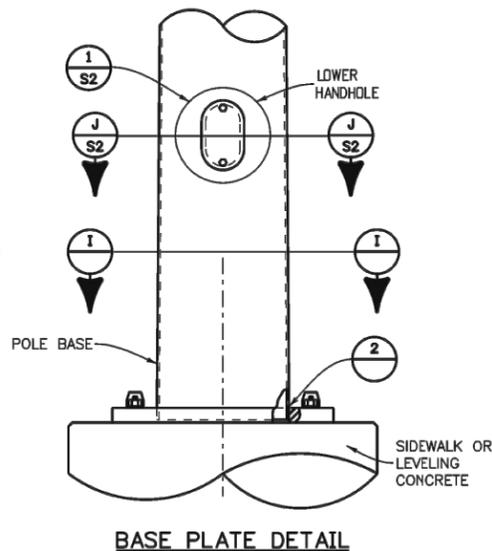
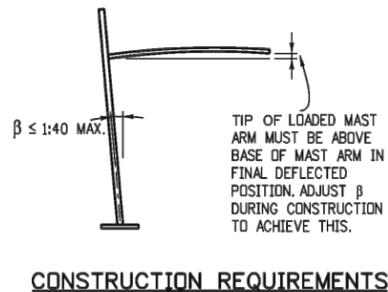
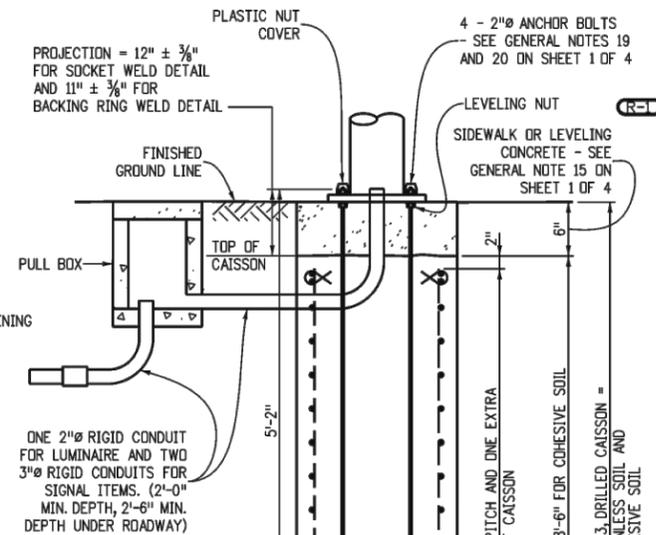
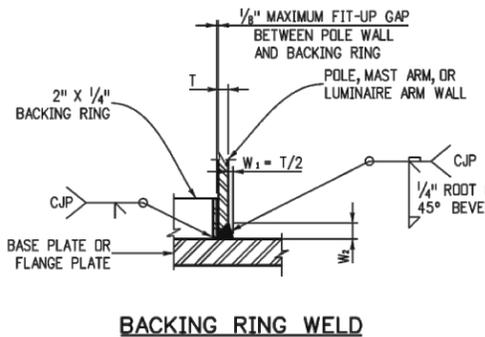
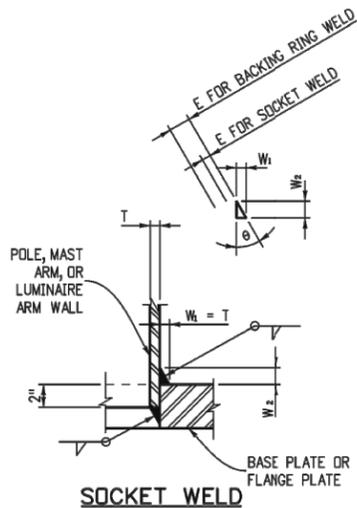
TRAFFIC SIGNAL CONSTRUCTION DRAWINGS

BY: JME
 SCALE: NTS
 DATE: 1/2020

DRAWING:
TS13B

SOCKET WELD DATA					
	ARM LENGTH (FT.)	W ₁ (IN.)	W ₂ (IN.)	E (IN.)	θ (DEG.)
MAST ARMS	25	0.2391	0.285	0.183	40
	35	0.2391	0.285	0.183	40
	45	0.3125	0.372	0.239	40
POLE	ALL	0.3125	0.372	0.239	40
LUMINAIRE ARMS	ALL	0.1793	0.214	0.138	40

BACKING RING WELD DATA					
	ARM LENGTH (FT.)	W ₁ (IN.)	W ₂ (IN.)	E (IN.)	θ (DEG.)
MAST ARMS	25	0.1196	0.489	0.289	14
	35	0.1196	0.489	0.289	14
	45	0.1566	0.563	0.385	16
POLE	ALL	0.1566	0.563	0.385	16
LUMINAIRE ARMS	ALL	0.0897	0.429	0.212	12



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ALTERNATE TRAFFIC SIGNAL
25' - 55' SINGLE MAST ARMS
 Issued By: Traffic & Safety Engineering Branch July 31, 2019

STANDARD PLAN NO.
S-614-40A
 Standard Sheet No. 4 of 4
 Project Sheet Number:

MASTARM POLES (MAX 55')



TRAFFIC SIGNAL CONSTRUCTION DRAWINGS

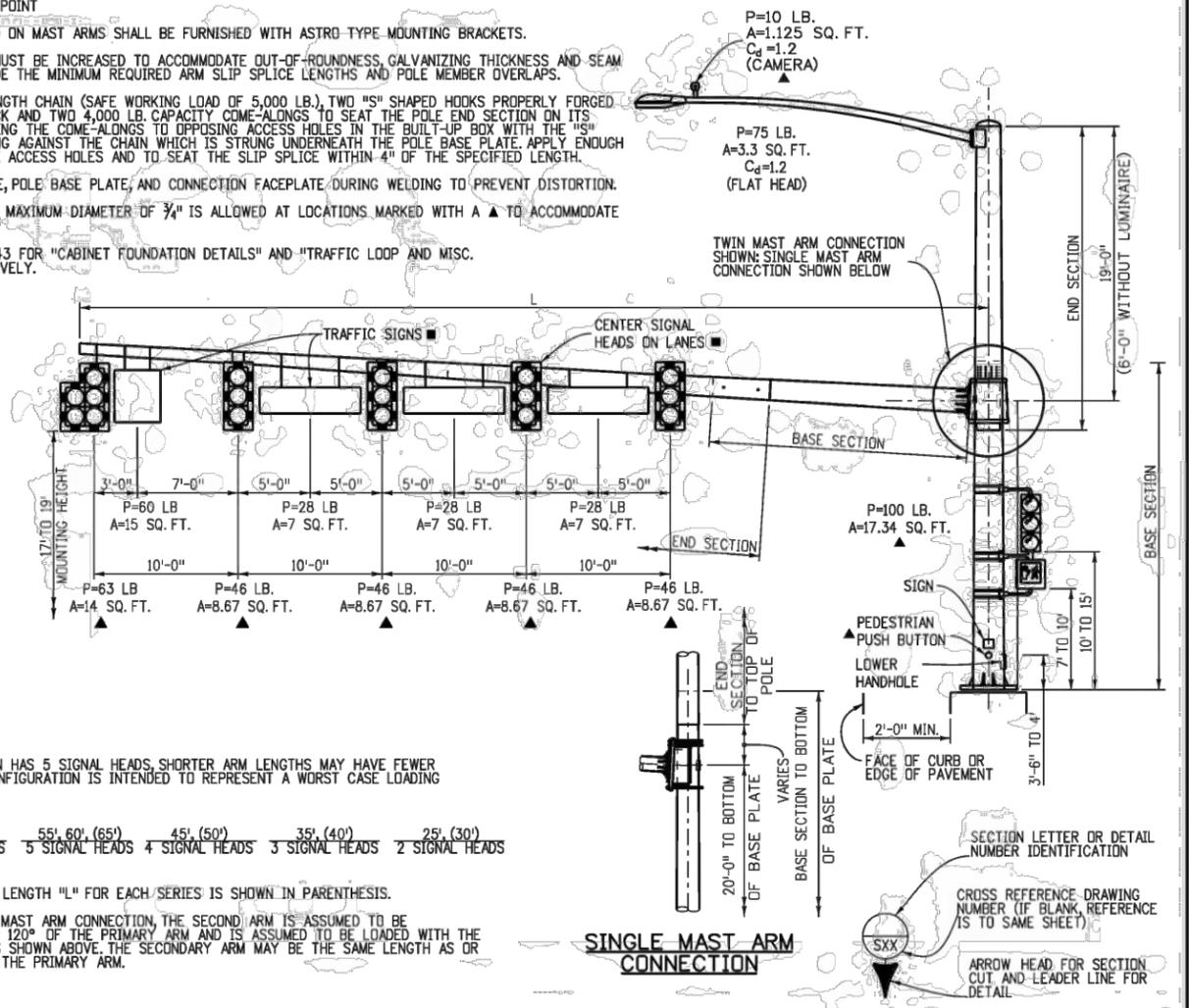
BY: JME
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DRAWING:
TS13D

GENERAL NOTES

- REFER TO ROADWAY PLANS FOR THE ACTUAL CONFIGURATION AND LOCATION OF TRAFFIC SIGNAL HEADS AND SIGNS MARKED WITH A ■.
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- ALL POLES AND ARMS SHALL BE ROUND OR DODECAGONAL (12 SIDED) TUBES WITH A 0.14 IN/FT TAPER.
- HARDENED WASHERS SHALL CONFORM TO ASTM F436.
- ALL POLES AND ARMS SHALL BE GALVANIZED INSIDE AND OUTSIDE AFTER FABRICATION IN ACCORDANCE WITH ASTM A123, UNLESS PAINTING IS CALLED FOR ON THE PLANS. PAINTING SHALL CONFORM TO SECTION 522, DUPLEX COATING SYSTEM.
- POLE AND MAST ARM SPLICES SHALL BE MECHANICALLY FORCED TOGETHER FOR A SNUG FIT.
- BLIND BOLTS SHALL BE A307 GRADE A STEEL AND ARE NOT REQUIRED FOR MULTISIDED POLES. MECHANICAL ALTERNATIVES TO BLIND BOLTS UTILIZING FRICTION KEYS, INTERLOCKING TEETH OR A COMBINATION THEREOF TO PREVENT THE BUILT-UP BOX FROM TWISTING ON THE POLE MAY BE USED AS APPROVED BY CDOT STAFF BRIDGE.
- ALL MAST ARMS MORE THAN 40 FT IN LENGTH SHALL BE TWO PIECE CONSTRUCTION TO LIMIT ARM WEIGHTS.
- GALVANIZED ASTM A325 H.S. BOLTS SHALL BE USED FOR ATTACHING LUMINAIRE AND MAST ARMS. A LUBRICATED TIGHTENING TORQUE OF 178 FT-LBS FOR 3/4" DIAMETER BOLTS, 395 FT-LBS FOR 1" DIAMETER BOLTS AND 1300 FT-LBS FOR 1 1/2" DIAMETER BOLTS SHALL BE USED TO TIGHTEN ALL H.S. BOLTS. MAST ARMS SHALL BE TEMPORARILY SUPPORTED TO TAKE LOAD OFF OF FIELD CONNECTIONS WHILE BOLTS ARE TIGHTENED IN ORDER TO FIRMLY SEAT THE FLANGE PLATE BOLTS SHALL BE SEQUENTIALLY TIGHTENED ASSUMING 12 BOLTS AND A CLOCK FACE, THE TIGHTENING SEQUENCE WOULD BE 12, 6, 1, 7, ETC. THIS PROCESS SHALL BE CONTINUED UNTIL NO LOOSE BOLTS ARE FOUND AFTER ALL BOLTS HAVE BEEN INITIALLY TIGHTENED.
- CAST POLE END CAP TO BE SECURED IN PLACE WITH 3 SET SCREWS.
- ALL SIGNAL HEADS, SIGNS, AND HARDWARE SHALL BE FIELD POSITIONED.
- ACCESSORIES TO BE HOT-DIP GALVANIZED IN ACCORDANCE WITH ASTM A153.
- ALL PLATES AND STIFFENERS SHALL BE FABRICATED WITH AASHTO M270 (ASTM A709) GRADE 36 STEEL AND SHALL COMPLY WITH THE DIMENSIONAL TOLERANCES SPECIFIED IN ASTM A6. ALL HANDHOLES SHALL BE FABRICATED WITH ASTM A572 GRADE 42 STEEL.
- LEVELING CONCRETE SHALL BE 3000 PSI AIR ENTRAINED CONCRETE VIBRATED IN PLACE BELOW THE POLE BASE PLATE.
- THE DESIGNS HEREIN ASSUME THAT SIGNALS ARE INSTALLED WITHIN THE ROADWAY EARTHWORK PRISM WITH THE FOLLOWING SOIL PARAMETERS:
SOIL DENSITY = 110 LB./CU.FT.
SOIL COHESION = 750 LB./SQ.FT. FOR MEDIUM STIFF COHESIVE SOIL
SOIL Ø ANGLE = 30° FOR MEDIUM DENSE COHESIONLESS SOIL
SF = 1.5 FOR TORSIONAL RESISTANCE AND 3.0 FOR FLEXURAL RESISTANCE
- CONTACT THE ENGINEER IF ANY OF THE FOLLOWING SOIL CONDITIONS ARE ENCOUNTERED DURING DRILLING:
(A) SIGNALS WILL NOT BE INSTALLED WITHIN THE ROADWAY EARTHWORK PRISM.
(B) THE SOIL HAS A HIGH ORGANIC CONTENT OR CONSISTS OF SATURATED SILT AND CLAY.
(C) THE SITE WONT SUPPORT THE WEIGHT OF THE DRILLING RIG.
(D) THE FOUNDATION SOILS ARE NOT HOMOGENOUS.
(E) FIRM BEDROCK IS ENCOUNTERED.
- CAISSONS SHALL BE PLACED AGAINST UNDISTURBED EARTH. WET OR CAVING HOLES SHALL BE BACKFILLED WITH FLOW-FILL AND REDRILLED AFTER A THREE DAY CURING PERIOD WITHOUT THE USE OF A CASING.
- CAISSONS SHALL BE CONSTRUCTED WITH AIR ENTRAINED CLASS BZ CONCRETE IN ACCORDANCE WITH SECTION 503 OF THE STANDARD SPECIFICATIONS. REINFORCING STEEL SHALL BE GRADE 60.
- CAISSON CONCRETE MUST HAVE A MINIMUM COMPRESSIVE STRENGTH OF 2,700 PSI BEFORE INSTALLING THE SIGNAL STRUCTURE; VERIFY CONCRETE STRENGTH WITH MATURITY METER.
- U-BOLTS AND ANCHOR BOLTS SHALL BE FABRICATED WITH AASHTO M314-90 GRADE 55 STEEL.
- ANCHOR BOLTS SHALL BE FABRICATED WITH HEAVY HEX NUTS AND FLAT WASHERS AND EXTENDED A MINIMUM OF 2" ABOVE THE NUT AFTER COMPLETING THE TIGHTENING PROCESS. THREAD UPPER 12 INCHES AND GALVANIZE UPPER 13 INCHES OF THE ANCHOR BOLTS. FIELD WELDING OF ANCHOR BOLTS TO REBAR DURING ERECTION WILL NOT BE ALLOWED. ANCHOR BOLTS SHALL BE SET WITH A STEEL TEMPLATE UNTIL THE CONCRETE HAS CURED AT LEAST TWO DAYS. THE ANCHOR BOLTS SHALL BE TIGHTENED USING THE TURN-OF-NUT METHOD. THE BOLTS SHALL FIRST BE TIGHTENED TO SNUG TIGHT, WHICH IS DEFINED AS THE TIGHTNESS THAT EXISTS WHEN THE UPPER AND LOWER NUTS ARE IN FIRM CONTACT WITH THE BASE PLATE, WITH MAST ARMS FREE TO DEFLECT. THE UPPER AND LOWER NUTS SHALL THEN EACH BE ROTATED AN ADDITIONAL 1/2 TURN (30° ± 5°) WITH A SLUGGING, HYDRAULIC OR AIR IMPACT WRENCH.
- WELDING OF STEEL SHALL CONFORM TO THE REQUIREMENTS OF ANSI/AWS D1.1. ALL AREAS TO BE WELDED SHALL BE GROUND TO BRIGHT METAL. ALL WELDING AND REQUIRED TESTING SHALL BE COMPLETE BEFORE ANY MATERIAL IS GALVANIZED. ALL CIRCUMFERENTIAL AND STIFFENER WELDS SHALL BE NON-DESTRUCTIVELY TESTED USING THE ENHANCED MAGNETIC PARTICLE METHOD IN ACCORDANCE WITH SUBSECTION 509.18 (d) OF THE STANDARD SPECIFICATIONS. THE ACCEPTANCE CRITERIA IS STATED IN TABLE 6.1 OF ANSI/AWS D1.1. ALL LONGITUDINAL WELDS WITHIN 6 INCHES OF FULL PENETRATION CIRCUMFERENTIAL GROOVE WELDS AND FULL PENETRATION GROOVE WELDS SHALL BE INSPECTED AS SPECIFIED ABOVE. MAXIMUM WELD UNDERCUT SHALL BE 0.01 INCHES.

- ALL ELECTRICAL CONNECTIONS TO THE SIGNALS SHALL BE GROUNDED IN ACCORDANCE WITH APPLICABLE ELECTRICAL CODES.
- TRAFFIC SIGNAL STRUCTURES HAVE BEEN DESIGNED IN ACCORDANCE WITH THE AASHTO STANDARD SPECIFICATIONS FOR STRUCTURAL SUPPORTS FOR HIGHWAY SIGNS, LUMINAIRES, AND TRAFFIC SIGNALS, FOURTH EDITION, 2001.
- A DESIGN WIND VELOCITY OF 100 MPH AND ONE 12' LANE WITH A 65 MPH TRUCK INDUCED GUST LOADING HAVE BEEN USED FOR THE DESIGNS HEREIN.
- CERTIFIED MILL TEST REPORTS INCLUDING CHARPY V-NOTCH TEST RESULTS, WELD INSPECTION REPORTS AND ENHANCED MAGNETIC PARTICLE TEST REPORTS SHALL BE SUBMITTED TO CDOT STAFF BRIDGE, 4201 E. ARKANSAS AVE. DENVER, COLORADO 80222 AS SOON AS THEY BECOME AVAILABLE. CVN TEST RESULTS FOR ASTM A572 GRADES 42 AND 65 STEEL SHALL HAVE A MINIMUM VALUE OF 15 FT-LBS AT 40°F AS PER THE H FREQUENCY TEST REQUIREMENTS IN AASHTO T243 (ASTM A873).
- SHOP DRAWINGS SHALL BE SUBMITTED TO THE ENGINEER FOR REVIEW IN ACCORDANCE WITH SUBSECTION 105.02 OF THE STANDARD SPECIFICATIONS.
- DEFINITIONS: U.D.N. = UNLESS OTHERWISE NOTED
W.P. = WORK POINT
- TRAFFIC SIGNALS MOUNTED ON MAST ARMS SHALL BE FURNISHED WITH ASTRO TYPE MOUNTING BRACKETS.
- END SECTION DIAMETERS MUST BE INCREASED TO ACCOMMODATE OUT-OF-ROUNDNESS, GALVANIZING THICKNESS AND SEAM WELD PROFILES TO PROVIDE THE MINIMUM REQUIRED ARM SLIP SPLICE LENGTHS AND POLE MEMBER OVERLAPS.
- USE 35# OF 3/4" HIGH STRENGTH CHAIN (SAFE WORKING LOAD OF 5,000 LB.), TWO "S" SHAPED HOOKS PROPERLY FORGED FROM 1" SQUARE BAR STOCK AND TWO 4,000 LB. CAPACITY COME-ALONGS TO SEAT THE POLE END SECTION ON ITS BASE SECTION BY ATTACHING THE COME-ALONGS TO OPPOSING ACCESS HOLES IN THE BUILT-UP BOX WITH THE "S" SHAPED HOOKS AND PULLING AGAINST THE CHAIN WHICH IS STRUNG UNDERNEATH THE POLE. BASE PLATE APPLY ENOUGH FORCE TO ALIGN THE WIRE ACCESS HOLES AND TO SEAT THE SLIP SPLICE WITHIN 4" OF THE SPECIFIED LENGTH.
- SECURE ARM FLANGE PLATE, POLE BASE PLATE, AND CONNECTION FACEPLATE DURING WELDING TO PREVENT DISTORTION.
- ONE DRILLED HOLE WITH A MAXIMUM DIAMETER OF 3/4" IS ALLOWED AT LOCATIONS MARKED WITH A ▲ TO ACCOMMODATE ELECTRICAL WIRING.
- SEE S-614-42 AND S-614-43 FOR "CABINET FOUNDATION DETAILS" AND "TRAFFIC LOOP AND MISC. SIGNAL DETAILS" RESPECTIVELY.



DESIGN DATA

- DRAWING SHOWN HAS 5 SIGNAL HEADS, SHORTER ARM LENGTHS MAY HAVE FEWER HEADS. THIS CONFIGURATION IS INTENDED TO REPRESENT A WORST CASE LOADING CONDITION.

70' (75')	55' (60')	45' (50')	35' (40')	25' (30')
5 SIGNAL HEADS	5 SIGNAL HEADS	4 SIGNAL HEADS	3 SIGNAL HEADS	2 SIGNAL HEADS

THE DESIGN LENGTH "L" FOR EACH SERIES IS SHOWN IN PARENTHESIS.
- FOR THE TWIN MAST ARM CONNECTION, THE SECOND ARM IS ASSUMED TO BE WITHIN 60° TO 120° OF THE PRIMARY ARM AND IS ASSUMED TO BE LOADED WITH THE SAME LOADS AS SHOWN ABOVE. THE SECONDARY ARM MAY BE THE SAME LENGTH AS OR SHORTER THAN THE PRIMARY ARM.

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Date:	Comments:

Colorado Department of Transportation

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Traffic & Safety Engineering MKB

TYPICAL TRAFFIC SIGNAL
30' - 75' DOUBLE MAST ARMS
65' - 75' SINGLE MAST ARMS

Issued By: Traffic & Safety Engineering Branch July 31, 2019

STANDARD PLAN NO.
S-614-40
Standard Sheet No. 1 of 5
Project Sheet Number:

MASTARM POLES (>55' AND DOUBLES)



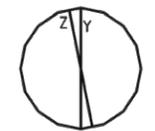
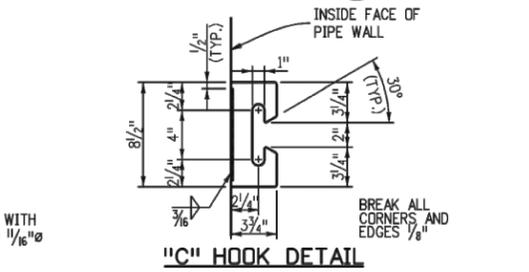
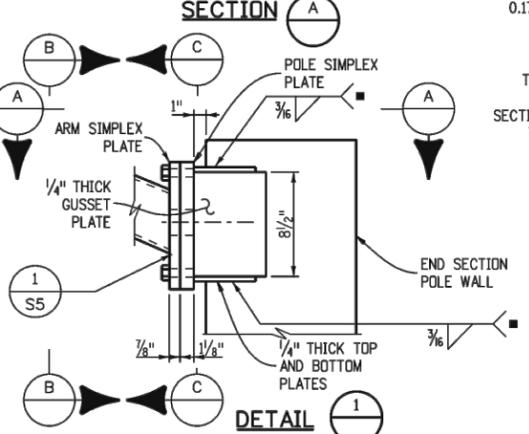
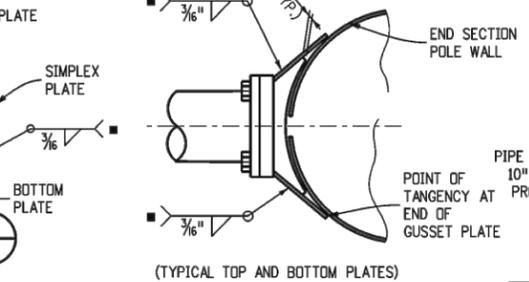
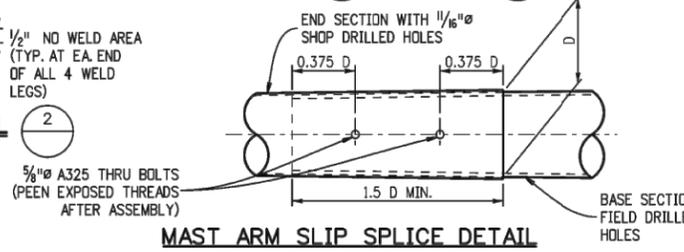
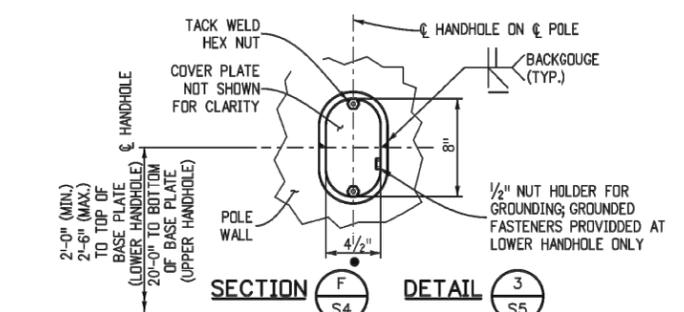
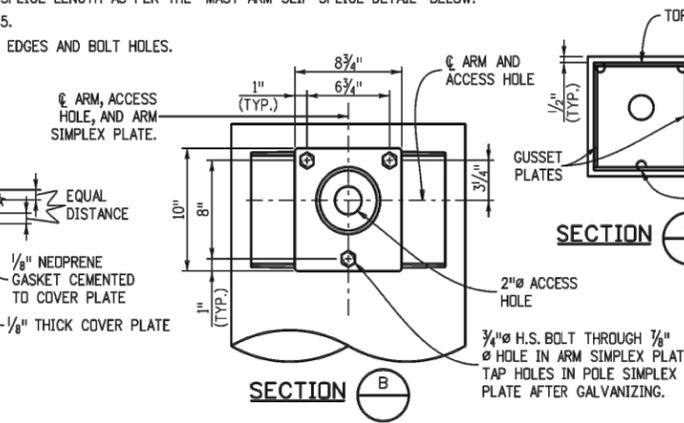
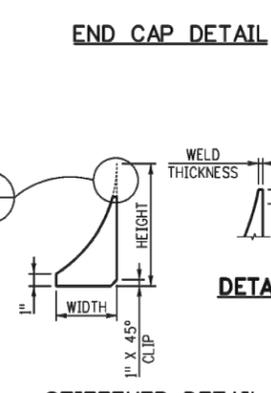
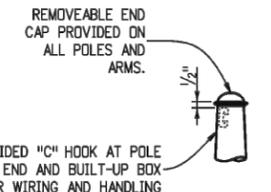
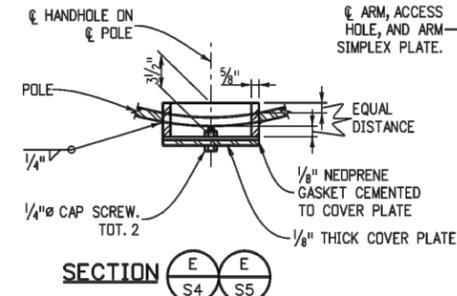
TRAFFIC SIGNAL CONSTRUCTION DRAWINGS

BY: JME
 SCALE: NTS
 DATE: 1/2020

DRAWING:
TS14A

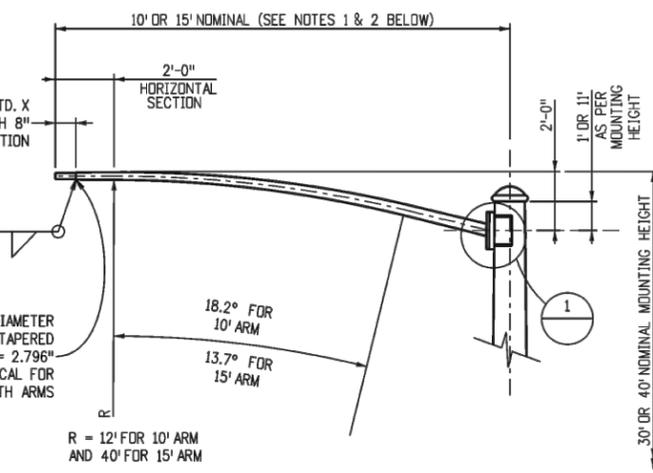
MAST ARM LENGTH (L) (FT.)	MAST ARM DATA								MAST ARM CONNECTION DATA															
	BASE SECTION *				END SECTION ♦				STIFFENER					FLANGE			BOLT							
	LENGTH (FT.)	TIP Ø (IN.)	TRUNK Ø (IN.)	THK. (IN.)	LENGTH (FT.)	TIP Ø (IN.)	TRUNK Ø (IN.)	THK. (IN.)	NO. OF	THK. (IN.)	WIDTH (IN.)	HEIGHT (IN.)	RADIUS (IN.)	ANGLE	WALL WELD (IN.)	PLATE WELD (IN.)	DIA. (IN.)	THK. (IN.)	SOCKET WELD (IN.)	NO. OF	DIA. (IN.)	CIRCLE DIA. (IN.)	HOLE DIA. (IN.)	ANGLE
30	29.25	6.50	10.59	0.1793	N.A.	N.A.	N.A.	N.A.	6	0.50	3.5	7	6.89	30.0°	0.179	0.375	20	1.00	0.179	6	1.0	16	1.125	60.0°
40	39.11	6.50	11.98	0.2391	N.A.	N.A.	N.A.	N.A.	8	0.50	4.0	8	8.12	22.5°	0.239	0.375	23	1.25	0.239	8	1.5	17	1.625	45.0°
50	25.15	9.47	12.99	0.3125	25	6.50	10.00	0.1793	8	0.75	4.0	8	8.12	22.5°	0.250	0.625	24	1.50	0.250	8	1.5	18	1.625	45.0°
65	25.35	12.52	16.07	0.3125	40	7.50	13.10	0.1793	8	0.75	5.0	10	10.60	22.5°	0.250	0.625	29	1.75	0.250	8	1.5	23	1.625	45.0°
75	35.23	12.52	17.45	0.3125	40	7.50	13.10	0.1793	10	0.75	5.5	11	11.84	18.0°	0.250	0.625	31	1.75	0.250	10	1.5	25	1.625	36.0°

- * BASE SECTION LENGTH INCLUDES THE SPLICE LENGTH AS PER THE "MAST ARM SLIP SPLICE DETAIL" BELOW.
- ♦ SEE GENERAL NOTE 31 ON SHEET 1 OF 5.
- STOP ALL WELDS 1/2" SHORT OF PLATE EDGES AND BOLT HOLES.
- 3/4" FOR 30' ARM UPPER HANDHOLE.



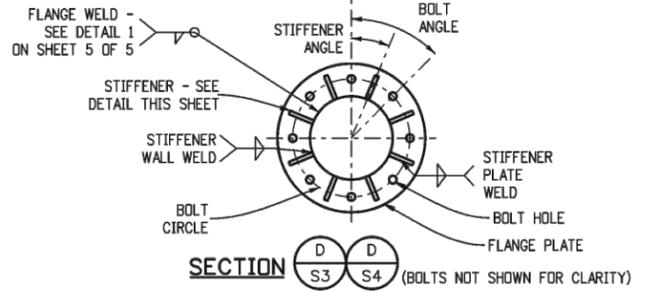
Y = DIAMETER OF A ROUND TUBE.
Z = PERPENDICULAR DISTANCE BETWEEN FLATS.
Y AND Z ARE OUTSIDE DIAMETER DIMENSIONS.
Z/Y RATIO MUST BE .98 MINIMUM.

OPTIONAL MULTI-SIDED POLE OR MAST ARM



LUMINAIRE ARM NOTES

- 10' LUMINAIRE ARM SHAFT: WALL THICKNESS = 0.1793"; LINEAR TAPER = 0.14 IN./FT.; DIAMETER AT ARM SIMPLEX PLATE = 4.066"
- 15' LUMINAIRE ARM SHAFT: WALL THICKNESS = 0.1793"; LINEAR TAPER = 0.14 IN./FT.; DIAMETER AT ARM SIMPLEX PLATE = 4.679"



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Traffic & Safety Engineering MKB

TYPICAL TRAFFIC SIGNAL
30' - 75' DOUBLE MAST ARMS
65' - 75' SINGLE MAST ARMS
Issued By: Traffic & Safety Engineering Branch July 31, 2019

STANDARD PLAN NO.
S-614-40
Standard Sheet No. 2 of 5
Project Sheet Number:

MASTARM POLES (>55' AND DOUBLES)



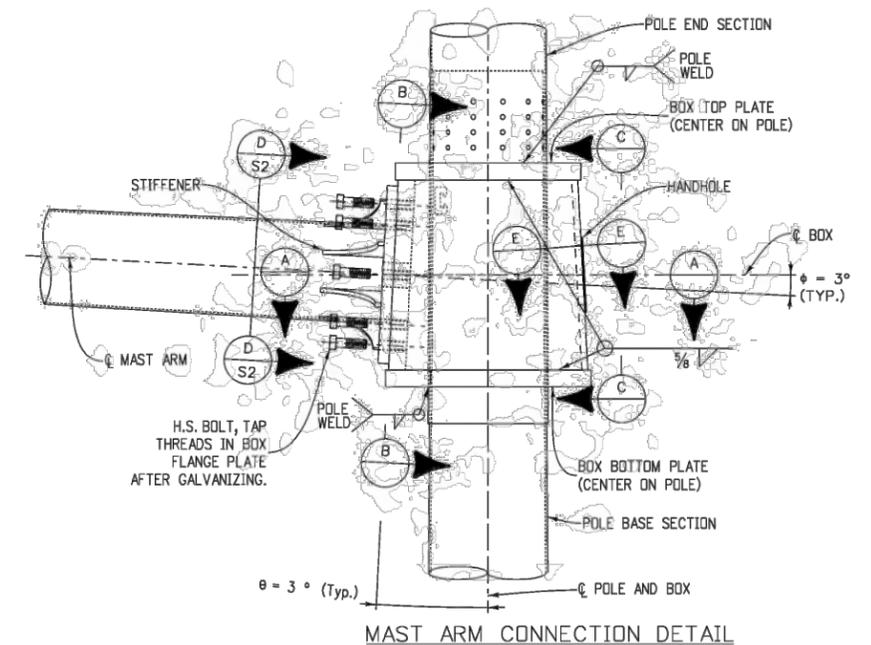
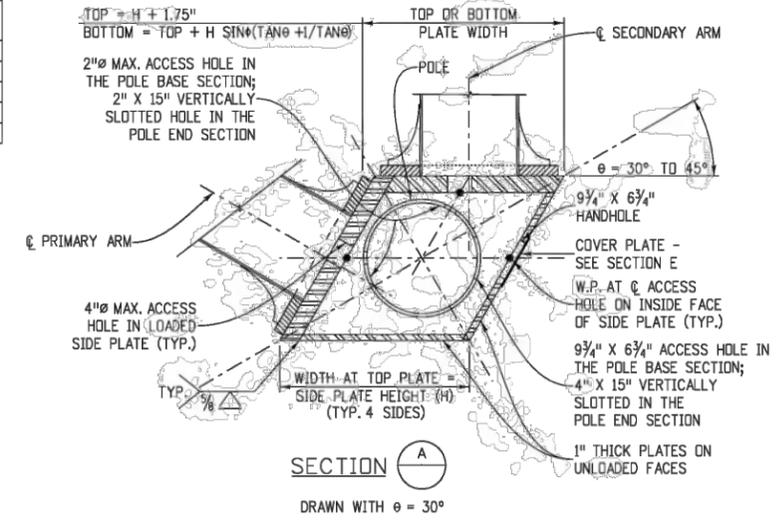
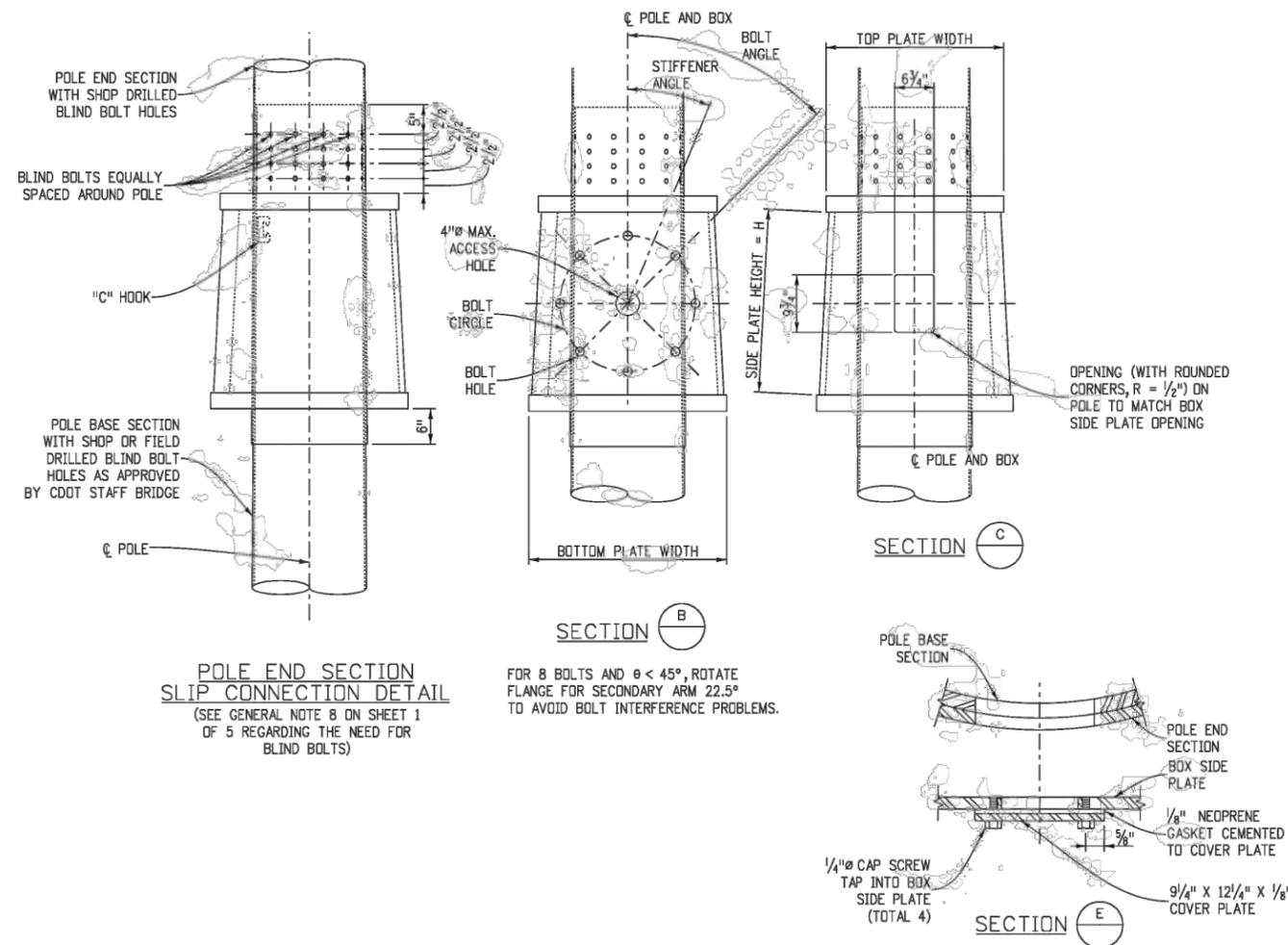
TRAFFIC SIGNAL CONSTRUCTION DRAWINGS

BY: JME
SCALE: NTS
DATE: 1/2020

DRAWING:
TS14B

MAST ARM LENGTH (FT.)	BLIND BOLT DATA				BUILT-UP BOX DATA *					POLE DATA							
	NO. OF	DIA. (IN.)	BOLTS PER ROW	NO. OF ROWS	THICKNESS OF BOX PLATES U.O.N. (IN.)	POLE WELD (IN.)	SIDE PLATE	TOP PLATE	BOTTOM PLATE	BASE SECTION				END SECTION WITH LUMINAIRE			
							H (IN.)	WIDTH FOR $\theta = 45^\circ$ (IN.)	WIDTH FOR $\theta = 45^\circ$ (IN.)	LENGTH (FT.)	TOP ϕ (IN.)	BOTTOM ϕ (IN.)	THK. (IN.)	LENGTH (FT.)	TOP ϕ (IN.)	BOTTOM ϕ (IN.)	THK. (IN.)
30	24	0.75	6	4	1.50	0.1875	22	23.75	26.053	22.29	9.11	12.23	0.3125	20.54	7.25	10.13	0.2391
40	30	0.75	6	5	2.00	0.1875	25	26.75	29.367	22.67	11.81	14.98	0.3125	20.71	10.00	12.90	0.2391
50	36	0.75	12	3	2.50	0.1875	26	27.75	30.471	22.33	14.86	17.98	0.3125	20.79	13.00	15.91	0.2391
65	48	0.75	12	4	2.75	0.1875	31	32.75	35.995	22.77	18.54	21.73	0.3125	21.02	16.75	19.69	0.2391
75	60	0.75	12	5	3.00	0.1875	33	34.75	38.204	23.08	20.75	23.98	0.3125	21.12	19.00	21.96	0.2391

* USE LARGER ARM IN A DOUBLE ARM SIGNAL TO DETERMINE PLATE THICKNESS AND DIMENSIONS.
 ◆ SEE GENERAL NOTE 31 ON SHEET 1 OF 5



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TYPICAL TRAFFIC SIGNAL
30' - 75' DOUBLE MAST ARMS
65' - 75' SINGLE MAST ARMS
 Issued By: Traffic & Safety Engineering Branch July 31, 2019

STANDARD PLAN NO.
S-614-40
 Standard Sheet No. 3 of 5
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MASTARM POLES (>55' AND DOUBLES)

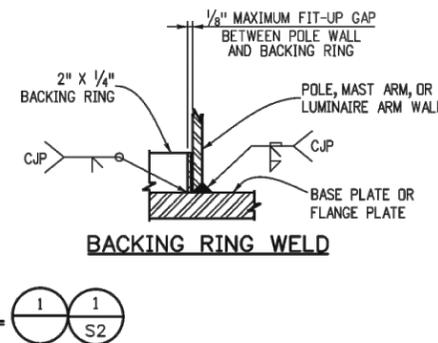
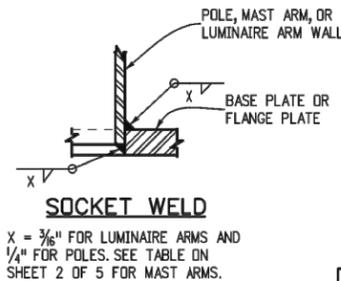
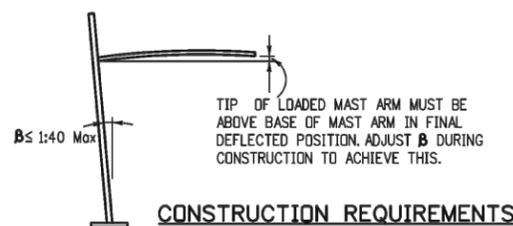
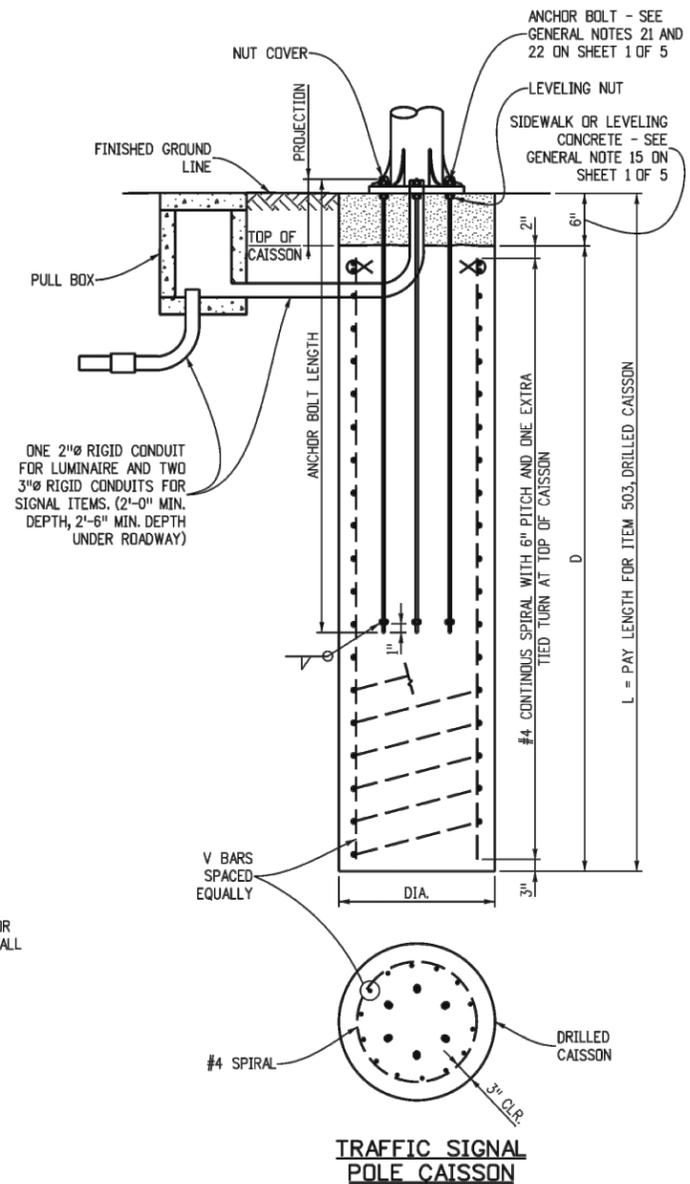
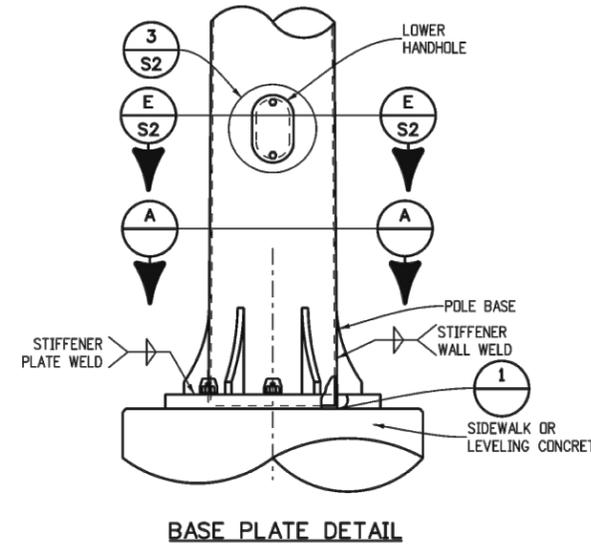
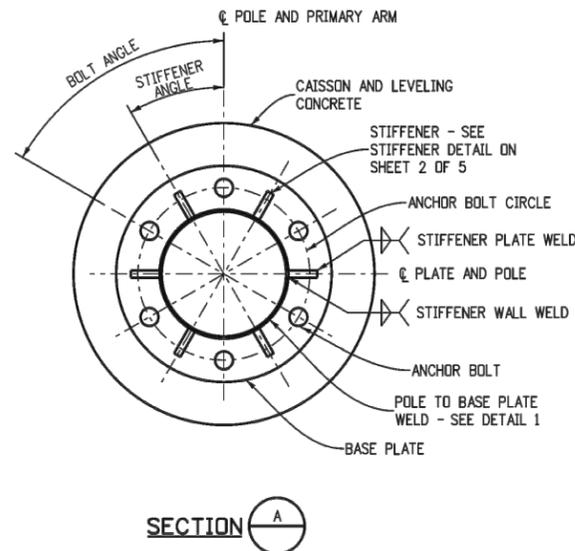


TRAFFIC SIGNAL CONSTRUCTION DRAWINGS

BY: JME
 SCALE: NTS
 DATE: 1/2020

DRAWING:
TS14C

MAST ARM LENGTH (FT.)	POLE BASE CONNECTION DATA														CAISSON DATA (FOR SINGLE AND DOUBLE ARM INSTALLATIONS)							
	STIFFENER						BASE PLATE		ANCHOR BOLT						V BARS							
	NO. OF	THK. (IN.)	WIDTH (IN.)	HEIGHT (IN.)	RADIUS (IN.)	ANGLE	WALL WELD (IN.)	PLATE WELD (IN.)	DIA. (IN.)	THK. (IN.)	NO. OF	DIA. (IN.)	LENGTH (IN.)	CIRCLE DIA. (IN.)	HOLE DIA. (IN.)	ANGLE	PROJECTION (IN.)	DIA. (IN.)	DEPTH (FT.)	PAY LENGTH (FT.)	SIZE	TOTAL
30	6	0.75	5.0	10	10.600	30.0°	0.25	0.625	24	2.25	6	2.0	63	17.75	2.25	60.0°	11.25	36	12.5	13	#9	11
40	6	0.75	5.5	11	11.841	30.0°	0.25	0.625	27	2.50	6	2.0	63	21.00	2.25	60.0°	11.50	36	14.5	15	#9	11
50	6	0.75	6.5	13	14.327	30.0°	0.25	0.625	32	2.75	6	2.0	63	25.00	2.25	60.0°	11.75	42	16.5	17	#9	14
65	6	0.75	8.0	16	18.063	30.0°	0.25	0.625	39	3.00	6	2.5	63	30.25	2.75	60.0°	12.50	48	20.5	21	#9	18
75	6	0.75	8.5	17	19.309	30.0°	0.25	0.625	42	3.25	6	2.5	63	33.00	2.75	60.0°	12.75	54	20.5	21	#9	23



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MASTARM POLES (>55' AND DOUBLES)



TRAFFIC SIGNAL CONSTRUCTION DRAWINGS

BY: JME
SCALE: NTS
DATE: 1/2020

DRAWING:
TS14E

<u>DRAWING NO.</u>	<u>TITLE</u>
W1	VALVE OPERATION
W2	WATER TRENCH DETAIL
W3	STANDARD VALVE AND BOX
W4	24" MANHOLE RING AND COVER
W5	WATERLINE LOWERING
W6	FIRE HYDRANTS, MAINS AND VALVES
W7A	STUB-OUT CONFIGURATIONS (1 OF 2)
W7B	STUB-OUT CONFIGURATIONS (2 OF 2)
W8	WATER SERVICE DETAIL
W9	5/8" - 1" WATER METER DETAIL
W10	1 1/2" - 2" WATER METER DETAIL
W11A	PRV IN RECTANGULAR VAULT (1 OF 2)
W11B	PRV IN RECTANGULAR VAULT (2 OF 2)
W12	POLYETHYLENE WRAP
W13	INSULATORS
W14	TEMPORARY BLOWOFF FOR 12" AND SMALLER PIPE
W15	UTILITY ENCASEMENT DETAIL
W16	CONCRETE THRUST BLOCK DETAIL
W17	METER PIT AND CURB STOP PROTECTION
W18	DITCH OR PIPE CROSSING DETAIL
W19	CASING PIPE DETAIL
W20	RESTRAINED PIPE LENGTHS
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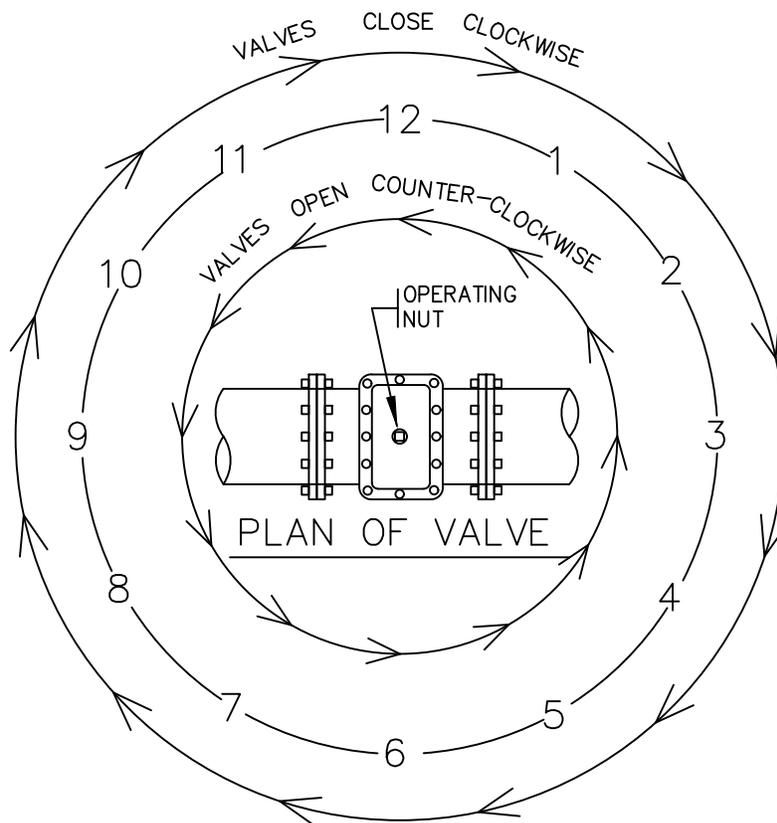
**WATER CONSTRUCTION
DRAWINGS**

BY: JME

SCALE: NTS

DATE: 1/2020

DRAWING:



NOTES:

1. NORMALLY VALVES WITH A BLACK OPERATING NUT INDICATE A STANDARD FIRESTONE VALVE (OPEN LEFT).

VALVE OPERATION

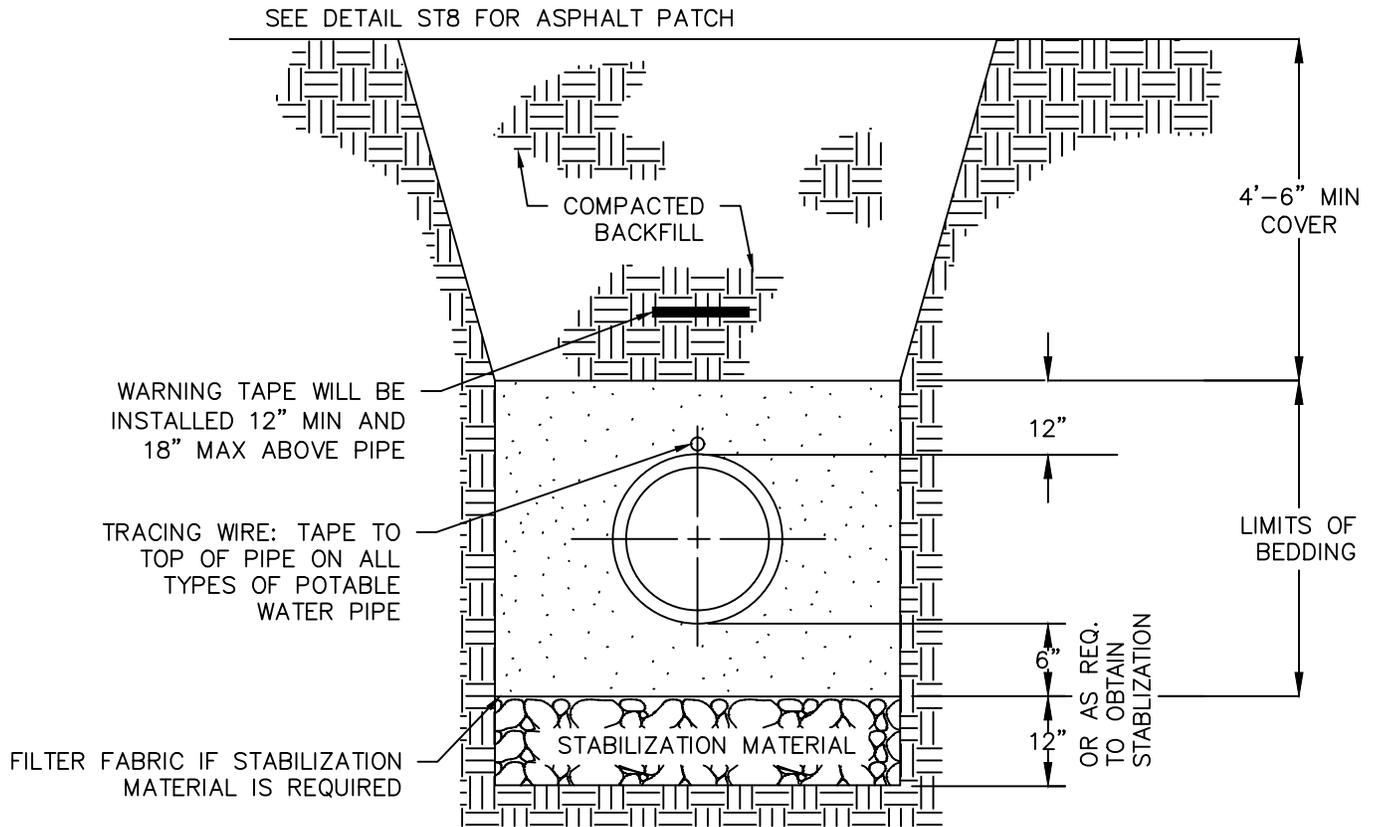


**WATER CONSTRUCTION
DRAWINGS**

BY: JME
SCALE: NTS
DATE: 1/2020

DRAWING:

W1



NOTES:

1. COMPACTION SHALL BE AS FOLLOWS: PIPE ZONE BEDDING 6" UNDER AND 12" OVER PIPE WILL REQUIRE 90% S.P.D. TRENCH ZONE ABOVE BEDDING MATERIALS, FULL TRENCH SECTION IN ROADWAY OR STREET R.O.W. LIMITS WILL REQUIRE 95% S.P.D. TRENCH ZONE ABOVE BEDDING MATERIALS, OUTSIDE OF STREET R.O.W. WILL REQUIRE 90% S.P.D.
2. 12 AWG. SINGLE STRAND INSULATED 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 TESTBOX.
3. FILTER FABRIC IS REQUIRED IF STABILIZATION MATERIAL IS USED. THE FABRIC SHALL BE INSTALLED AS SHOWN IN THE DETAIL.
4. TRENCH TO 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" BELOW THE BOTTOM OF THE PIPE TO 12" ABOVE THE TOP OF THE PIPE.
6. TRENCH WIDTH SHALL NOT BE MORE THAN 24" NOR LESS THAN 12" WIDER THAN THE LARGEST OUTSIDE DIAMETER OF THE PIPE.

WATER TRENCH DETAIL

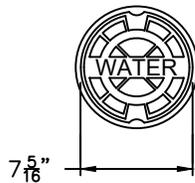
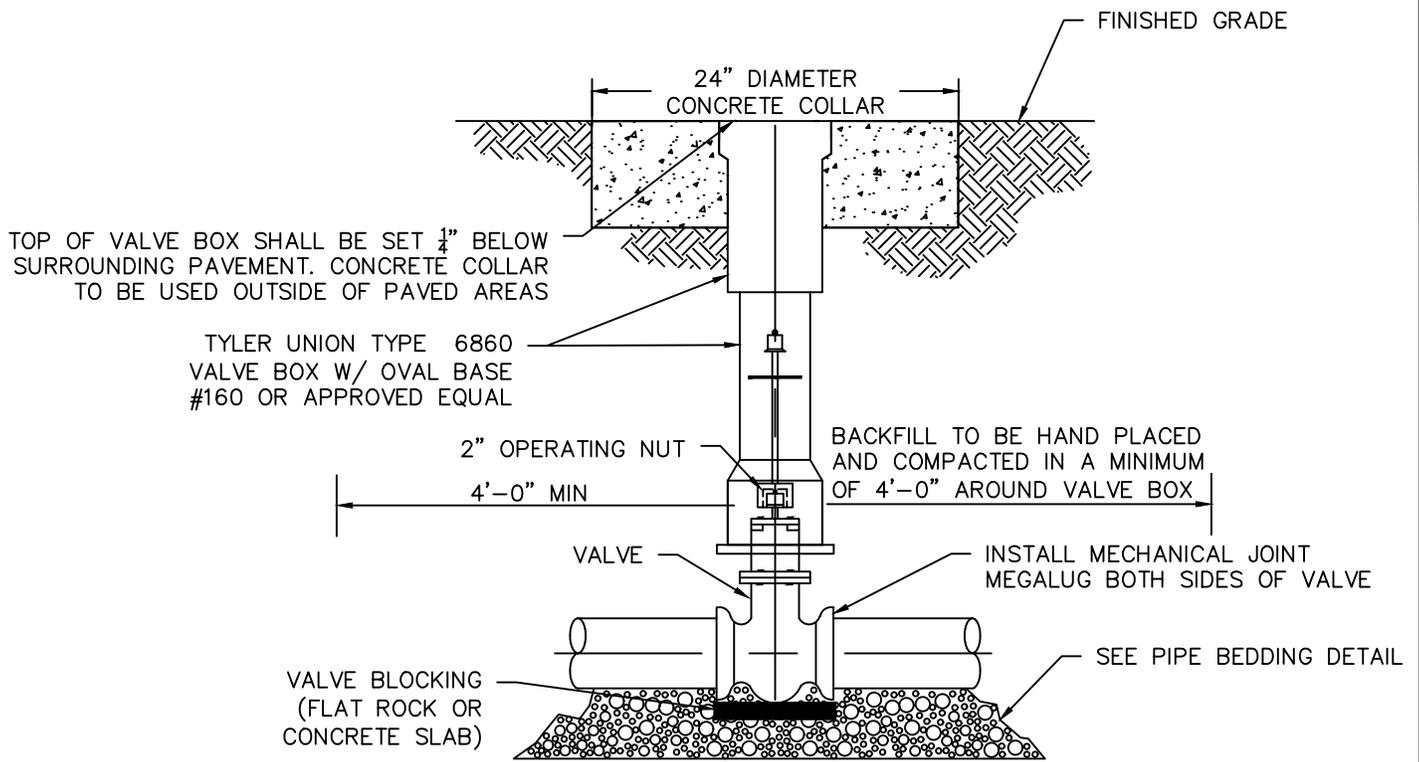


**WATER CONSTRUCTION
DRAWINGS**

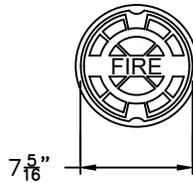
BY: JME
SCALE: NTS
DATE: 1/2020

DRAWING:

W2



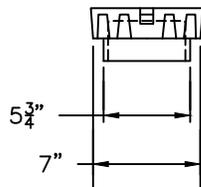
POTABLE VALVE BOX COVER PLAN



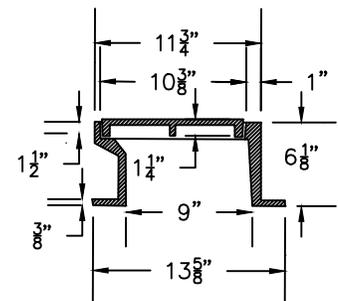
FIRE VALVE BOX COVER PLAN



NON-POTABLE VALVE BOX COVER PLAN



POTABLE & FIRE VALVE BOX COVER ELEVATION



NON-POTABLE VALVE BOX COVER ELEVATION

NOTES:

- POTABLE & FIRE VALVE BOX LID RESTS INSIDE THE UPPER VALVE BOX SECTION.
- NON-POTABLE VALVE BOX LID SLIDES OVER THE TOP OF THE UPPER VALVE BOX SECTION.
- NON-POTABLE, WATER OR FIRE CAST IN TOP OF APPROPRIATE VALVE BOX COVER.
- VALVE BOX SHALL NOT BE SUPPORTED BY WATER LINE.
- VALVE BOX TO BE PLUMB AND CENTERED OVER NUT.
- UTILIZING A VALVE BOX ALIGNMENT DEVICE IS OPTIONAL.
- IF 2" OPERATING NUT IS MORE THAN 6' BELOW FINISHED GRADE, A VAULT NUT EXTENDER SHALL BE INSTALLED TO PUT THE VALVE NUT AT AN ELEVATION OF 4' BELOW FINISHED GRADE.

STANDARD VALVE AND BOX

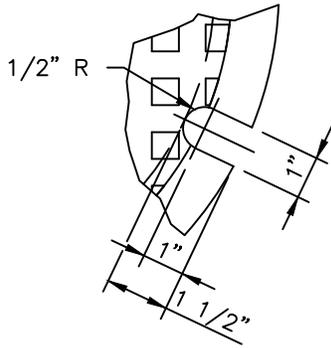
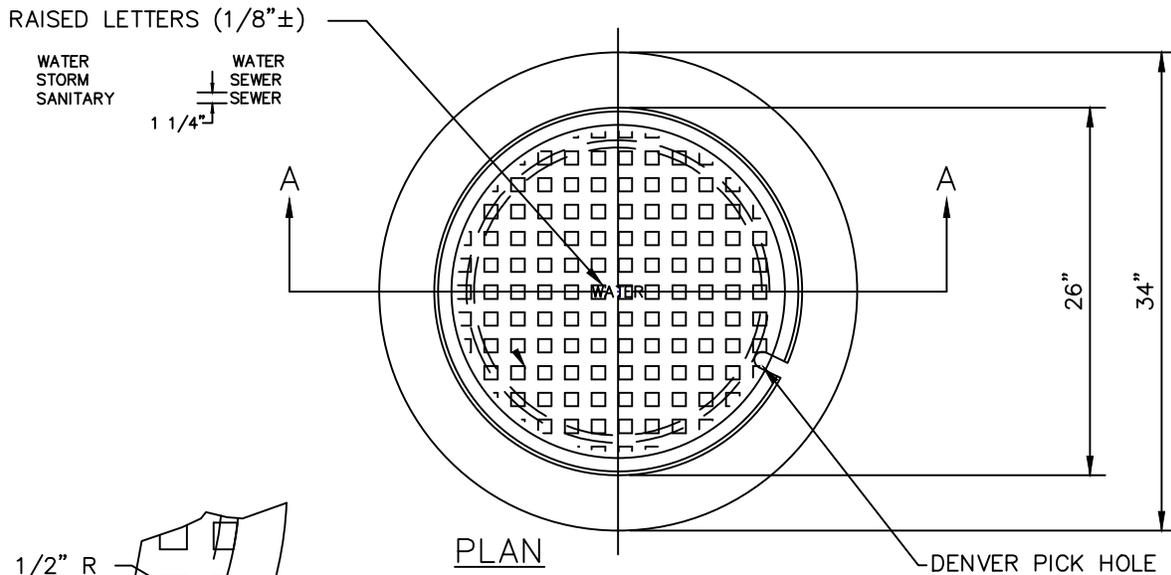


**WATER CONSTRUCTION
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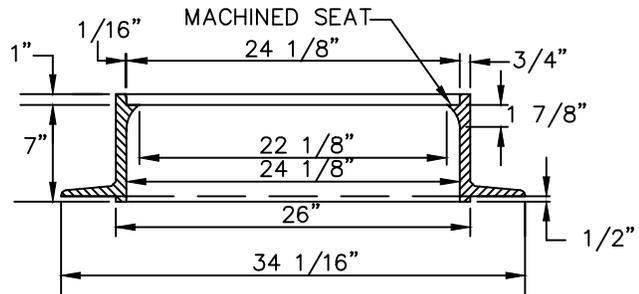
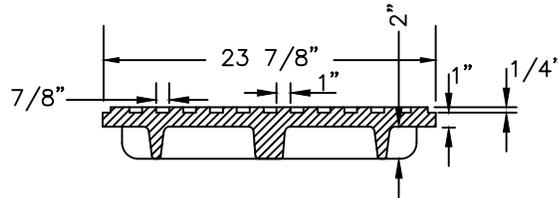
BY: NLH
SCALE: NTS
DATE: 07/2025

DRAWING:

W3



LIFTING NOTCH



SECTION A-A

1. CASTING SPECIFICATIONS: ASTM A-48 WITH A MINIMUM TENSILE STRENGTH OF 25 KSI (CLASS 25)
2. ALL CASTINGS TO BE DIPPED IN ASPHALT BASE PAINT (OR APPROVED EQUAL)
3. CASTINGS SHALL BE AS SPECIFIED BELOW OR APPROVED EQUAL:

MANUFACTURERS	CAT. #
NEENAH	R-1706
CASTINGS, INC.	MH-400-24 C.I.
HUTCHINSON FDRY. & STL. INC.	MH-400
EAST JORDAN	FRAME-2420Z

4. ALL NEW MANHOLES MUST INCLUDE A PLASTIC OR VINYL TAG ATTACHED TO THE TOP STEP STATING THE FOLLOWING "CAUTION CONFINED SPACE; ENTRY PERMIT REQUIRED.

24" MANHOLE RING AND COVER

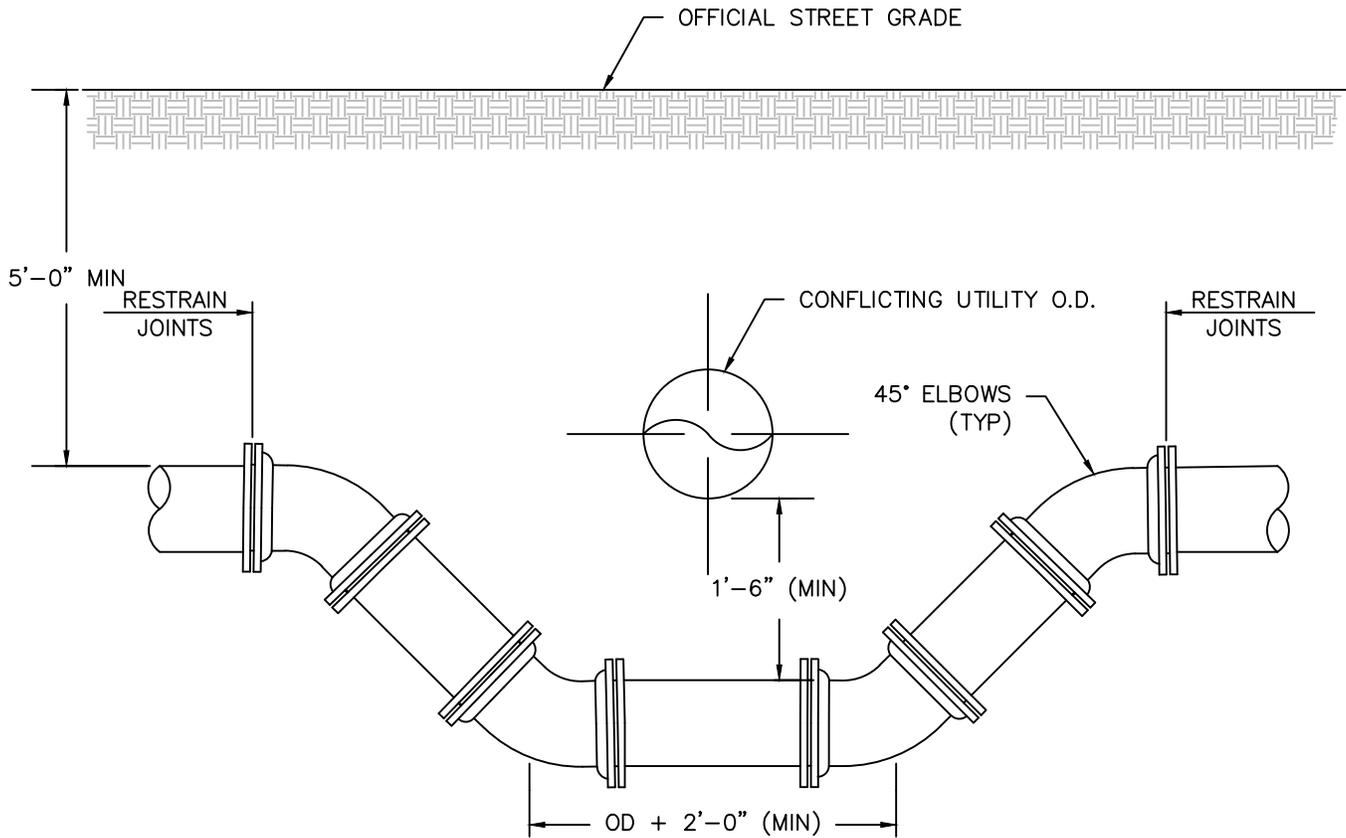


WATER CONSTRUCTION
DRAWINGS

BY: NLH
SCALE: NTS
DATE: 07/2025

DRAWING:

W4



NOTES:

1. LOWERING OF THIS TYPE WILL BE RESTRAINED BY MEANS OF THRUST BLOCKING AND MEGALUGS OR RODDING.
2. FOR SIZING INFORMATION OF THRUST BLOCKS REFER TO THRUST BLOCK DETAILS.
3. WHEN RESTRAINING PIPE BY MEANS OF RODDING JOINTS, $\frac{3}{4}$ " TIE RODS, NUTS AND WASHERS WILL BE USED AND ARE TO BE MADE OF "COR-TEN" STEEL 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. LENGTH OF EXTENSION OF PIPE AND RESTRAINED JOINTS SHALL BE IN ACCORDANCE WITH THE ENGINEERING STANDARDS.
8. CATHODIC PROTECTION SHALL BE AS REQUIRED IN ACCORDANCE WITH THE ENGINEERING STANDARDS.
9. A BORED CROSSING MAY BE REQUIRED BY THE ENGINEER.

Pipe Size	Test Pressure (psi)	Min. Number of Tie Rods
10" and Under	150	2
	200	2
12"	150	2
	200	4

TABLE 1

WATERLINE LOWERING

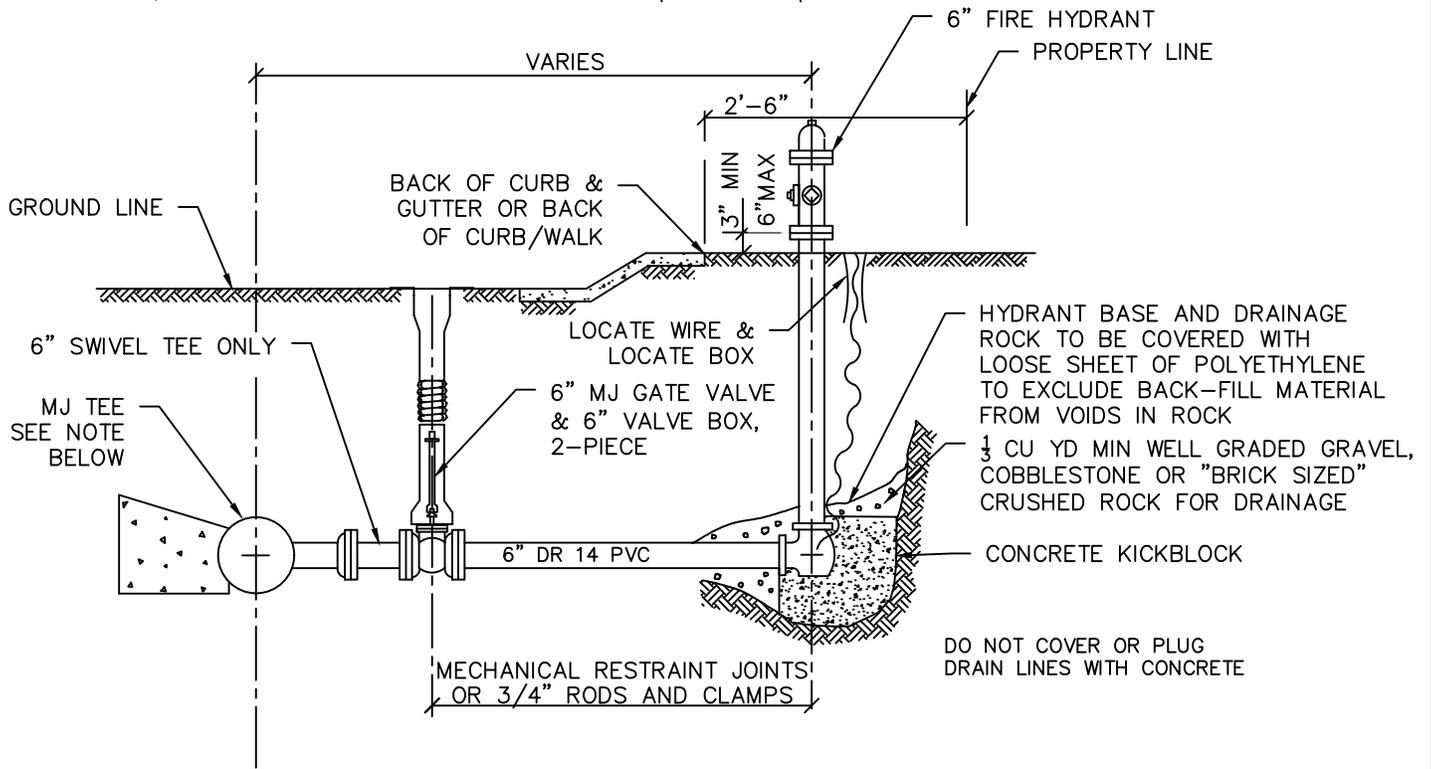
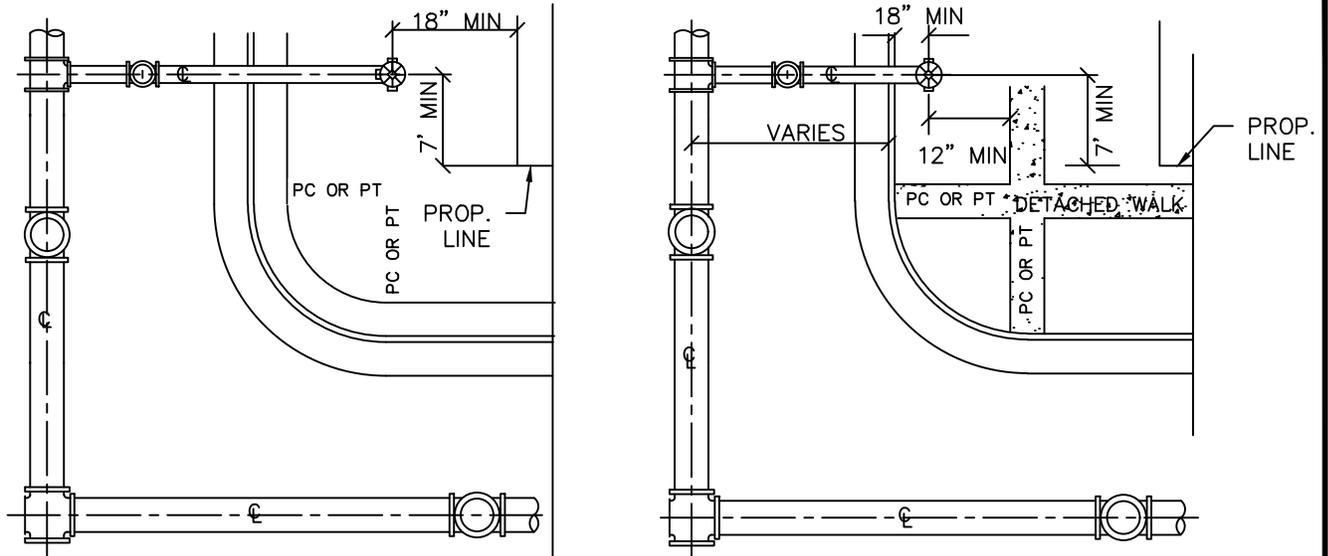


WATER CONSTRUCTION DRAWINGS

BY: JME
SCALE: NTS
DATE: 1/2020

DRAWING:

W5



NOTES:

1. NO HORIZONTAL OR VERTICAL BENDS ARE ALLOWED IN FIRE HYDRANT BRANCH OR SPRINKLER LINES
2. MAXIMUM OF ONE FIRE HYDRANT EXTENSION
3. CONTRACTOR TO TAKE CARE NOT TO BLOCK WEEP HOLES
4. ALL DUCTILE IRON PIPE TO BE POLYETHYLENE WRAPPED

FIRE HYDRANTS, MAINS AND VALVES

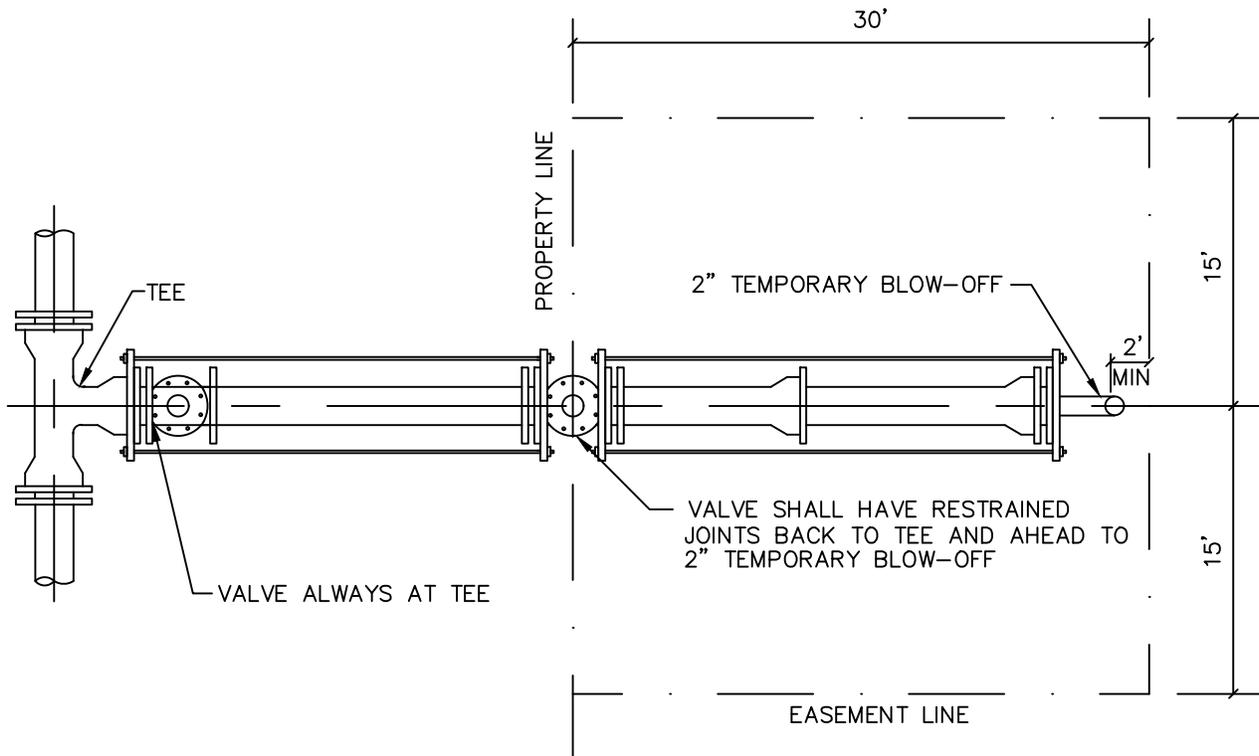
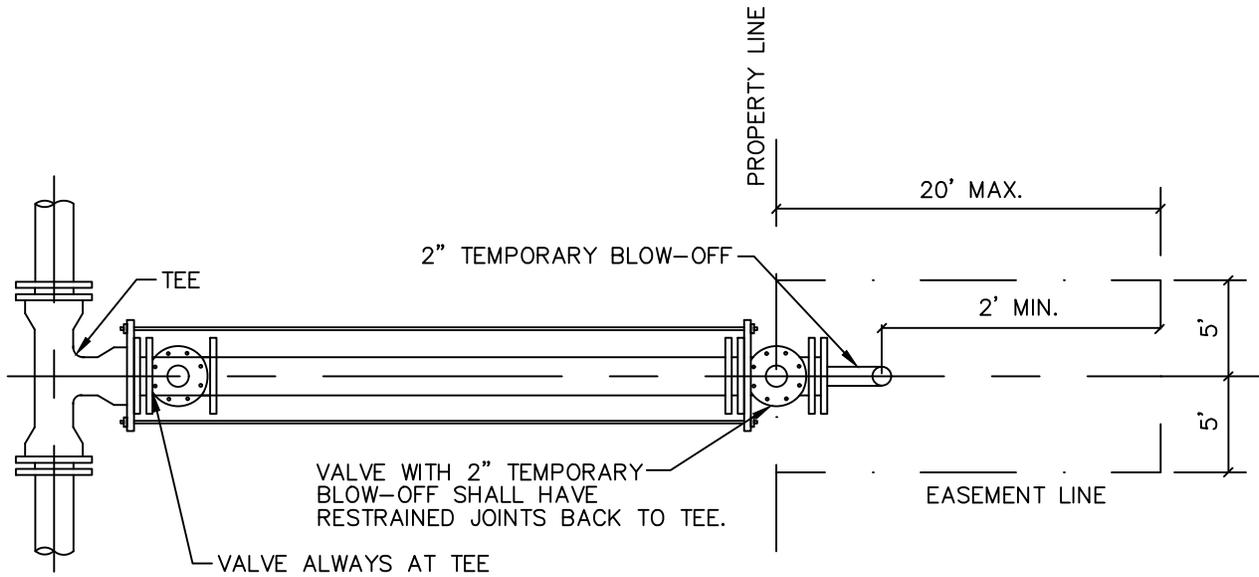


**WATER CONSTRUCTION
DRAWINGS**

BY: NLH
SCALE: NTS
DATE: 07/2025

DRAWING:

W6



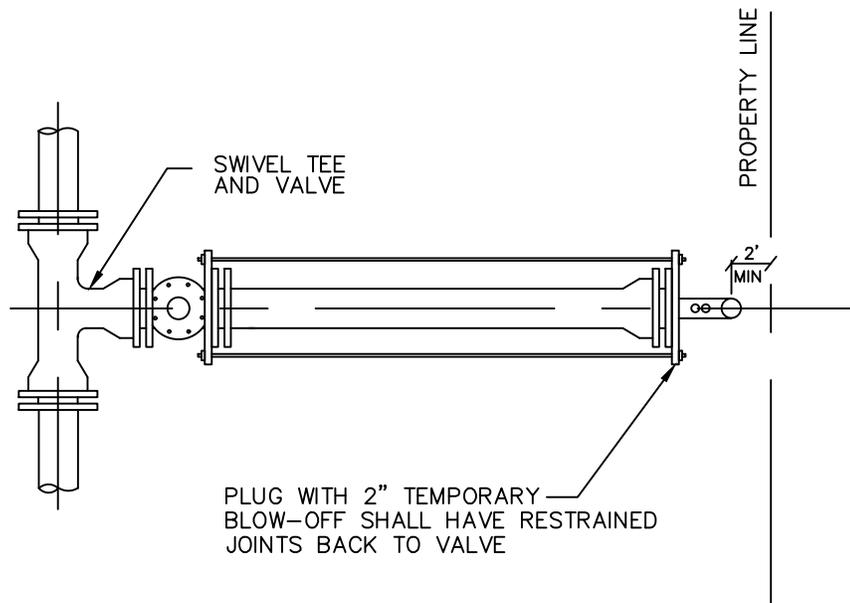
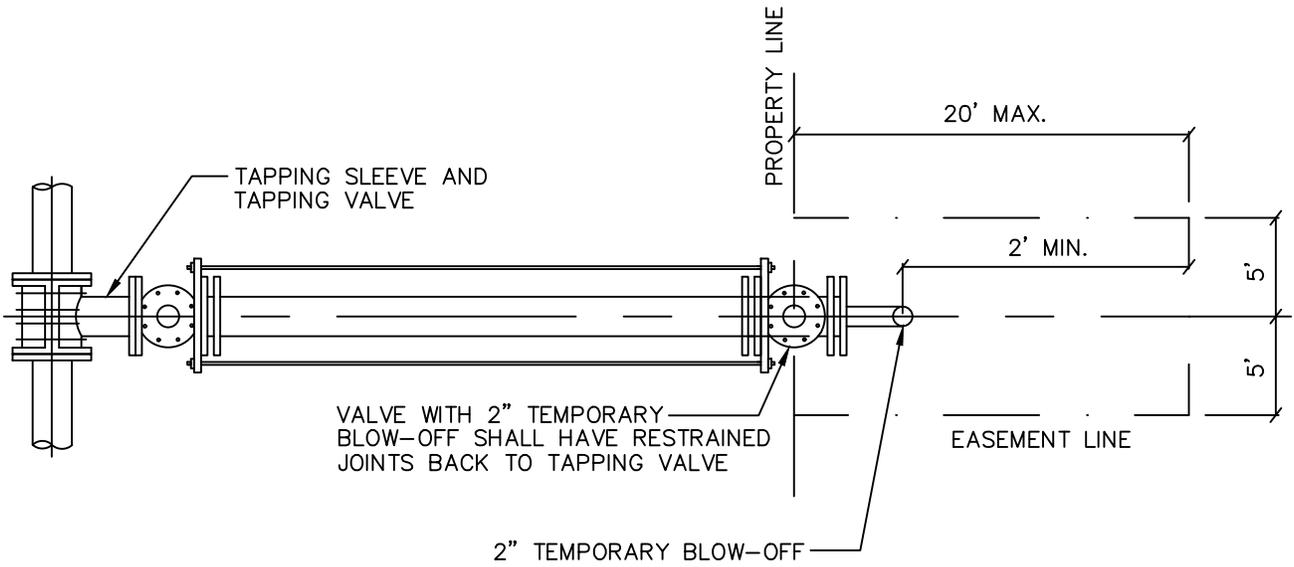
STUB-OUT CONFIGURATIONS (1 OF 2)



**WATER CONSTRUCTION
DRAWINGS**

BY: NLH
SCALE: NTS
DATE: 07/2025

DRAWING:
W7A



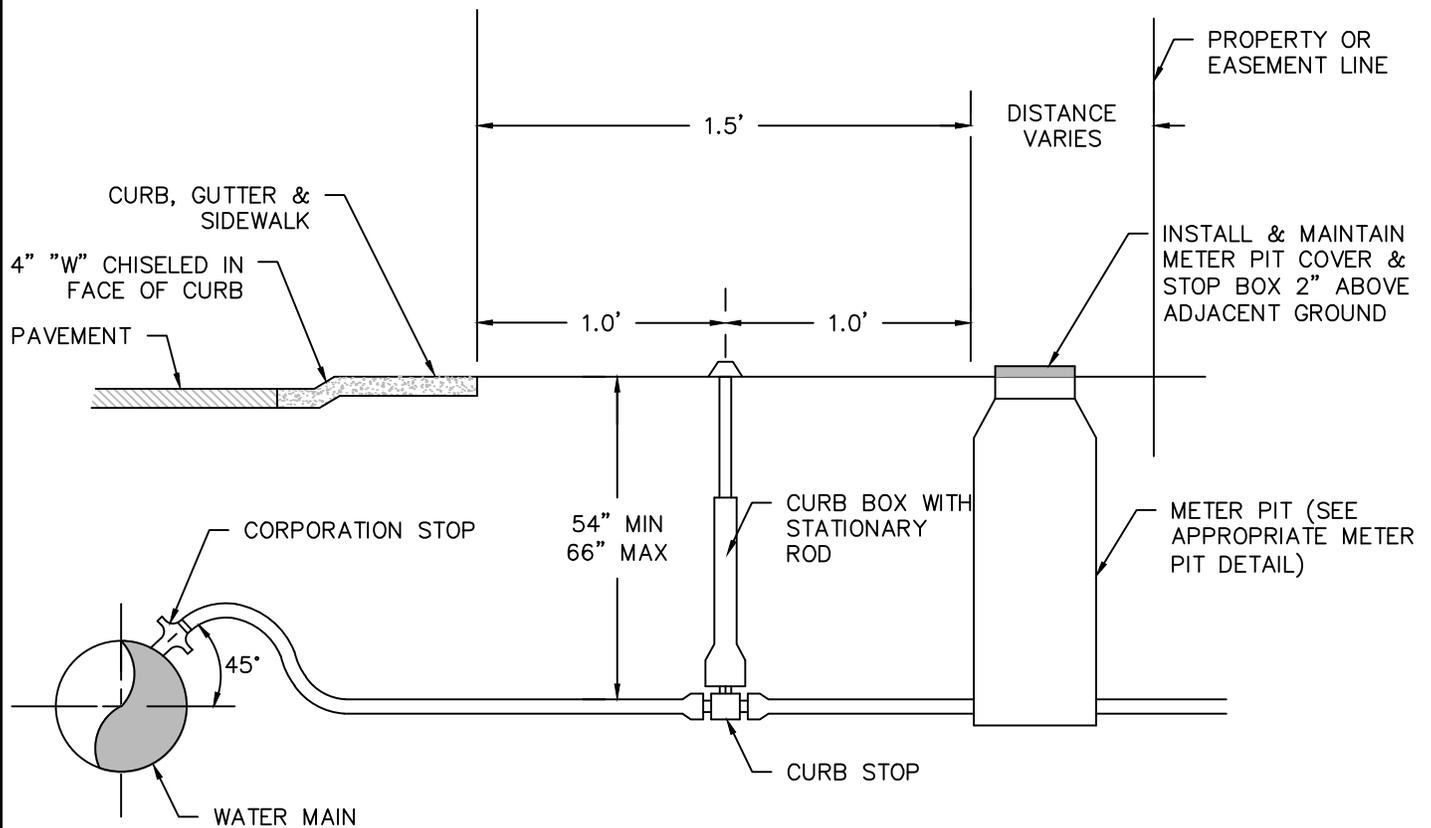
STUB-OUT CONFIGURATIONS (2 OF 2)



**WATER CONSTRUCTION
DRAWINGS**

BY: NLH
SCALE: NTS
DATE: 07/2025

DRAWING:
W7B



NOTES:

1. FOR 5/8-INCH THROUGH 1-INCH SERVICES, USE SADDLE TAP WITH CORP.
2. FOR 1 1/2-INCH AND 2-INCH SERVICES, INSTALL WITH SADDLE TAP AND CORPORATION STOP AT TIME OF CONSTRUCTION .
3. LOCATION OF CURB BOX AND METER PIT SHALL BE ACCORDING TO APPROVED UTILITY DRAWINGS.
4. TOWN'S RESPONSIBILITY FOR MAINTENANCE SHALL BE THE WATER MAIN, CORPORATION STOP, CURB STOP, SERVICE PIPING UP TO AND INCLUDING THE METER PIT. OWNER'S RESPONSIBILITY SHALL BE FROM THE METER PIT TO THE BUILDING.
5. NO COUPLINGS SHALL BE ALLOWED BETWEEN CURB STOP AND METER SETTER.
6. SERVICE SHALL BE TYPE K COPPER FROM CORPORATION STOP TO 5-FEET PAST METER PIT (MINIMUM).

WATER SERVICE DETAIL

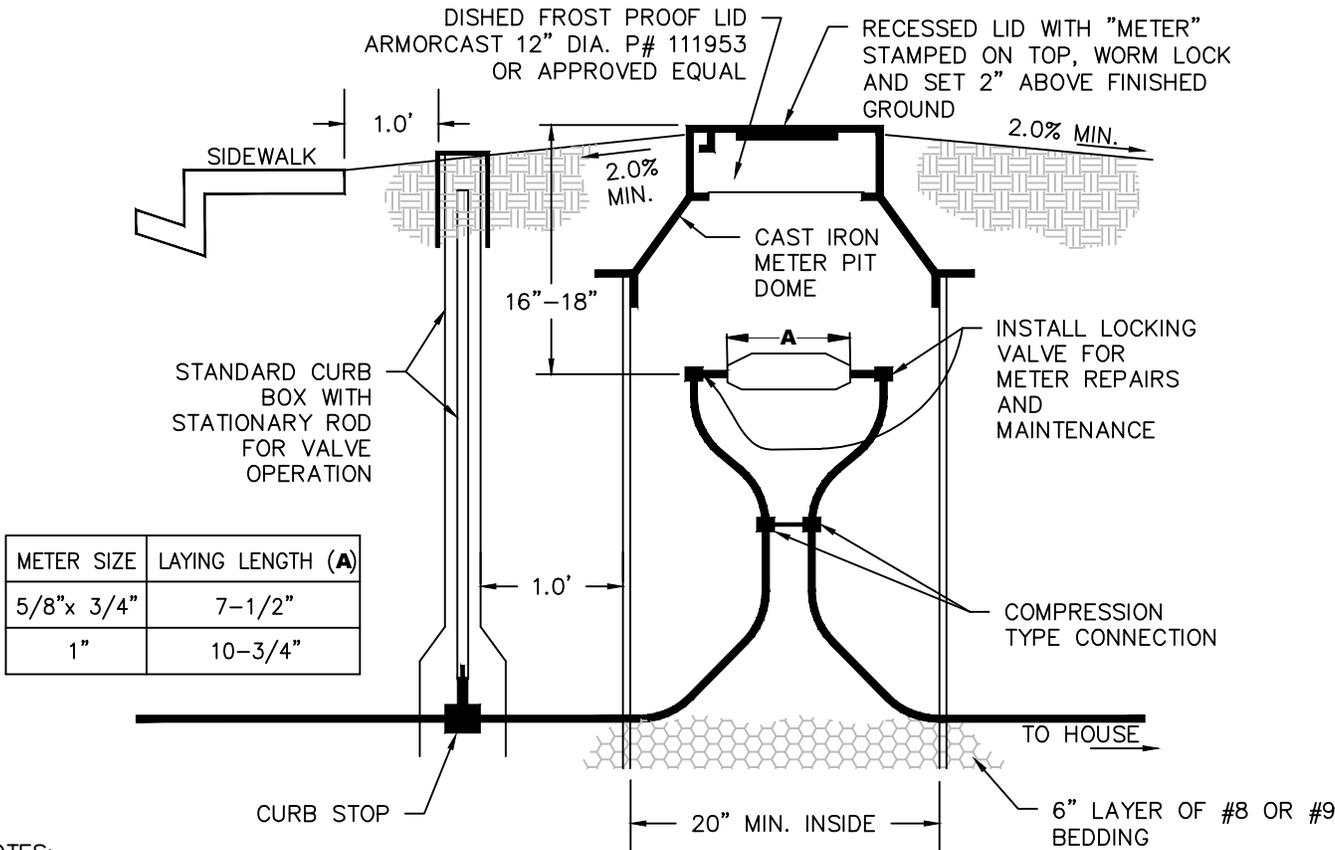


**WATER CONSTRUCTION
DRAWINGS**

BY: NLH
SCALE: NTS
DATE: 07/2025

DRAWING:

W8



NOTES:

- METER PIT AND CURB STOP ARE NOT TO BE INSTALLED IN ANY STREET, ALLEY, DRIVEWAY, SIDEWALK, OR PARKING AREA. METER PIT MUST BE INSTALLED IN LANDSCAPED AREA.
- NO SHRUBS, BOULDERS, RETAINING WALLS, CONCRETE, PAVERS OR OTHER LANDSCAPING FEATURES SHALL BE INSTALLED WITHIN 5' OF THE METER PIT. NO TREES SHALL BE INSTALLED WITHIN 10' OF THE METER PIT. IF LANDSCAPING CHANGES THE GRADE AROUND THE METER PIT THE OWNER SHALL BE REQUIRED TO ADJUST THE METER PIT COVER TO BE 1/2" ABOVE THE FINISHED GRADE AND ENSURE POSITIVE DRAINAGE AWAY FROM THE METER PIT IN ALL DIRECTIONS.
- THE TOWN SHALL PROVIDE THE METER. NOTIFY THE ENGINEERING AND UTILITIES DEPARTMENT ONE WEEK IN ADVANCE OF INSTALLATION SO THAT THE METERS CAN BE ORDERED IF THERE ARE NONE IN STOCK. THE TOWN SHALL INSTALL THE METER.
- RESIDENTIAL METER PITS SHOULD BE INSTALLED AFTER MAINLINE TESTING IS COMPLETED AND ACCEPTED.
- BACKFILL TO BE HAND PLACED AND COMPACTED WITHIN A FOOT OF THE PIT.
- EXTENSIONS AND OFF GRADE EXTENSIONS SHALL BE INSERTED BETWEEN THE DOME AND TOP RING TO PUT LID TO GRADE.
- NO CONNECTIONS OR CHANGES IN PIPE DIAMETER SHALL BE MADE IN THE METER PIT OR IN THE DISTANCE OF FIVE FEET BEYOND THE METER PIT WALL ON THE OUTLET SIDE.
- LAWN SPRINKLER CONNECTIONS SHALL BE A MINIMUM OF FIVE FEET FROM THE METER PIT WALL ON THE OUTLET SIDE.
- ANY VARIATION OR DEVIATION FROM THIS STANDARD REQUIRES APPROVAL PRIOR TO INSTALLATION FROM THE TOWN ENGINEER.

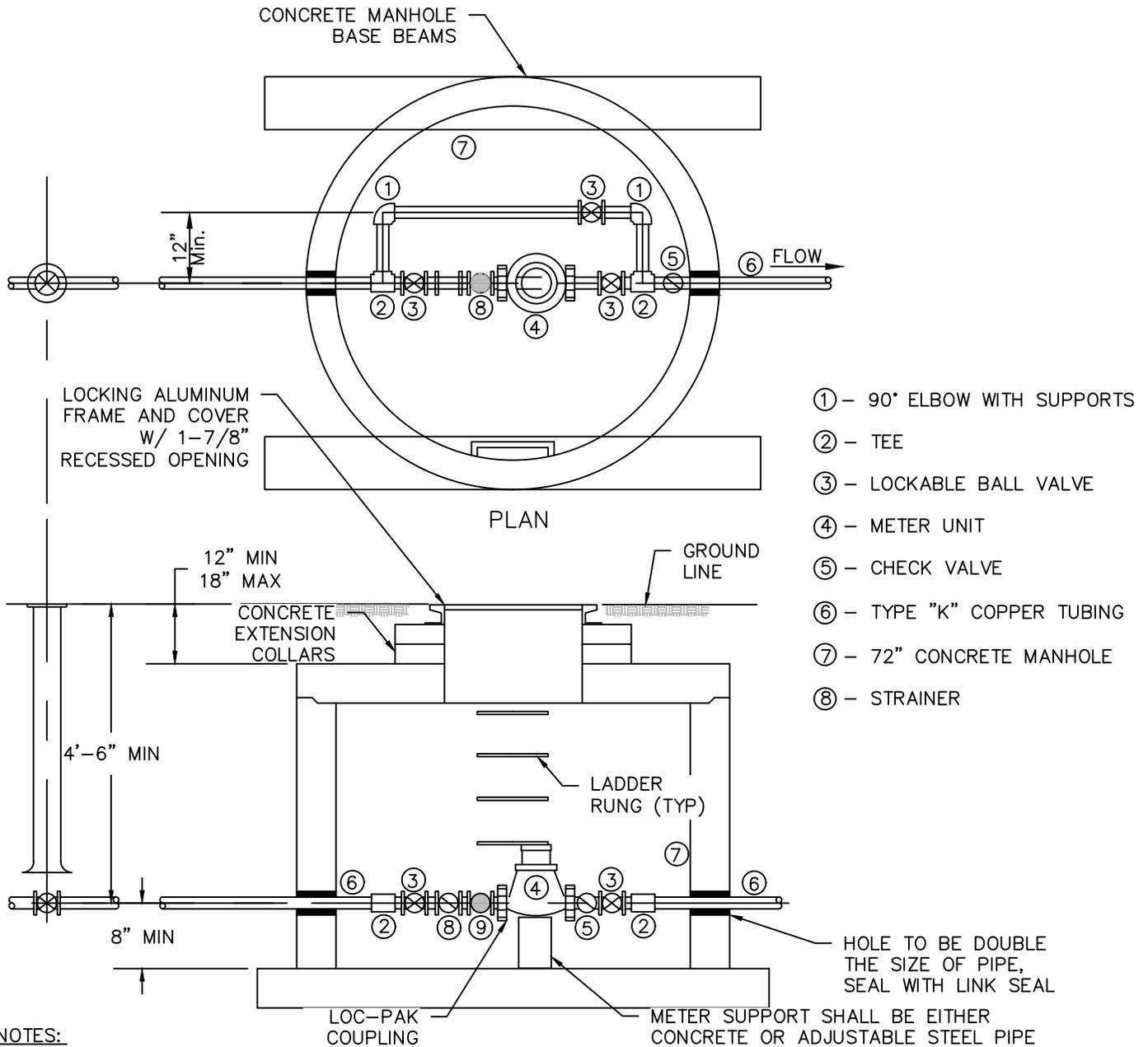
5/8IN - 1IN WATER METER DETAIL



**WATER CONSTRUCTION
DRAWINGS**

BY: NLH
SCALE: NTS
DATE: 07/2025

DRAWING:
W9



NOTES:

1. MANHOLE BASE BEAMS REQUIRED FOR DRIVEWAYS, OR PARKING AREA WHEN APPROVED.
2. A 72" DIAMETER MANHOLE PIT WILL ACCOMMODATE 1-1/2" & 2" METERS W/ CUSTOM SETTER.
3. JOINTS INSIDE METER VAULT SHALL BE EITHER THREADED OR SOLDERED W/ 95-5 TIMANTIMONY SOLDER.
4. NO CONCRETE TO BE LAID IN FLOOR OF METER MANHOLE.
5. METER SHALL BE FLANGED W/ BRASS COMPANION FLANGES.
6. NO CONNECTIONS OR CHANGES IN PIPE DIAMETER SHALL BE MADE IN THE METER PIT OR IN THE DISTANCE OF FIVE FEET BEYOND THE METER PIT ON THE OUTLET SIDE.
7. LADDER RUNGS SHALL BE ON THE OPPOSITE SIDE OF BYPASS.
8. BYPASS SHALL NOT BE INSTALLED FOR USE WITH AN IRRIGATION SYSTEM.
9. CONCRETE OR ADJUSTABLE STEEL PIPE SUPPORTS SHALL BE PROVIDED UNDER THE 90 DEGREE BENDS ON THE BYPASS.
10. METER VAULTS IN DRIVE AREAS MUST USE TRAFFIC RATED LID. A TRAFFIC RATED BOX MUST BE PROVIDED IN A LANDSCAPED AREA WITH 2" CONDUIT FROM THE VAULT TO THE REMOTE LOCATION PROVIDED FOR THE READ OUT.
11. WALL PENETRATIONS FOR SERVICE ENTRY AND EXIT MAY BE DOGHOUSE STYLE. HOWEVER, SHALL

1 1/2 IN - 2 IN WATER METER DETAIL



**WATER CONSTRUCTION
DRAWINGS**

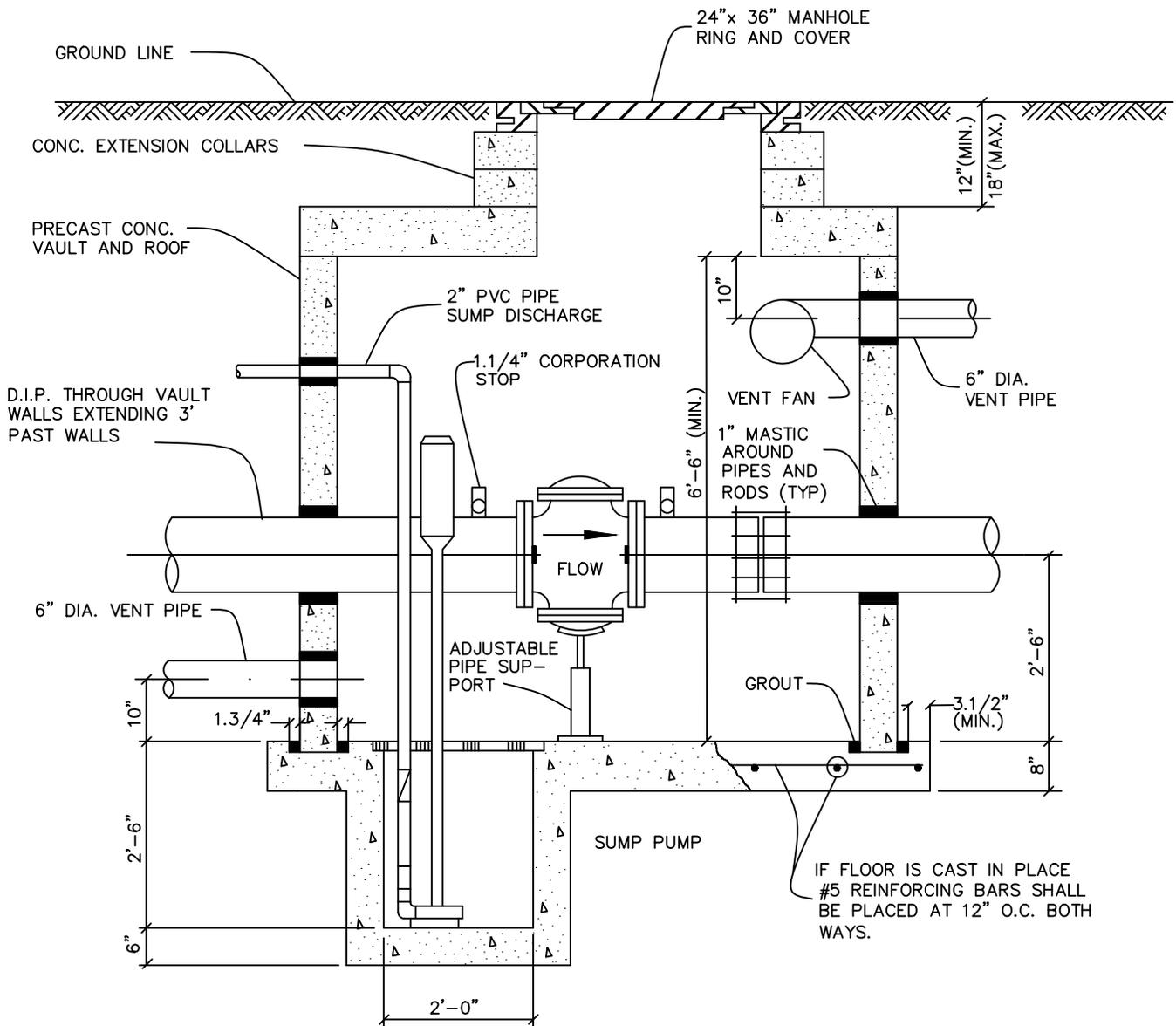
BY: NLH

SCALE: NTS

DATE: 07/2025

DRAWING:

W10



NOTES:

1. A PERMIT IS REQUIRED FOR SUMP PUMP TO DISCHARGE TO STORM SEWER.
2. SUMP PUMP AND VENT FAN REQUIRED IN VAULTS.
3. THIS MANHOLE IS SUITABLE FOR CHECK VALVE INSTALLATIONS.
4. FOR PLAN VIEW AND ADDITIONAL NOTES SEE SHEET 1 OF 2.

PRV IN RECTANGULAR VAULT (2 OF 2)

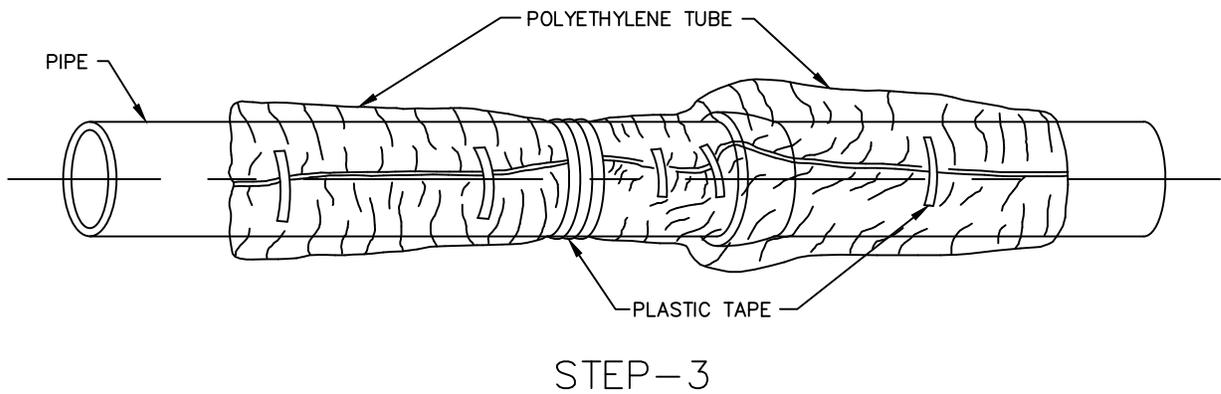
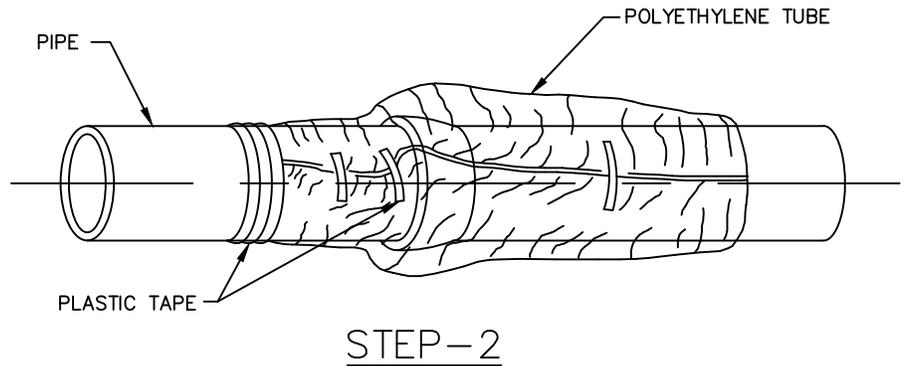
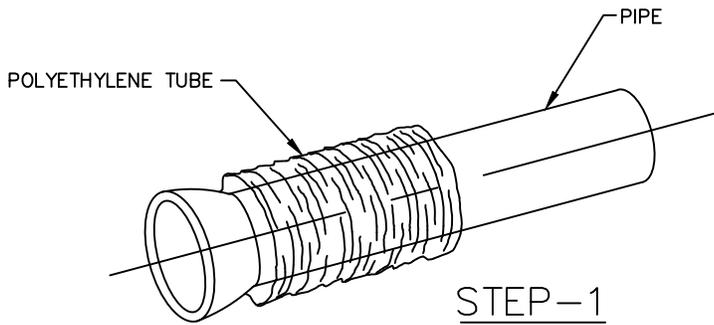


**WATER CONSTRUCTION
DRAWINGS**

BY: JME
SCALE: NTS
DATE: 1/2020

DRAWING:

W11B



FIELD INSTALLATION-POLYETHYLENE WRAP

- STEP-1 PLACE TUBE OF POLYETHYLENE MATERIAL AROUND PIPE PRIOR TO LOWERING PIPE INTO TRENCH.
- STEP-2 PULL THE TUBE OVER THE LENGTH OF THE PIPE. TAPE TUBE TO PIPE AT JOINT. FOLD MATERIAL AROUND THE ADJACENT SPIGOT END AND WRAP WITH THREE CIRCUMFERENTIAL TURNS OF TWO-INCH WIDE PLASTIC TAPE TO HOLD PLASTIC TUBE AROUND SPIGOT END.
- STEP-3 ADJACENT TUBE OVERLAPS FIRST TUBE AND IS SECURED WITH PLASTIC ADHESIVE TAPE. THE POLYETHYLENE TUBE MATERIAL COVERING THE PIPE WILL BE LOOSE. EXCESS MATERIAL SHOULD BE NEATLY DRAWN UP AROUND THE PIPE BARREL, FOLDED INTO AN OVERLAP ON TOP OF THE PIPE AND HELD IN PLACE BY MEANS OF PIECES OF THE PLASTIC TAPE AT APPROXIMATELY THREE TO FIVE FOOT INTERVALS.

NOTE: ALL RODDING TO BE ENCASED IN POLYETHYLENE SEPARATED FROM THE PIPE

POLYETHYLENE WRAP

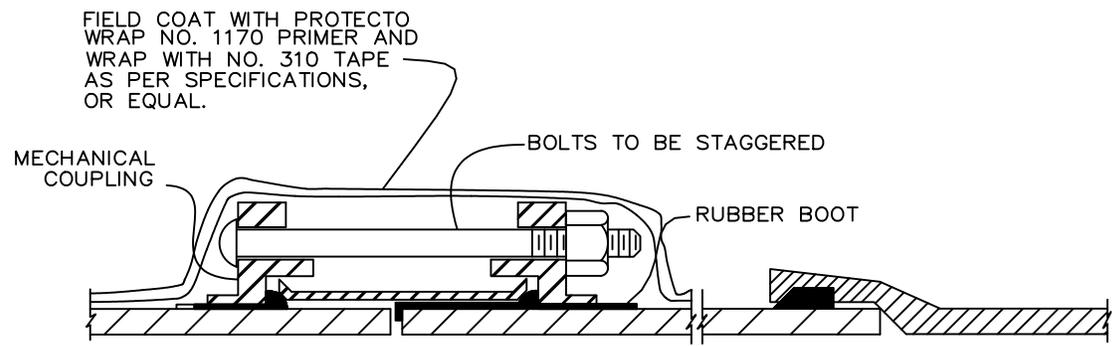
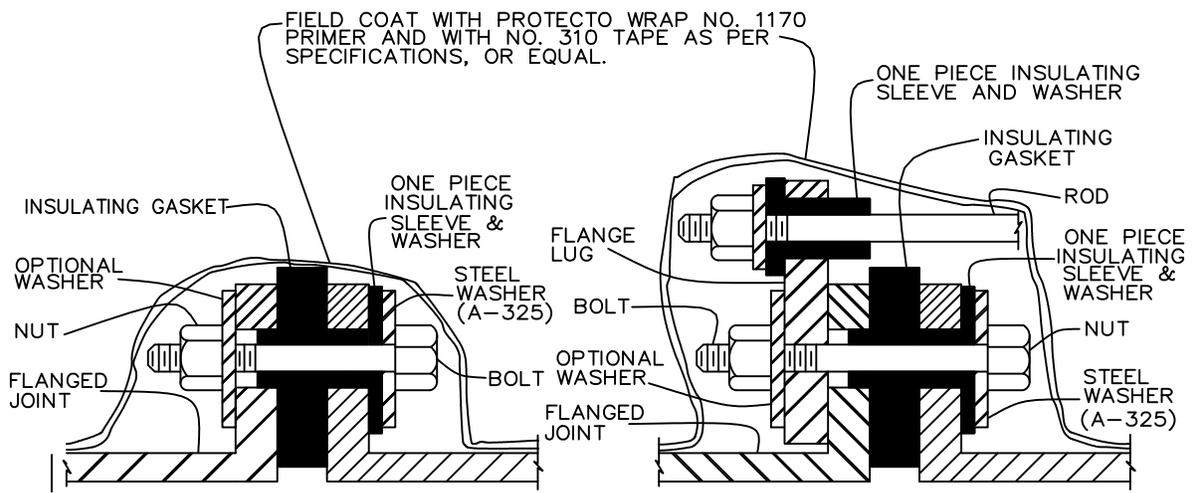


WATER CONSTRUCTION
DRAWINGS

BY: JME
SCALE: NTS
DATE: 1/2020

DRAWING:

W12



INSULATORS

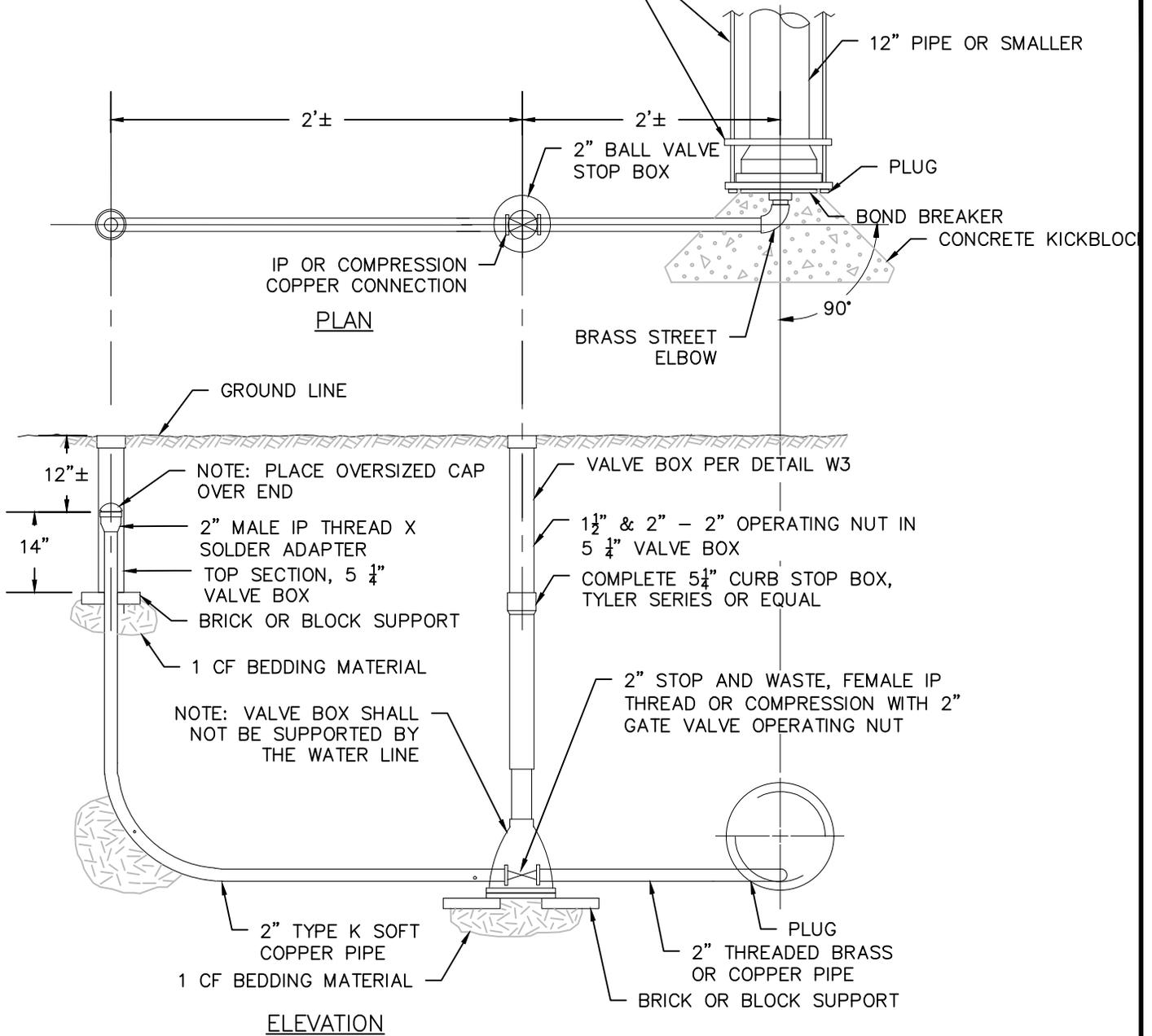


WATER CONSTRUCTION DRAWINGS

BY: JME
SCALE: NTS
DATE: 1/2020

DRAWING:
W13

NOTE
 PLUG SHALL BE MECHANICALLY RESTRAINED:
 A—FOR SLEEVE TYPE MACHINED COUPLING PIPE,
 TIE BACK TO NEXT COUPLING
 B—FOR BELL AND SPIGOT PIPE, TIE TO BELL



NOTE: FOR 12" AND SMALLER PIPE

TEMPORARY BLOWOFF FOR 12" AND SMALLER PIPE

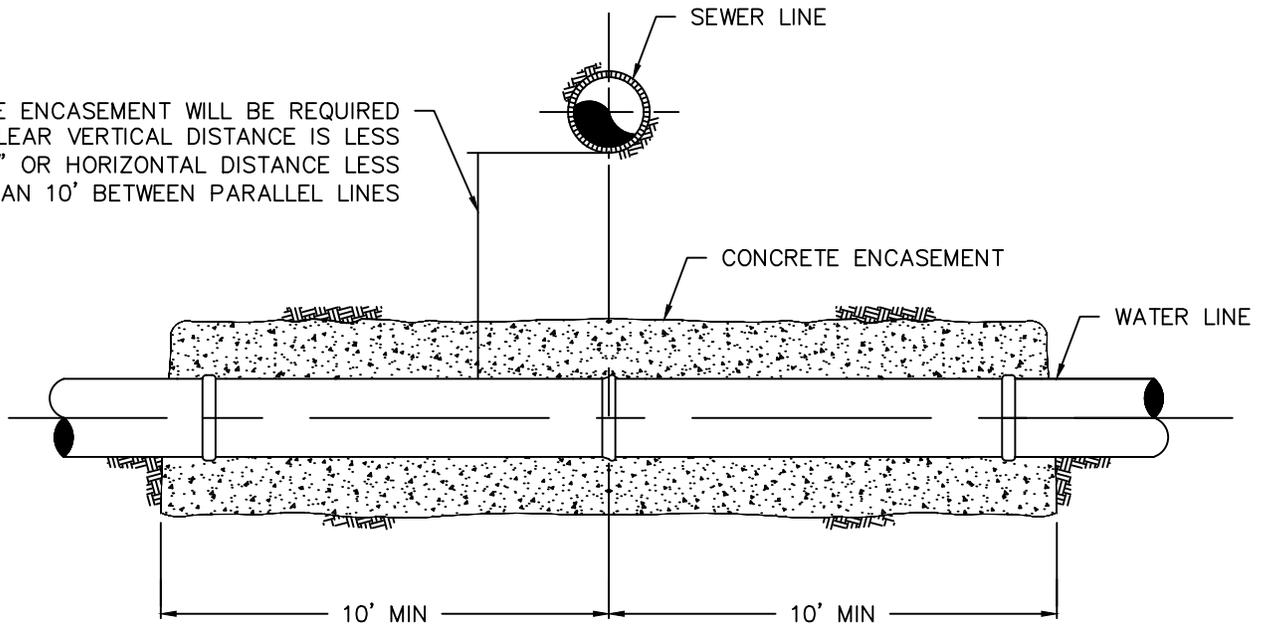


WATER CONSTRUCTION DRAWINGS

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 DATE: 07/2025

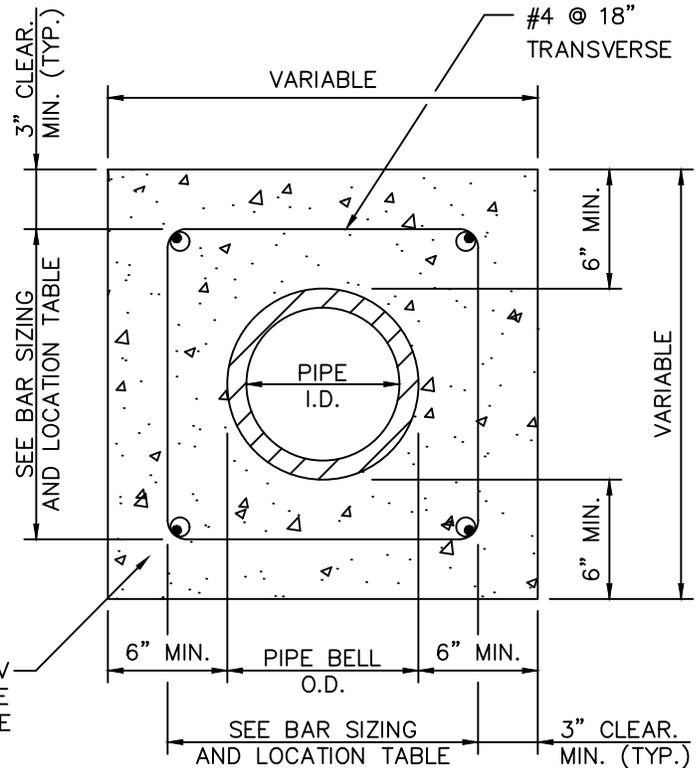
DRAWING:
W14

CONCRETE ENCASEMENT WILL BE REQUIRED WHEN CLEAR VERTICAL DISTANCE IS LESS THAN 1'-6" OR HORIZONTAL DISTANCE LESS THAN 10' BETWEEN PARALLEL LINES



REINFORCEMENT STEEL

PIPE I.D.	LONGITUDINAL BARS - LOCATION		
6 IN.	4-NO. 4 BARS	1 EACH	CORNER
8 IN.	4-NO. 4 BARS	1 EACH	CORNER
10 IN.	8-NO. 4 BARS	3 EACH	SIDE
12 IN.	8-NO. 4 BARS	3 EACH	SIDE
15 IN.	8-NO. 4 BARS	3 EACH	SIDE
18 IN.	8-NO. 4 BARS	3 EACH	SIDE
21 IN.	12-NO. 4 BARS	4 EACH	SIDE
24 IN.	12-NO. 4 BARS	4 EACH	SIDE
27 IN.	12-NO. 4 BARS	4 EACH	SIDE
30 IN.	12-NO. 4 BARS	4 EACH	SIDE
33 IN.	12-NO. 4 BARS	4 EACH	SIDE
36 IN.	16-NO. 4 BARS	5 EACH	SIDE



2500 P.S.I. TYPE V CEMENT, CONCRETE VIBRATED IN PLACE

NOTES:

1. CONCRETE ENCASEMENT REQUIRED IN ALL CASES WHERE SEWER LINE IS ABOVE WATER LINE.
2. THE TOWN SHALL REVIEW THIS DETAIL FOR USE ON A CASE BY CASE BASIS. SPECIAL ENCASEMENTS MAY BE REQUIRED AT CREEK CROSSINGS AND CONDUIT CROSSINGS

UTILITY ENCASEMENT DETAIL

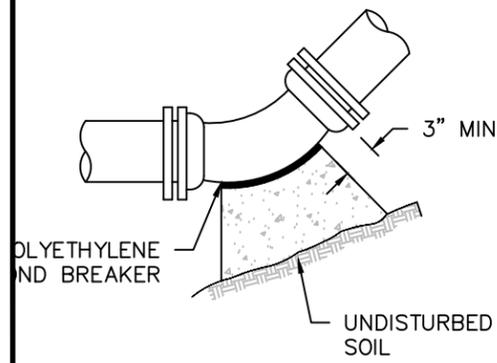


WATER CONSTRUCTION DRAWINGS

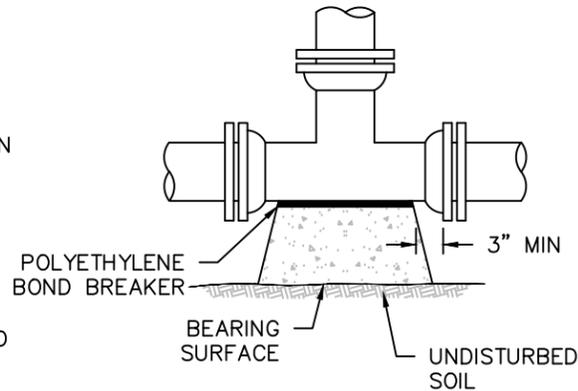
BY: JME
SCALE: NTS
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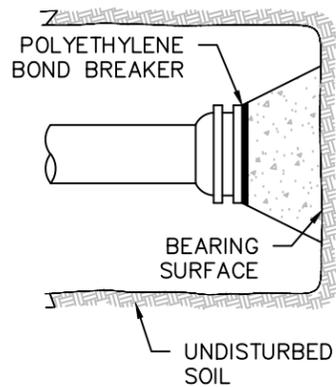
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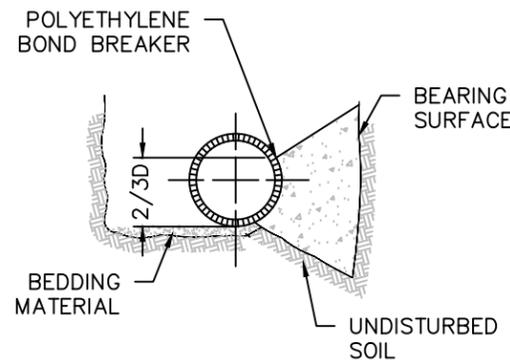
TYPICAL BEND



TEE

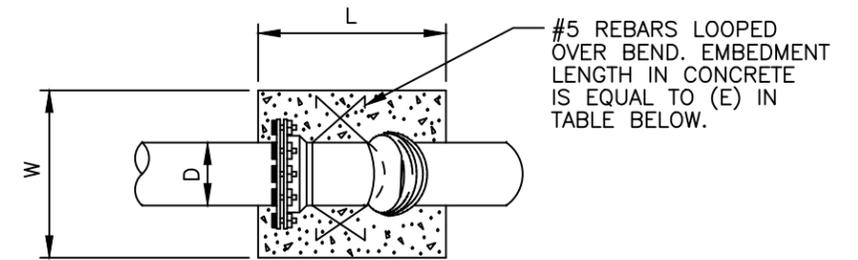


DEAD END

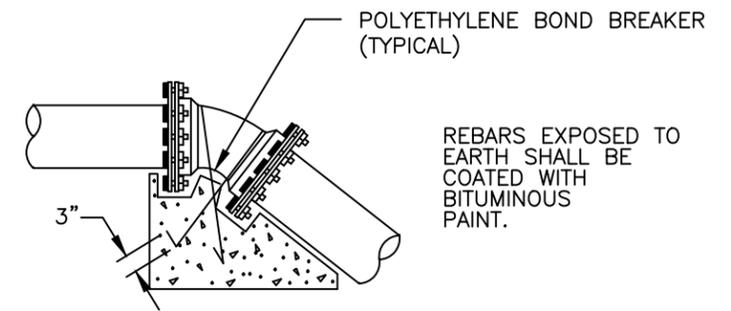


TYPICAL CROSS SECTION

SIZE	BEARING AREA (SQUARE FEET) FOR CONCRETE THRUST BLOCKS							
	BENDS				TEES	DEAD ENDS	CROSS W/ 1 BRANCH PLUGGED	CROSS W/ 2 BRANCHES PLUGGED
	90°	45°	22-1/2°	11-1/4°				
3	1.5	0.8	0.4	0.2	1.1	1.1	1.1	1.1
4	2.7	1.4	0.7	0.4	1.9	1.9	1.9	1.9
6	6.0	3.2	1.7	0.8	4.2	4.2	4.2	4.2
8	10.7	5.8	2.9	1.5	7.5	7.5	7.5	7.5
10	16.7	9.0	4.6	2.3	11.8	11.8	11.8	11.8
12	24.0	13.0	6.6	3.3	17.0	17.0	17.0	17.0
14	32.7	17.7	9.0	4.5	23.1	23.1	23.1	23.1
15	37.5	20.3	10.3	5.2	26.5	26.5	26.5	26.5
16	42.7	23.1	11.8	5.9	30.2	30.2	30.2	30.2
18	54.0	29.2	14.9	7.5	38.2	38.2	38.2	38.2
20	66.6	36.1	18.4	9.2	47.1	47.1	47.1	47.1
21	73.5	39.8	20.3	10.2	52.0	52.0	52.0	52.0
22	80.6	43.6	22.2	11.2	57.0	57.0	57.0	57.0
24	96.0	51.9	26.5	13.3	67.9	67.9	67.9	67.9
30	149.9	81.2	41.4	20.8	106.0	106.0	106.0	106.0
36	215.9	116.9	59.6	29.9	152.7	152.7	152.7	152.7



PLAN



PROFILE

SIZE OF PIPE (D)	11 1/4 DEG.					22 1/2 DEG.					45 DEG.				
	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:

- REFER TO CONCRETE THRUST BLOCK TABLE FOR MINIMUM BEARING SURFACE AREAS.
- ALL FITTINGS TO BE WRAPPED WITH POLYETHYLENE.
- PIPE INSTALLED UNDER CONDITIONS DIFFERENT FROM THOSE NORMALLY ENCOUNTERED SHALL REQUIRE THRUST BLOCKS DESIGNED FOR THOSE PARTICULAR CONDITIONS.
- THRUST BLOCKS ON PIPE LARGER THAN 12" SHALL BE DESIGNED FOR CONDITIONS EXISTING AT THE INSTALLATION SITE.
- REFER TO SECTION 03300 FOR CONCRETE REQUIREMENTS.
- CALCULATION MADE FOR THIS TABLE ASSUME:
100 P.S.I. INTERNAL STATIC PRESSURE
1,000 P.S.F. SOIL BEARING CAPACITY
1.5 FACTOR OF SAFETY
- FOR STATIC PRESSURES GREATER THAN 100 P.S.I. AND/OR SOIL BEARING CAPACITY LESS THAN 1,000 P.S.F., THE DESIGN ENGINEER SHALL PROVIDE SPECIFIC CALCULATIONS FOR REVIEW AND APPROVAL.
- ALL CONCRETE SHALL BE 4000 P.S.I. MINIMUM.

VERTICAL THRUST BLOCK NOTES:

- THRUST BLOCKING SHALL BE CAST AGAINST UNDISTURBED EARTH. FORMS SHALL BE USED AS REQUIRED TO OBTAIN ADEQUATE BEARING AND TO CONFINE THE CONCRETE. THRUST BLOCKING SHALL BEAR ON THE FITTING OR END CAP ONLY AND SHOULD NOT BE ALLOWED TO SPILL OVER THE JOINT OR AGAINST THE PIPE.
- VOLUME IS IN CUBIC FEET.
- ALL CONCRETE TO BE 4000 P.S.I. MIN.
- BLOCKS TO BE CENTERED HORIZONTALLY ON THE BEND.
- DESIGN BASED ON A TEST PRESSURE OF 150 P.S.I. AND SAFETY FACTOR (S_f) OF 1.5
- $V_g = \frac{S_f PA \sin \theta}{W_m}$
- $W_m = 140 \# / FT^3$
- THE DESIGN ENGINEER IS RESPONSIBLE FOR VERIFYING THE ACTUAL SITE CONDITIONS WITH RESPECT TO THE ASSUMPTIONS LISTED ABOVE.

CONCRETE THRUST BLOCK DETAIL



WATER CONSTRUCTION DRAWINGS

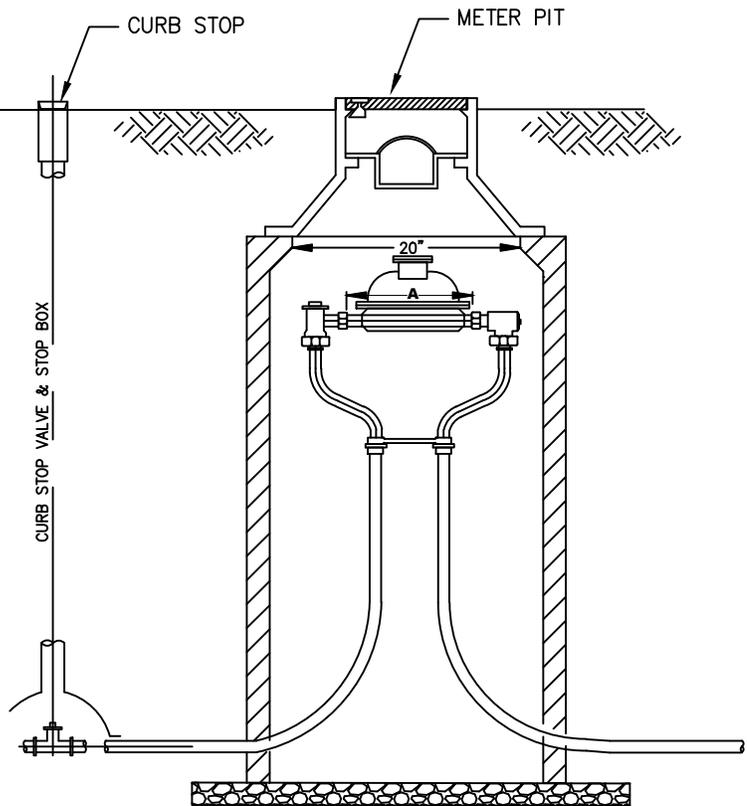
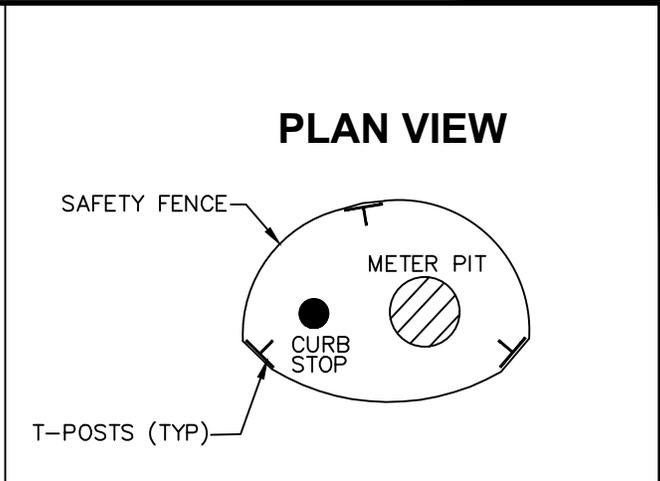
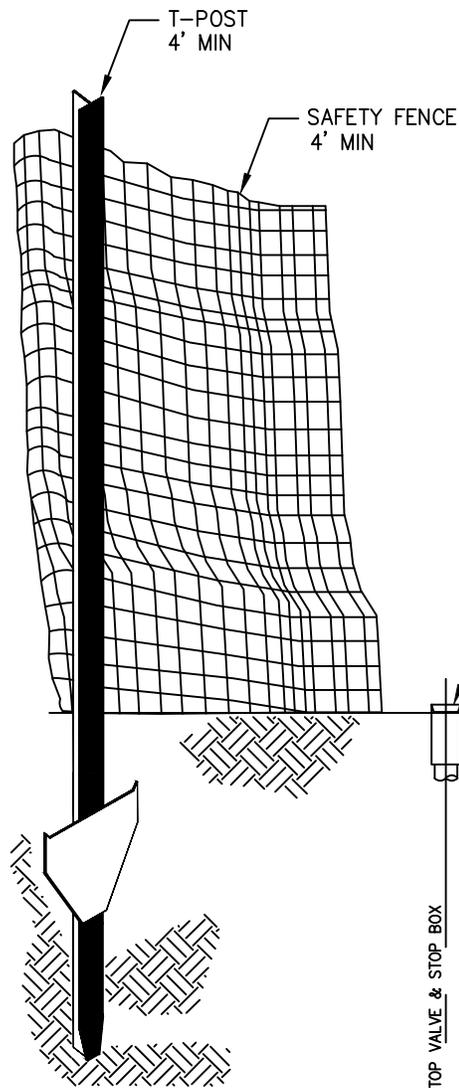
BY: JME

SCALE: NTS

DATE: 1/2020

DRAWING:

W16



NOTE:

ALL METER PITS AND CURB STOPS SHALL BE PROTECTED AT THE TIME OF INSTALLATION WITH A MINIMUM OF 3-T POSTS AND ORANGE SAFETY FENCE. THE T-POSTS AND SAFETY FENCE SHALL REMAIN IN PLACE AND IN GOOD CONDITION UNTIL THE LANDSCAPING IS INSTALLED.

METER PIT AND CURB STOP PROTECTION

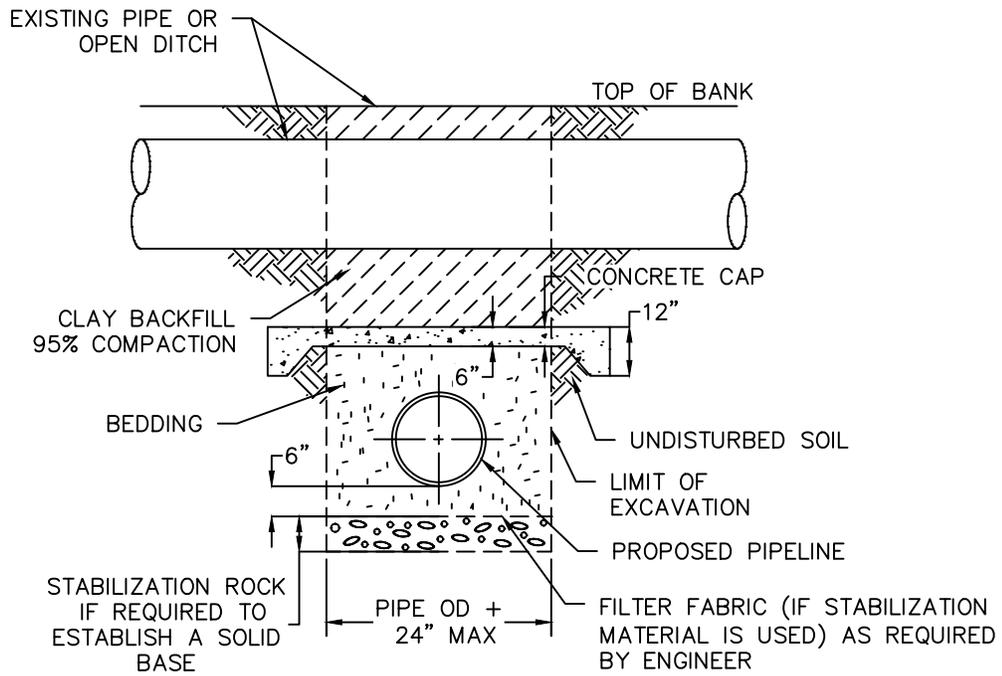


WATER CONSTRUCTION
DRAWINGS

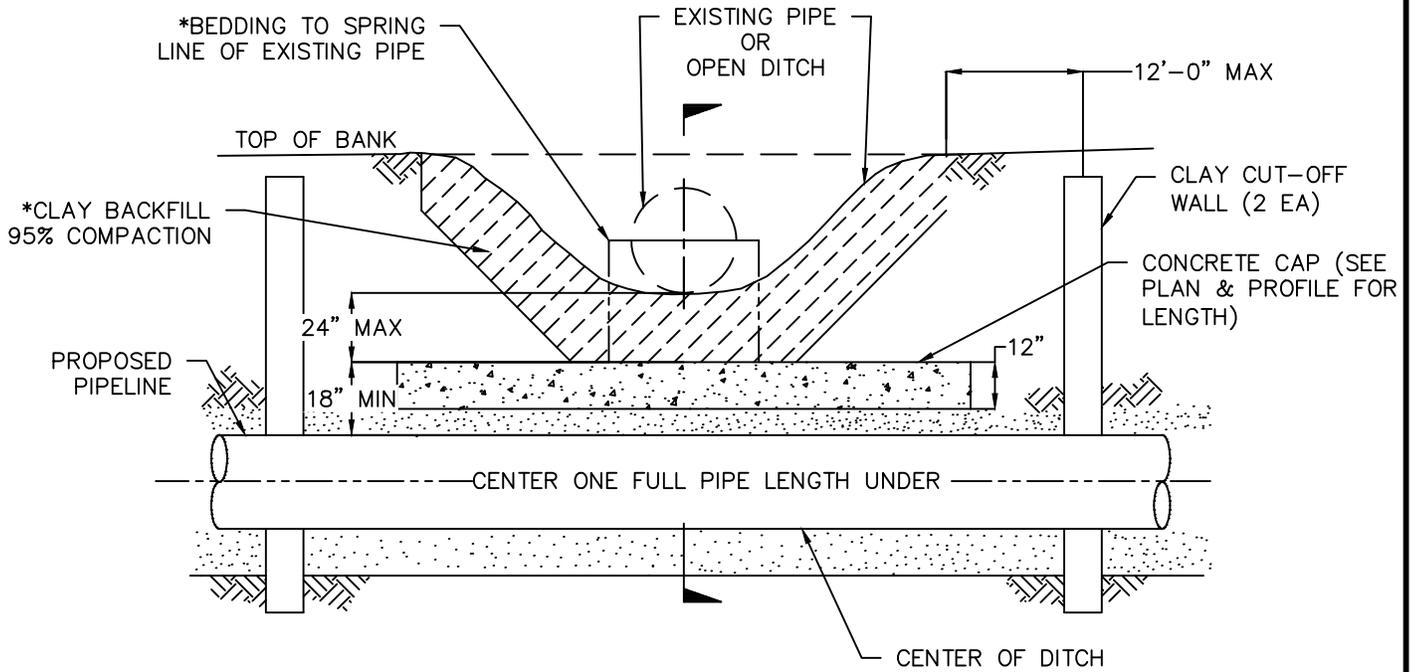
BY: NLH
SCALE: NTS
DATE: 07/2025

DRAWING:

W17



SECTION



PROFILE

*USE CLAY BACKFILL ONLY WHEN CROSSING OPEN DITCH. USE BEDDING MATERIAL TO SPRING LINE OF EXISTING PIPE WHEN CROSSING PIPE.

DITCH OR PIPE CROSSING DETAIL

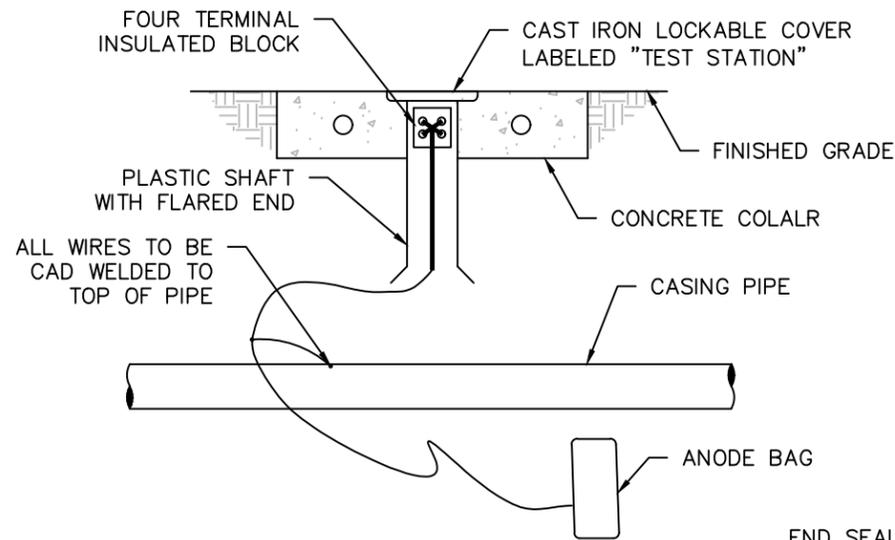


**WATER CONSTRUCTION
DRAWINGS**

BY: JME
SCALE: NTS
DATE: 1/2020

DRAWING:

W18

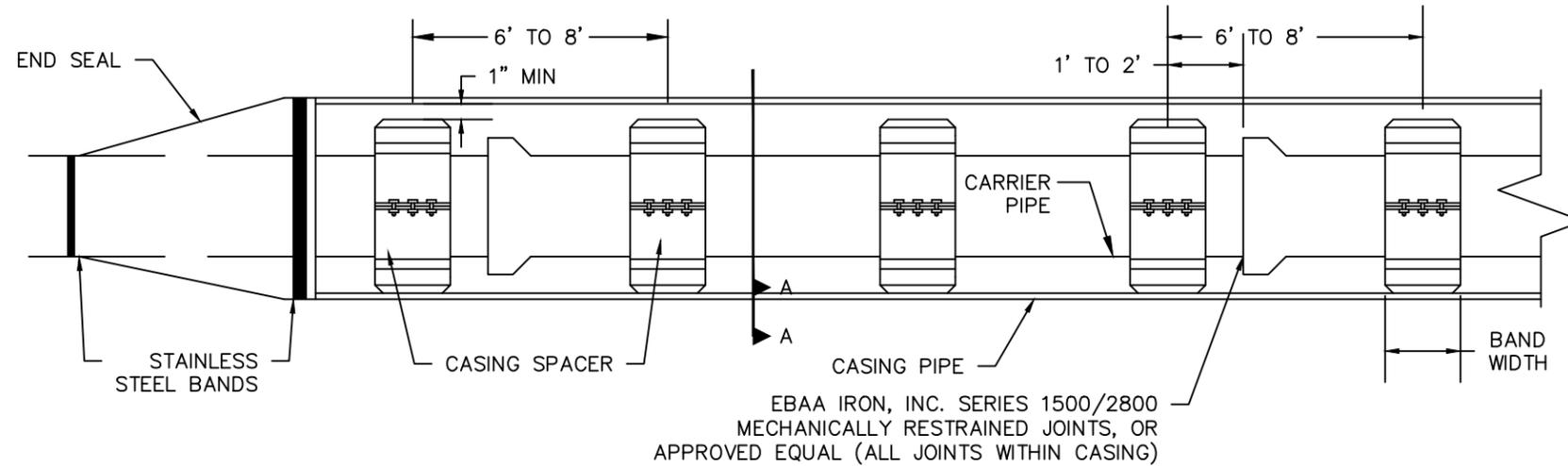


CATHODIC PROTECTION NOTES:

1. INSTALL THE ANODES VERTICALLY OR HORIZONTALLY IN SOIL WITH TOP OF ANODES BELOW THE SPRINGLINE OF THE PIPE. ANODES MUST BE PLACED IN NATIVE SOIL, NOT SELECT BACKFILL SUCH AS SAND, BEDDING, OR CRUSHED ROCK.
2. INSTALL A 17 LB HIGH POTENTIAL MAGNESIUM ANODE BAG ON EACH END OF STEEL CASING PIPES WITH A CATHODIC TEST STATION.
3. STATION TEST WIRES TO BE THHN/THWH.
4. INSTALL A MINIMUM OF 2 FT SLACK AT EACH END OF WIRES.
5. BE CAUTIOUS DURING BACKFILLING. DO NOT DAMAGE OR STRESS WIRES OR CONNECTIONS.
6. ANODES ARE TO BE PLACED AT PIPE DEPTH OR BELOW AND 5' AWAY FROM THE PIPE.

CARRIER PIPE DIAMETER (in)	MINIMUM CASING PIPE INSIDE DIAMETER (in)	BORINGS AND ENCASEMENTS	CASING SPACERS (Y or N)
		STEEL CASING PIPE MIN WALL THICKNESS (in)	
4"	21"	0.375	Y
6"	21"	0.375	Y
8"	21"	0.375	Y
12" TO 20"	30"	0.500	Y

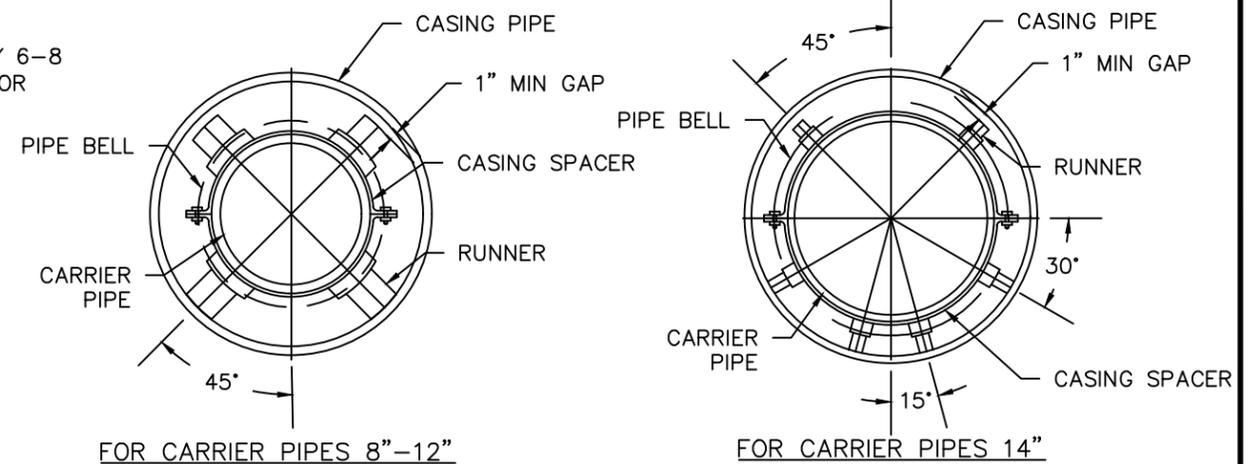
CATHODIC TEST STATION DETAIL



NOTES:

1. CASING PIPE, CASING SPACERS, AND END SEALS TO BE INSTALLED PER WATER CONSTRUCTION SPECIFICATIONS.
2. RECOMMENDED CASING SPACER POSITIONING – PLACE ONE CASING SPACER 1–2 FT ON EITHER SIDE OF THE BELL JOINT AND ONE EVERY 6–8 FT APART THERE AFTER FOR A TOTAL OF 3 CASING SPACERS PER PIPE LENGTH UNLESS OTHERWISE SPECIFIED BY THE MANUFACTURER OR TOWN.
3. FOR 12" DIAMETER AND SMALLER CARRIER PIPES USE 8" CASING SPACER BANDWIDTH.
4. FOR CARRIER PIPES LARGER THAN 12' DIAMETER USE 12" CASING SPACER BANDWIDTH.
5. CASING SPACERS TO BE IN THE "CENTER RESTRAINED" POSITION.
6. ALL BORINGS & ENCASEMENTS WILL REQUIRE END SEALS AS SHOWN.
7. TRACER WIRE SHALL BE EXTENDED THROUGH THE CASING PIPE.

ELEVATION VIEW



SECTION A-A

CASING PIPE DETAIL



WATER CONSTRUCTION DRAWINGS

BY: NLH

SCALE: NTS

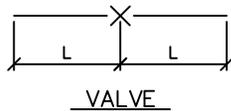
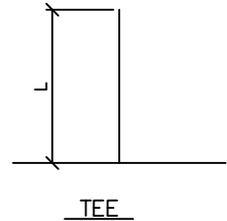
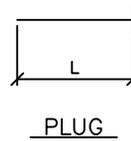
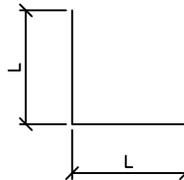
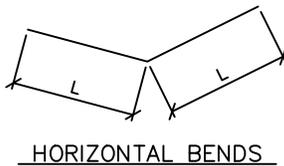
DATE: 07/2025

DRAWING:

W19

ROD DIAMETER, GRADE & LENGTH OF RESTRAINED PIPE

PIPE SIZE	4"			6"			8"			12"			16"			20"			24"		
	D	L	G	D	L	G	D	L	G	D	L	G	D	L	G	D	L	G	D	L	G
90° BEND, TEE, PLUG	3/4"	30'	MS	3/4"	45'	MS	3/4"	60'	MS	3/4"	86'	MS	1"	108'	HS	1 1/4"	132'	HS	-	155'	-
VALVE	-	-	-	-	-	-	-	-	-	-	-	-	1"	108'	HS	1 1/4"	132'	HS	-	155'	-
45° BEND	3/4"	9'	MS	3/4"	13'	MS	3/4"	18'	MS	3/4"	25'	MS	1"	32'	MS	3/4"	39'	HS	-	45'	-
22 1/2° BEND	3/4"	1'	MS	3/4"	4'	MS	3/4"	5'	MS	3/4"	7'	MS	3/4"	8'	MS	3/4"	10'	MS	-	12'	-
11 1/4° BEND	-	-	-	-	-	-	3/4"	1'	MS	3/4"	2'	MS	3/4"	2'	MS	3/4"	3'	MS	-	3'	-



NOTES:

1. LENGTH OF RESTRAINED PIPE MEASURED EACH WAY FROM VALVES AND BENDS.
2. CLAMPS AND RODS NOT ALLOWED FOR 24" & LARGER PIPES.
3. D=DIAMETER, L=LENGTH, G=GRADE, MS=MILD STEEL, HS=HIGH STRENGTH.
4. MIN 4.5' GROUND COVER REQD.
5. BASED ON 150 PSI INTERNAL PRESSURE.
6. MS = MILD STEEL ROD ASTM A 36.
7. HS = HIGH STRENGTH ROD ASTM A 193 GRADE B7.
8. NUTS SHALL BE ASTM A 307 GRADE A OR B HEXAGON HEAVY SERIES. HS NUTS SHALL CONFORM TO MS-22.
9. LENGTH REFERS TO THE AMOUNT OF PIPE WHICH MUST BE RESTRAINED TOGETHER.
10. LENGTH OF RESTRAINED PIPE CHART IS ALSO FOR THE LENGTH OF JOINT RESTRAINT FOR MEGALUGS.
11. TEES & CROSSES MUST BE RESTRAINED IN ALL APPLICABLE DIRECTIONS.
12. 12" AND SMALLER IN LINE VALVES AND TEES SHALL HAVE A MECHANICAL JOINT RESTRAINT DEVICE ON EACH SIDE OF THE FITTING OR VALVE.
13. A SECOND VALVE WILL BE REQD TO BE CLOSED WHEN EXCAVATING NEXT TO A EXIST VALVE.
14. WHEN REDUCERS ARE USED ON VALVE INSTALLATIONS THE LENGTH OF RESTRAINT SHALL BE BASED ON THE SIZE OF THE PIPE NOT THE SIZE OF THE VALVE.
15. ALL REDUCERS/INCREASERS SHALL HAVE MECHANICAL RESTRAINT DEVICES ON EACH SIDE OF FITTING.
16. PIPE JOINT RESTRAINT MAY BE ACCOMPLISHED USING HARNESS RODS, MECHANICAL JOINT RESTRAINT OR RESTRAINED JOINT PIPE AND FITTINGS.
17. AN ANALYSIS OF THE NECESSARY RESTRAINT LENGTH FOR PIPE LARGER THAN 24" SHALL BE SUBMITTED TO THE TOWN ENGINEER FOR REVIEW AND APPROVAL ON A CASE BY CASE BASIS.

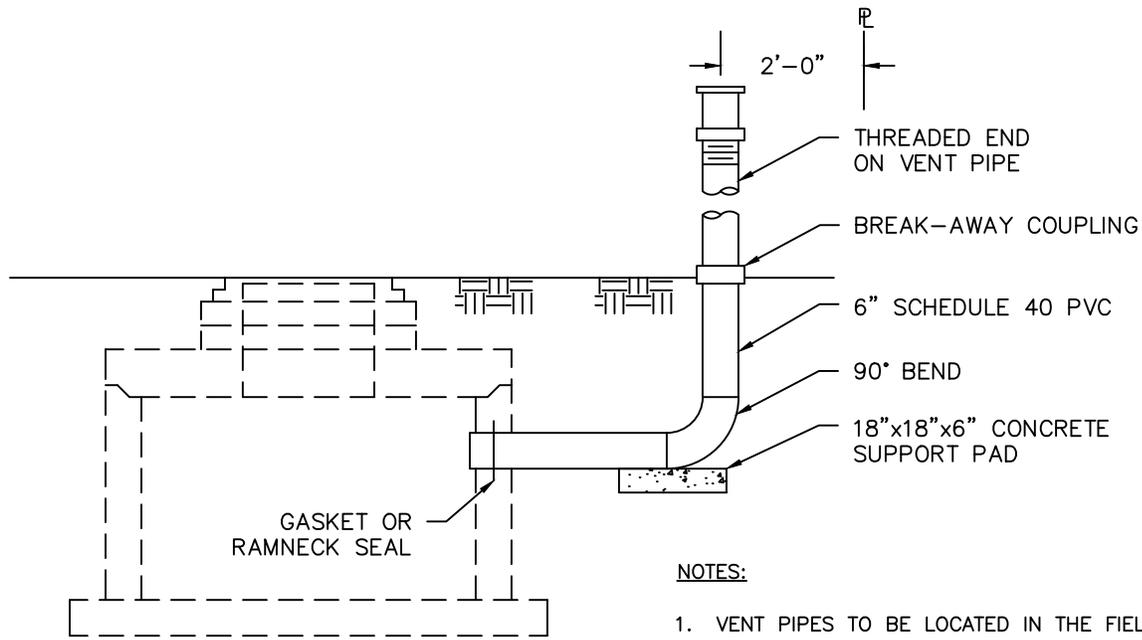
RESTRAINED PIPE LENGTHS



**WATER CONSTRUCTION
DRAWINGS**

BY: JME
SCALE: NTS
DATE: 1/2020

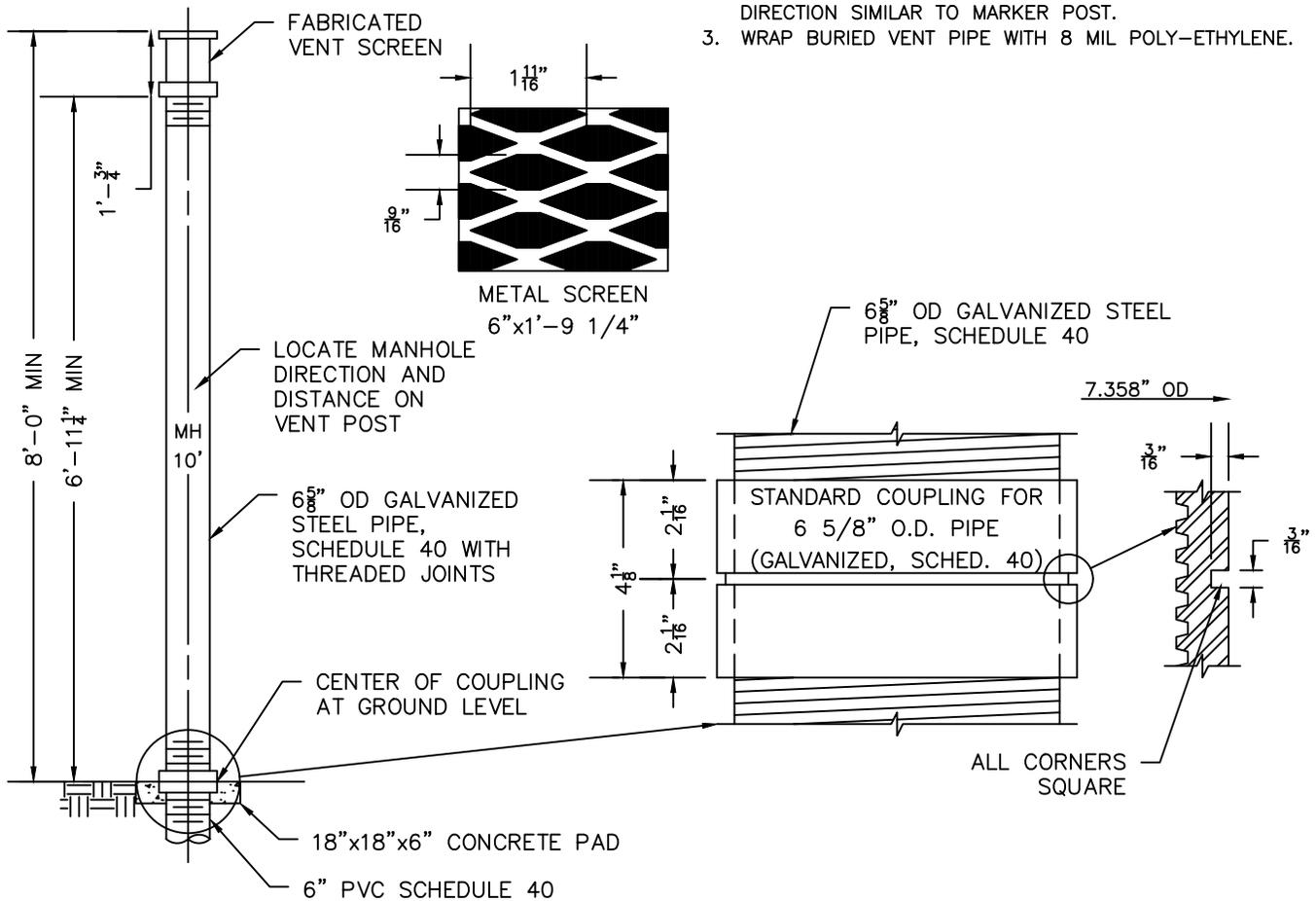
DRAWING:
W20



VENT PIPE INSTALLATION

NOTES:

1. VENT PIPES TO BE LOCATED IN THE FIELD AT THE NEAREST INTERSECTION OF THE STREET PROPERTY LINE AND SIDE LOT LINE.
2. PAINT PIPE AND LOCATE M.H. WITH DISTANCE AND DIRECTION SIMILAR TO MARKER POST.
3. WRAP BURIED VENT PIPE WITH 8 MIL POLY-ETHYLENE.



GALVANIZED STEEL VENT PIPE

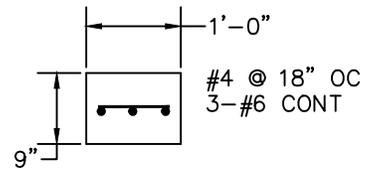
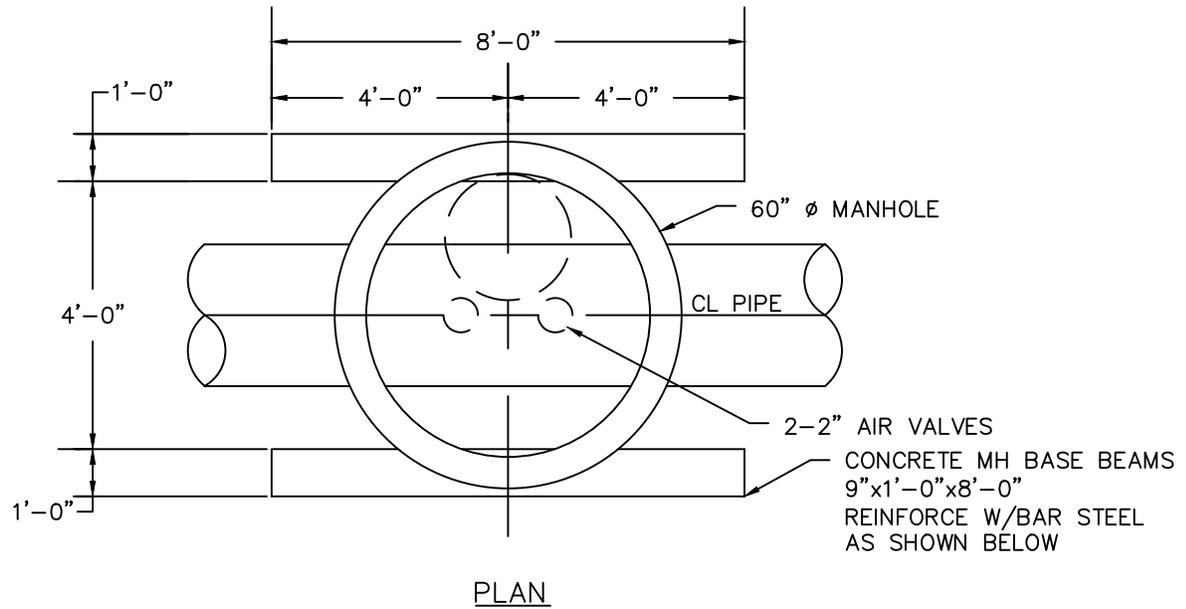
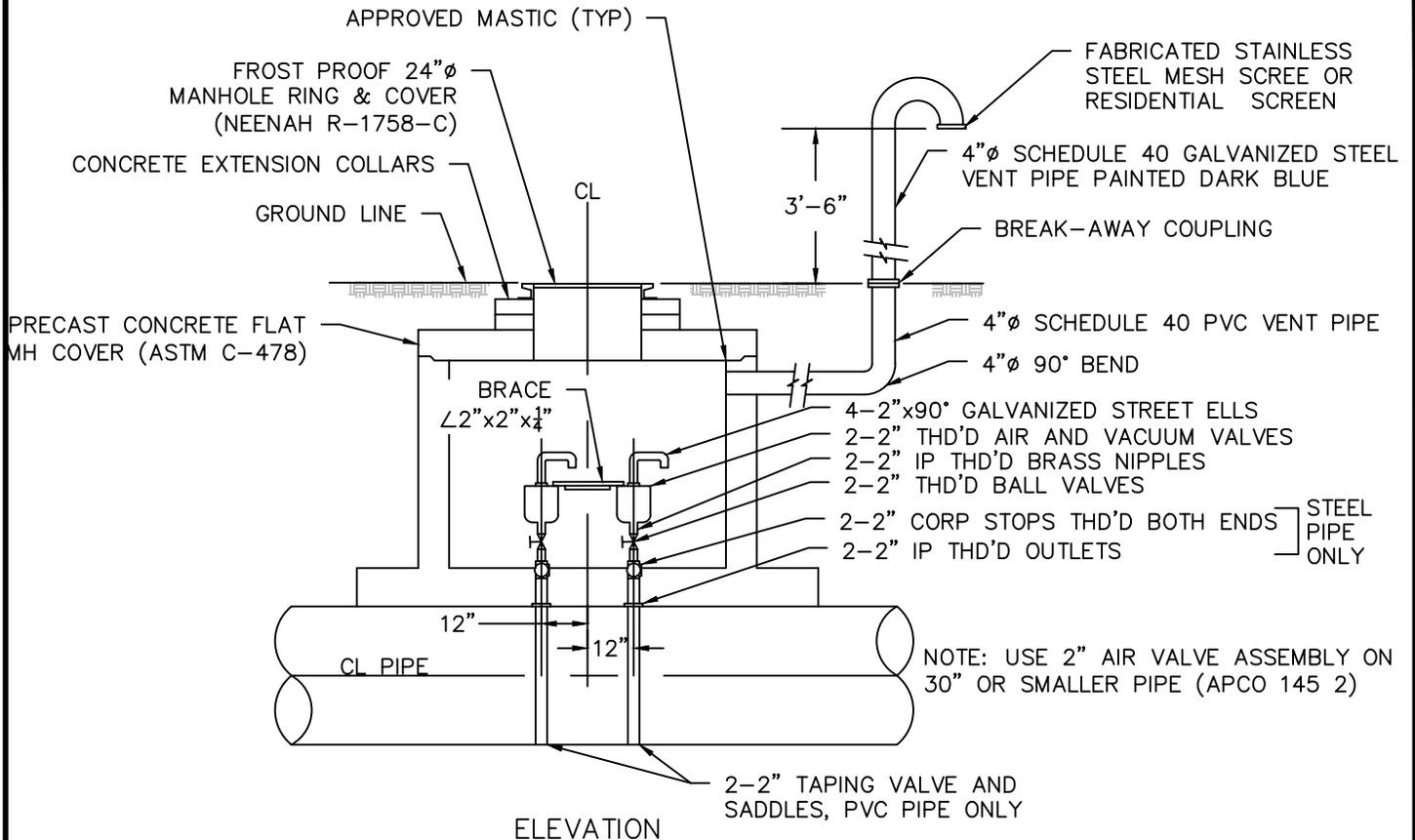


WATER CONSTRUCTION DRAWINGS

BY: JME
SCALE: NTS
DATE: 1/2020

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W21



AIR AND VACUUM VALVE DETAIL

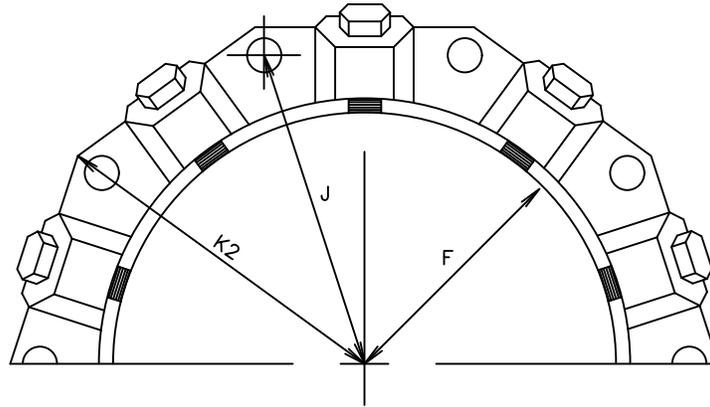


WATER CONSTRUCTION DRAWINGS

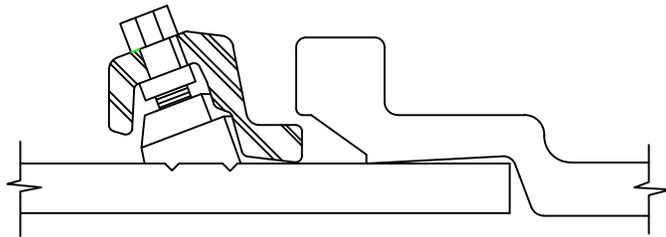
BY: JME
SCALE: NTS
DATE: 1/2020

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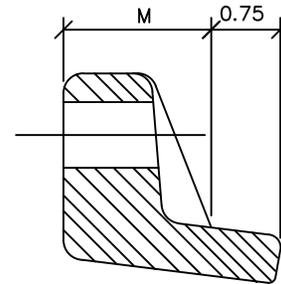
W22



MECHANICAL JOINT RESTRAINT



WEDGE DETAIL



BOLT HOLE DETAIL

DIMENSIONS

	NOMINAL PIPE SIZE	NO. OF BOLTS	NO. OF WEDGES	K2 INCHES	J INCHES	F INCHES	M INCHES	
P V C	4"	2	2					P V C
	6"	6	3	11.12	9.50	7.00	0.88	
	8"	6	4	13.37	11.75	9.15	1.00	
	10"	8	6	15.62	14.00	11.20	1.00	
	12"	8	8	17.88	16.25	13.30	1.25	
D I	4"	4	2					D I
	6"	6	3	11.12	9.50	7.00	0.88	
	8"	6	4	13.37	11.75	9.15	1.00	
	10"	8	6	15.62	14.00	11.20	1.00	
	12"	8	8	17.88	16.25	13.30	1.25	

NOTES:

1. DIMENSIONS FOR 16" AND 20" D.I. PIPE NOT SHOWN.
2. OTHER MECHANICAL JOINT RESTRAINT DEVICES MUST BE APPROVED BEFORE INSTALLATION.

MECHANICAL JOINT RESTRAINT DETAIL

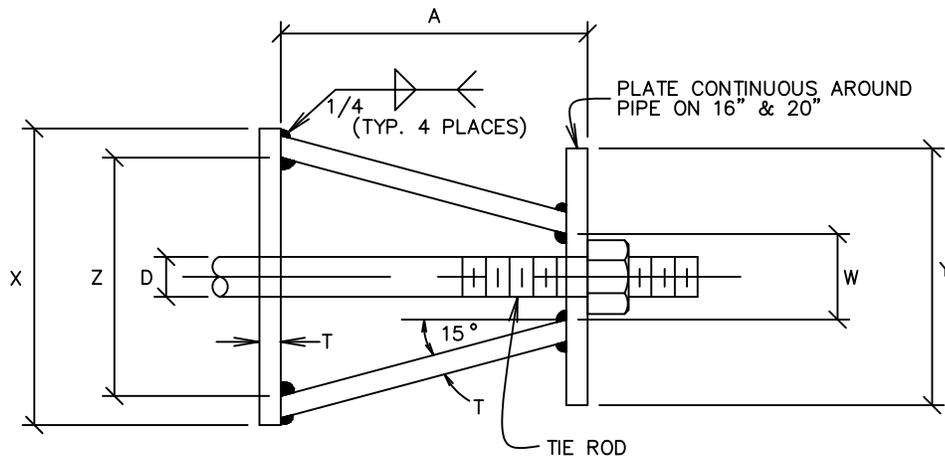


WATER CONSTRUCTION DRAWINGS

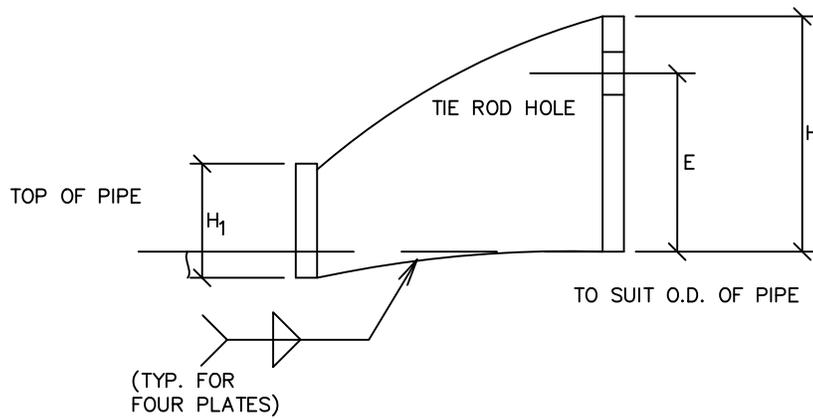
BY: JME
SCALE: NTS
DATE: 1/2020

DRAWING:

W23



TOP VIEW



SIDE VIEW

	CARRIER PIPE NOMINAL DIA.	STUD DIA. D	A	W	Z	T	H	E	H ₁	Y	X
W/O FLANGED LUGS	4" TO 12"	3/4"	5"	1-1/2"	3-3/4"	3/8"	4-1/8"	3-1/8"	2"	4-1/2"	5"
	16"	1"	5-3/4"	1-3/4"	4-1/2"	1/2"	4-1/2"	3-1/4"	2"	RING	6"
	20"	1-1/4"	7-1/2"	2"	5-3/4"	5/8"	5"	3-3/4"	2-1/2"	RING	7-1/2"

NOTES:

1. USE TWO HIGH-STRENGTH STEEL TIE-RODS AT END OF CASING.
2. TIE-ROD HOLE DIAMETER $\frac{1}{8}$ " LARGER THAN STUD DIAMETER.
3. BOTTOM EDGE OF ALL PLATES SHAPED TO FIT O.D. OF PIPE.
4. HARNESS LUGS AS PER AWWA MANUAL M-11.

COMBINATION FLANGED HARNESS LUG DETAIL

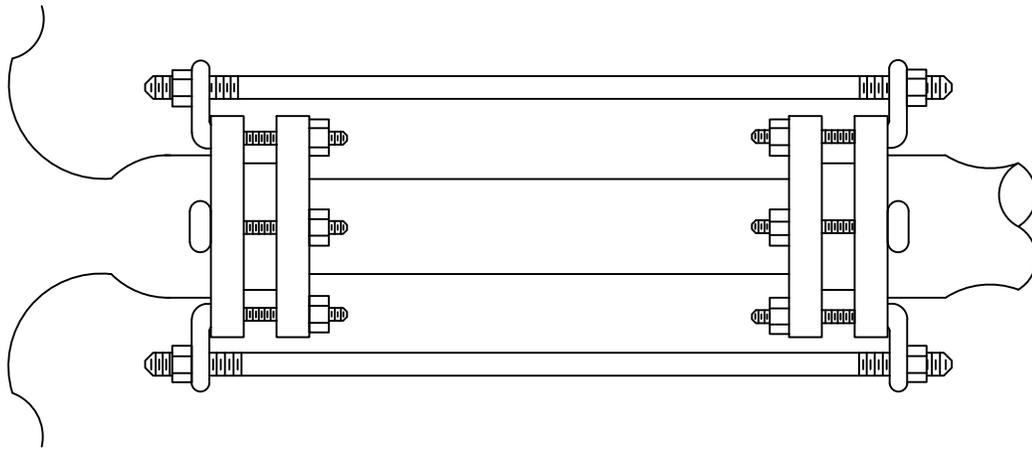


WATER CONSTRUCTION
DRAWINGS

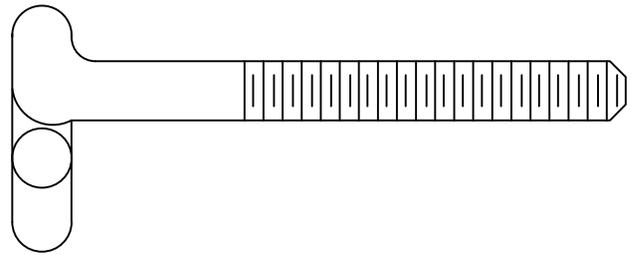
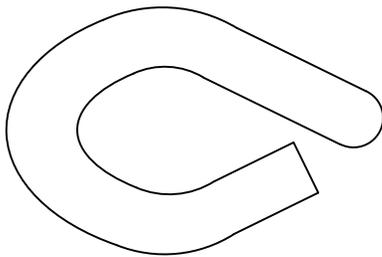
BY: JME
SCALE: NTS
DATE: 1/2020

DRAWING:

W24



PLAN



DETAIL

DIMENSIONS

ALLOWABLE PIPE DIAMETER INCHES	BOLT SIZE	NO . OF BOLTS REQUIRED
4	3/4"	2
6	3/4"	2
8	3/4"	2
10	3/4"	4
12	3/4"	6

NOTES:

1. THE BOLT SHALL BE MANUFACTURED OF "COR-TEN" OR APPROVED EQUAL.
2. THE BOLT MAY BE HEAT TREATED.

JOINT RESTRAINT DETAIL

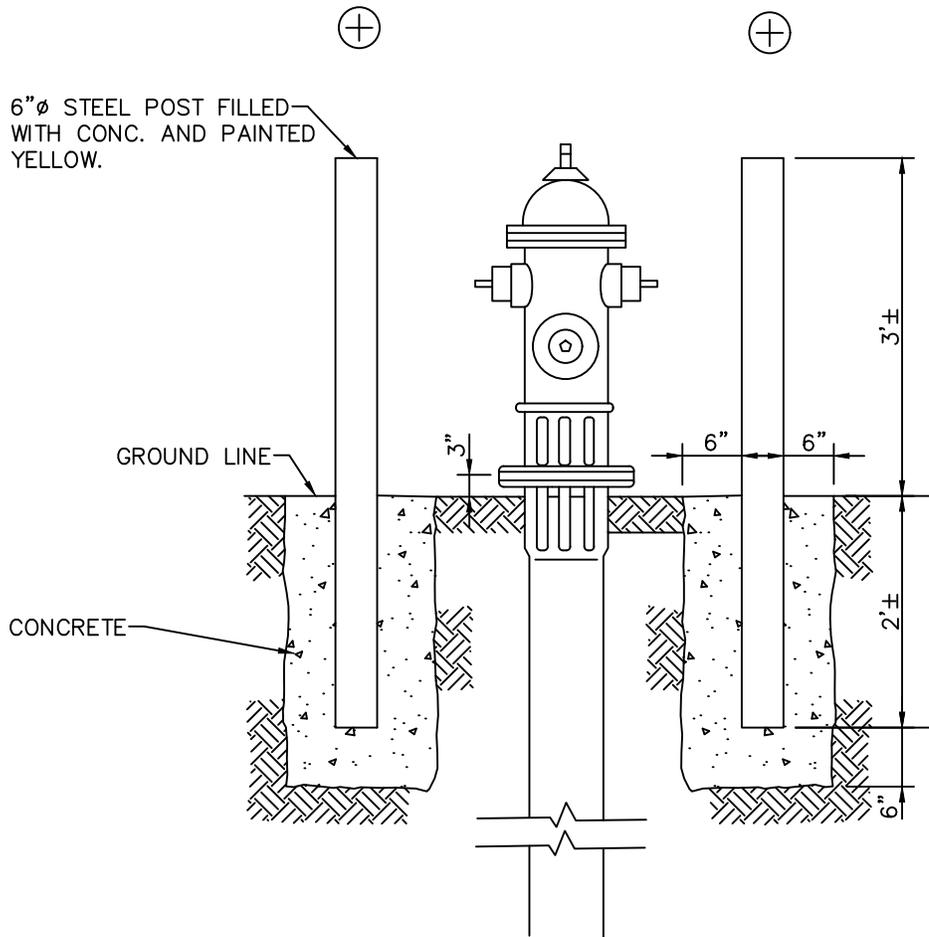
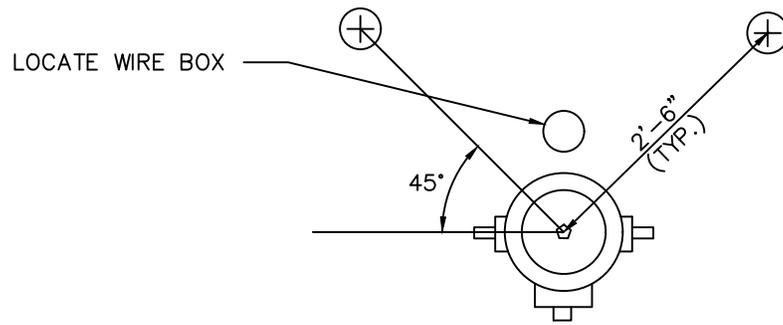


**WATER CONSTRUCTION
DRAWINGS**

BY: JME
SCALE: NTS
DATE: 1/2020

DRAWING:

W25



NOTES:

1. TO BE USED IN COMMERCIAL OR INDUSTRIAL AREAS WHERE HYDRANTS ARE UNPROTECTED FROM TRAFFIC FLOW.
2. STEAMER CONNECTION ON FIRE HYDRANT SHOULD FACE THE STREET.

FIRE HYDRANT GUARDS

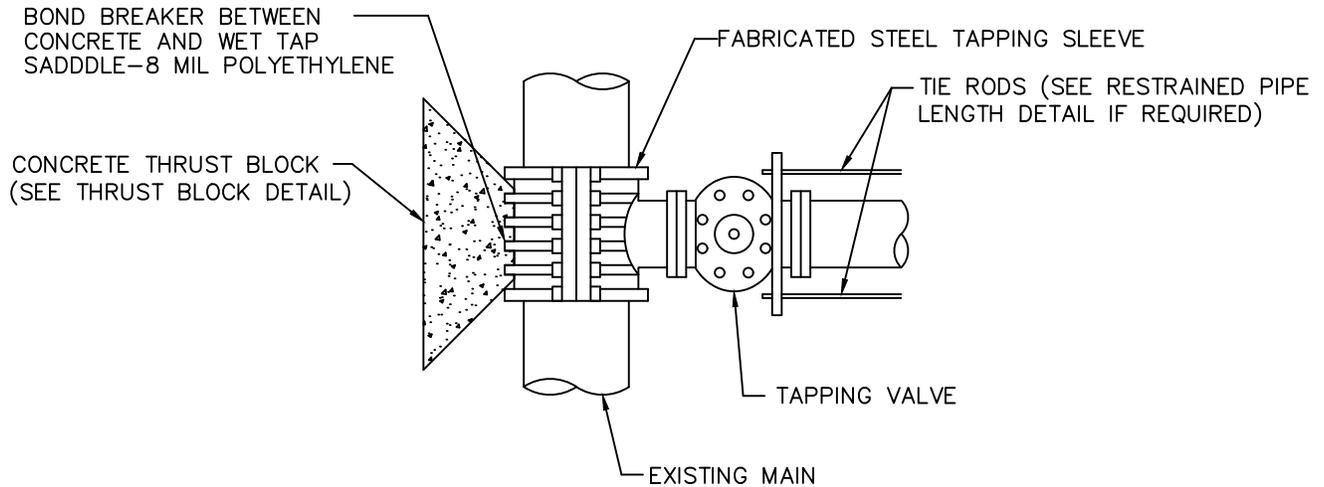


**WATER CONSTRUCTION
DRAWINGS**

BY: JME
SCALE: NTS
DATE: 1/2020

DRAWING:

W26



NOTES:

1. FABRICATED STEEL TAPPING SLEEVE SHALL BE:

ROMAC FTS419 OR APPROVED EQUAL TO BE USED FOR PVC UP TO 75% OF EXISTING MAIN

ROMAC FTS420 OR APPROVED EQUAL TO BE USED FOR DIP UP TO 75% OF EXISTING MAIN

ROMAC FTS425 OR APPROVED EQUAL TO BE USED ON ALL AC PIPE AND ANYTIME A BRANCH

LINE IS GREATER THAN 75% OF EXISTING MAIN

TAPPING TEE AND VALVE



**WATER CONSTRUCTION
DRAWINGS**

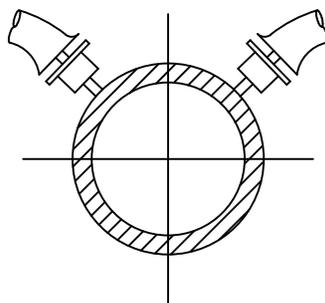
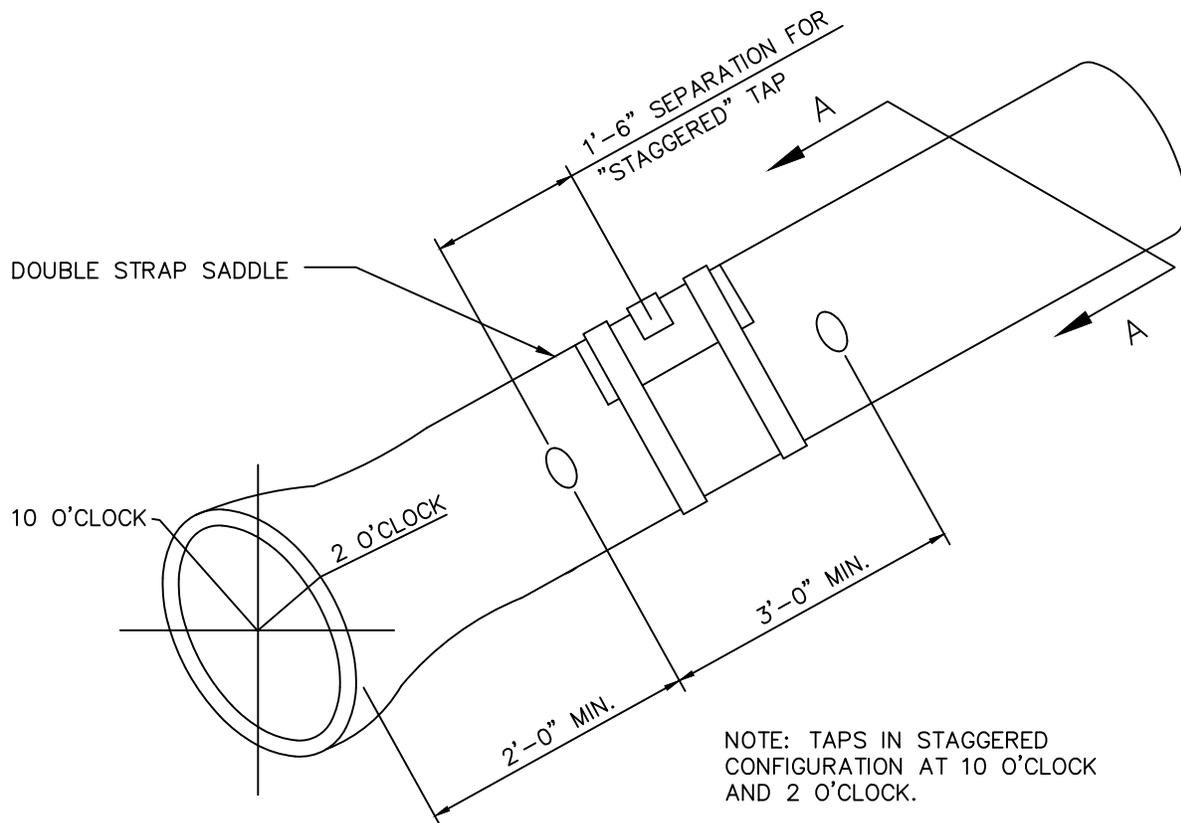
BY: JME

SCALE: NTS

DATE: 1/2020

DRAWING:

W27



SECTION A-A

NOTE:

SERVICE TAP – WATER SERVICE TAP SHALL BE MADE AT EITHER THE 2 O'CLOCK OR THE 10 O'CLOCK POSITION ON THE CIRCUMFERENCE OF A WATER MAIN. THE MINIMUM DISTANCE BETWEEN A TAP MADE AT THE 2 O'CLOCK POSITION AND THE ONE MADE AT THE 10 O'CLOCK POSITION SHALL BE 18" MEASURED ALONG THE PIPE. THE MINIMUM DISTANCE BETWEEN SUCCESSIVE TAPS MADE EITHER AT THE 2 O'CLOCK OR THE 10 O'CLOCK POSITION SHALL BE 3'. THE MINIMUM DISTANCE FROM EITHER THE BELL OR SPIGOT END OF A PIPE TO TAP SHALL BE 2'. A MAXIMUM OF 4 WATER SERVICE TAPS SHALL BE ALLOWED PER LENGTH OF PIPE. DOUBLE STRAP SADDLE (ROMAC 202B OR APPROVED EQUAL) SHALL BE USED FOR ALL SERVICE TAPS.

DOMESTIC WATER TAPPING DETAIL

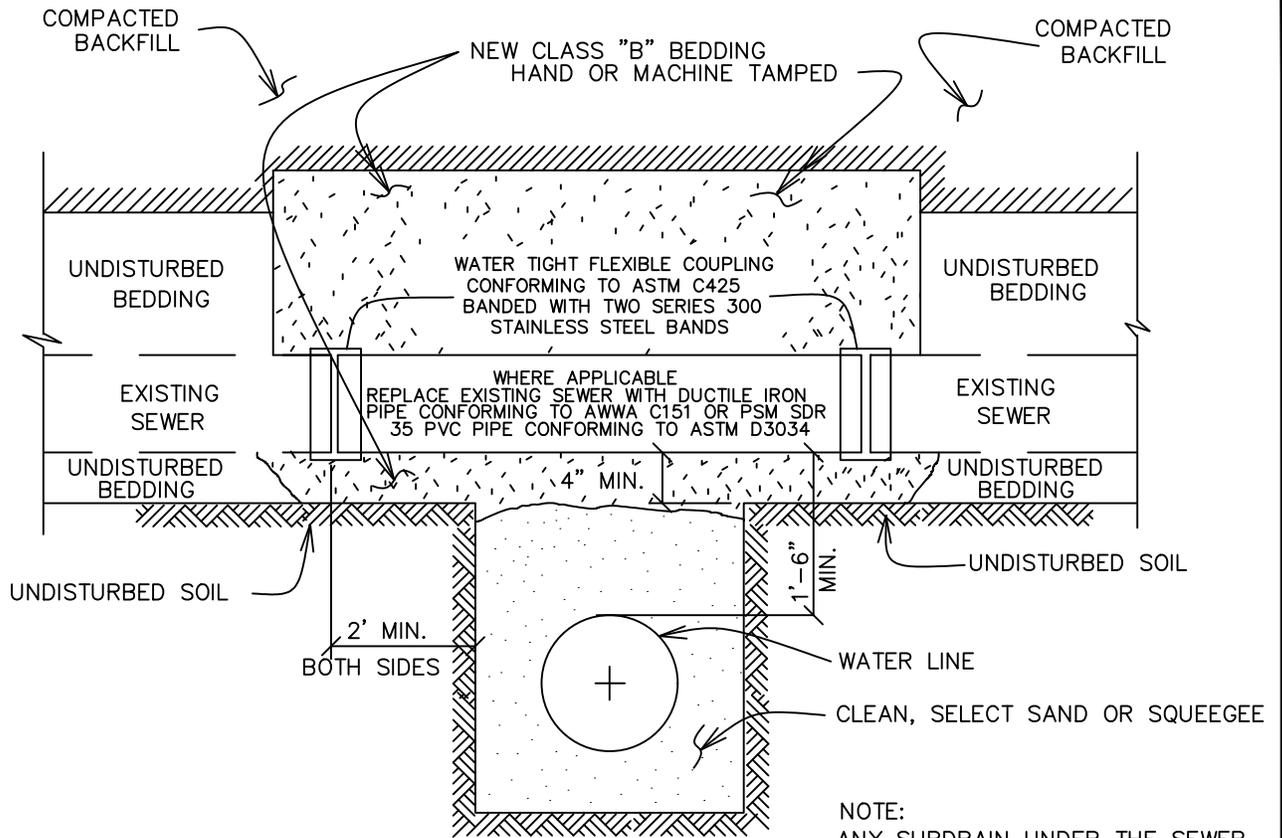


**WATER CONSTRUCTION
DRAWINGS**

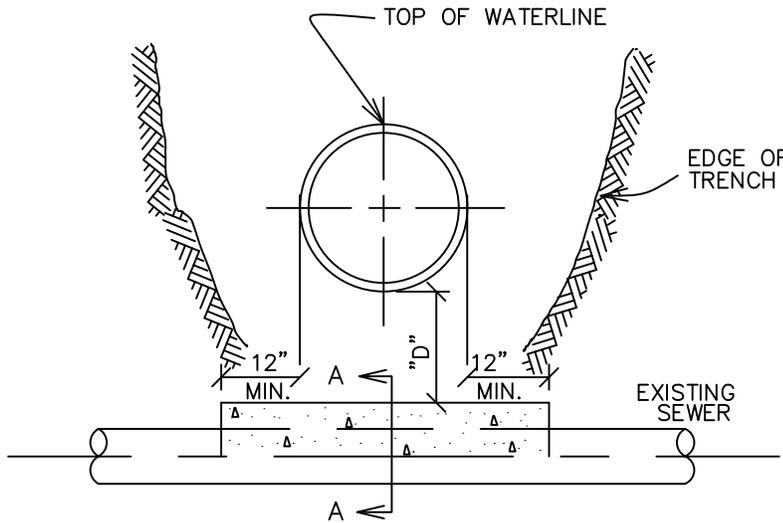
BY: JME
SCALE: NTS
DATE: 1/2020

DRAWING:

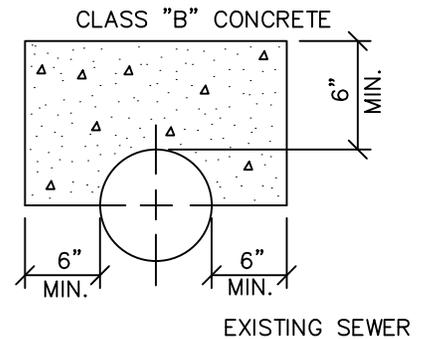
W28



NOTE:
 ANY SUBDRAIN UNDER THE SEWER SHALL BE REPLACED SUCH THAT NO FLOW SHALL ENTER THE WATER LINE TRENCH.



SEWER CROSSING UNDER
 WITH "D" LESS THAN 2'



SECTION A-A

NOTE:
 ALL EXISTING SEWER DAMAGED DURING INSTALLATION
 MUST BE REPLACED WITH PVC PIPE

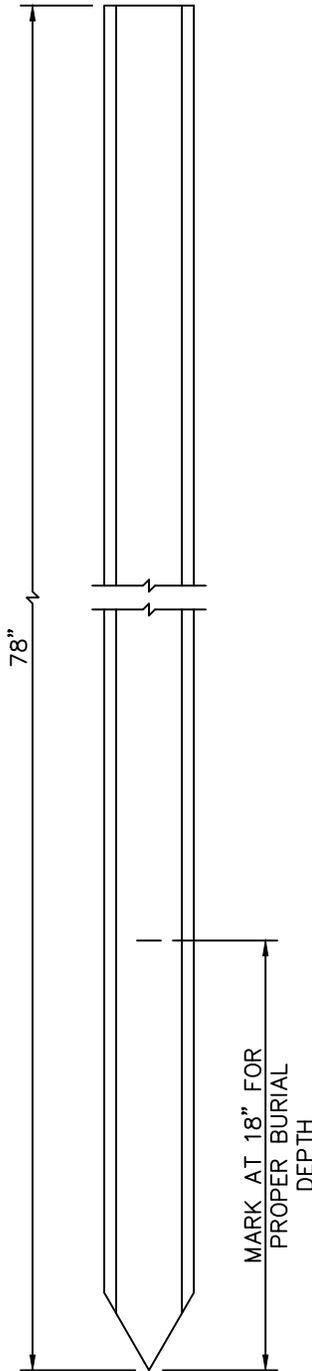
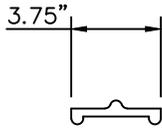
CROSSING STORM AND SANITARY SEWERS



WATER CONSTRUCTION
 DRAWINGS

BY: JME
 SCALE: NTS
 DATE: 1/2020

DRAWING:
W29



FIBERGLASS MARKER POST

4" DIA. STEEL POST PAINTED BLUE, FILLED WITH CONCRETE

12" SIZE (12 INCHES)

G.V. OBJECT (GATE VALVE)

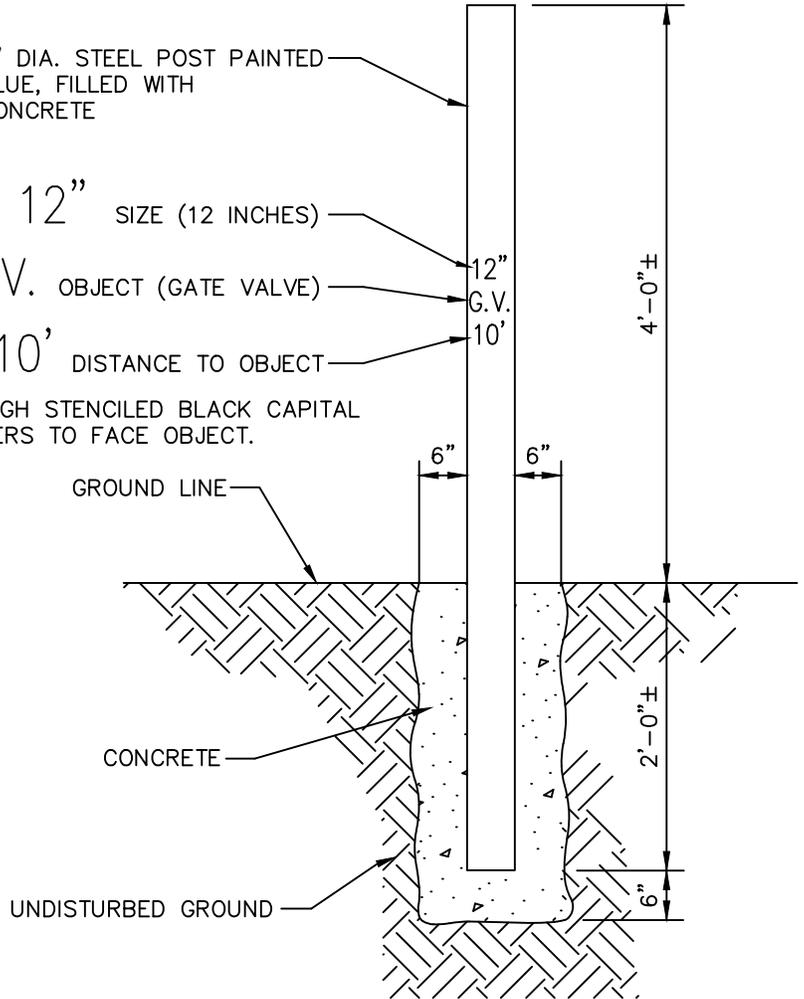
10' DISTANCE TO OBJECT

2" HIGH STENCILED BLACK CAPITAL LETTERS TO FACE OBJECT.

GROUND LINE

CONCRETE

UNDISTURBED GROUND



STEEL MARKER POST

NOTES:

1. FIBERGLASS MARKER POST SHALL BE CARSONITE CUM-375 OR EQUAL IWTH ANCHORS AND APPROPRIATE DECALS FOR WATER.
2. COLOR FOR WATER - BLUE
3. COLOR FOR NON-POTABLE - PURPLE

MARKER POST



WATER CONSTRUCTION DRAWINGS

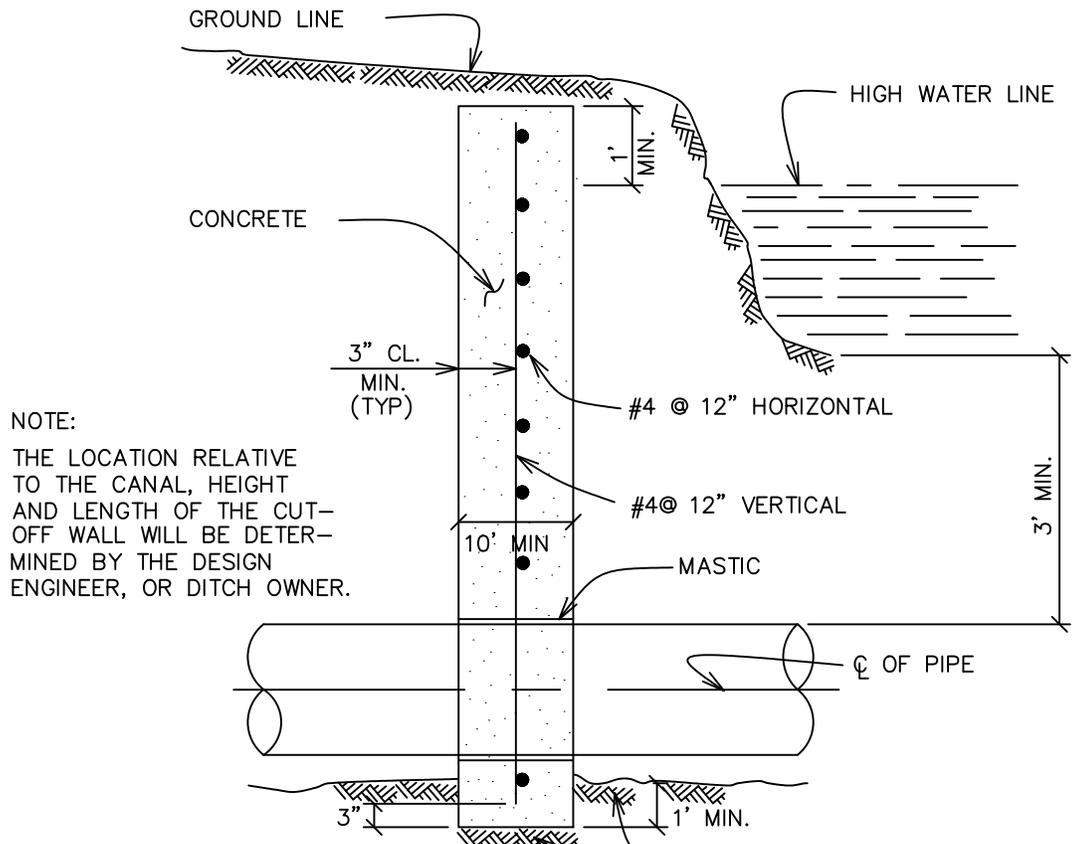
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DATE: 1/2020

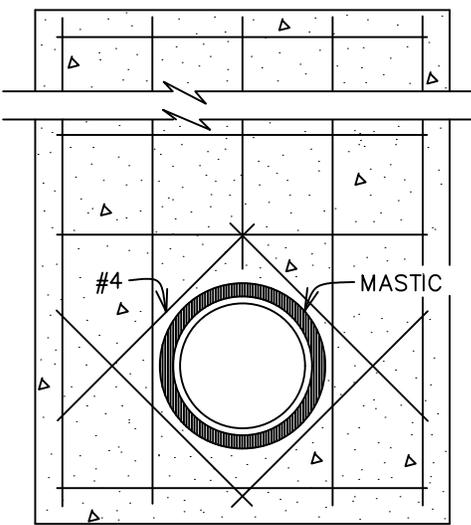
DRAWING:

W30

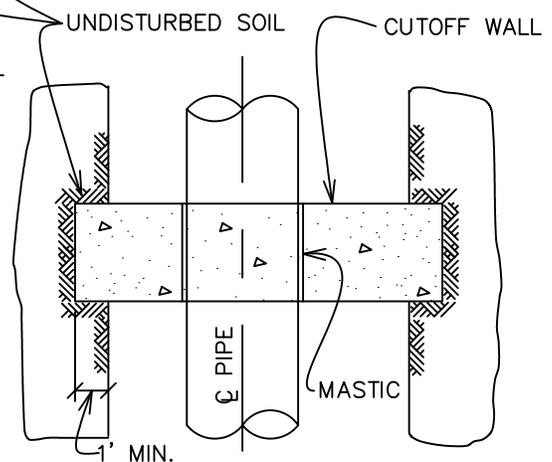


NOTE:
 THE LOCATION RELATIVE
 TO THE CANAL, HEIGHT
 AND LENGTH OF THE CUT-
 OFF WALL WILL BE DETER-
 MINED BY THE DESIGN
 ENGINEER, OR DITCH OWNER.

SIDE VIEW



FRONT VIEW



NOTE:
 REINFORCEMENT
 NOT SHOWN.

TOP VIEW

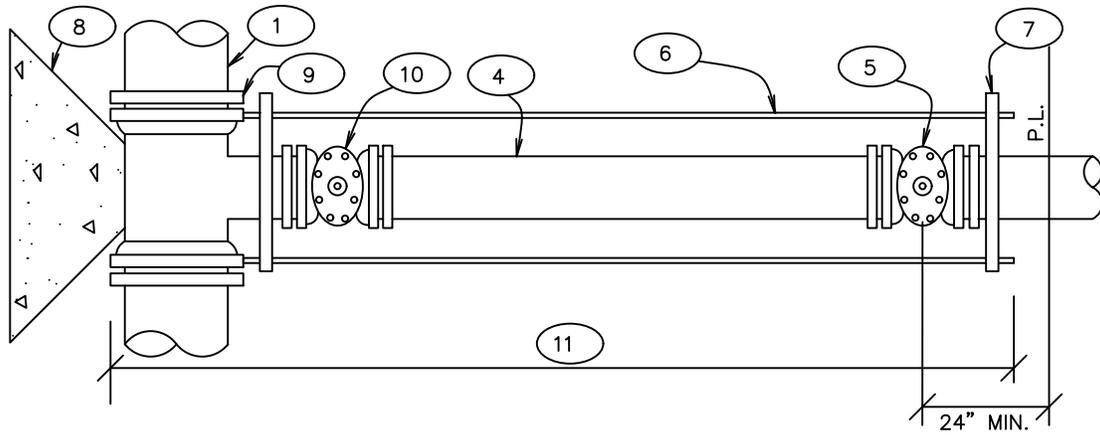
TYPICAL CUTOFF WALL FOR DITCH CROSSING



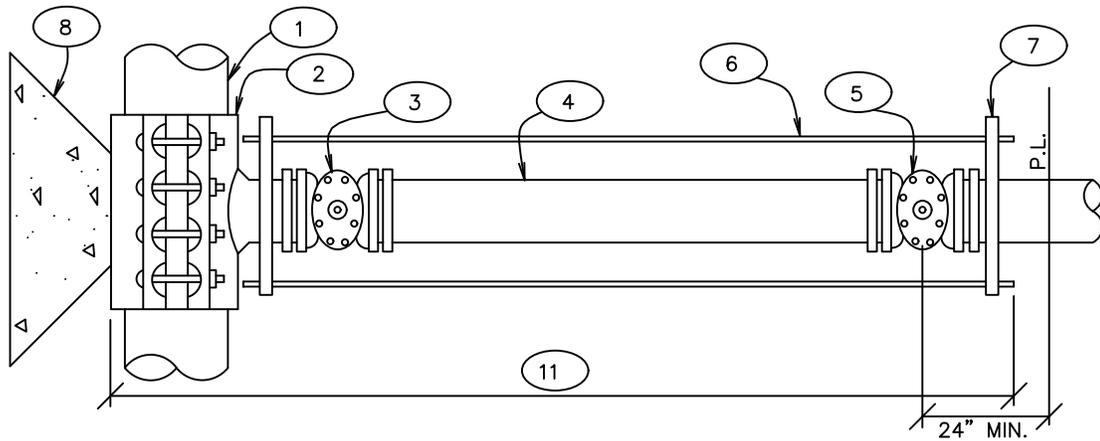
WATER CONSTRUCTION
 DRAWINGS

BY: JME
 SCALE: NTS
 DATE: 1/2020

DRAWING:
W31



FIRELINE OR DOMESTIC CONNECTION WITH MAIN EXTENSION



FIRELINE OR DOMESTIC CONNECTION

- | | | | |
|---|--|----|--|
| 1 | EXISTING MAIN | 8 | CONCRETE KICKBLOCK |
| 2 | TAPPING SLEEVE | 9 | M.J. ANCHORING TEE (SWIVEL TEE WHERE APPLICABLE) |
| 3 | TAPPING VALVE | 10 | M.J. VALVE |
| 4 | DOUBLE SPIGOT PIPE | 11 | POLYETHYLENE WRAPPED |
| 5 | PROPERTY LINE VALVE | | |
| 6 | TIE RODS (MEGALUGS MAY BE USED IN PLACE OF RODDING.) | | |
| 7 | PIPE CLAMP | | |

2" AND LARGER DOMESTIC AND FIRELINE CONNECTIONS

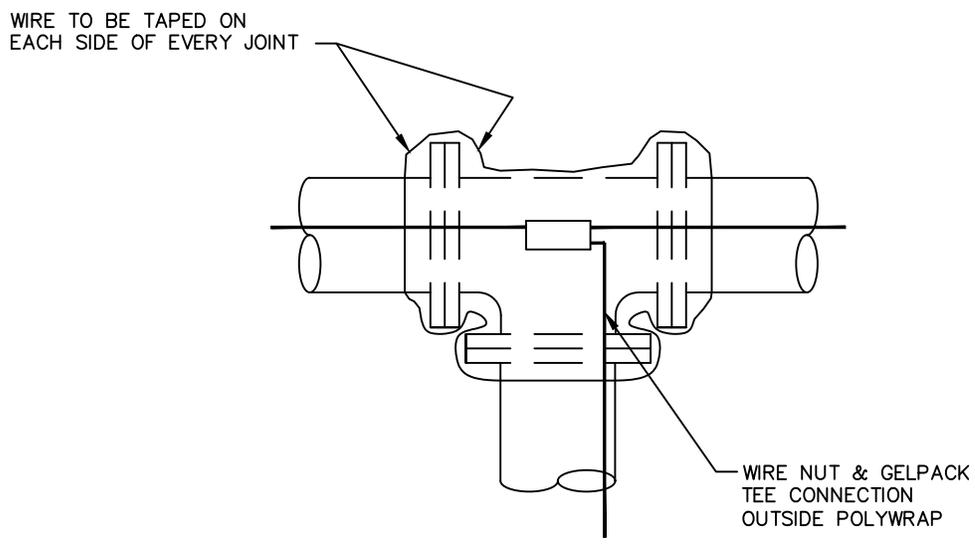
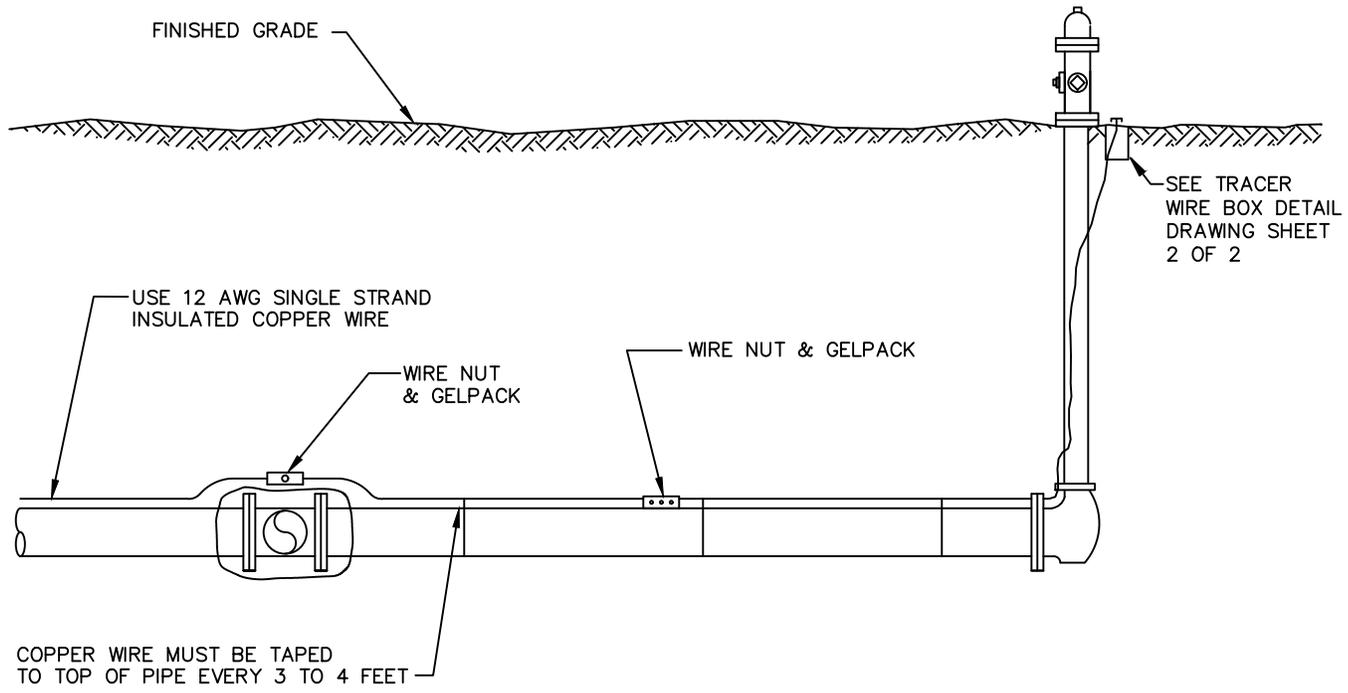


WATER CONSTRUCTION
DRAWINGS

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DATE: 1/2020

DRAWING:

W32



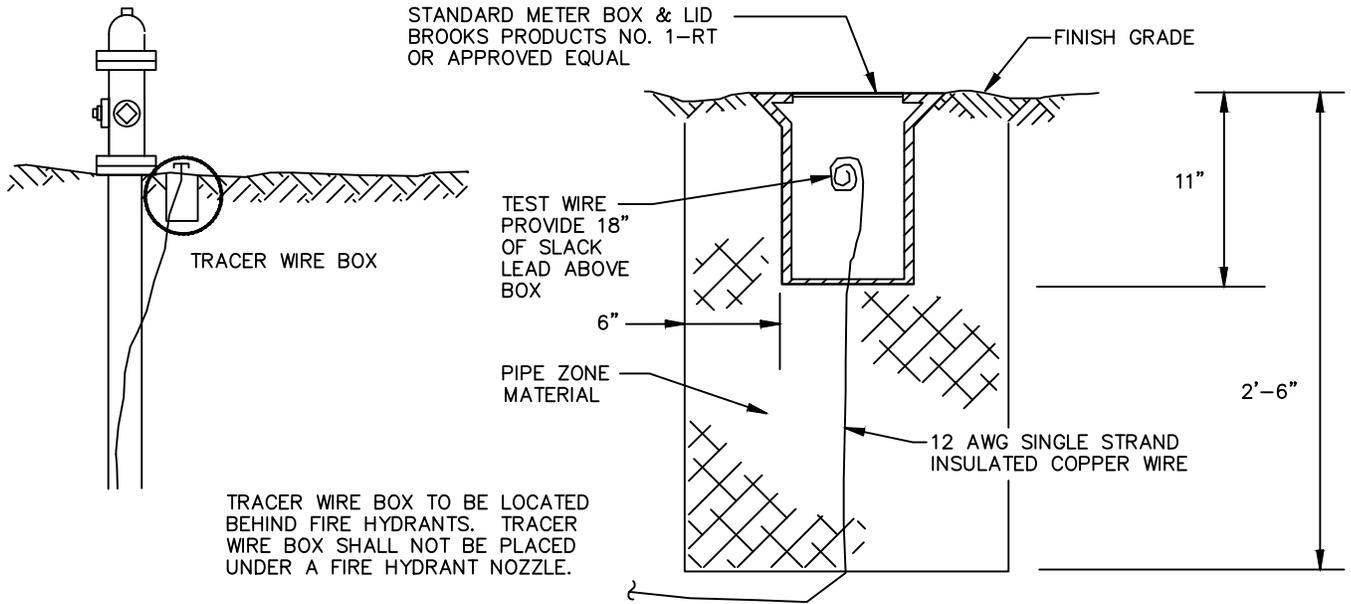
TRACER WIRE (1 OF 2)



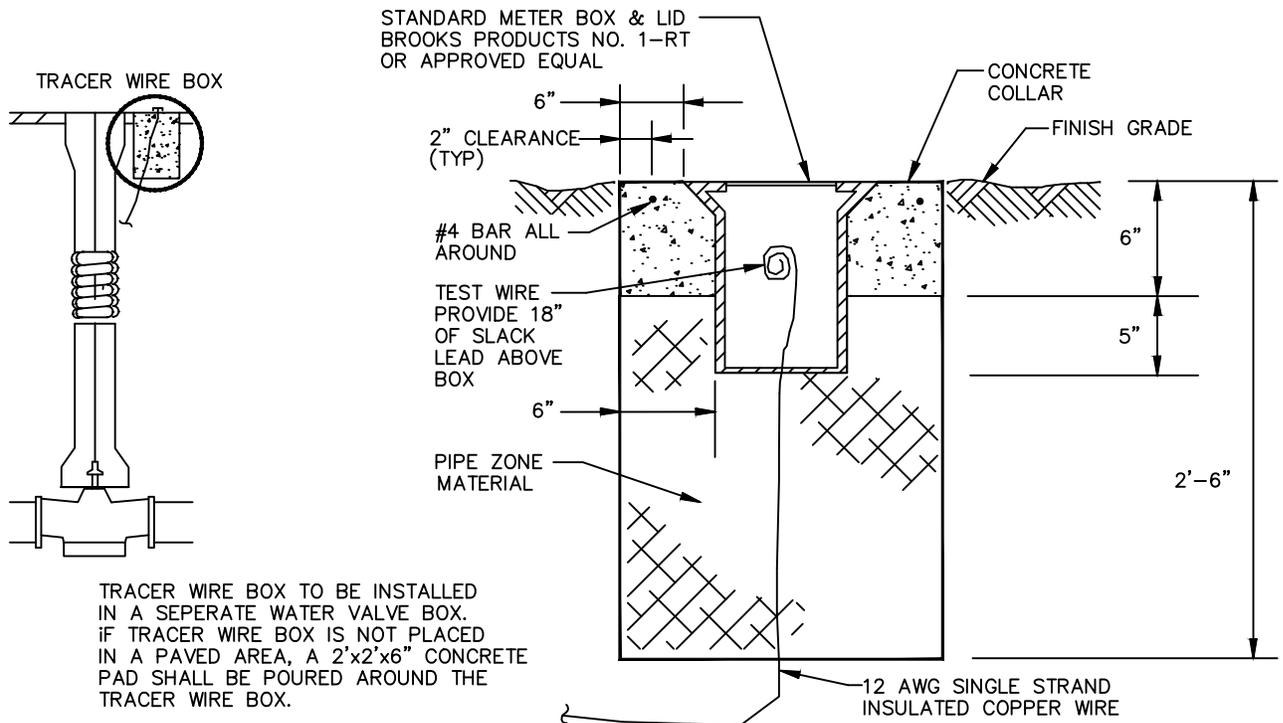
WATER CONSTRUCTION DRAWINGS

BY: JME
 SCALE: NTS
 DATE: 1/2020

DRAWING:
W33A



TRACER WIRE BOX AT FIRE HYDRANT



TRACER WIRE BOX FOR AREA WITH NO FIRE HYDRANT

TRACER WIRE (2 OF 2)



WATER CONSTRUCTION
DRAWINGS

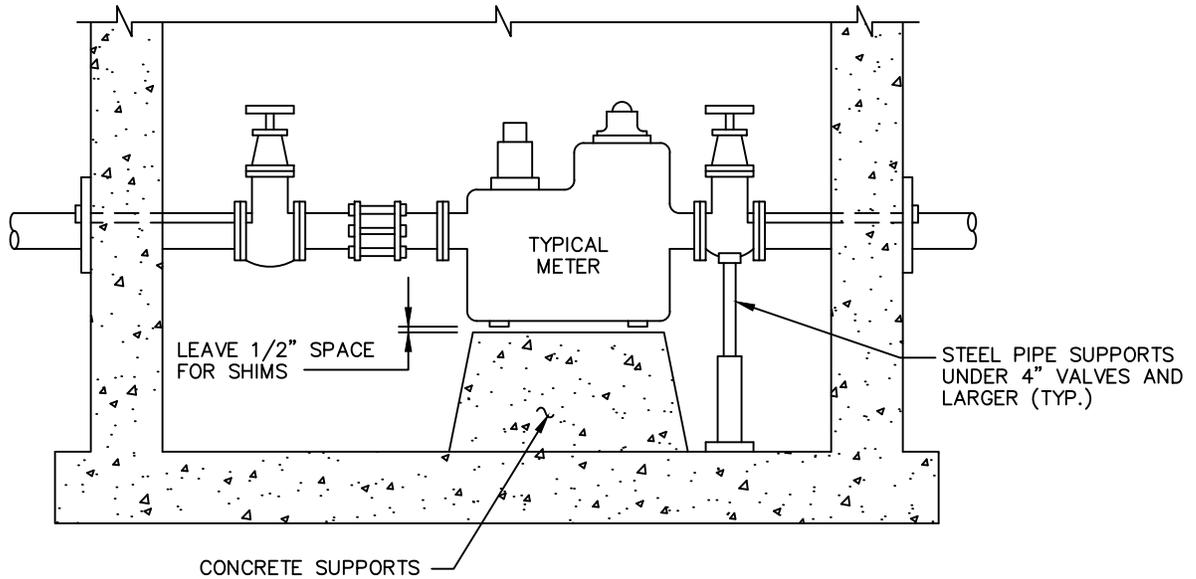
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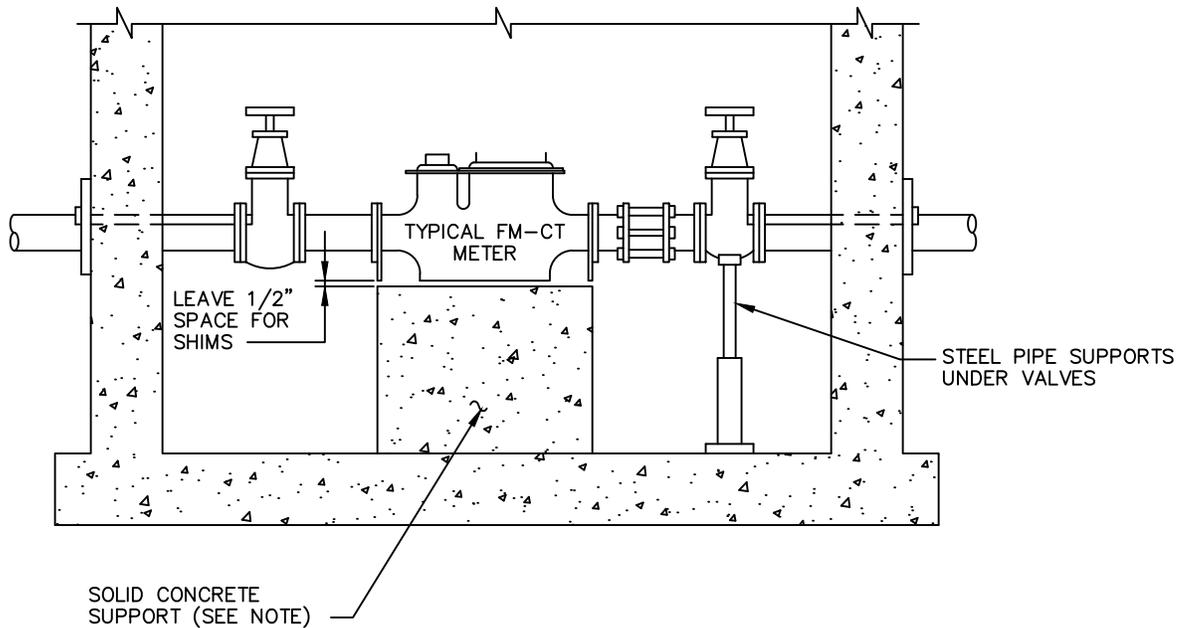
DATE: 1/2020

DRAWING:

W33B



TYPICAL CONCRETE METER SUPPORTS
FOR 2", 3", 4", 6", 8", & 10" METERS



TYPICAL CONCRETE METER SUPPORTS
FOR F.M.-C.T. METERS

NOTE:
SOLID CONCRETE BASE EXTENDS UNDER
THE FM-CT METER BY PASS FOR 6",
8", AND 10".

SIZE OF CONCRETE SUPPORT
6" FM-CT W=3'-9" L=3'-0"
8" FM-CT W=4'-5" L=3'-8"
10" FM-CT W=5'-8" L=4'-8"

CONCRETE METER SUPPORTS



WATER CONSTRUCTION
DRAWINGS

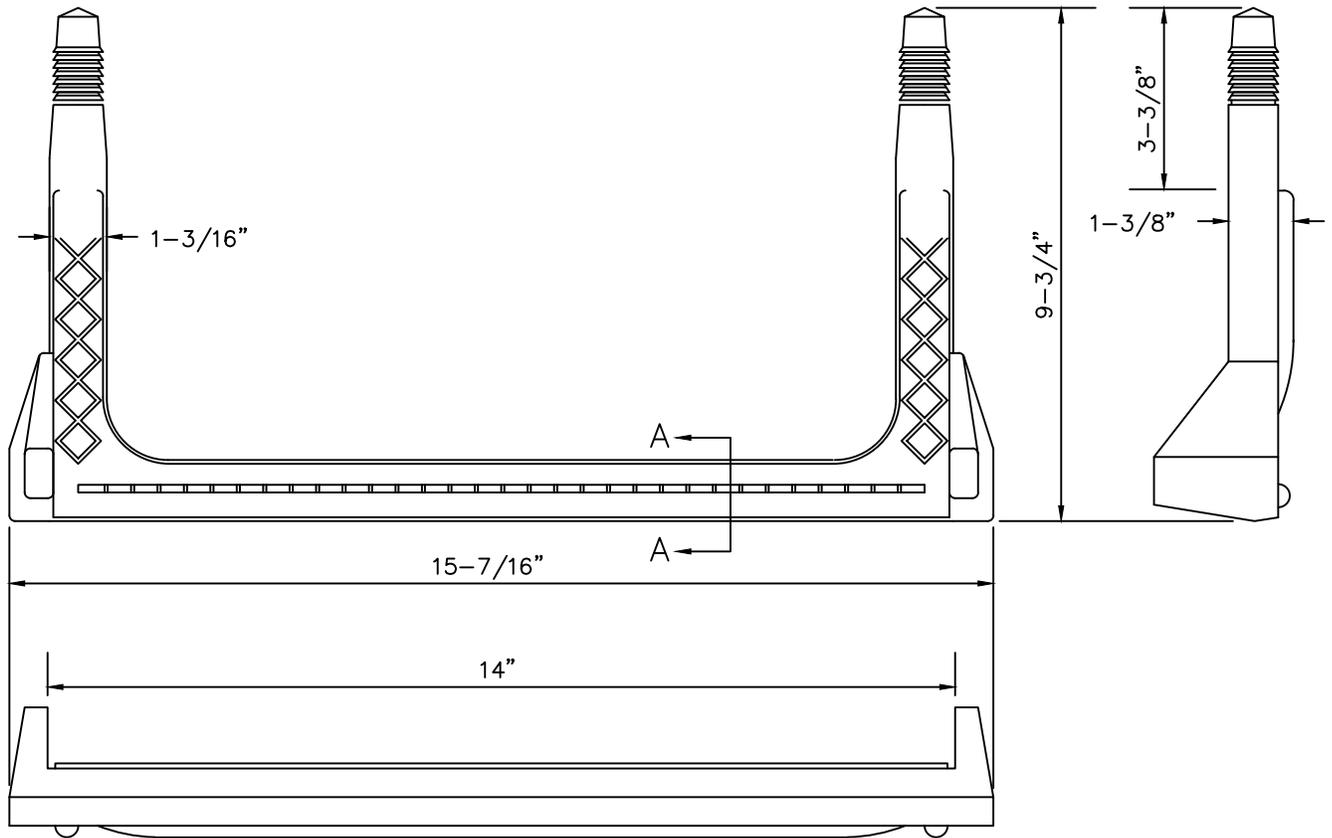
BY: JME

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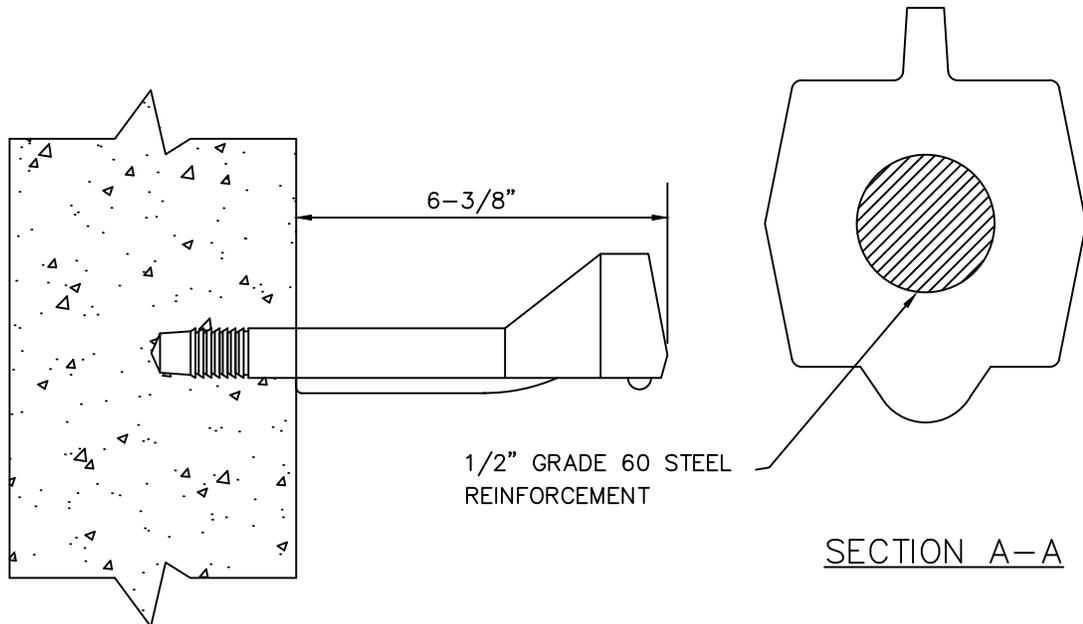
DATE: 1/2020

DRAWING:

W34



COPOLYMER POLYPROPYLENE PLASTIC



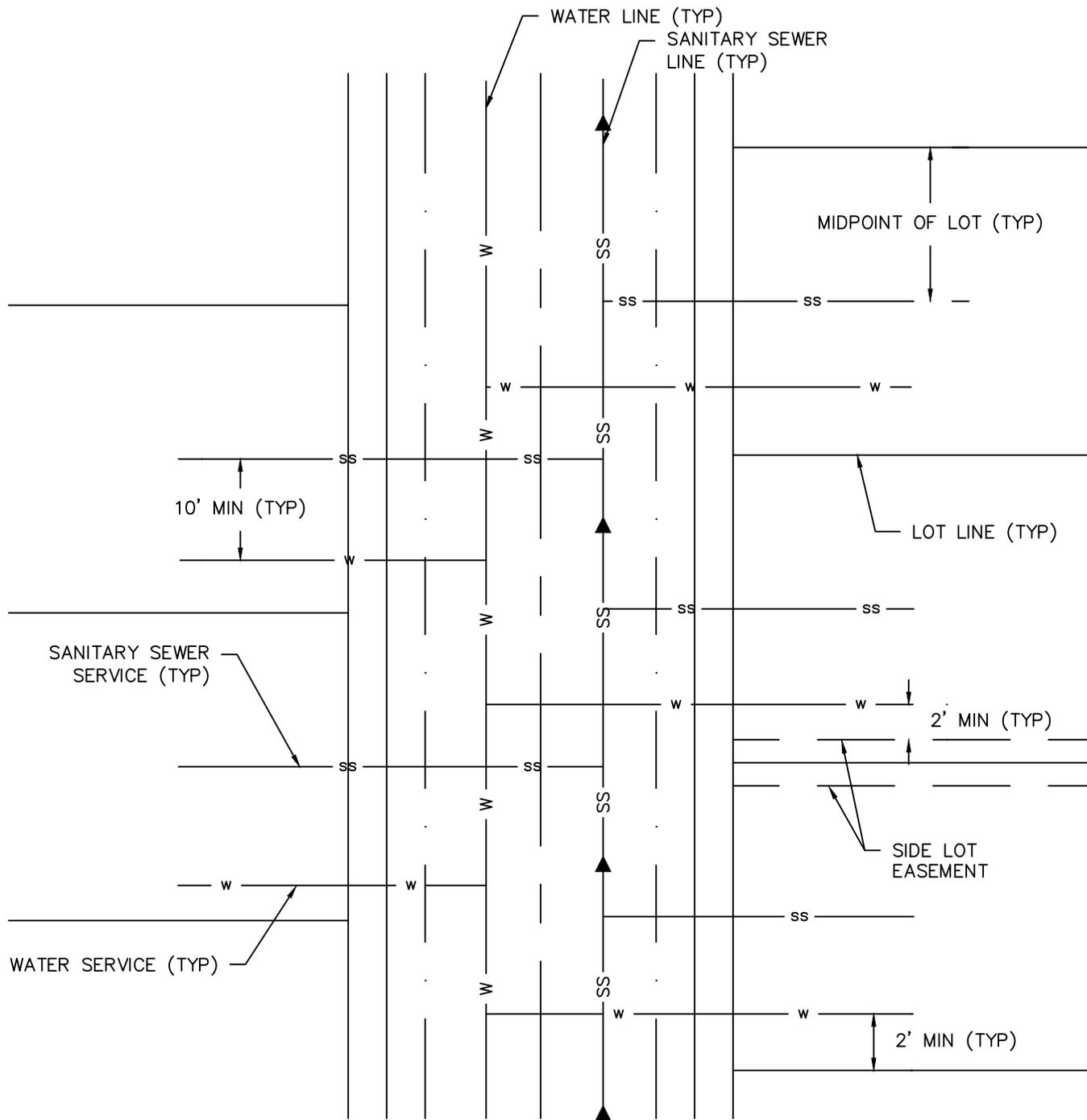
PLASTIC STEP



**WATER CONSTRUCTION
DRAWINGS**

BY: JME
SCALE: NTS
DATE: 1/2020

**DRAWING:
W35**



NOTES:

1. SANITARY SEWER SERVICES SHALL BE INSTALLED IN THE CENTER OF THE LOT PER THE ST. VRAIN SANITATION DISTRICT STANDARDS.
2. WATER SERVICES SHALL BE INSTALLED A MINIMUM OF 10 FEET FROM THE SEWER SERVICE.
3. WATER SERVICES SHALL NOT BE LOCATED UNDER DRIVEWAYS.
4. STAMP AN "S" AND A "W" IN THE FACE OF CURB (4" HEIGHT) AT THE LOCATION OF THE WATER AND SANITARY SEWER SERVICE LOCATIONS, "S" FOR SEWER AND "W" FOR WATER.

WATER AND SEWER SERVICE LOCATIONS

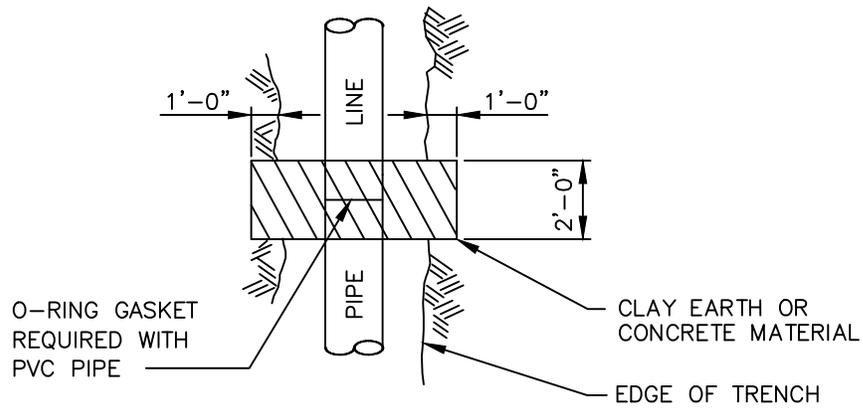


**WATER CONSTRUCTION
DRAWINGS**

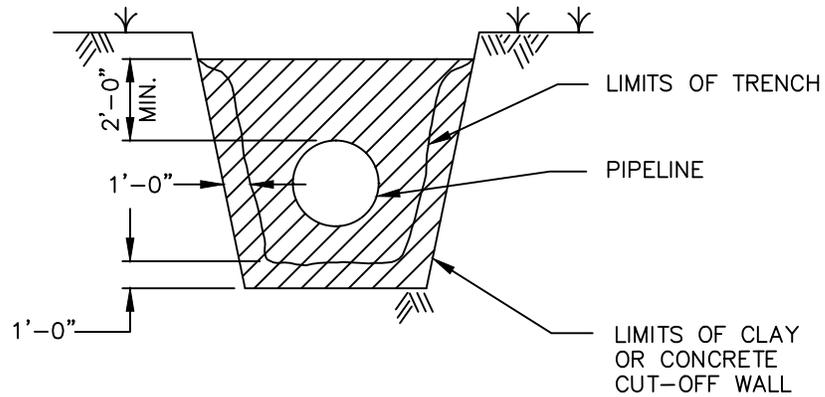
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SCALE: NTS
DATE: 1/2020

DRAWING:

W36



PLAN



SECTION

NOTES:

1. CLAY OR CONCRETE WALL EXTENDS A MINIMUM OF 12" INTO UNDISTURBED SOIL ON EACH SIDE AND ON BOTTOM OF TRENCH.
2. CLAY MATERIAL TO BE CLASSIFIED AS CL, CH OR OH.
3. APPROVED FLOW-FILL MATERIAL MAY BE USED INSTEAD OF CLAY MATERIAL.

CLAY OR CONCRETE CUT-OFF WALL



**WATER CONSTRUCTION
DRAWINGS**

BY: JME
SCALE: NTS
DATE: 1/2020

DRAWING:

W37

GENERAL METER NOTES

1. LOCATION OF THE METER TO BE ESTABLISHED BY THE DEVELOPMENT ENGINEER.
2. ALL SETTINGS MUST BE INSPECTED BY THE RESIDENT PROJECT REPRESENTATIVE.
3. IF THE STREET OR GROUND IS NOT TO OFFICIAL GRADE AT THE TIME OF INSTALLATION OF THE METER, THE OWNER MUST RAISE OR LOWER THE METER VAULT WHEN THE FINAL GRADE IS ESTABLISHED.
4. LEADED JOINTS AND GALVANIZED PIPING SHALL NOT BE ALLOWED INSIDE THE METER VAULTS.
5. A BYPASS IS TO BE INSTALLED ON 1-1/2" AND LARGER METERS UNLESS OTHERWISE SPECIFIED.
6. THE SERVICE LINE THROUGH AND ON BOTH SIDES OF THE METER PIT MUST BE OF THE SAME MATERIAL.
7. NO CONNECTIONS SHALL BE MADE IN THE METER PIT. SPRINKLER CONNECTIONS MUST BE MADE MORE THAN FIVE (5) FEET FROM THE METER PIT ON THE DOWNSTREAM SIDE.
8. GATE VALVES:
 - A. ALL GATE VALVES UNDER 3" FOR USE W/COPPER PIPE SHALL BE ALL BRONZE, W/ NON-RISING STEMS AND SOLID WEDGE DISC, MANUFACTURED IN ACCORDANCE WITH A.S.T.M. SPEC. B62 AND FEDERAL SPEC. W.W.-V-54 CLASS A, 125PSI W.S.P., 200PSI W.O.G. OR CURB STOPS IN ACCORDANCE WITH AWWA C800 AND MS-23 OF THE MATERIAL SPECIFICATIONS.
 - B. ALL GATE VALVES 3" AND LARGER SHALL CONFORM WITH THE TOWN OF FIRESTONE'S STANDARD SPECIFICATIONS.
9. ALL DRESSER (OR APPROVED EQUAL) COUPLINGS SHALL HAVE THE PIPE STOP REMOVED.

WATER METER NOTES



WATER CONSTRUCTION
DRAWINGS

BY: JME

SCALE: NTS

DATE: 1/2020

DRAWING:

W38

GENERAL NOTES – CONSTRUCTION

1. ALL CONSTRUCTION SHALL CONFORM TO THE LATEST "DESIGN STANDARDS AND CONSTRUCTION SPECIFICATIONS FOR PUBLIC IMPROVEMENTS" BY THE TOWN OF FIRESTONE. COPIES OF THE STANDARDS AND SPECIFICATIONS MAY BE OBTAINED FROM THE TOWN WEB SITE. CONTRACTOR SHALL HAVE A SET ON SITE AT ALL TIMES.
2. THE OWNER SHALL SCHEDULE A PRE-CONSTRUCTION MEETING WITH THE TOWN OF FIRESTONE ENGINEERING STAFF PRIOR TO THE START OF CONSTRUCTION. THOSE IN ATTENDANCE SHALL INCLUDE THE OWNER, HIS ENGINEER, THE TOWN ENGINEERING STAFF, REPRESENTATIVES OF THE CONTRACTORS AND OTHER AFFECTED AGENCIES. PLANS SIGNED AND ACCEPTED BY THE TOWN WILL BE DISTRIBUTED AT THE PRE-CONSTRUCTION MEETING. CONTRACTOR SHALL HAVE (1) COPY OF THE SIGNED PLANS ON SITE AT ALL TIMES.
3. THE TOWN OF FIRESTONE, THROUGH ACCEPTANCE OF THIS DOCUMENT, ASSUMES NO RESPONSIBILITY FOR THE COMPLETENESS AND/OR ACCURACY OF THIS DOCUMENT. THE OWNER AND DESIGN ENGINEER UNDERSTAND THAT THE RESPONSIBILITY FOR THE ENGINEERING ADEQUACY OF THE FACILITIES DEPICTED IN THIS DOCUMENT LIES SOLELY WITH THE REGISTERED PROFESSIONAL ENGINEER WHOSE STAMP AND SIGNATURE ARE AFFIXED TO THIS DOCUMENT. REPORT ALL DISCREPANCIES TO THE DESIGN ENGINEER IMMEDIATELY.
4. PRIOR TO BEGINNING THE WORK, THE CONTRACTOR SHALL OBTAIN ANY/ALL WRITTEN AGREEMENTS FOR INGRESS AND EGRESS TO THE WORK SITE FROM ADJACENT PRIVATE PROPERTY OWNERS. A COPY OF ALL AGREEMENTS SHALL BE PROVIDED TO THE TOWN. ACCESS TO ANY ADJACENT PRIVATE PROPERTY SHALL BE MAINTAINED THROUGHOUT THE CONSTRUCTION PERIOD.
5. ALL MATERIALS AND WORKMANSHIP SHALL BE SUBJECT TO INSPECTION BY THE TOWN ENGINEERING STAFF. THE TOWN RESERVES THE RIGHT TO ACCEPT OR REJECT ANY SUCH MATERIALS AND WORKMANSHIP THAT DOES NOT CONFORM TO TOWN STANDARDS AND SPECIFICATIONS. INSPECTIONS AND ONSITE VISITS ARE NOT TO BE CONSTRUED AS A GUARANTEE BY THE TOWN ENGINEERING STAFF OF THE CONTRACTORS' CONTRACTUAL COMMITMENT. REQUESTS FOR INSPECTION BY THE TOWN SHALL BE MADE BY THE CONTRACTOR A MINIMUM OF TWENTY-FOUR (24) HOURS IN ADVANCE.

6. CONSTRUCTION WATER IS AVAILABLE TO THE CONTRACTOR AS ESTABLISHED IN THE TOWN STANDARDS AND SPECIFICATIONS. IT SHALL BE THE RESPONSIBILITY OF THE CONTRACTOR TO CONTACT THE TOWN REGARDING CURRENT REGULATIONS, FEES AND REQUIRED AGREEMENTS RELATED TO THE PROVISION OF CONSTRUCTION WATER.
7. THE CONTRACTOR SHALL COORDINATE HIS ACTIVITIES WITH THE AFFECTED UTILITY COMPANIES AND SHALL NOTIFY THE UTILITY NOTIFICATION CENTER, PHONE NUMBER 811, THREE (3) BUSINESS DAYS PRIOR TO THE START OF CONSTRUCTION.
8. UTILITIES IN THE AREA OF CONSTRUCTION ARE APPROXIMATE ONLY. THEY HAVE BEEN LOCATED FROM FIELD INVESTIGATION AND THE BEST AVAILABLE UTILITY RECORDS. THE CONTRACTOR SHALL BE RESPONSIBLE FOR THE LOCATION, PROTECTION AND REPAIR OF ALL UTILITIES ENCOUNTERED DURING CONSTRUCTION WHETHER SHOWN ON THESE PLANS OR NOT. THE CONTRACTOR SHALL CONTACT ALL RESPECTIVE UTILITIES AND HAVE ALL UTILITIES FIELD-LOCATED PRIOR TO CONSTRUCTION. IF ANY UNKNOWN SUBSURFACE STRUCTURES ARE ENCOUNTERED DURING CONSTRUCTION, IT SHALL BE BROUGHT TO THE IMMEDIATE ATTENTION OF THE TOWN ENGINEERING STAFF AND DESIGN ENGINEER PRIOR TO PROCEEDING.
9. THE CONTRACTOR SHALL NOTIFY TOWN ENGINEERING STAFF OF ANY PROBLEM IMPACTING WATER AND WASTE WATER FACILITIES THAT WOULD POTENTIALLY REQUIRE A VARIANCE FROM THE APPROVED PLANS AND SPECIFICATIONS. ANY VARIANCE FROM THE APPROVED DOCUMENTS SHALL BE AT THE SOLE DISCRETION OF THE TOWN ENGINEERING STAFF.
10. CONTRACTOR SHALL OBTAIN, AT HIS OWN EXPENSE, ALL APPLICABLE SPECIFICATIONS AND PERMITS NECESSARY TO PERFORM THE PROPOSED WORK.
11. AS-BUILT DRAWINGS AS REQUIRED IN THE SPECIFICATIONS, ARE TO BE SUBMITTED BY THE OWNER/DEVELOPER PRIOR TO INITIAL ACCEPTANCE OF THE CONSTRUCTION.
12. THE CONTRACTOR SHALL BE RESPONSIBLE FOR REMOVING AND REPLACING ANY EXISTING SIGNS, STRUCTURES, FENCES, ETC., ENCOUNTERED ON THE JOB AND RESTORING THEM TO THEIR ORIGINAL CONDITION.

13. THE CONTRACTOR IS RESPONSIBLE FOR:
 - A. NOTIFYING THE TOWN UTILITY CUSTOMERS OF POTENTIAL SERVICE OUTAGES, AND COORDINATE WITH THE TOWN FOR DETERMINATION OF MINIMUM TIME REQUIREMENT.
 - B. NOTIFYING THE TOWN ENGINEERING STAFF IF WORK IS SUSPENDED FOR ANY PERIOD OF TIME AFTER INITIAL START-UP. THE CONTRACTOR SHALL NOTIFY THE TOWN FORTY-EIGHT (48) HOURS PRIOR TO RESTART.
 - C. IN THE EVENT OF AN AFTER HOURS EMERGENCY, CALL 720-652-4222.
 - D. NOTIFYING THE FREDERICK FIRESTONE FIRE PROTECTION DISTRICT OF ALL STREET CLOSURES AND EXISTING FIRE HYDRANTS TAKEN OUT OF SERVICE A MINIMUM OF FORTY-EIGHT (48) HOURS PRIOR TO THE START OF CONSTRUCTION.
14. PRIOR TO INSTALLATION OF UTILITY MAINS, ROAD CONSTRUCTION MUST HAVE COMPLETED THE OVER LOT GRADING STAGE.
15. THE CONTRACTOR SHALL BE RESPONSIBLE FOR REMOVING ANY GROUNDWATER ENCOUNTERED DURING THE CONSTRUCTION OF ANY PORTION OF THIS PROJECT. A CONSTRUCTION DEWATERING PERMIT MUST BE OBTAINED FROM THE COLORADO DEPARTMENT OF PUBLIC HEALTH AND ENVIRONMENT (CDPHE). GROUNDWATER SHALL BE PUMPED, PIPED, REMOVED AND DISPOSED OF IN A MANNER WHICH DOES NOT CAUSE FLOODING OF EXISTING STREETS OR EROSION OF ABUTTING PROPERTIES IN ORDER TO CONSTRUCT THE IMPROVEMENTS SHOWN ON THESE PLANS. THE USE OF ANY SANITARY SEWER TO DISPOSE OF TRENCH WATER WILL NOT BE PERMITTED. NO CONCRETE SHALL BE PLACED WHERE GROUNDWATER IS VISIBLE OR UNTIL THE GROUNDWATER TABLE HAS BEEN LOWERED BELOW THE PROPOSED IMPROVEMENTS. ANY UNSTABLE AREAS, AS A RESULT OF GROUNDWATER, ENCOUNTERED DURING THE CONSTRUCTION OF THE PROPOSED IMPROVEMENTS SHALL BE STABILIZED AS AGREED UPON BY THE CONTRACTOR, THE TOWN, AND THE DESIGN ENGINEER AT THE TIME OF THE OCCURRENCE
16. IT SHALL BE THE RESPONSIBILITY OF THE DESIGN ENGINEER TO RESOLVE CONSTRUCTION PROBLEMS WITH THE TOWN DUE TO CHANGED CONDITIONS ENCOUNTERED BY THE CONTRACTOR DURING THE PROGRESS OF ANY PORTION OF THE PROPOSED WORK. IF, IN THE OPINION OF THE TOWN, PROPOSED ALTERATIONS TO THE SIGNED CONSTRUCTION PLANS INVOLVES SIGNIFICANT CHANGES TO THE CHARACTER OF THE WORK, OR TO THE FUTURE CONTIGUOUS PUBLIC OR PRIVATE IMPROVEMENTS, THE DESIGN ENGINEER SHALL BE RESPONSIBLE FOR SUBMITTING REVISED PLANS TO THE TOWN FOR REVIEW AND ACCEPTANCE, PRIOR TO ANY FURTHER CONSTRUCTION RELATED TO THAT PORTION OF THE WORK.

17. DURING THE COURSE OF CONSTRUCTION OF THE PROJECT, THE CONTRACTOR SHALL BE SOLELY AND COMPLETELY RESPONSIBLE FOR CONDITIONS AT AND ADJACENT TO THE JOB INCLUDING SAFETY OF ALL PERSONS AND PROPERTY DURING PERFORMANCE OF THE WORK. THE CONTRACTOR SHALL PROVIDE ALL LIGHTS, SIGNS, BARRICADES, FLAGMEN, OR OTHER DEVICES NECESSARY TO PROVIDE FOR PUBLIC SAFETY. THIS REQUIREMENT SHALL APPLY CONTINUOUSLY AND IS NOT LIMITED TO NORMAL WORKING HOURS. THE TOWN OR THE DESIGN ENGINEER EXERCISE NO CONTROLS OVER THE SAFETY OR ADEQUACY OF ANY EQUIPMENT, BUILDING COMPONENTS, SCAFFOLDING, FORMS OR OTHER WORK AIDS USED IN OR ABOUT THE PROJECT, OR IN THE SUPERINTENDING OF THE SAME. THE CONTRACTOR SHALL DEFEND, INDEMNIFY AND HOLD HARMLESS FROM ANY AND ALL LIABILITY, REAL AND ALLEGED, IN CONNECTION WITH THE PERFORMANCE OF WORK ON THIS PROJECT, EXCEPTING FOR LIABILITY ARISING FROM THE SOLE NEGLIGENCE OF THE OWNER, THE DESIGN ENGINEER OR THE TOWN. THE TOWN ENGINEERING STAFF, OR ANY CONTRACTED ENGINEER, ARE NOT RESPONSIBLE FOR SAFETY IN, ON OR ABOUT THE PROJECT SITE, NOR FOR COMPLIANCE BY THE APPROPRIATE PARTY OF ANY REGULATIONS RELATING THERETO.
18. WORK IN PUBLIC STREETS, ONCE BEGUN, SHALL BE PROSECUTED TO COMPLETION WITHOUT DELAY SO AS TO PROVIDE MINIMUM INCONVENIENCE TO ADJACENT PROPERTY OWNERS AND TO THE TRAVELING PUBLIC.
19. REGULAR WORK HOURS ARE SEVEN (7) A.M. UNTIL SEVEN (7) P.M. OR DUSK (WHICHEVER OCCURS FIRST) OF THE SAME DAY, MONDAY THROUGH FRIDAY. THE CONTRACTOR WILL NOT PERMIT OVERTIME WORK OUTSIDE OF REGULAR WORKING HOURS OR THE PERFORMANCE OF WORK ON SATURDAY, SUNDAY OR ANY LEGAL HOLIDAY WITHOUT RECEIVING WRITTEN CONSENT FROM THE TOWN ENGINEER. REQUESTS FOR WEEKEND WORK APPROVAL MUST BE SUBMITTED, IN WRITING TO THE TOWN NO LATER THAN WEDNESDAYS AT 3:30PM FOR SUBSEQUENT WEEKEND AND REQUESTS FOR HOLIDAY WORK APPROVAL MUST BE SUBMITTED, IN WRITING TO THE TOWN NO LATER THAN 7:00AM-2 BUSINESS DAYS PRIOR TO THE HOLIDAY. ALL EXPENSES INCURRED BY THE TOWN SHALL BE REIMBURSED AT A RATE TO BE DETERMINED BY DIRECTOR OF FINANCE.
20. THE CONTRACTOR SHALL TAKE ALL NECESSARY AND PROPER PRECAUTIONS TO PROTECT ADJACENT PROPERTIES FROM ANY AND ALL DAMAGE THAT MAY OCCUR FROM STORM WATER RUNOFF AND/OR DEPOSITION OF DEBRIS RESULTING FROM ANY AND ALL WORK. THE OWNER/CONTRACTOR IS RESPONSIBLE FOR OBTAINING A STORMWATER DISCHARGE PERMIT FOR CONSTRUCTION ACTIVITIES FOR ANY PROJECT

DISTURBING OVER ONE ACRE FROM BOTH THE COLORADO DEPARTMENT OF PUBLIC HEALTH AND THE TOWN.

21. EACH TYPE OF CONSTRUCTION SHALL BE COMPLETED BY A CONTRACTOR THAT HAS DEMONSTRATED ACCEPTABLE QUALIFICATIONS TO THE TOWN AND IS A LICENSED CONTRACTOR IN THE TOWN.
22. THE CONTRACTOR SHALL BE RESPONSIBLE FOR ALL TRAFFIC CONTROL DURING CONSTRUCTION. ALL TRAFFIC CONTROLS SHALL CONFORM TO THE TOWN STANDARDS AND SPECIFICATIONS AND THE MANUAL ON UNIFORM TRAFFIC CONTROL DEVICES, (MUTCD) LATEST EDITIONS. A PLAN SHALL BE SUBMITTED TO THE TOWN FOR REVIEW AND ACCEPTANCE PRIOR TO CONSTRUCTION.
23. ALL BACKFILL SHALL CONFORM TO THE TRENCH DETAIL LOCATED IN THE TOWN STANDARDS & SPECIFICATIONS.
24. THE CONTRACTOR SHALL IMMEDIATELY REMOVE ANY CONSTRUCTION DEBRIS OR MUD TRACKED ONTO EXISTING ROADWAYS.
25. THE CONTRACTOR SHALL REPAIR ANY EXCAVATION OR PAVEMENT FAILURES CAUSED BY HIS CONSTRUCTION.
26. THE CONTRACTOR SHALL RENEW OR REPLACE ANY EXISTING TRAFFIC STRIPING AND/OR PAVEMENT MARKINGS, WHICH HAVE BEEN EITHER REMOVED OR THE EFFECTIVENESS OF WHICH HAS BEEN REDUCED DURING HIS OPERATION. RENEWAL OF PAVEMENT STRIPING AND MARKING SHALL BE DONE IN CONFORMANCE WITH THE TOWN STANDARD SPECIFICATIONS.
27. IT SHALL BE THE CONTRACTOR'S RESPONSIBILITY TO TAKE EVERY MEASURE NECESSARY TO COMPLY WITH ANY STATE, COUNTY OR TOWN DUST CONTROL ORDINANCE.
28. CONSTRUCTION VEHICLES SHALL USE TRUCK ROUTES DESIGNATED BY THE TOWN. OVERSIZE AND/OR OVERWEIGHT VEHICLES REQUIRE AN OVERWEIGHT VEHICLE PERMIT FROM THE TOWN PRIOR TO TRAVELLING ON TOWN STREETS.
29. THE OWNER/DEVELOPER WILL BE HELD RESPONSIBLE FOR THE PROPER FUNCTIONING OF THE IMPROVEMENTS FOR A MINIMUM OF TWO (2) YEARS FROM THE DATE OF INITIAL ACCEPTANCE OF THE IMPROVEMENTS BY THE TOWN. ANY FAILURE DURING THIS PERIOD OF GUARANTEE SHALL BE REMEDIED BY THE OWNER/CONTRACTOR TO THE SATISFACTION OF THE TOWN AT NO EXPENSE TO THE TOWN.



30. THE SOILS ENGINEER SHALL PERFORM SUFFICIENT INSPECTIONS DURING GRADING AND CONSTRUCTION SO THAT AN OPINION CAN BE RENDERED AND VERIFIED IN WRITING AS TO COMPLIANCE WITH THE PLANS AND CODES WITHIN THE SOILS ENGINEER'S PURVIEW.

GENERAL NOTES – GRADING

1. ALL CONSTRUCTION ACTIVITIES THAT DISTURBS ONE OR MORE ACRES OF LAND, AS WELL AS ACTIVITIES THAT DISTURB LESS THAN ONE ACRE OF LAND, BUT IS PART OF A LARGER COMMON PLAN OF DEVELOPMENT, MUST COMPLY WITH BOTH LOCAL AND STATE REGULATIONS REGARDING STORMWATER DRAINAGE ON CONSTRUCTION SITES. OWNERS OR CONTRACTORS MUST OBTAIN A COLORADO STORMWATER DISCHARGE PERMIT FOR CONSTRUCTION ACTIVITIES FROM THE COLORADO DEPARTMENT OF PUBLIC HEALTH AND ENVIRONMENT (CDPHE) AND A STORMWATER QUALITY PERMIT FROM THE TOWN OF FIRESTONE. OWNERS AND OPERATORS SHALL:
 - A. MAINTAIN A COPY OF THE STORM WATER MANAGEMENT PLAN (SWMP) ONSITE AT ALL TIMES, THOUGH A DIGITAL COPY WILL SUFFICE. THE SWMP MUST BE MAINTAINED AND MADE AVAILABLE TO TOWN INSPECTORS UPON REQUEST.
 - B. INSTALL AND MAINTAIN EROSION, SEDIMENT, AND MATERIALS MANAGEMENT CONTROL BMPS AS SPECIFIED IN THE SWMP.
 - C. INSPECT ALL BEST MANAGEMENT PRACTICES (BMPS) AT LEAST EVERY SEVEN (7) DAYS OR EVERY FOURTEEN (14) DAYS AND WITHIN TWENTY FOUR (24) HOURS AFTER ANY PRECIPITATION OR SNOWMELT EVENT THAT CAUSES SURFACE RUNOFF.
 - D. MAINTAIN INSPECTION AND MAINTENANCE RECORDS OF BMPS ONSITE WITH THE SWMP. COPIES OF THESE REPORTS SHALL BE PROVIDED TO THE TOWN ENGINEERING STAFF.
 - E. BASED ON INSPECTIONS PERFORMED BY THE PERMIT HOLDER OR BY TOWN PERSONNEL, MODIFICATIONS TO THE SWMP WILL BE NECESSARY IF AT ANY TIME THE SPECIFIED BMPS DO NOT MEET THE OBJECTIVES OF THE PERMIT. ALL MODIFICATIONS SHALL BE COMPLETED AS SOON AS PRACTICABLE AFTER THE REFERENCED INSPECTION, AND SHALL BE RECORDED ON THE OWNER'S COPY OF THE SWMP.
 - F. THE OPERATOR SHALL AMEND THE SWMP WHENEVER THERE IS A MINOR CHANGE TO ADDRESS A SPECIFIED CONTROL MEASURE THAT DOES NOT MEET THE REQUIREMENTS OF THE STORMWATER QUALITY PERMIT. SIGNIFICANT CHANGES IN DESIGN, CONSTRUCTION, OPERATION, OR MAINTENANCE, WHICH HAS A SIGNIFICANT EFFECT ON THE POTENTIAL FOR DISCHARGE OF POLLUTANTS TO THE RECEIVING WATERS, OR IF THE SWMP PROVES TO BE INEFFECTIVE IN ACHIEVING THE GENERAL

OBJECTIVES OF CONTROLLING POLLUTANTS IN STORM WATER DISCHARGES ASSOCIATED WITH CONSTRUCTION ACTIVITIES, A REVISED SWMP SHALL BE SUBMITTED TO THE TOWN ENGINEER.

- G. INSTALLATION AND MAINTENANCE OF BMPS SHALL BE SUPERVISED BY PERSONNEL CERTIFIED IN EROSION AND SEDIMENT CONTROL.
2. 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 FIRESTONE "DESIGN STANDARDS AND CONSTRUCTION SPECIFICATIONS OF PUBLIC IMPROVEMENTS", LATEST EDITION.
 3. ALL GRADING AND FILLING OPERATIONS SHALL BE OBSERVED, INSPECTED AND TESTED BY A LICENSED SOILS ENGINEER. ALL TEST RESULTS SHALL BE SUBMITTED TO THE TOWN ENGINEERING STAFF.
 4. 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. IT SHALL BE THE RESPONSIBILITY OF THE CONTRACTOR TO AVOID ANY DAMAGE TO EXISTING FOLIAGE THAT LIES IN THE PROJECT AREA UNLESS DESIGNATED FOR REMOVAL AND SHALL BE LIABLE FOR SUCH DAMAGE AT HIS/HER EXPENSE.
 5. TOPSOIL SHALL BE STOCKPILED TO THE EXTENT PRACTICABLE ON THE SITE FOR USE ON AREAS TO BE RE-VEGETATED. ANY AND ALL STOCKPILES SHALL BE LOCATED AND PROTECTED FROM EROSION ELEMENTS.
 6. TEMPORARY VEGETATION SHALL BE INSTALLED ON ALL DISTURBED AREAS WHERE PERMANENT SURFACE IMPROVEMENTS ARE NOT SCHEDULED FOR IMMEDIATE INSTALLATION. SEEDING WILL BE DONE ACROSS THE SLOPE FOLLOWING THE CONTOURS. VEGETATION SHALL CONFORM TO THE TOWN STANDARDS AND SPECIFICATIONS. PROJECT SCHEDULING SHOULD TAKE ADVANTAGE OF SPRING OR FALL PLANTING SEASONS FOR NATURAL GERMINATION. SEEDED AREAS SHALL BE IRRIGATED IN ACCORDANCE WITH THE TOWN STANDARDS AND SPECIFICATIONS.
 7. AT ALL TIMES, A WATER TRUCK SHALL BE ON-SITE AND 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.
8. FILL SLOPES SHALL BE COMPACTED BY MEANS OF SHEEPSFOOT COMPACTOR OR OTHER SUITABLE EQUIPMENT. COMPACTING SHALL CONTINUE UNTIL SLOPES ARE STABLE AND THERE IS NOT AN APPRECIABLE AMOUNT OF LOOSE SOIL ON THE SLOPES.
 9. TEMPORARY CUT/FILL SLOPES SHALL ABIDE BY THE SOILS REPORT. PERMANENT SLOPES SHALL BE AS SHOWN ON PLANS.
 10. DEPTH OF MOISTURE-DENSITY CONTROL SHALL BE FULL DEPTH ON ALL EMBANKMENT AND SIX (6) INCHES ON THE BASE OF CUTS AND FILLS.
 11. OUTLET SIDES OF ALL STORM PIPES SHALL BE GRADED TO DRAIN AND SHALL HAVE SUFFICIENT EROSION PROTECTION.
 12. THE PERMITTEE OR HIS AGENT SHALL NOTIFY THE SITE GEOTECHNICAL ENGINEER WHEN THE GRADING OPERATION IS READY FOR EACH OF THE FOLLOWING INSPECTIONS:
 - A. INITIAL INSPECTION WHEN THE PERMITTEE IS READY TO BEGIN WORK, BUT NOT LESS THAN TWO (2) DAYS BEFORE ANY GRADING OR GRUBBING IS STARTED.
 - B. AFTER THE NATURAL GROUND OR BEDROCK IS EXPOSED AND PREPARED TO RECEIVE FILL, BUT BEFORE FILL IS PLACED.
 - C. EXCAVATION INSPECTION AFTER THE EXCAVATION IS STARTED BUT BEFORE THE VERTICAL DEPTH OF THE EXCAVATION EXCEEDS TEN (10) FEET.
 - D. FILL INSPECTION AFTER THE FILL PLACEMENT IS STARTED, BUT BEFORE THE FILL EXCEEDS TEN (10) FEET.
 13. TEMPORARY CUT/FILL SLOPES SHALL NOT BE STEEPER THAN 2:1 (2H:1V). PERMANENT SLOPES SHALL NOT BE STEEPER THAN 4:1 (4H:1V) IN AREAS TO BE SEEDED OR SODDED.

GENERAL NOTES – ROADWAY

1. ALL STATIONING IS BASED ON CENTERLINE OF ROADWAYS UNLESS OTHERWISE NOTED.
2. THE CONTRACTOR SHALL PREPARE THE SUBGRADE BY SCARIFYING THE UPPER ONE (1) FOOT OF THE SUBGRADE IN CUT AREAS OR AREAS WITH LITTLE OR NO FILL, UNLESS SPECIFIED IN THE SOILS REPORT. THE WORK SHALL CONFORM TO THE COLORADO DEPARTMENT OF TRANSPORTATION STANDARD SPECIFICATIONS.
3. PAVEMENT SHALL NOT BE CONSTRUCTED UNTIL ALL UNDERGROUND UTILITIES HAVE BEEN INSTALLED, TESTED AND ACCEPTED BY THE TOWN OF FIRESTONE ENGINEERING STAFF.
4. IT SHALL BE THE RESPONSIBILITY OF THE OWNER/CONTRACTOR TO SUPERVISE AND CERTIFY THAT PROPER COMPACTION HAS BEEN OBTAINED BY SUBCONTRACTORS AND AGENCIES CONCERNING UTILITY LINE BACKFILL INCLUDING, BUT NOT LIMITED TO, SEWER, WATER, ELECTRICAL, GAS AND LANDSCAPE IRRIGATION LINES AND ACCEPTED BY THE TOWN ENGINEERING STAFF AND THE SOILS ENGINEER.
5. STREET PAVING SHALL NOT START UNTIL:
 - a. A SOILS REPORT AND PAVEMENT DESIGN IS ACCEPTED BY THE TOWN ENGINEERING STAFF.
 - b. ALL STREETS ARE COMPACTED IN ACCORDANCE WITH THE SOILS REPORT AND THE TOWN SPECIFICATIONS.
 - c. ALL COMPACTION TEST REPORTS HAVE BEEN SUBMITTED TO THE TOWN ENGINEERING STAFF PRIOR TO PROOF ROLLS.
 - d. PROOF ROLLS ARE PERFORMED USING A LOADED SINGLE AXLE 2000 GALLON WATER TRUCK AND MONITORED BY THE TOWN ENGINEERING STAFF.
6. THE OWNER/CONTRACTOR SHALL BE RESPONSIBLE FOR ADJUSTING ALL UTILITY MANHOLE COVERS AND ACCESS LIDS TO GRADE.
7. ALL CONCRETE SHALL BE A MINIMUM OF CLASS B, IN CONFORMANCE WITH CDOT STANDARDS.
8. ALL CONCRETE EDGES MUST BE ROUNDED TO A FOURTH (1/4) INCH RADIUS, EXCEPT WHERE SHOWN OTHERWISE ON DRAWINGS.

9. ONE HALF (1/2) INCH EXPANSION JOINTS SHALL BE INSTALLED AT ALL CURB RETURNS, CURB CUTS AND EXISTING STRUCTURES. CONTROL JOINTS SHALL BE INSTALLED PER THE TOWN STANDARDS AND SPECIFICATIONS.
10. BEFORE PLACING OF ASPHALT THE SUBGRADE SHALL RECEIVE A GROUND STERILANT APPLIED AT A RATE IN ACCORDANCE TO MANUFACTURERS RECOMMENDATIONS.
11. THE GRADATION OF THE MINERAL AGGREGATE WILL BE GRADING SX (1/2" NOMINAL) FOR ALL TOP LIFTS AND OVERLAYS.
12. TACK COAT SHALL BE USED PRIOR TO OVERLAY, (CSS-1H), 50:50 DILUTION, 0.10 GAL/SY. ALL EDGES ABUTTING NEW PAVEMENT SHALL BE TACKED.
13. WHEN IT IS REQUIRED TO MATCH EXISTING PAVEMENT, EXISTING PAVEMENT SHALL BE SAW CUT IN A MANNER TO AFFECT A SMOOTH, VERTICAL STRAIGHT CUT EDGE. T PATCH MILLING MUST BE DONE PER STANDARD DETAILS.
14. ALL SAWCUT EDGES OF EXISTING PAVEMENT SHALL BE CLEAN AND COATED WITH TACK COAT PRIOR TO PLACING NEW PAVEMENT ADJACENT TO THE EXISTING PAVEMENT.
15. ALL ASPHALT SHALL BE ONE FOURTH (1/4) INCH ABOVE CONCRETE EDGES, MANHOLE COVERS AND ACCESS LIDS.
16. SIGNAGE AND STRIPING SHALL CONFORM TO THE MANUAL ON UNIFORM TRAFFIC CONTROL DEVICES, THE COLORADO DEPARTMENT OF TRANSPORTATION STANDARD SPECIFICATIONS FOR ROAD AND BRIDGE CONSTRUCTION, THE COLORADO DEPARTMENT OF TRANSPORTATION M&S STANDARDS, AND THE TOWN STANDARDS.
17. THE PURCHASE AND INSTALLATION OF STREET NAME SIGNS SHALL BE THE RESPONSIBILITY OF THE OWNER/CONTRACTOR. THE OWNER/CONTRACTOR SHALL SECURE THE APPROVAL OF THE TOWN ENGINEERING STAFF FOR TYPE AND LOCATION OF THE STREET NAME SIGNS PRIOR TO INSTALLATION.
18. ALL NEW ROADWAY SECTIONS SHALL HAVE SUBGRADE PREPARATION AND INITIAL ASPHALT PAVEMENT PLACED WITH A 1% CROWN. FINAL OVERLAY IS TO BE PLACED WITH A 2% CROWN. SEE DETAIL ST7 IN THE "STANDARD DETAILS-STREET" FOR MORE INFORMATION.



19. DETERMINATION OF CROWN FOR CUL DE SAC PAVING SHALL BE EVALUATED ON A CASE BY CASE BASIS.

GENERAL NOTES – SANITARY SEWER

1. TOWN OF FIRESTONE SEWER SERVICE IS UNDER THE JURISDICTION OF THE ST. VRAIN SANITATION DISTRICT (SVSD). ALL SANITARY SEWER SHALL BE CONSTRUCTED IN ACCORDANCE WITH SVSD STANDARDS AND CRITERIA IN ADDITION TO THE TOWN STANDARDS AND SPECIFICATIONS.
2. MINIMUM VERTICAL SEPARATIONS BETWEEN ALL UTILITY PIPES SHALL BE EIGHTEEN (18) INCHES. IF VERTICAL SEPARATIONS ARE LESS THAN EIGHTEEN (18) INCHES, THE UTILITY PIPES SHALL BE REINFORCED AND PROTECTED AS REQUIRED BY CURRENT TOWN STANDARD SPECIFICATIONS.
3. WATER, SANITARY SEWER STORM SEWER LINES SHALL HAVE A MINIMUM HORIZONTAL SEPARATION OF TEN (10) FEET. WHEN A TEN (10) FOOT SEPARATION IS NOT PROVIDED OR WHEN SEWER AND STORM SEWER LINES CROSS WATER LINES WITH LESS THAN ONE AND ONE-HALF (1½) FEET OF VERTICAL SEPARATION, SEWER AND STORM SEWER LINE JOINTS SHALL BE CONCRETE ENCASED. FOR PERPENDICULAR CROSSINGS, ENCASED JOINTS SHALL EXTEND TEN (10) FEET, PERPENDICULAR TO THE WATER LINE IN BOTH DIRECTIONS
4. ALL SANITARY SEWER SERVICES AND WATER SERVICES ARE TO BE TEN (10) FEET APART.
5. SERVICE LATERALS SHALL EXTEND TEN (10) FEET BEYOND BACK OF WALK, OR FIVE (5) FEET BEYOND RIGHTS OF WAY OR UTILITY EASEMENTS, WHICHEVER IS GREATER. THE ENDS SHALL BE MARKED BY A GREEN PAINTED WOOD POST UNTIL CURB AND GUTTER IS IN PLACE. WHEN CURB AND GUTTER IS IN PLACE THE LATERALS SHALL BE MARKED ON THE CONCRETE CURB FACE WITH AN "S" or "X".
6. BEDDING MATERIAL SHALL CONFORM TO SVSD AND TOWN STANDARDS AND SPECIFICATIONS.
7. WARNING TAPE SHALL BE INSTALLED 12" MINIMUM AND 18" MAXIMUM ABOVE SEWER PIPE.
8. PRECAST CONCRETE MANHOLE SECTIONS SHALL BE IN ACCORDANCE WITH ASTM C-478. CAST IRON RING AND COVER SHALL CONFORM TO ASTM A-48.
9. MANHOLES SHALL BE A MINIMUM FOUR (4) FOOT DIAMETER AND CONSTRUCTED PER THE STANDARDS AND SPECIFICATIONS.

10. MANHOLE RIMS SHALL BE SET AT AN ELEVATION RELATIVE TO THE PAVEMENT, IN ACCORDANCE WITH THE TOWN STANDARDS. WHETHER THE MANHOLE IS AT PAVED OR UNPAVED GRADE, A MINIMUM OF ONE (1) AND A MAXIMUM OF FOUR (4) CONCRETE RINGS SHALL BE USED TO ADJUST THE RIM ELEVATION TO FINAL GRADE. THE MAXIMUM ACCEPTABLE VERTICAL ADJUSTMENT UTILIZING CONCRETE RINGS IS EIGHTEEN (18) INCHES.

GENERAL NOTES – WATER

1. AT ALL POINTS OF CONNECTION OF NEW WATER MAINS TO EXISTING MAINS, THE CONTRACTOR SHALL BE RESPONSIBLE FOR EXCAVATING AND VERIFYING LOCATION OF THE EXISTING LINES PRIOR TO ANY CONSTRUCTION.
2. EXCEPT IN CASE OF AN EMERGENCY, VALVES ON THE TOWN OF FIRESTONE WATER SYSTEM SHALL BE OPERATED BY OR UNDER THE DIRECTION OF THE APPROPRIATE TOWN PERSONNEL. THE CONTRACTOR SHALL GIVE THE TOWN ENGINEERING STAFF 48 HOURS NOTICE TO ARRANGE FOR OPERATING VALVES. BOTH THE CONTRACTOR AND THE APPROPRIATE TOWN PERSONNEL SHALL BE PRESENT WHEN THE VALVES ARE OPERATED.
3. WATER, SANITARY SEWER STORM SEWER LINES SHALL HAVE A MINIMUM HORIZONTAL SEPARATION OF TEN (10) FEET. WHEN A TEN (10) FOOT SEPARATION IS NOT PROVIDED OR WHEN SEWER AND STORM SEWER LINES CROSS WATER LINES WITH LESS THAN ONE AND ONE-HALF (1½) FEET OF VERTICAL SEPARATION, SEWER AND STORM SEWER LINE JOINTS SHALL BE CONCRETE ENCASED. FOR PERPENDICULAR CROSSINGS, ENCASED JOINTS SHALL EXTEND TEN (10) FEET, PERPENDICULAR TO THE WATER LINE IN BOTH DIRECTIONS.
4. ALL WATER LINES SHALL HAVE A MINIMUM OF FIVE (5) FEET OF COVER AND BE LOCATED A MINIMUM OF TEN (10) FEET FROM THE SANITARY SEWER AND STORM SEWER AND THREE (3) FEET FROM THE EDGE OF CONCRETE CURB AND GUTTER PAN.
5. ALL CHANGES IN WATERLINE ALIGNMENT SHALL BE ACCOMPLISHED USING PIPE BENDS; JOINT DEFLECTION IS NOT PERMITTED. HIGH DEFLECTION COUPLERS MAY BE CONSIDERED FOR VERTICAL DEFLECTION ONLY, SUBJECT TO APPROVAL. LOCATIONS WHERE HIGH DEFLECTION COUPLERS ARE PROPOSED MUST BE CLEARLY IDENTIFIED ON THE DRAWINGS.
6. WHEN IT IS NECESSARY TO DEPRESS WATER LINES AT UTILITY CROSSINGS, A MINIMUM CLEARANCE OF ONE AND ONE-HALF (1-1/2) FEET SHALL BE MAINTAINED BETWEEN OUTSIDES OF PIPE.
7. DISTANCES FOR WATER LINES ARE THE HORIZONTAL DISTANCE BETWEEN THE CENTERS OF THE FITTINGS. THEREFORE, DISTANCES SHOWN ON THE PLANS ARE APPROXIMATE AND COULD VARY DUE TO VERTICAL ALIGNMENT AND FITTING DIMENSIONS.
8. ALL WATER LINE VALVES SHALL BE SET ADJACENT TO THE TEE, EXCEPT FOR POINTS THAT FALL IN THE FLOW LINE OF A CONCRETE CROSS PAN. IN WHICH CASE, THE VALVE SHALL BE LOCATED SO THAT

- SURFACE DRAINAGE DOES NOT INFILTRATE THE VALVE BOX. VALVE BOXES SHALL BE SET AT AN ELEVATION IN ACCORDANCE WITH TOWN PAVING REQUIREMENTS.
9. ALL WATER MAINS SHALL BE POLYVINYL CHLORIDE (PVC) PRESSURE PIPE UNLESS SPECIFIED OTHERWISE. NOMINAL PVC PIPE SIZES 8-INCH THROUGH 12-INCH SHALL CONFORM TO ALL REQUIREMENTS OF AWWA STANDARD C-900, PRESSURE CLASS 150 (DR18). NOMINAL PVC PIPE SIZES 16-INCH THROUGH 24-INCH SHALL CONFORM TO ALL REQUIREMENTS OF AWWA STANDARD C-905, PRESSURE CLASS 165 (DR25). ALL PVC PIPES SHALL HAVE OUTSIDE DIAMETERS EQUIVALENT TO CAST IRON PIPE.
 10. FIRE HYDRANT ASSEMBLY INCLUDES THE FIRE HYDRANT, SIX (6) INCH VALVE, AND SIX (6) INCH PIPE. INSTALLATION SHALL BE IN ACCORDANCE WITH THE TOWN STANDARDS AND SPECIFICATIONS.
 11. ALL FITTINGS SHALL BE MADE FROM DUCTILE IRON, FURNISHED WITH MECHANICAL JOINT ENDS OR INTEGRAL RESTRAINED JOINTS, AND SHALL HAVE A PRESSURE RATING OF 350 PSI.
 12. POLYETHYLENE WRAPPING SHALL BE INSTALLED AROUND ALL DUCTILE IRON PIPES, FITTINGS, VALVES, FIRE HYDRANT BARRELS AND ROD AND CLAMPS. THE POLYETHYLENE SHALL HAVE A MINIMUM THICKNESS OF EIGHT (8) MILS, IN ACCORDANCE WITH AWWA STANDARD C-105.
 13. ALL WATER LINE PIPE SHALL BE PROVIDED WITH A MINIMUM GAGE SIZE OF 12 SINGLE STRAND INSULATED COPPER WIRE. SPLICES IN TRACER WIRE SHALL BE CAPPED IN WATER PROOF GEL CAP TYPE CONNECTORS SUITED FOR DIRECT BURY APPLICATION (3M TYPE DBY-6 LOW VOLTAGE OR EQUAL). WIRE SHALL BE ATTACHED TO TOP OF WATER LINE WITH 2-INCH WIDE PVC TAPE @ 5-FT INTERVALS ALONG PIPE. TRACER WIRE SHALL EXTEND TO THE SURFACE AND BE COILED IN A LOCATE BOX AT THE BACKSIDE OF EITHER EACH FIRE HYDRANT OR VALVE. UNDER THE SUPERVISION OF TOWN ENGINEERING STAFF, TEST SHALL BE MADE BY THE CONTRACTOR @ THE COMPLETION OF CONSTRUCTION TO INSURE THAT THE TRACER WIRES CARRY A CONTINUOUS CURRENT BETWEEN ALL ACCESS POINTS.
 14. WARNING TAPE SHALL BE INSTALLED 12" MINIMUM AND 18" MAXIMUM ABOVE WATER PIPE.
 15. BEDDING MATERIAL SHALL CONFORM TO TOWN STANDARDS AND SPECIFICATIONS.
 16. VALVES SHALL OPEN COUNTER CLOCKWISE. VALVES 12-INCH AND SMALLER SHALL BE RESILIENT SEAT GATE VALVES. LARGER VALVES SHALL BE BUTTERFLY VALVES.

17. VALVE BOXES SHALL BE RAISED TO ONE-FOURTH (1/4) INCH BELOW GRADE AFTER COMPLETION OF SURFACE PAVING OR FINAL GRADING. VALVE BOXES IN NON-PAVED AREAS SHALL HAVE A CONCRETE COLLAR AROUND THE VALVE LID IN ACCORDANCE WITH THE DETAIL.
18. ALL SERVICE LINE TAPS SHALL HAVE DOUBLE STRAP BRASS TAPPING SADDLES. (ROMAC 202B OR APPROVED EQUAL).
19. ALL RESIDENTIAL WATER TAPS SHALL BE FIVE-EIGHTS (5/8) INCH OR AS REQUIRED BY THE CURRENT BUILDING CODE.
20. ALL WATER SERVICE LATERALS SHALL EXTEND FIVE (5) FEET BEYOND RIGHT OF WAY OR UTILITY EASEMENTS, WHICHEVER IS GREATER. THE ENDS SHALL BE MARKED BY A BLUE PAINTED WOOD POST UNTIL CURB AND GUTTER IS IN PLACE. WHEN CURB AND GUTTER IS IN PLACE THE LATERALS SHALL BE MARKED ON THE CONCRETE CURB FACE WITH A "V" or "W".
21. CONCRETE THRUST BLOCKS AND/OR "MEGA-LUG" MECHANICAL RESTRAINTS ARE REQUIRED AT ALL MECHANICAL FITTINGS. THRUST BLOCKS MAY NOT BE REQUIRED IF PIPE RESTRAINT IS PROVIDED IN ACCORDANCE WITH RESTRAINED PIPE DETAIL.
22. NO WORK SHALL BE BACKFILLED (INCLUDING BEDDING MATERIAL ABOVE THE SPRING LINE OF THE PIPE) UNTIL THE CONSTRUCTION HAS BEEN INSPECTED AND APPROVED FOR BACKFILLING BY TOWN ENGINEERING STAFF.
23. ONLY ONE CONNECTION TO THE EXISTING WATER DISTRIBUTION SYSTEM SHALL BE MADE UNTIL ALL HYDROSTATIC TESTING, CHLORINATION AND FLUSHING HAS BEEN COMPLETED.
24. DISINFECTION AND HYDROSTATIC TESTING SHALL BE DONE IN THE PRESENCE OF A TOWN ENGINEERING STAFF. CONTACT THE TOWN ENGINEERING DIVISION FORTY-EIGHT (48) HOURS PRIOR TO DISINFECTING AND/OR TESTING.
25. DISINFECTION AND FLUSHING SHALL BE DONE IN ACCORDANCE WITH THE REQUIREMENTS OF THE COLORADO DEPARTMENT OF HEALTH AND THE PROCEDURE SET FORTH IN AWWA C651, "STANDARD FOR DISINFECTING WATER MAINS". THE CHLORINATION OF THE WATER LINE SHALL BE PERFORMED PRIOR TO THE HYDROSTATIC TESTING. ALL VALVES, FIRE HYDRANTS AND OTHER APPURTANCES SHALL BE OPERATED WHILE PIPELINE IS FILLED WITH THE CHLORINATING AGENT TO INSURE THAT HIGH CHLORINE CONTACT IS MADE WITH ALL INTERNAL SURFACES.

26. TWO TWENTY-FOUR (24) HOUR BACTERIOLOGICAL TESTS, FROM MULTIPLE POINTS TO BE DETERMINED BY THE TOWN ENGINEER, FOR TOTAL COLI-FORM BACTERIA SHALL BE PERFORMED BY THE TOWN A MINIMUM OF 24 HOURS APART. IF EITHER OF THESE TESTS FAIL, THE LINE SHALL BE RE-CHLORINATED, RE-FLUSHED AND THEN RETESTED. THE DEVELOPER AND/OR CONTRACTOR SHALL BE RESPONSIBLE FOR REIMBURSING THE TOWN FOR ALL COSTS ASSOCIATED WITH THE WATER QUALITY TESTING.
27. ALL WATER LINES SHALL BE HYDROSTATIC TESTED. PRESSURE AND LEAKAGE TESTS SHALL BE CONDUCTED ACCORDING TO THE APPLICABLE SECTIONS OF AWWA C600/605 TO A MINIMUM PRESSURE OF ONE HUNDRED AND FIFTY (150) POUNDS PER SQUARE (PSI) INCH AT THE LOW POINT OF THE SECTION BEING TESTED FOR THE DURATION OF TWO (2) HOURS. THE MAXIMUM LENGTH OF LINE TO BE TESTED SHALL BE ONE THOUSAND (1,000) FEET. ALL JOINTS IN CONNECTIONS ARE TO BE WATERTIGHT WITHIN TOLERANCES ALLOWED BY THE SPECIFICATIONS IN AWWA C600/605. ANY LEAKAGE THAT IS DISCOVERED BY OBSERVATION OR TESTS SHALL BE LOCATED AND MADE WATERTIGHT BY THE CONTRACTOR. PRESSURE AND LEAKAGE TESTS SHALL NOT BE CONDUCTED UNTIL THE LINE HAS PASSED ALL REQUIRED DISINFECTION TESTS.
28. INITIAL ACCEPTANCE OF THE NEW WATER LINES ARE CONTINGENT UPON RECEIVING COPIES OF:
 - A. WATER TRENCH COMPACTION TEST RESULTS
 - B. HYDRO STATIC TESTING OF 100% OF THE SYSTEM
 - C. HEALTH DEPARTMENT TESTS. (CHLORINE AND/OR CLEAR WATER AS REQUIRED)
29. ALL METER PITS AND CURB STOPS SHALL BE PROTECTED AT THE TIME OF INSTALLATION WITH A MINIMUM OF THREE (3) T-POSTS AND ORANGE SAFETY FENCE. THE T-POST AND SAFETY FENCE SHALL REMAIN IN PLACE AND IN GOOD CONDITION UNTIL THE LANDSCAPING IS INSTALLED.
30. ALL WATER VAULTS SHALL BE WATER TIGHT. CONTRACTOR SHALL SEAL VAULTS TO ENSURE SURFACE WATER DOES NOT INFILTRATE INTO THE VAULTS. VAULT LIDS SHALL BE PLACED TO ENSURE THAT SURFACE WATER DOES NOT FLOW INTO THE VAULTS.

GENERAL NOTES – STORM SEWER

1. EXCEPT WHERE NOTED, ALL STORM SEWER PIPE SHALL BE REINFORCED CONCRETE, CLASS III AND SHALL CONFORM TO REQUIREMENTS OF ASTM C76. ALL RCP SHALL HAVE RUBBER GASKETED JOINTS AND SHALL CONFORM TO REQUIREMENTS OF ASTM C443, AND SHALL PROVIDE WATERTIGHT PERFORMANCE CHARACTERISTICS.
2. TONGUE AND GROOVE JOINTS SHALL NOT BE ALLOWED.
3. THE MINIMUM COVERAGE FOR ALL STORM DRAINAGE PIPES SHALL BE 1.5 FEET FOR CLASS III PIPE AND 1 FOOT FOR CLASS IV PIPE.
4. WATER, SANITARY SEWER STORM SEWER LINES SHALL HAVE A MINIMUM HORIZONTAL SEPARATION OF TEN (10) FEET. WHEN A TEN (10) FOOT SEPARATION IS NOT PROVIDED OR WHEN SEWER AND STORM SEWER LINES CROSS WATER LINES WITH LESS THAN ONE AND ONE-HALF (1½) FEET OF VERTICAL SEPARATION, SEWER AND STORM SEWER LINE JOINTS SHALL BE CONCRETE ENCASED. FOR PERPENDICULAR CROSSINGS, ENCASED JOINTS SHALL EXTEND TEN (10) FEET, PERPENDICULAR TO THE WATER LINE IN BOTH DIRECTIONS.
5. BEDDING MATERIAL SHALL CONFORM TO TOWN OF FIRESTONE STANDARDS AND SPECIFICATIONS.
6. ALL MANHOLES SHALL BE CONCRETE AND CONFORM TO CDOT STANDARD M-604-20.
7. THE MINIMUM MANHOLE DIAMETER SHALL BE AS SPECIFIED BELOW:

<u>PIPE DIAMETER</u>	<u>MANHOLE SIZE</u>
15" TO 18"	4' DIAMETER
21" TO 42"	5' DIAMETER
48" TO 54"	6' DIAMETER
60" AND LARGER	BOX BASE MANHOLE
8. ALL STREET INLETS SHALL BE CURB OPENING TYPE R CONFORMING TO CDOT STANDARD M-604-12, EXCEPT WHERE OTHERWISE NOTED.
9. ALL INLET ACCESS COVERS SHALL HAVE THE WORDS "NO DUMPING – DRAINS TO RIVERS" AND "STORM SEWER" CAST INTO THE COVER PER TOWN STANDARD DETAIL.
10. ALL END SECTIONS SHALL CONFORM TO CDOT STANDARD M-603-10.

11. WHERE RIPRAP OR GROUTED BOULDERS ARE CALLED FOR ON THE PLANS FOR EROSION CONTROL, IT SHALL CONFORM TO THE URBAN STORM DRAINAGE CRITERIA MANUAL SPECIFICATIONS (LATEST REVISION).