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Whenever used in these General Conditions or in the other Contract Documents the following terms have the meanings indicated which are applicable to both the singular and plural thereof:

**ADDENDA** – Written or graphic instruments issued prior to the opening of Bids which clarify, correct or change the Bidding Requirement or the Contract Documents.

**AGREEMENT** – The written contract between OWNER and CONTRACTOR covering the Work to be performed; other Contract Documents are attached to the Agreement and made a part thereof as provided therein.

**APPLICATION FOR PAYMENT** – The form accepted by ENGINEER which is to be used by CONTRACTOR in requesting progress or final payments and which is to be accompanied by such supporting documentation as is required by the Contract Documents.

**BID** – The offer or proposal of the bidder submitted on the prescribed form setting forth the prices for the Work to be performed.

**BIDDING DOCUMENTS** – The advertisement or invitation to Bid, instruction to bidders, the Bid form, and the proposed Contract Documents (including all Addenda issued prior to receipt of Bids).

**BIDDING REQUIREMENTS** – The advertisement or invitation to Bid, instructions to bidders, and the Bid form.

**BONDS** – Performance and Payment bonds and other instruments of security.

**CHANGE ORDER** – A document recommended by ENGINEER, which is signed by CONTRACTOR and OWNER and authorizes an addition, deletion or revision in the Work, or an adjustment in the Contract Price or the Contract Times, issued on or after the Effective Date of the Agreement.

**CIP** – Capital Improvement Project

**CONTRACT DOCUMENTS** – The Agreement, Addenda (which pertain to the Contract Documents), CONTRACTOR’S Bid (including documentation accompanying the Bid and any post Bid documentation submitted prior to the Notice of Award) when attached as an exhibit to the Agreement, the Notice to Proceed, the Bonds, these General Conditions, the Supplementary Conditions, the Specifications and the Drawings as the same are more specifically identified in the Agreement, together with all Written Amendments, Change Orders, Work Change Directives, Field Orders and ENGINEER’S written interpretations and clarifications.

**CONTRACT PRICE** – The moneys payable by OWNER to CONTRACTOR for completion of the Work in accordance with the Contract Documents.

**CONTRACT TIMES** – The numbers of days or the dates stated in the Agreement: (i) to achieve Substantial Completion, and (ii) to complete the Work so that it is ready for final payment as evidenced by ENGINEER’S written recommendations of final payment.

**CONTRACTOR** – The person, firm or corporation with whom OWNER has entered into the Agreement.

**DEFECTIVE** – An adjective which when modifying the word Work refers to Work that is unsatisfactory, faulty or deficient, in that it does not conform to the Contract Documents, or does not meet the requirements of any inspection, reference standard, test or approval referred to in the Contract Documents, or has been damaged prior to ENGINEER’S recommendation of final payment (unless responsibility for the protection thereof has been assumed by OWNER at Substantial Completion).

**DEVELOPER** – The person or persons legally responsible to the Town for construction of improvements within a subdivision.
DRAWINGS – The drawing which show the scope, extent and character of the Work to be furnished and performed by CONTRACTOR and which have been prepared or approved by ENGINEER and are referred to in the Contract Documents, Shop Drawings are not Drawings as so defined.

EFFECTIVE DATE OF THE AGREEMENT – The date indicated in the Agreement on which it becomes effective, but if no such date is indicated it means the date on which the Agreement is signed and delivered by the last of the two parties to sign and deliver.

ENGINEER – The Town Engineer or authorized designate.

ENGINEER'S CONSULTANT – A person, firm or corporation having a contract with ENGINEER to furnish services as ENGINEER’S independent professional associate or consultant with respect to the Project and who is identified as such in the Supplementary Conditions.

FIELD ORDER – A written order issued by ENGINEER which orders minor changes in the Work but does not involve a change in the Contract Price or the Contract Time.

GPCD – Gallons per capita per day

GPM – Gallons per minute

INSPECTOR – Staff Engineer or Town authorized designate.

LIENS – Liens, charges, security interests or encumbrances upon real property or personal property.

MGD – Millions Gallons per Day

NOTICE OF AWARD – The written notice by OWNER to the apparent successful bidder starting that upon compliance by the apparent successful bidder with the conditions precedent enumerated therein, within the time specified, OWNER will sign and deliver the Agreement.

NOTICE TO PROCEED – A written notice given by OWNER to CONTRACTOR (with a copy to ENGINEER) fixing the date on which the Contract Times will commence to run and on which CONTRACTOR shall start to perform CONTRACTOR’S obligations under the Contract Documents.

OWNER – The Town of Lochbuie.

PARTIAL UTILIZATION – Use by OWNER of a substantially completed part of the Work for the purpose for which it is intended (or a related purpose) prior to Substantial Completion of all the Work.

PROJECT – The total construction of which the Work to be provided under the Contract Documents may be the whole, or a part as indicated elsewhere in the Contract Documents.

PSI – Pounds per square inch

RESIDENT PROJECT REPRESENTATIVE – Town authorized representative ENGINEER who may be assigned to the site or any part thereof.

SAMPLES – Physical examples of materials, equipment, or workmanship that are representative of some portion of the Work and which establish the standard by which such portion of the Work will be judged.

SHOP DRAWINGS – All drawings, diagrams, illustrations, schedules and other data or information which are specifically prepared or assembled by or for CONTRACTOR and submitted by CONTRACTOR to illustrate some portion of the Work.

SPECIFICATIONS – Those portions of the Contract Documents consisting of written technical descriptions of materials, equipment, construction systems, standards and workmanship as applied to the Work and certain administrative details applicable thereto.
SUBSTANTIAL COMPLETION – The Work (or a specified part thereof) has progressed to the point where, in the opinion of ENGINEER as evidenced by ENGINEER’S definitive certificate of Substantial Completion, it is sufficiently complete, in accordance with the Contract Documents, so that the Work (or specified part) can be utilized for the purposes of which it is intended, or if no such certificate is issued, when the Work is complete and ready for final payment as evidenced by ENGINEER’S written recommendation of final payment.

SUPPLIER – A manufacturer, fabricator, supplier, distributor, materialman or vendor having a direct contract with CONTRACTOR or with any Subcontractor to furnish materials or equipment to be incorporated in the Work by CONTRACTOR or any Subcontractor.

TOWN – The Department of Public Works or a representation of the Department of Public Works.

TOWN ENGINEER – Director of Public Works Department of Town authorized designate.

WORK – The entire completed construction or the various separately identifiable parts thereof required to be furnished under the Contract Documents. Work includes and is the result of performing or furnishing labor and furnishing and incorporating materials and equipment into the construction and performing or furnishing services and furnishing documents, all as required by the Contract Documents.

WORK CHANGE DIRECTIVE – A written directive to CONTRACTOR, issued on or after the Effective Date of the Agreement and signed by OWNER and recommend by ENGINEER ordering an addition, deletion or revision in the Work, or responding to differing or unforeseen physical conditions under which the Work is to be performed. A Work Change Directive will not change the Contract Price or the Contract Times, but is evidence that the parties expect that the change directed or documented by a Work Change Directive will be incorporated in a subsequently issued Change Order following negotiation by the parties as to its effect, if any on the Contract Price or Contract Times.

WRITTEN AMENDMENT – A written amendment of the Contract Documents, signed by OWNER and CONTRACTOR on or after the Effective Date of the Agreement and normally dealing with the non-engineering or non-technical rather than strictly construction-related aspects of the Contract Documents.
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1.01 GENERAL

These guidelines are intended to provide an overall direction for preparation of engineering and construction plans. While the level of information required is minimum, design engineers and professionals are encouraged to exceed these minimum design levels and prepare more enhanced detailed plans. All construction plans will be checked for conformance with the STANDARDS AND SPECIFICATIONS, prior to acceptance by Town. This acceptance shall be for conformance to Town requirements; engineering, design or needs will remain the responsibility of the professional design engineer. One set (blueline) of the final plans will be submitted to the Town for review prior to approval. This set will be returned if changes are required or recommended. The redlined set must be returned with the next submittal. Upon final approval of the plans by the Town, a minimum of 4 sets of prints (blueline) will be submitted. These sets of prints 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 stamped with an approval stamp by the Town and signed by the Director of Public Works. One of the signed sets shall be returned to the design engineer, and three sets shall be kept by the Town. A copy of the plans with the Town approval stamp shall be kept on the job by the Contractor/Developer for the duration of the project. All drawings and prints shall be 24" x 36" in size. Should circumstances warrant changes to the accepted plans or specifications, written approval must be obtained from the Town. It will be the duty of the design engineer and the Contractor to record any and all changes on Record Drawings at the completion of the project. Record drawings shall be provided to the Town prior to construction acceptance in 24" x 36" Mylar and on a CD in the latest version of AutoCAD.

1.02 SHOP DRAWINGS AND ENGINEERING DATA

Engineering data covering all equipment and fabricated materials which will become Town property shall be submitted to the Town for review. This data shall include drawings and descriptive information in sufficient detail to show the kind, size, arrangement, and operation of component materials and devices; the external connections, anchorages, and supports required; performance characteristics; and dimensions needed for installation and correlation with other materials and equipment.

All submittals, regardless of origin, shall be stamped with the approval of the Contractor/Developer and identified with the Contractor's/Developer's name, name of project or subdivision and references to applicable specification paragraphs and Contract Drawings. Each submittal shall indicate the intended use of the item in the Work. When catalog pages are submitted, applicable items shall be clearly identified. The current revision, issue number, and date shall be indicated on all drawings and other descriptive data.
The Contractor’s/Developer’s stamp of approval is a representation to the Town that the Contractor/Developer accepts full responsibility for determining and verifying all quantities, dimensions, field construction criteria, materials, catalog numbers, and similar data, and that he has reviewed or coordinated each submittal with the requirements of the Work and the Contract Documents.

All deviations from the Contract Documents shall be identified on each submittal and shall be tabulated in the Contractor’s/Developer’s letter of transmittal. Such submittals shall, as pertinent to the deviation, indicate essential details of all changes proposed by the Contractor/Developer (including modifications to other facilities that may be a result of the deviation).

The Contractor/Developer shall accept full responsibility for the completeness of each submission, and, in the case of a resubmission, shall verify that all exceptions previously noted by the Town have been taken into account. In the event that more than one resubmission is required because of failure of the Town for review of the additional resubmissions.

The Town’s review of drawings and data submitted by the Contractor/Developer will cover only general conformity to the Drawings and Specifications, external connections, and dimensions which effect the layout. The Town’s review does not indicate a thorough review of all dimensions, quantities, and details of the material, equipment, device, or item shown. The Town’s review of submittals shall not relieve the Contractor/Developer from responsibility for errors, omissions, or deviations, nor responsibility for compliance with the Contract Documents or these standards.

The Contractor/Developer shall submit 3 copies of each submittal for review. The Town will not accept submittals from anyone but Contractor/Developer.

When the drawings and data are returned marked “NOT ACCEPTABLE” or “RETURNED FOR CORRECTION”, the corrections shall be made as noted thereon and as instructed by the Town and the number of corrected copies designated by the Town resubmitted.

When corrected copies are resubmitted, the Contractor/Developer shall in writing direct specific attention to all revisions and shall list separately any revisions made other than those called for by the Town on previous submissions.

When the drawings and data are returned marked “EXCEPTIONS NOTED”, “NO EXCEPTIONS NOTED”, or “RECORD COPY”, no additional copies need be furnished.
1.03 CONSTRUCTION PLANS

All final drawings submitted for approval and record shall meet or exceed minimum standards.

Drawings shall meet current Town drafting standards.

Each set of plans will have a title sheet containing the title of the project and a vicinity map. The letter size, style, etc. is left to designer’s discretion.

Vicinity map on title sheet must have a scale of 1 in. = 2,000 ft., showing the location and names of all arterial streets within 1 mile of the proposed improvement site. The project area shall be indicated by shading or thick lines, with beginning and end stationing marked.

Existing topography will be drawn in dashed lines or must be screened if prepared in solid lines to distinguish from proposed design.

a. General Information

   All construction plans will show the following information:

   • Scale
   • North arrow on all sheets.
   • Title block (lower right hand corner only) to include the land improvement name and the type of improvement, name, address, zip, and telephone number of the designer or consulting engineer, name, address, zip, telephone number of the contact for the developer.
   • Date of plan and date of any revision.
   • Benchmark description on each sheet, elevation, datum, tie to Town bench loop and description of Town benchmark tied to.
   • A typical cross section is to be shown for all streets on the details sheet of the submittal, indicating type of street(s) and profile grade design point, street width, right-of-way, cross slope, flow line, P.C. etc.
   • Full intersection layout is required to be submitted on one sheet. Match lines will not be allowed to bisect the intersection design.

b. Private Improvements

   Private improvements such as streets, utilities, etc. shall be clearly noted as such on each sheet of the construction plans. Where private improvements occur, the note below shall appear on each sheet of the construction plans.
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"Town of Lochbuie shall not be liable for the maintenance of (name specific improvement)."

1. Site Plan View

Site layout plans for proposed land improvement or enhancement must have a horizontal scale of 1 in. = 30 ft., or 1 in. = 50 ft. Larger sites exceeding design frames on standard engineering plans (24" x 36") may use more than one sheet.

Site plan must reflect all existing features including underground, surface, and overhead systems and facilities, contours and spot elevations, grid system coordinates, section corner and survey monument locations and descriptions, and construction benchmark descriptions. All of the information must be based on USGS/NGS datum. Other additional ground control points must have descriptions of the same type and format. Proposed improvements will have similar format as mentioned above, plus additional information such as sizes, dimensions, quantities, etc.

Geometric layouts must have complete information including but not limited to stationing, horizontal curve data, return radius, etc. Designs including utility, traffic control elements and components, and other improvements must be called out and labeled specifically. All special section cutouts and details must be numbered, labeled, and referred to its corresponding sheet number.

2. Profile View

Profile sheet(s) must have horizontal scale of 1 in. = 20 ft., or 1 in. = 50 ft. and vertical scale 1 in. = 2 ft., or 1 in. = 5 ft. respectively. All existing underground systems must be shown and called out with detailed data. Location station and full depth of soil borings and soil types (legend) will be indicated.

Waterlines must have information labels including pipe size, length, pipe and fitting material and type, profile grade and control point elevations, valves, PRV's, tees, reducers, anticipated operating pressures, etc.

Wastewater lines must have information labels including pipe material, size, length, profile grade, manhole numbering system, invert elevations, station calls, rim elevations, etc.

Storm sewers and flood control systems must contain all of the above information plus detailed data for inlets, outlet structures, wingwalls, aprons, gabions, rip rap, trash racks, box culverts, bridges, channels, swales, etc.

Streets, bike paths, trails, and other transportation facilities must have information labels including center line profile grades, stations, vertical curve data, detail calls, intersections,
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grade breaks points, stopping site distances, high points, low points, flow line profiles,
street lights, traffic control devices, termination boxes, median islands, pavement
markings, etc.

3. Street and Utility Plan and Profile

All infrastructure designs including transportation, utility, and flood control systems must
be prepared on plan and profile sheets. The upper half would be a plain section for plan
view, and the lower half would have grids for plotting the profile view. Separate sheets
for plan and profile are not acceptable. The amount and extent of information must be
the same as in previous sections of this chapter.

a. Plan View Requirements

The plan view shall indicate the following:

Property and/or right-of-way lines, easements and/or tracts. Type and dimension
of easement or tract is to be clearly labeled. Property lines and right-of-way lines
to be dimensioned.

Survey lines and stations shall be based on center line stationing. Stationing is to
be equated to top of curve at bubbles, cul-de-sacs, horizontal curves and other
departures from normal street cross sections.

Street and street names. Indicate street width.

Existing utilities and structures with appropriate stationing including, but not
limited to:

- water and hydrants
- sanitary sewer
- storm drainage facilities
- telephone
- gas
- electricity
- cable TV
- drainageways
- driveway locations and sidewalks
- streetlights
- traffic signal poles and controllers
- pavement edges
- trees

Station of drainage appurtenances and flow directional arrows.

Match lines and sheet numbers.

Station and elevation of all curb returns, horizontal PCs, PTs, etc. existing and
proposed. Also the high or low point on all vertical curbs, at inlets (including
invert), and 50 ft. maximum intervals along the streets.
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Curb return radius, existing and proposed.

Curb ramp locations.

Complete horizontal curve data. (R,D,L,Tan)

All crown lines where departing from the normal cross sections (transitions to existing roadways) with appropriate transition starting elevation.

Center line stations of all intersecting streets.

Survey line ties to section corners and quarter section corners.

b. Profile View Requirements

The profile shall indicate the following: (profile required on water line 12 in. diameter or greater)

All design elevations shall be center line, flow line, or invert of pipe. Top of pipe is acceptable for existing utilities or utility crossings.

Draw and label both the existing and proposed grade lines.

Center line stationing continuous for entire length of the street or project with center line station of all intersecting streets. Flow line of curb stationing for cul-de-sacs is acceptable.

Existing improvements to be shown in the profile shall include but not be limited to, sidewalks, curbs, gutters, and asphalt, all with certified as-built grade and elevations including bike paths and detailed material types.

Existing utilities, particularly where crossed, with grades and elevations.

Station and elevation of all horizontal PCs, PTs, existing and proposed.

Station and elevation of grade breaks, existing and proposed.

Proposed construction:
Vertical curves with VPI, VPC, VPT, high points or low point elevations and stations.
Slope and distance for all tangent lines.
Curb return profiles.
Size, type and structural class of pipe, including ASTM or AWWA specifications.

Pipe bedding requirements.
Station and elevation on all drainage and other proposed utilities.
4. Cross Sections

Streets, flood control systems, utilities, and all other infrastructures serving more than 5 single dwelling units, commercial, industrial, and public sites will have cross section sheets prepared for 50 ft. and 100 ft. intervals based on profile sections.

Cross sections must extend beyond the property and ROW limits to indicate matching points with existing ground or surface elevations. Cross section intervals may differ at times to indicate critical locations within the project limits. When subsurface excavation or construction (of any kind) is proposed, all underground systems must be plotted with information labels such as sizes, dimensions, invert, material types etc.

5. Details

The construction plans shall include adequate details and complete design calculations of special structures not covered by the Town of Lochbuie Standard Details.

Each plan set must have detail sheets to provide vital information for proper bidding and construction of an improvement. Details are prepared in two categories:

Standard details for typical construction. Usually these are the Town’s Public Works standard details printed in the Standards Manual or Colorado Department of Transportation M&S – Standards, MUTCH, AASHTO, or other nationally practiced industry standard details not specifically covered by the Public Works Department Standards Manual.

Project specific details. These details must be prepared for each project to further explain the unique circumstance under which the project must be interpreted and constructed. The range of these details will vary from paving sections to utility trenches to structures and all components of the project.

6. Street Signing, Striping and Lighting Plan

Plan sets must include a separate sheet for street signing, striping and lighting when applicable. These sheets are required when surface alterations, additions, disturbances, or enhancements are proposed with any construction project. CDOT approval shall be required of such plans if the roadway is a state highway.

A complete signing and striping plan shall be submitted as a part of the design documents for the review by the Town. All signing and striping design shall conform to the Manual on Uniform Traffic Control Devices. Refer to the section for street sign specifications. Lighting shall conform to the lighting requirements of Section 7.
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1.04 PRIVATE IMPROVEMENTS

Improvements having a direct impact of any kind on public properties or right-of-ways and easements controlled by the Town will be subject to full compliance with Public Works Department Standards Manual and policies.

1.05 DRAFTING STANDARDS

1. General Requirements

The following guidelines must be used for board drafting or computer plotting of the plans:

All notes, general and specific, referring to existing topography will be done in standard lower case lettering with a No. 1 pen.

Lower case lettering will be 1/8 in. high. One-eighth inch is the height of the letter stems, such as “t” or “h” or “d”. The lower proportions and letters, such as “n” and “r” should be approximately two-thirds that height.

Right-of-way lines and property lines will be drawn with a No. 1 pen.

Center lines, working lines and survey lines will be drawn with a No. 0 pen.

Street names and proper names will be done in caps. The height and pen size will be determined by the available space, but should be bold enough to stand out.

Stations in both the plan and profile view will be done 1/4 in. in height with a No. 1 pen.

Stations in the profile should be written horizontally with the space provided at the bottom of the profile grid.

2. Design Features

Will be drawn in solid lines using pen No. 2 or thicker lines.

All notes, general and specific, will be done in standard upper case lettering with a No. 1 pen.

All match lines will be labeled “Match Sta. 10+00” using 1/3 in. high letters and a No. 3 pen.

If the profile is very flat or the background is dark, pen sizes will move up one size.
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01/01/04

For the elevations on each side of the profile, use a pen No. 1 and 1/4 in. height.

Street names and proper names will be done in caps. The height and pen size will be determined by the available space but should be bold enough to stand out.

3. Miscellaneous

All note lines will be drawn with a template using a No. 1 pen.

All dimension lines will be drawn with a No. 0 pen.

Intersections must be drawn on one sheet so that it is not spread out on to two sheets. Do not repeat the same information on two different sheets.

Draw sidewalk and bikeway ramps to the face of the curb not to the toe.

Each sheet shall include a title block, project name, a project number, date scale, and sheet number (no. _______ of _______ total sheets).

Letter height and pen size for the title block will depend on the length of the title, but it should be done in upper case letters and should remain constant for all plan sheets except the title page.

The following approval block shall be included on the cover sheet for all construction drawing packages submitted to the town.

APPROVED FOR ONE YEAR FROM THIS DATE:

The town engineer’s signature affixed to this document indicates that the town engineer has reviewed the document and found it in general conformance with the town of Lochbuie engineering standards or approved variances to those regulations. The town engineer, through approval of this document, assumes no responsibility, other than stated above, for the completeness and/or accuracy of these documents. The owner and 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 is affixed to this document.

ACCEPTED BY: ___________________________________________

CITY ENGINEER

DATE

4. Revisions

A revision is defined as any change in alignment, profile or design prior to approval of the plans by the Director of Public Works and any changes made after approval of the plans by the Director of Public Works.

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All revisions will be noted in the “Revision Record” box on the plans. If more revisions are made than there is room for in the given Revision Box, an additional Revision Box shall be added to the plans. If at all possible, the additional Revision Box should be put in the lower right hand corner of the sheet just above the title block. The revision box shall include revision numbers, a brief description of what is being revised and a Town approval box.

Example:

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<thead>
<tr>
<th>Revision</th>
<th>Description</th>
<th>Designed By</th>
<th>Date</th>
</tr>
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<tbody>
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<td></td>
</tr>
<tr>
<td>2</td>
<td>Modified Curb Return</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3</td>
<td>Added Manhole</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

1.06 UNDERGROUND UTILITIES LOCATIONS

The type, size, locations and number of all known underground utilities are approximate when shown on the drawings. It shall be the responsibility of the contractor to verify the existence and location of all underground utilities along the route of work. Before commencing new construction, the contractor shall verify underground utilities.

1.07 PERMITS

Permits shall be required for any work performed in the public right-of-way. Permits shall be obtained from the Lochbuie Department of Public Works before any work is commenced, and such permits shall only be issued to contractors licensed, bonded, and insured in the Town. No work relating to water and sanitary sewer utilities done outside the Town limits of Lochbuie, yet still in the Lochbuie service area, shall commence until the appropriate entities have been notified and the necessary permits purchased. All permits relating to any work involving the Town Utility System must be approved by the Town prior to issuance.

1.08 APPLICATION PROCEDURE

The Lochbuie Department of Public Works will establish and amend from time to time procedures to be followed by developers performing work on water and sanitary sewer utilities. These procedures will include all requirements for documentation, submittals, fees, engineering design, construction, and acceptance.

1.09 CONSTRUCTION

Following final approval of the plans, the developer may proceed with construction. In addition to all construction requirements contained in other portions of these Standards, the Developer and his Contractor shall observe the following:
A. Prior to the commencement of work, a preconstruction conference shall be held between personnel representing the Lochbuie Department of Public Works and the Contractor who is scheduled to perform the work.

B. Construction shall commence within 6 months of the approval date shown on the plans or the plans must be resubmitted for review and re-approval.

C. The work shall be surveyed and staked under the supervision of a licensed land surveyor in accordance with the approved plans.

D. The Lochbuie Department of Public Works shall be notified at least 48 hours prior to start of work.

E. Adequate provisions for notification of customers who may experience a loss of water or sewer services must be developed. Such outages shall be kept to a minimum in compliance with these standards.

F. All work relating to water and sanitary sewer utilities shall be inspected by a Department of Public Works Inspector. Mains will only be tapped after having been installed to the satisfaction of the Inspector, chlorinated, pressure/clearwater tested and released by the Department of Public Works. The Contractor shall make his own water taps on new water mains installed by the Contractor prior to integration with the present Town water system, and the Town shall not assess any tap charge for the same except that the owner shall pay an inspection fee and the cost of the water meter in effect at the time the building permit is issued, the meter to be supplied by the Town.

G. No work shall commence until the installing Contractor has an approved set of plans from the Lochbuie Department of Public Works and current specifications in his possession. The Town's approval will be for general conformity to the plans and will not constitute blanket approval of all dimensions, quantities and details of the material or equipment shown. Nor shall such approval relieve the Contractor or consulting engineer of this responsibility for errors contained in the drawings.

H. Streets shall not be paved until meter pit locations have been verified in the field. No paving permits shall be issued until a release is given by the Lochbuie Department of Public Works.

I. Approval by the Town shall in no manner relieve the Developer/Contractor from responsibility for errors or omissions in the plans. Any errors shall be corrected by the Developer/Contractor to the satisfaction of the Lochbuie Department of Public Works and at no expense to the Town.

J. Where a conflict occurs between or within standards, specifications, and drawings, the more stringent or higher quality requirements shall apply.
K. Installation of all new facilities in Lochbuie's service area shall be inspected and approved by a Lochbuie Department of Public Works Inspector.

L. The Inspector shall see that materials are furnished and the work is performed in accordance with Town Department of Public Works approved plans and specifications. The Contractor shall furnish all reasonable aid and assistance required by the Town or inspector for the proper examination of the material and work. All work shall be performed in accordance with accepted workmanship practices and these engineering standards. Any work not accepted by the Inspector shall be redone until compliance with these standards is achieved.

Instructions given by the inspector relating to quality of materials and workmanship must be obeyed at once by the Contractor. The Inspector shall not supervise nor set out work or give line and grade stakes.

All materials used shall be subject to the inspection and approval of the Inspector at all times. The Inspector has the right to perform any testing deemed necessary to ensure compliance of the material with these standards. No material shall be used before being inspected and approved by the Inspector. Failure or neglect on the part of the Inspector to condemn or reject inferior materials or work shall not be construed to imply their acceptance should their inferiority become evident at any time prior to final acceptance of the work. Inspectors have the authority to reject defective or inferior materials and/or defective workmanship and to suspend work until such time as the Contractor shall correct the discrepancies in question. Whenever defective materials and work are rejected, the Contractor shall promptly remove such defective materials from the job site and replace all defective portions to the satisfaction of the Engineer or his representative. In the event the Contractor fails to remove rejected items from the job site within a reasonable length of time, the Engineer may arrange for such removal at the expense of the Contractor. Inspection shall not relieve the Contractor from any obligation to perform the work strictly in accordance with the plans and specifications or any approved modifications thereof. Work not so constructed shall be removed and corrected by the Contractor at his sole expense, whenever so ordered by the Engineer, without reference to any previous error or oversight inspection.

M. Except in cases of emergency, authorization from the Town in advance, maintenance or protection of work already done, no work shall be allowed between the hours of 5 p.m. and 8 a.m. nor on Saturday, Sunday or legal holidays unless approved by the Engineer in each case. When Inspectors are required to work overtime, it shall be at the Contractor's expense, provided, however, such Inspectors shall remain employees of the Town for all purposes. Forty-eight hours notice shall be required for requesting any inspection in services outside of normal business hours. Payment for such overtime work shall be made by check to the Town Department of Public Works prior to final acceptance.
N. In the event one or more inspectors representing private consulting engineering firms are also inspecting a project, along with Town Department of Public Works Inspectors, the instructions given by the Department of Public Works shall prevail in the event of conflicting instructions.

1.10 WARRANTEE OF WORK

The contractor shall warrant to the Town that all work is free from defects in workmanship or materials for a period of 2 years commencing upon the date of final acceptance by the Town. The contractor shall be responsible for any settlement or deterioration and shall maintain the surface over trenches in approved condition throughout the warranty period. The contractor shall further indemnify and hold harmless the Town from and against any loss, claim or demand for damage arising out of defective workmanship or materials, during said 2 year period. Bonding shall refer to Public Works specs; Bonding.

1.11 BONDING

Developers and/or Contractors will be required to provide a bond to the Town to provide protection against the following situations:

A. Repairs or work performed by the Town caused by the Contractor.

B. Necessary repair of damages caused by the Contractor.

C. Necessary repairs caused by installing defective material.

D. Necessary repairs caused by poor installation techniques.

E. Costs incurred by the Town due to the Contractor’s failure to perform in accordance with these standards.

F. Maintenance guarantee for 2 years.

1.12 TRAFFIC CONTROL

- The flow of traffic on streets and roadways within the Town right-of-ways shall be maintained at all times during construction per current MUTCD barricading manual and standards at time of construction.

- The Contractor shall be responsible for the provision of a safe travelway on all roadways on and adjacent to the job site. The Contractor shall erect or cause erection of proper traffic control warning devices around all excavations, embankments and obstructions and shall be responsible for the proper maintenance of said erected
devices. The Contractor shall have a certified traffic control designee on staff for preparing traffic control plans in order to receive Town approval.

- The Contractor shall cause suitable warning lights or flares to be provided and kept lighted at night or other times when visibility is limited.

- The Contractor shall provide flag person protection when needed or as may be determined by the Town or his duly authorized agent for the protection of the public, as well as workers on the job site.

- The Contractor shall coordinate his work and obtain approval in writing from the Town in order that arrangements may be made for detours, parking, access to property adjacent to work, etc. 48 hours prior to their need.

- The Contractor shall not close any street or portion of a street without receiving a traffic variance from the Town 48 hours prior to such closure. It is the Contractor’s responsibility to notify Adams County Communications Center, which will notify the Town Police and Fire Departments, 24 hours prior to closing any street which such closure has been authorized by the Town. The Contractor shall also notify the School District Transportation Department of such closure when the schools are in session during construction. The Contractor shall also notify the above immediately after opening of any street, alley, or fire lane.

- The Town shall close down any work (except in extreme emergencies) which is not controlled in accordance with approved MUTCD barricading procedures or on projects which require a traffic variance and such has not been obtained by the Contractor. No work shall be allowed at signalized intersections or on major arterial roadways which impedes normal traffic flow from 6:00 a.m. until 8:30 a.m. and 4:30 p.m. until 6:00 p.m., except during emergencies or with prior approval of the Town. The Town may require the Contractor to obtain the services of an off duty Lochbuie Police Officer to regulate traffic when work is performed at the signalized intersection.
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2.00 CONSTRUCTION

All work shall be in accordance with the Colorado Department of Highways, Division of Highways, Standard Specifications for Road and Bridge Construction, and CDOT M & S Standards, latest editions, as applicable, and as amended by these specifications.

2.01 CURB AND GUTTER AND SIDEWALKS

Sidewalk width, cross slope, and alignment shall conform to the approved typical roadway section and lines and grades shown on the plans. Alignment of meandering walks shall be approved on a project specific basis. All sidewalks shall have a transverse broom finish. Curb & gutter shall conform to the dimensional properties of the approved section and be constructed to a neat line matching the lines and grade of the plans.

All curb, gutter and sidewalk shall have transverse contraction joints at 10 foot maximum intervals, at curb ramps, and at all intersection radius points. Expansion joints shall be placed at 200 foot maximum intervals (sidewalk only).

Expansion joint material shall be placed at existing concrete and new driveway access ramps. Expansion joint material shall be placed against cleanly saw cut vertical concrete face and shall not protrude above the adjacent concrete surface.

All concrete shall be class B unless noted otherwise in these specifications.

Sidewalks shall be a minimum thickness of 6" and shall transition in thickness at drive ramps to 6" for residential ramps and 8" for commercial ramps and alleys, over a distance of 5 feet each side of drive. Fiber mesh reinforcement shall be required for all sidewalks 6' wide or greater, handicap ramps, crossovers and all curb cuts.

All sidewalks shall have a transverse broom finish.

2.02 STORM DRAINAGE

Drainage systems shall be designed in accordance with the latest Town requirements. Drainage plans must be approved before final approval of street plans.

2.03 CROSSPANS

The use of double crossovers is only allowed on a case by case basis. Double crossovers may be used at the intersection of a residential street only when absolutely necessary to prevent flooding of one side of the street. Crossovers are not allowed across collector or arterial streets.
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2.04 INLETS

Inlets shall be located so that gutter flow depths are maintained in accordance with the drainage requirements of Chapter 3. Due to presence of curb ramps, inlets are not allowed in the curb return. Multiple inlets shall be located at the tangent points of the curb.

2.05 CROSS SLOPES

Street must be crowned with minimum cross slope of 2% and maximum of 3%, measured from center line to lip of curb or lip of median curb to lip of outside curb on streets with raised center islands. Parabolic or curbed crowns or offset crown are not allowed. The top of curb elevation must be the same on both sides of a street, except at intersections or where superelevation is required.

2.06 HORIZONTAL ALIGNMENT

All streets shall intersect at right angles for a minimum distance of 50 ft. from the edge of the intersection.

Super elevation shall be as recommended by the AASHTO Guidelines. Minimum spacing between connecting roadways are as follows:

<table>
<thead>
<tr>
<th>Type of Street</th>
<th>Minimum Spacing</th>
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<tbody>
<tr>
<td>Arterial Street</td>
<td>500 ft.</td>
</tr>
<tr>
<td>Collector Street</td>
<td>300 ft.</td>
</tr>
<tr>
<td>Residential Street</td>
<td>150 ft.</td>
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</table>

Reverse curves shall be joined by a tangent of at least 100 ft. in length.

Minimum design vehicle for residential and local street classifications shall be a SU-30 and for collector and arterials shall be a WB-50 as detailed by American Association of State Highway and Transportation Officials (AASHTO).

Curb radii at intersections where two arterial streets meet shall be governed by the latest edition of the “Policy on Design of Urban Highways and Arterial Streets”, AASHTO and subject to the approval of the Town. Street and alley design criteria shall meet the requirements of Table 2-1.
The design of freeways shall be governed by the latest edition of the "Policy on Geometric Design of Rural Highway", AASHTO, and subject to the written approval of the Town.

2.07 VERTICAL ALIGNMENT

The minimum allowable profile grade for any street or alley shall be 0.5%, the maximum allowable grade for any street shall be 6%. Continuous changing of grades that create a roller coaster effect shall not be permitted unless written approval is given by the Town. Connections with existing streets shall be accomplished through smooth transitions and existing grades shall be shown for at least 200 ft. on each side of the intersection. The grade and ground lines of all streets that dead end, except cul-de-sacs, shall be continued for 500 ft. or to its intersection with an arterial street. The grade and ground lines for arterial streets shall be continued 500 ft. beyond their ends.

Grade breaks will be allowed if the algebraic difference (A) in grades is less than 0.5%. The maximum allowable grade of a street or drive going onto an intersection shall not exceed 4% for at least a distance of 50 ft.

Design Controls for Sag and Crest Vertical Curves (based on a minimum design speed of 30 mph).

**Algebraic Difference in Grades Minimum Length of Vertical Curve**

- 0.5% - 1.0%  
- 1.0% - 3.0%  
- 3.0% - 5.0%  
- 5.0% - 8.0%  

50 ft.  
100 ft.  
200 ft.  
300 ft.

Greater than 8.0% shall be governed by AASHTO geometric design manual.
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Notes to Table:

- All vertical curves shall be labeled with a length of curve (L), algebraic difference in grades (A in percent) and elevations at 25 ft. stations and at points of curvature.

- The minimum speeds listed shall also apply to horizontal alignment. Horizontal curve radius and super elevation shall be in accordance with the recommendations of the AASHTO geometric design manual when scope of design criteria falls outside of the chapter's boundaries.

- Vertical curves are not necessary when (A) is less than 0.5%. For (A) between 0.5% and 1.0%, (L) need not exceed 50 ft. for Sag Vertical Curve.

2.08 CURB RAMPS

Laws require that curb ramps be installed at intersections and at certain mid block locations for all new construction or reconstruction of curb, gutter and sidewalk (State of Colorado C.R.S. 43-2-1079(2)). Curb ramps shall also be placed where bike paths meet streets. Curb ramps shall be shown at all curb returns and at all “T” intersections in accordance with Colorado Department of Transportation latest M and S Standards, except as modified by the Town of Lochbuie Standards.

MUST MEET ALL AADA REQUIREMENTS

Town Modifications to CDOT curb ramp standards:

- Do not place transverse tooled joints in ramp area. Broom finish ramp and wings.

All curb ramp locations at intersections involving major streets shall follow Town design criteria unless approved otherwise.

2.09 SIGHT RESTRICTIONS

No physical objects may be placed in the sight triangle area which has a height of greater than 30 in. or may grow to exceed 30 in. (See Drawing #2.03)

2.10 MEDIAN DESIGN AT INTERSECTION WITH MAJOR STREET

The minimum median width shall be 6 ft. (flow line to flow line) and shall be constructed in such a way to drain all storm waters away from the median. The area between median curb shall be concrete.

The minimum median width required for landscaping shall be 16 ft. (flow line to flow line).
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STREET FUNCTIONAL CLASSIFICATIONS

Refer to the Town’s most current Transportation Master Plan for current street function classifications.

2.11 TYPICAL STREET CROSS SECTIONS

Refer to the drawings at the end of this Section for typical street cross sections.

2.12 DECELERATION LANE DESIGN

Refer to the latest version of CDOT Design Guide – Volume 1 – AASHTO Chapters, Chapter 9 for Deceleration Lane Design.

The required pavement section for all decel/accel lanes shall be the same as the street pavement thickness.

2.13 CUL-DE-SAC DESIGN

All cul-de-sacs shall have turn around right-of-way diameter of at least 100 ft. with a pavement diameter of 90 ft. Dead-end streets less than 150 ft. in length in a single-family area may use a “T” design with approval of the Town and Fire District. Minimum design vehicle shall be WB-40.

2.14 COMMERCIAL AND MULTI-FAMILY DRIVEWAY RAMPS

Shall be used at all developments accessing collector and arterial streets or when required by the Town.

There shall be a minimum of 40 ft. between driveway ramps or driveway ramps or drive access permits and no more than one curb cut or drive access per lot unless approved by Public Works Department due to an extreme hardship or safety problem caused by only one access. No drive access or curb cut shall be permitted within 50 ft. of a corner as measured from the flow line of the intersecting street to the nearest edge of the access point or curb opening. Drive access or curb cuts must be located beyond the P.C. of the corner radius and will not be allowed within 10’ of a property line. Drive access or curb cuts shall be a minimum of 20 ft. wide and a maximum of 36 ft. wide. Refer to the standard drawings.

2.15 RESIDENTIAL DRIVEWAY RAMPS

There shall be a minimum of 30 ft. between driveway ramps or drive access points and no more than one curb cut or drive access per lot for urban residential design. No drive access or curb cut shall be permitted within 30 ft. of a corner as measured from the flow.
The distance of sign posts from the curb face and alignment of the sign face shall be in accordance with the latest edition of the Manual on Uniform Traffic Control Devices. Refer to the sign detail drawings.

All posts shall be installed by first driving a 3 ft. anchor 2-1/4" x 2-1/4"x 36" –12 gauge (note size of anchor and depth of anchor in drawing for appropriate installation) using a telespar driving cap to accommodate the size of anchor being used.

Cut sign post to proper length and slide into anchor as shown on drawing and secure with two TL-3806 drive rivets or approved equal; one on the sign face side and the other to the right or left of the post. Care must be taken to set sign posts as not to obscure another sign or so that new installation is not obscured by another object.

All traffic signs of Type I or Type II shall be mounted at a height of 7 ft. for sidewalk or 9 ft. for bike path or jointly used pedestrian/bike path from the top of the curb to the bottom of the sign, except for “Keep Right” sign which shall be mounted at a height of 5 ft. from the top of curb to the bottom of the sign. Street name signs mounted by themselves shall be mounted at the same height as if they were accompanied by a “Stop” sign. Note Type I installation on the drawing.

All Type I, Type II, and Type III traffic sign panels shall be fastened directly to the post. Fasten sign panel to telespar tubing by first placing 2 3/8 in. zinc plated flat washers on face of sign and secure with 2 TL-3806 drive rivets or approved equal. Where a high intensity sign is mounted it is necessary to place a fiber washer against the sign before the flat washer.

All sign hardware shall be vandal proof and all drive rivets and washers shall be galvanized or cadmium plated.

Vertical spacing between sign panels on the same post shall be 1 in. minimum to 1 1/2 in. maximum.

2.23 FIRE LANE DESIGN REQUIREMENTS

Any public vehicle access must meet the requirements of the Public Works Department as well as the requirements of the Fire District.

Minimum width of an unobstructed drive access where no parking is allowed, shall be 20 feet.

Minimum width of a drive access with parking on both sides shall be 40 feet.

Minimum vertical clearance of any drive access shall be 14 feet.

Minimum outside curve radius shall be 52 feet with a minimum 20 foot unobstructed drive access width.
2.24 FIRE LANE SIGN SPECIFICATIONS

Size: 12” x 18”

Material: 0.100-in. thick aluminum alloy Engineer Grade Reflective Sheeting

Color: Red letters on white background. The letter on the symbol sign shall be black.

Wording: NO PARKING (or) FIRE LANE FIRE LANE (with appropriate arrow)

General: Letter size, border, hole locations, corner radii per Manual on Uniform Traffic Control Devices

2.25 PARKING DESIGN STANDARDS

Lochbuie zoning ordinance regulates design of parking lots. The following requirements will have to be met when construction of parking lots or spaces fall within or tie-in to the public R.O.W.

---

![Diagram of parking lot dimensions](image)

Parking Lot Dimensions in Feet for 9 Foot Stalls at Various Angles

<table>
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<th>Stall width Parallel to Aisle</th>
<th>a(angle)</th>
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</tr>
</tbody>
</table>

---
Access of a minimum width of 12 feet shall be provided to all off-street parking spaces.

Except for parking areas provided for single-family units, suitable curbs or barricades shall be provided to protect public sidewalks and to prevent parking in areas where parking is not permitted.

Driveways parallel to public sidewalks must be separated from such walks by an 8 foot landscaped area or a solid wall at least 3 feet in height.

Wheel or bumper guards shall be located so that no part of any vehicle shall extend beyond the boundary lines of the parking area, intrude on pedestrian ways, or come in contact with walls, fences or plantings.

See Ordinance 905, Sec. I as amended by the “Town of Lochbuie Zoning Ordinance” for the number of parking spaces required.

2.26 ROADWAY PAVEMENT DESIGN

A.) SCOPE AND LIMITATIONS

Design of the pavement structure is the determination of the thickness of sub-bases, bases and surfacing to be placed over the existing soils. The basic purpose is the selection of the most suitable materials and their advantageous use. Their grouping in horizontal layers under the pavement from good to poor should be such that the most benefit will be derived from the inherent qualities of each material. In establishing the depth of each layer the object is to provide an optimum thickness of overlying material that will reduce the unit stress on the lower layer commensurate with the load carrying capacity and cohesiveness of particles of the material within that layer.

The Colorado Department of Transportation Roadway Design Manual, Design of Pavement Structures, shall be used for pavement designs. Information contained in this section is intended to revise and supersede the CDOT Roadway Design Manual. Any changes from this Section must be approved by the Director of Public Works. Pavement designs are required on all paving within the public right-of-way. Single family unit drives beyond the property lines are excluded to the extent they will not cause damage of any kind to the public right-of-ways.

B.) SOIL INVESTIGATION, SAMPLING AND TESTING

This Section establishes the standards to be used for soil investigation, sampling and testing for pavement design. This work shall be performed by a soils engineer licensed in the State of Colorado.
CHAPTER TWO  
STANDARDS AND SPECIFICATIONS  
TRANSPORTATION IMPROVEMENTS

The guidelines established in the "Recommended Practice of Investigating and Sampling Soils and Rock for Engineering Purposes" (AASHTO T-86-74) as modified in 1981 (Interim Method T86-811) shall be used.

The "Soil Survey of Adams County Area, Colorado", published in October 1974 by the U.S. Department of Agriculture Soil Conservation, shall be used only for reconnaissance identification of the soil types that may be encountered. All soil sample locations shall be referenced to the soil type identified in the Soil Survey of Adams County. A sufficient number of soil samples shall be obtained and tested to adequately characterize each soil type encountered. A minimum of four samples per 1000 linear ft., measured along the roadway center line, shall be obtained and tested for each soil investigation. More tests may be required by the Town. (Note: No mixing of separate soil samples for testing will be allowed.) The poorest soils encountered shall be used for calculating the pavement thickness using the Hveem Stabilometer (R-value) method.

When the Soil Survey of Adams County identifies certain important typical engineering characteristics of a soil profile, such as high shrink-swell potential or a seasonal high water table, these characteristics shall be assumed to exist for initial study and design purposes only. A final soil investigation and testing report must be prepared and used for engineering designs.

When expansive clayey soils are encountered, the minimum treatment of the subbase soils shall include compaction of the soils to a 97% of the Standard Proctor maximum density at optimum to plus three percent optimum moisture content.

The subbase soil shall be maintained at this moisture content until covered by the overlying material. Expansive soils must be studied under case-by-case rule under the supervision of a geotechnical engineer.

When a seasonal water table is encountered within 3 ft. of the proposed subgrade, underdrains will be required to reduce damage and road failure.

When embankment materials are to be placed within the prism of the roadway, the material shall be tested and an R-value determined. In no case will an embankment material be placed within the roadway prism with an R-value less than 30.

C.) PAVEMENT SECTION REQUIREMENTS

Design and placement of street paving section is governed by the latest CDOT procedures, standards, and practices except for the minimum section thickness. Minimum requirements shown in Table 2.2 are based on construction practices, subgrade materials, pavement performance, pavement maintenance and repair frequencies, field observations of the Town streets and the right-of-way drainage capabilities.
CHAPTER TWO  STANDARDS AND SPECIFICATIONS
TRANSPORTATION IMPROVEMENTS

Bituminous paving section must consist of layers of grade “S” or “SG” mix performing as a bearing pad and binder course and one layer of grade “SX” performing as a wearing course. Grade “S” may be substituted for the wearing course with the permission from the Town. All mixes shall be provided with superfave performance graded binders per CDOT standards. Construction of single layer asphaltic mat and placement of pavement in narrow strips with multiple seams and joints shall be avoided at all times. “End of Day” construction joint or terminated pavement joint due to equipment break down or tie-in to existing pavement must be constructed in 5 ft. long thickened edge transitions. Depth of thickened edge must be 1.5 times the thickness of the slab. Consequently, continuation of terminated slabs must begin with an identical transition.

END OF DAY CONSTRUCTION JOINT

2.27 MINIMUM PAVING REQUIREMENTS

Top lift of HBP shall not be installed in a residential development until the construction for 75% of the houses on that street have been completed.

In no case shall the pavement section be less than the values shown in the table below.

--- PAVEMENT DESIGN REPORT REQUIRED/ON SITE BARIERS REQUIRED ---

TABLE 2-2
MINIMUM PAVEMENT SECTIONS

<table>
<thead>
<tr>
<th>Street Classification</th>
<th>Full Depth</th>
<th>Composite/Alternate Sections</th>
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</thead>
<tbody>
<tr>
<td>Residential</td>
<td>7 in. H.B.P. plus 8 in. of compacted subgrade</td>
<td>N/A</td>
</tr>
<tr>
<td>Collector</td>
<td>9 in. H.B.P. plus 8 in. of compacted subgrade 8 in. concrete paving on 8 in. of compacted subgrade</td>
<td>4.5 in. H.B.P. plus 8 in. of class 6 roadbase on 8 in. compacted subgrade 8 in. concrete plus 8 in. of class 6 roadbase plus 8 in. of compacted subgrade</td>
</tr>
<tr>
<td>Arterial</td>
<td>11 in. H.B.P. plus 8 in. of compacted subgrade 9 to 10 in. concrete paving plus 8 in. of compacted subgrade*</td>
<td>6 in. H.B.P. plus 8 in. of class 6 roadbase plus 8 in. compacted subgrade 8 in. concrete plus 8 in. of class 6 roadbase plus 8 in. of compacted subgrade</td>
</tr>
</tbody>
</table>

*NOT ALLOWED

DEPARTMENT OF PUBLIC WORKS
STANDARDS
Notes:

1. All subgrade shall be proof-rolled with a loaded tandem axle truck to determine any unacceptable compaction.

2. Acceptable subgrade material consists of the following categories:
   
   Existing material if it can be acceptably graded and compacted. Material is subject to approval by the Town.
   
   Imported and graded material must come from an approved designated source. Imported and graded material is subject to approval by the Town.
   
   Subgrade material must be free of organic material, loam, clay, bentonite, silt, contaminants, and other expansive soil mixes.

3. If during the paving operation, specifically during proof-rolling of the subgrade, “soft spots” are encountered that visually deflect, the soft area must be removed and replaced with road-base material and compacted to 97% of the Standard Proctor maximum density at plus/minus 3% optimum moisture content prior to paving with Hot Bituminous Pavement (HBP).

4. If unsuitable subgrade is encountered during subgrade preparation for a roadway section, the over-excavation of the entire roadway section, with replacement of the removed subgrade with a uniform pavement section, will be required.

5. If a segment of road being prepared for paving fails a proof roll, that failing material must be removed and repaired in a suitable manner with acceptable materials. The goal is to provide a uniform pavement section that will meet the load bearing functions of the roadway and serve the transportation needs of the community. The practice of over-excavating the area and thickening up the asphalt shall not be an acceptable repair. This practice does nothing to remedy the failing subgrade condition, does not provide a uniform section, and only prolongs the eventual failure of that section of roadway.

2.28 ASPHALTIC MIX DESIGNS

Include design life of 20 years and minimum of Inherent Reliability of 80%.

All bituminous pavement mixes must conform to the latest CDOT “Standards and Specifications for Road and Bridge Construction” and the CDOT “Materials Manual”.

Contractors and developers shall submit a mix design for each grading on a project at least 10 days prior to construction for Town review and approval. All mixes shall be provided with superpave performance graded binders.
Contractors and developers must retain the services of a licensed materials engineer to provide testing. Density tests must be taken for each lift at a minimum of one test per hundred ton, or more frequently if requested by the Town Inspector, to assure asphalt is placed at 95% Marshall Density according to ASTM D 1559.

A gradation extraction test must be performed for any job in excess of 300 tons. Jobs where the total tonnage exceeds 1000 tons must have samples taken representing each grading and mix design for Marshall Density, stability flow and gradation extraction tests.

Samples for gradation extraction tests must be taken for each day of paving. (Total job tonnage exceeds 1000 tons and paving takes place over a number of days).

Core samples must be taken to verify paving section if directed by the Town Inspector.

2.29 DESIGN TRAFFIC NUMBERS (EDLA)

Town of Lochbuie
Minimum Design Traffic Numbers (DTN) For Use In Pavement Design

The minimum equivalent 18-kip Estimated Daily Load Applications (EDLA) for pavement design within the Town of Lochbuie on the basis of street classification and land use are as follows:

<table>
<thead>
<tr>
<th>Street Classification</th>
<th>Land Use</th>
<th>Land Use</th>
<th>Land Use</th>
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<tr>
<td>Arterial</td>
<td>Residential</td>
<td>Commercial</td>
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<td>Minor</td>
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<td>Commercial</td>
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<tr>
<td></td>
<td>Rural</td>
<td>N/A</td>
<td>N/A</td>
</tr>
</tbody>
</table>

Town may require a traffic study for pavement design for streets in commercial and industrial land use areas.

EDLA's at intersections shall be a combination of the EDLA's of both intersecting streets as shown below. The combination of EDLA's is not required where 2 service roadways intersect.
2.30 BIKE PATH DESIGN

A.) HORIZONTAL DESIGN CRITERIA

Cross Section - Path on independent right-of-way

Note: Independent bike path shall be separated from the edge of the roadway (curb and gutter) by a minimum of 8 ft. Wherever possible pedestrian and bicycle facilities shall be separated.

Cross Section – bike lane (minimum 5 ft. additional pavement required for each on street bike lane).
provided the total height from the bottom of ring to top of cover does not exceed 12 in. A berm made with HBP must be placed around the adjusted structures to prohibit their movement during paving operations. Berm must be at least 1.5 in. below the finish grade.

Adjust the structures during the overlay operation immediately after paving. Adjustment will not be allowed when temperature of the mix falls below 200° F.

Patch back around the manhole or valve box shall be uniform and require a clean cut out. Compaction of the patch shall meet 95% Marshall Density, minimum, and extend no more than 1 foot beyond the manhole or valve box.

2.32 UTILITY TRENCH CUT PERMIT

A right-of-way permit must be obtained from the Town for all trenching within the public right-of-way. For utility work that is greater in size than service cuts, a complete set of design drawings must be submitted for approval prior to permit issuance.

2.33 TRENCH LOCATION

Whenever possible, utility trenches shall be located a minimum distance of 8 ft. (longitudinally running) from the lip of the gutter pan and outside of wheel paths.

2.34 PAVEMENT REMOVAL

The pavement cut shall follow a line parallel to the pipe center line and 1 foot beyond the trench wall. In the event pavement beyond the original cut line is undermined or damaged during construction, additional pavement shall be removed after the trench backfill is in place. The additional pavement shall consist of a cut parallel to the pipe center line with a transition to the original cut on each side.

The use of mechanical impact cutters (such as a hydrohammer with a cutting blade) shall not be permitted. A jackhammer can be used for pavement cuts if approved by the Town providing the cut is continuous, straight and clean. After the trench is backfilled a neat and straight asphalt saw cut line must be performed prior to trench patching.

2.35 TRENCH EXCAVATION

The width of trenches shall be only that necessary for the proper installation of the pipe. Refer to Water and Sewer sections of these Standards for Trench Excavation Requirements.
2.36 MAJOR UTILITY PROJECT

A complete set of boring logs and proctor curves are required as part of the construction documents to be used for moisture and density control of the backfill material. If this information is not submitted for review, all backfill material shall be class 6 aggregate base course material. All unsatisfactory material encountered during trenching excavation shall be disposed of by the contractor and replaced by suitable backfill material as approved by the Town.

2.37 MINOR UTILITY PROJECT

All excavated material from service connection excavations and emergency repairs shall be disposed of by the contractor and replaced in full with class 6 aggregate base course material. All class 6 backfill material shall conform to the gradations in the CDOT Standard Specifications for Road and Bridge Construction.

2.38 TRENCH BACKFILL COMPACTION

Refer to Water and Sewer sections of these Standards for Trench Backfill Compaction Requirements.

2.39 PAVEMENT REPLACEMENT

Hot bituminous pavement patches shall meet the mix design requirement included in the CDOT Standards. Patch thickness shall conform to the requirements of Table 2-2. Trench cuts and pavement replacement in new pavement (<2 years old) shall be avoided. If this cannot be avoided, the method and extent of pavement replacement shall be approved by the Town. In general, complete lane removal and replacement may be required for parallel utilities. Large patches may be required for perpendicular trenches.

2.40 SURFACE TOLERANCES

The variation between any two contacts with the surface shall not exceed 1/4 in. in 10 ft. for the life of the 1 year guarantee period. The tool for such measurement shall be a 10 ft. metal straight edge. If the surface variations exceed 1/4 in. in 10 ft., both pavement and backfill shall be removed and replaced at the contractor’s cost.

2.41 GUARANTEE PERIOD

All trenching work within the right-of-way shall be guaranteed for 1 year from the date of the acceptance of the patch. At the end of the 1 year period, each cut shall be reviewed in the field by the Inspector. Any deficiencies found at that time shall be rectified by the contractor at his cost.
6" VERTICAL CURB & GUTTER

MOUNTABLE CURB & GUTTER

EDGE OF TRAVEL

12" 24"

FL. PER PLAN 6" 12"

36" 7.5"

15" R 15" R

CENTER OF ROUNDABOUT
MOUNTABLE CURB, GUTTER &
Note:
Stop sign location should be approximately 20' to 25' from the flow line and 1' to 2' from the back of walk.
Layout is for residential streets, other layouts should be approved by the City Engineer.
CONSTRUCTION JOINTS ARE REQUIRED AT EACH SIDE OF WARPED SECTION.

DRIVE RAMP OPENING
COMMERCIAL MINIMUM 20', MAXIMUM 36'
RESIDENTIAL MINIMUM 10', MAXIMUM 20'

SECTION A-A
This cross-section can only be used:
1. Internal subdivision streets no greater than 2650 LF.

2. 10 foot trail on one side.
THIS COLLECTOR TO BE USED:

HOUSING FACING OR ACCESSING THE STREET.
INTERNAL COLLECTOR GREATER THAN 2650 LF.
10 FOOT TRAIL ON ONE SIDE.
THIS COLLECTOR TO BE USED:
1. HOUSING NOT ACCESSING OR FACING STREET.
2. RESIDENTIAL SUBDIVISION ONLY.
3. TRAIL 10' ON ONE SIDE.
NOTE:
1. IF LESS THAN 36 FEET OF FLOW LINE IS REQUESTED, THE STREET CANNOT BE LONGER THAN 600 FEET AND ACCESS NO MORE THAN 30 UNITS.
NOTE:
1. GROUND COVER IN H.O.A. MAINTAINED AREA TO BE APPROVED BY CITY.
2. PAVEMENT THICKNESS SHALL FOLLOW THAT OF A RESIDENTIAL SECTION.
3. MINIMUM SLOPE OF ALLEY INVERT SHALL BE 0.5%.
SPECIFICATION DRAWING FOR SECTION CORNER IN RANGE BOX

30" FLARED, 2½" DIAMETER PIPE WITH BRASS OR ALUMINUM CAP

BACKFILL DIRT AND GRAVEL

1½" MAX. WASHED ROCK
METRO SIZE STREET NAME SIGN

All street name signs shall conform to the latest Manual on Uniform Traffic Control Devices section 2D-39. Signs shall be aluminum alloy or approved equal with interstate blue reflective background, white letters, numbers, and border.

All street name signs for the intersection of arterial with arterial or collector streets, or the intersection of collector streets with collector streets shall be metro size signs, and shall be 9" wide by 42" long minimum (length may increase as necessary to accommodate longer street names) with 5" or 4" upper case capital letters for the name of the street and 2-1/2" uppercase capital letters for "AV", "ST" etc. and spaced at the top of the sign to allow room for 2-1/2" block numbers below the abbreviation of "AV", "ST" etc. A standard City logo shall be placed to the left side of the sign blank as indicated in the drawing.

Street name signs shall be installed at the southeast or the northeast corner of the street intersection or as determined by the Traffic Engineer. Street signs shall be installed with the numbered street to the top of the post and the name sign mounted below the numbered sign.

Letter and number font shall be series C by Scotch 3M or approved equal.
All numbered street signs shall conform to the latest Manual on Uniform Traffic Control Devices section 2D-39. Signs shall be aluminum alloy or approved equal with interstate blue reflective background, white letters, numbers and border.

All numbered street signs for the intersection of arterial with arterial or collector streets, or the intersection of collector streets with collector streets shall be metro size signs, and shall be 9" wide by 42" long minimum (length may increase as necessary to accommodate longer street names) with 5" or 4" upper case capital letters for the number of the street and 2-1/2" uppercase capital letters for "ND" or "TH" to be held even with the top of the number. Abbreviations for the "S" or "N" shall be 2-1/2" uppercase capital letters centered on the sign and 2-1/2" uppercase capital letters for "AV", "ST" etc. and spaced at the top of the sign to allow room for 2-1/2" block numbers below. A standard City logo shall be placed to the left side of the sign blank as indicated in the drawing.

Street name signs shall be installed at the southeast or the northeast corner of the street intersection or as determined by the Traffic Engineer. Street signs shall be installed with the numbered street to the top of the post and the name sign mounted below the numbered sign.

Letter and number font shall be series C by Scotch 3M or approved equal.
NOTE:
STREET NUMBERED SIGNS SHALL BE MOUNTED ABOVE STREET NAME SIGNS.
STREET SIGNS SHALL BE MOUNTED BY DOUBLING UP THE SIGNS (SIGNS ON EACH SIDE OF THE TELESPAR TUBING AS SHOWN). SIGNS SHALL BE 6"x30", 4" HIGHWAY GOTHIC "C" FORCED LENGTH TEXT.
LN, ST, AVE, ETC. 70% SUPERSCRIPT WHITE ON BLUE. ALL TEXT UPPER CASE.
GENERAL NOTES

1. CONCRETE SHALL BE CLASS B INLET, BUT BE OBTAINABLE IN COLOR, SIZE, OR SHAPE.

2. CONCRETE, REINFORCING STEEL, AND GRADE INSTALLATION REQUIREMENTS SHALL COMPLY WITH APPROPRIATE CODES AND STANDARDS.

3. STANDARD INLET DETAILS SHALL BE USED ON ALL TYPE D DIKES. Replacement parts are specified on the plans.

4. PIPE LENGTHS SHALL BE PROVIDED WITH INLET DIMENSIONS X EXCEEDING 2'-0" AND SHALL BE ACCORDING TO CODES AND STANDARDS.

5. REINFORCING STEEL SHALL BE READY TO BE JOINED, AND SUPPORTS, WHICH ARE A WAY OF JOINING STEEL.

QUANTITIES FOR ONE INLET

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<th>DESCRIPTION</th>
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<td>6</td>
<td>3/4&quot; MESH STUCCO</td>
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INLET, TYPE D

STANDARD PLAN NO. M-604-11

Sheet No. 1 of 1
### TABLE ONE: BAR LIST FOR CURB INLETS, TYPE "R"

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<th>Number</th>
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<th>Type</th>
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### TABLE TWO: BARS AND QUANTITIES VARIABLE WITH "R"

<table>
<thead>
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<th>Number</th>
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<th>Bar Count</th>
<th>Type</th>
<th>Bar Spacing</th>
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<td>12-16</td>
<td>25</td>
</tr>
</tbody>
</table>

### GENERAL NOTES

1. All concrete shall be Class B.
2. Concrete walls shall be formed on both sides and shall be 8 in. thick.
3. Wall slabs shall be in accordance with Jossen in this.
4. Concrete face assembly shall be cornered after wetting.
5. Concrete top of wall shall be cornered 1/8 in. and all other corners shall be cut in the desired curvature and cutout beyond the transition cutoff.
6. Remaining bars shall be formed and made 2 in. away from the bottom of the wall.
7. Shredded and molded of typical marshall ring and cover are required.
8. Material for making these and covers shall be 6 in. or 9 in. cast iron.
9. Where five finishes with the half are variable, the dimensions shown are not necessarily representative of the actual dimensions.
10. Structural steel shall be gauged and shall conform to the requirements of the plan.

### BAR DESIGNATION DIAGRAMS (Dimensions are Out-to-Out of bar)

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**Colorado Department of Transportation**

**Computer File Information**

**Standard Plan Revised**

**Curb Inlet Type R**

**Standard Plan No.**

**M-604-12**

**Sheet No. 2 of 2**
T-BASE MANHOLES:

1. The T-BASE section shall be shop-fabricated for delivery to the construction site as a complete unit.
2. These details shall only be constructed to shop fabricated, and shall be constructed in accordance with the latest applicable standard specifications. The contractor shall furnish all shop fabricated parts and equipment, including the T-BASE section, at no cost and risk to the owner. All work related to the installation of the T-BASE section shall be performed by the contractor at no cost to the owner.
3. The T-BASE section shall be designed and fabricated in accordance with the latest applicable standard specifications.
4. The T-BASE section shall be designed and fabricated in accordance with the latest applicable standard specifications.

SECTION F-F
ADJUST MANHOLE
20° OR LESS

CIRCULAR RCP
(LONGITUDINAL SECTION)

CIRCULAR RCP
(TRANSVERSE SECTION)

MANHOLE T-BASE

STANDARD PLAN NO.
M-604-20

Sheet No. 3 of 3

50
### General Notes

1. Adequate cover shall be provided during construction to protect the structure from damage.

2. Pipe shall be placed with longitudinal joints at the sides or quarter points but not along top of vertical abs.

3. Structural plate pipes of equal or greater diameter, consisting of sections of the standard specification, may be substituted for the pipes on these sheets at no additional cost to the project.

4. When a joint is to be extended with pipe of a different material, the connection shall be made to the specs on the plans or as approved.

5. Extensions for pipe arch culverts shall match the corrugations and the span and rise proportions of the culvert to be extended.

6. Installation and compaction shall be in accordance with Section 204.

7. Pipe arch with equal torino and with span and rise dimensions approximately equal to those required by plan will be furnished.

8. Pipe arch is intended for use inside minimum cover requirements for round pipe cannot be met. When cover exceeds 11 ft., use round pipe.

9. Minimum cover for metal or plastic pipe is the distance from the top of the pipe to the top of structure.

10. Cover greater than 0.75 ft. shall be used only after thorough investigation of foundation material.

### 2 1/2" x 1/2" Corrugations

<table>
<thead>
<tr>
<th>Round Steel Pipe</th>
<th>Round Steel Pipe</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Pipe Size</strong></td>
<td><strong>Wall Thickness</strong></td>
</tr>
<tr>
<td><strong>(Inches)</strong></td>
<td><strong>(Inches)</strong></td>
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<tr>
<td>12</td>
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<td>0.126</td>
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### 3" x 1 Corrugations

<table>
<thead>
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<th>Round Steel Pipe</th>
<th>Round Steel Pipe</th>
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<tbody>
<tr>
<td><strong>Pipe Size</strong></td>
<td><strong>Wall Thickness</strong></td>
</tr>
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### 5" x 1 Corrugations

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<td><strong>(Inches)</strong></td>
<td><strong>(Inches)</strong></td>
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### 2 1/2" x 1/2" Corrugations

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### Plastic Pipe

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<tr>
<td>REINFORCED POLYVINYL CHLORIDE (PVC)</td>
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**Footnotes:**** 1**'s X 1/2" wall cover on per manufacturer's recommendation, whichever is greater.

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**Colorado Department of Transportation**

**Computer File Information**

**Standard Plan Revised**

**METAL AND PLASTIC CULVERT PIPE**

**STANDARD PLAN NO.**

**M-603-1**

**Project Development Branch SD**

**Sheet No. 1 of 2**
2 3/4" x 1/2" CORRUGATIONS
ROUND ALUMINUM PIPE

<table>
<thead>
<tr>
<th>PIPE DIA.</th>
<th>MIN. COVER</th>
<th>HEIGHT OF COVER LIMITS (FEET)</th>
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3 3/4" CORRUGATIONS
ROUND ALUMINUM PIPE

<table>
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6 3/4" CORRUGATIONS
ROUND ALUMINUM PIPE

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2 3/4" x 1/2" CORRUGATIONS
ALUMINUM PIPE ARCH

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<th>SPAN X RISE</th>
<th>EDU.</th>
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<td>60 x 31</td>
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INSTALLATION OF METAL OR PLASTIC CULVERT PIPE

BUILD DIAMETER TO TOP AND DIAMETER TO DEPTH REQUIRED

INSTALLATION OF MULTIPLE METAL OR PLASTIC CULVERT PIPE

BUILD DIAMETER TO TOP AND DIAMETER TO DEPTH REQUIRED

METAL OR PLASTIC CULVERT WITH END SECTIONS

METAL OR PLASTIC CULVERT WITHOUT END SECTIONS

LEGEND

H = HEIGHT OF COVER LIMITS
L = LENGTH OF CULVERT TO BE MEASURED ON PLANS IN ACCORDANCE WITH SECTION 482.1 OR 482.2

MINIMUM SPACE BETWEEN OUTSIDE WALLS OF PIPE OR DIAMETER SEGMENTS

GENERAL NOTES

FOR REINFORCED RINGS SEE SHEET NO. 1

Pipe-Arch will be constructed with equal tapering and up to 1/2" and 1/4" pipe spacers in the pipe arch. The pipe will be constructed of a minimum of 2 1/2" diameter or 3" diameter, and the pipe will be placed in accordance with Section 482.1 or 482.2.

Pipe-Arch will be constructed in accordance with the standards of the American Concrete Pipe Association, using pipe in accordance with Section 482.1 or 482.2. The pipe will be placed in accordance with Section 482.1 or 482.2.

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Pipe-Arch will be constructed in accordance with the standards of the American Concrete Pipe Association, using pipe in accordance with Section 482.1 or 482.2. The pipe will be placed in accordance with Section 482.1 or 482.2.
DIMENSIONS FOR REINFORCED CONCRETE PIPE

<table>
<thead>
<tr>
<th>Type of Pipe</th>
<th>Elliptical (VE)</th>
<th>Horizontal (EL)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Size (ID)</td>
<td>Wall Thickness (OUTSIDE)</td>
<td>Size</td>
</tr>
<tr>
<td></td>
<td>(INCHES)</td>
<td>(FOOT)</td>
</tr>
<tr>
<td>12</td>
<td>2.00</td>
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<tr>
<td>15</td>
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<tr>
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<td>4.00</td>
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</table>

GENERAL NOTES

REINFORCED CONCRETE PIPE

1. PIPE DESIGN IS BASED ON A CIRCUMFERENTIAL DIRECTION.
2. ALL HEIGHTS CHECKED FROM BAND ALONG IN THE WIDTHS OF PIPE WALLS TO BE DETERMINED FOR THE WALLS.
3. ALL HEIGHTS ARE CHECKED FROM BAND ALONG IN THE WIDTHS OF PIPE WALLS TO BE DETERMINED FOR THE WALLS.
4. THE BANDS ALONG IN THE WIDTHS OF PIPE WALLS TO BE DETERMINED FOR THE WALLS.
5. ALL HEIGHTS ARE CHECKED FROM BAND ALONG IN THE WIDTHS OF PIPE WALLS TO BE DETERMINED FOR THE WALLS.
6. ALL HEIGHTS ARE CHECKED FROM BAND ALONG IN THE WIDTHS OF PIPE WALLS TO BE DETERMINED FOR THE WALLS.

NONREINFORCED CONCRETE PIPE

1. ALL heights of fill over top of pipe in feet.
2. ALL heights of fill over top of pipe in feet.
3. ALL heights of fill over top of pipe in feet.
4. ALL heights of fill over top of pipe in feet.
5. ALL heights of fill over top of pipe in feet.
6. ALL heights of fill over top of pipe in feet.

ALLOWABLE HEIGHTS OF FILL OVER REINFORCED CONCRETE PIPE

<table>
<thead>
<tr>
<th>Height of Fill (in feet)</th>
<th>Class VE 20</th>
<th>Class VE 30</th>
<th>Class VE 40</th>
<th>Class VE 50</th>
<th>Class VE 60</th>
<th>Class VE 70</th>
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<tr>
<td>6</td>
<td>10</td>
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</tbody>
</table>

STANDARD PLAN NO. M-603-2

Issued By: Project Development Branch October 1, 2000
Sheet No. 1 of 1
GENERAL NOTES

1. AVOID PLACING GRADE STRUCTURES, TRAFFIC SIGNAL EQUIPMENT, JUNCTION BOXES, OR OTHER OBSTRUCTIONS IN FRONT OF RAMP ACCESS AREAS.


SECTION A-A

SECTION B-B

SECTION C-C

ISOMETRIC VIEW
GENERAL NOTES

1. HIGH PLACING DRAINAGE STRUCTURES, TRAFFIC SIGNAL EQUIPMENT, JUNCTION BOXES, OR OTHER OBSTRUCTIONS IN FRONT OF RAMP ACCESS AREAS.

2. RAMP SLOPES SHALL NOT BE STEeeper THAN 1:2:1. THE DETECTABLE WALKING AND MEAL AREA SLOPES SHALL NOT BE STEEPER THAN 1:1:1.5.

3. CONSTRUCTION OF THE CONCRETE PEDESTRIAN CURB TO BE INCLUDED IN THE COST OF THE CURB RAMP.

4. SIDEWALK RAMP 2A MAY BE USED IN MID-BLOCK.

ISOMETRIC VIEW
CONCRETE DRIVEWAY ENTRANCE TYPE 1

SECTION A-A

SECTION B-B

CONCRETE CEMENT MIXER

CONCRETE CURB & GUTTER

TYPE 1 ISOMETRIC VIEW

CONCRETE DRIVEWAY ENTRANCE TYPE 2

SECTION C-C

SECTION D-D

CONCRETE CEMENT MIXER

CONCRETE CURB & GUTTER

TYPE 2 ISOMETRIC VIEW

GENERAL NOTES
1. AVOID PLACING DRAINAGE STRUCTURES, TRAFFIC SIGNAL EQUIMENT, JUNCTION BOXES, OR OTHER OBSTRUCTIONS IN FRONT OF RAMP ACCESS AREAS.
2. FOR THE CURB AND GUTTER SHOWN, SEE PLANS FOR CURB TYPE 3.
3. RAMP SLOPES SHALL NOT BE STEEPER THAN 12:1.
4. CONSTRUCTION OF THE CONCRETE PEDESTRIAN CURB TO BE INCLUDED IN THE COST OF THE CURB RAMP.

STANDARD PLAN NO. M-609-1
Sheet No. 3 of 3
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## CHAPTER THREE

STANDARDS AND SPECIFICATIONS
DRAINAGE AND FLOOD CONTROL

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<td>CURB INLETS</td>
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FIGURES
CHAPTER THREE  STANDARDS AND SPECIFICATIONS
DRAINAGE AND FLOOD CONTROL

3.01 GENERAL

The following is a list of minimum requirements for drainage study, design development,
and construction specifications are regulated and practiced by the Department of Public
Works. The Town will follow Adams County Storm Drainage Design Manual as the
primary reference and Urban Drainage Flood Control Districts Design Criteria as the
secondary reference unless stated otherwise.

3.02 PROJECT DESIGN

The interim standards require a technical report for all new developments and
redevelopments with inadequate drainage facilities. A technical report will include the
following sections:

Site Description – Geographic location, legal boundaries, and size of the site or drainage
basin.

Existing Site Topography and Drainage Flow Patterns – Study will identify and quantify
all the existing stream flows, irrigation canals, offsite runoff and site generated runoff.

Analysis and Design Criteria – Hydrologic study and environmental impact assessment
(pollution and elimination, sediment control, etc.) of the site or drainage basin,
computation of flows based on initial and major rainfall return frequencies for pre-
developed and post developed conditions. Rainfall return frequencies are based on the
following development categories:

<table>
<thead>
<tr>
<th>Development Category</th>
<th>Initial Storm Frequencies</th>
<th>Major Storm Frequencies</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low/Medium Density Residential</td>
<td>2 year return</td>
<td>100 year return</td>
</tr>
<tr>
<td>High Density Residential or Commercial</td>
<td>5 year return</td>
<td>100 year return</td>
</tr>
<tr>
<td>Development or Paved Parking Lots</td>
<td>10 year return</td>
<td>100 year return</td>
</tr>
</tbody>
</table>

Surface runoff on paved streets must be diverted to gutter pans and directed to closed
systems or conveyance swales, and finally to discharge outlets. Storm runoff from the
initial storm may not exceed curb capacity (6”). In situations where site is relatively flat,
streets must be designed to have high and low points to lead runoff to low collection
points and conveyance systems. Minimum flow line grade should be 0.50%.

During major flood events, streets and sidewalks may overtop and act as flood channels.
In this case, street gutter depths shall not exceed 12” and flood spread should be
restricted to street right-of-way.
3.03 DESIGN PROPOSAL

A detail design proposal for drainage collection and conveyance system addressing water quality, quantity, and temporary/permanent sediment control structures.

A drainage plan should include the following elements:

1. Contours of the project at a minimum 2 ft. interval, including the source of the data.

2. Street horizontal and vertical alignment and street names.

3. Typical street cross-sections, including street paving, pavement drainage, right-of-ways data, and proposed slopes.

4. Lotting pattern with lot numbers.

5. Location of all drainage structures including stationing when connected to roadway structures or right-of-way or numbered in a logical pattern when not connected with the roadway.

6. Culverts: All culverts will be terminated with headwalls. Where culverts exist on lot lines between dwellings, necessary casements and a culvert extending 25 ft. beyond the rear of the dwelling shall be shown.

7. Statement of the criteria used in the drainage design, including the following:
   a. Rate of precipitation
   b. Formulas used in sizing drainage structures
   c. All constants or factors involved

8. Size, invert elevations and percent of grade of all storm drains, catch basins, and inlets and indicate the pipe materials used (concrete required under public roadways).

9. Location of easements for access to drainage structures and details of access for maintenance of structures.

10. Total drainage area contributory to each drainage pipe, including off-site area.
11. Design and velocity of drainage ditches and method of erosion control to be used on banks and bottoms.

12. Plan, cross-section, and flow line profiles of all proposed and existing ditches.

13. Drainage area contributing to the channel at control points, including off-site area.

14. Address potential for surcharge from on-site and off-site areas. Note relation of the on-site area to potential recharge areas.

15. Complete information with respect to out-fall pipes or ditches, including off-site areas. Indicate where all drainage leaves the site.

16. Maximum flood stage elevations on any stream flowing through or adjacent to the property, or whose proximity may affect drainage or access to the property.

17. Minimum finished floor elevations based on 100-year flood level plus 1.5 ft., sewer requirements, or site characteristics. Site characteristics include but are not limited to drainage requirements and acceptable driveway grades.

18. Elevations based on Mean Sea Level Datum as established by USGS NAD 83 or the difference in datum indicated.

3.04 CERTIFICATION OF REPORT

A technical drainage and flood control report must include a statement of certification, prepared and signed and sealed by a Colorado Registered Professional Civil Engineer, with full familiarity and knowledge of the Urban Drainage and Flood Control District design and construction manual volumes one, two and three, Colorado Department of Transportation and Federal Highway Administration design and construction practices. The statement of certification must convey that proposed improvements will not cause any damage to adjacent or downstream properties resulting from erosion, flood, or environmental impact during construction and after completion.

Developed areas or partially developed sites with adequate flood control and detention systems, verified by their respective reports and field flood tests are excluded from the above mentioned requirements.

While the use of computer programs approved by UD&FCD or CDOT and FHWA is acceptable, design engineers should keep in mind that computer printout sheets generated by commercial or public domain software programs will not be acceptable as justification for validity of design computations, or a substitute for technical report.
3.05 CONSTRUCTION PLANS

Construction documents must consist of plan view(s), profile(s), and construction detail sheets with sufficient technical information and notes for proposed drainage collection and flood conveyance systems. Plans must include hydraulic grade lines for collection systems with design points obtained from the Public Works Department as-built outfall system water surface profile elevations. Detention and Retention facilities must be provided with Stage-Storage curves and spillway capacity curves where applicable. All proposed hydraulic profiles must remain 1.5 ft. or more below the finished street flowing or below the lowest point in finished surfaces except for buildings or occupied structures which are subject to Uniform Building Code.

3.06 CONSTRUCTION PRACTICES

Construction requirements for drainage and flood control projects are similar to those required by the Colorado Department of Transportation and Urban Drainage and Flood Control District except as modified by the Town. Contractors and engineers will closely comply with the Town’s latest construction specifications and methods.

Certain projects including minor redevelopment in an existing established area (and not damaged by surface runoff), or improvements leading to decreased impervious surface, may be exempted from the above requirements. The type projects however, will be reviewed on a case by case basis.

3.07 MANHOLE CONSTRUCTION

Manhole construction shall be similar to the sanitary sewer manholes and shall follow sanitary sewer criteria. Manhole size and pipe size criteria shall be the same as sanitary sewer criteria.

3.08 CURB INLETS

Refer to CDOT Standards for curb inlet details.
<table>
<thead>
<tr>
<th>SECTION</th>
<th>TITLE</th>
<th>PAGE NO.</th>
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<tr>
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<td>Operating Pressure Requirements</td>
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<td>Fire line to Non-Residential Area</td>
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<td>Hydraulic Design</td>
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<td>15.</td>
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<td>4.03</td>
<td>STREET CUTS</td>
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<tr>
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<td>SAFETY</td>
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<td>4.07</td>
<td>BONDING</td>
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</tr>
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<td>4.08</td>
<td>ACCEPTANCE OF WORK</td>
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<td>1.</td>
<td>Ductile Iron Pipe</td>
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<td>2.</td>
<td>Poly Vinyl Chloride Pressure Pipe</td>
<td>10</td>
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<tr>
<td>3.</td>
<td>Steel Pipe</td>
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<td>4.</td>
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<td>5.</td>
<td>Valve Boxes</td>
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<td>6.</td>
<td>Butterfly Valves</td>
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<td>7.</td>
<td>Pressure Reducing and Regulating Valves</td>
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<td>8.</td>
<td>Air Valves</td>
<td>22</td>
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</tbody>
</table>
4.01 DESIGN CRITERIA

1. General

All water distribution systems will comply with the requirements of these 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. 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. A preconstruction meeting shall be held with Town personnel prior to installation of any water utilities.

2. Water Distribution System Modeling

All new water distribution systems shall be modeled using Cybernet or Water CAD in accordance with criteria below. Output data showing all assumptions shall be submitted to the Town for review.

3. Design Flow Requirements

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

<table>
<thead>
<tr>
<th>Land Type</th>
<th>Avg. Demand</th>
<th>Max. Day Demand Factor to Avg. Demand</th>
<th>Peak Hour Factor to Max. Day Demand</th>
</tr>
</thead>
<tbody>
<tr>
<td>Residential</td>
<td>145 gpcd</td>
<td>3.05</td>
<td>1.9</td>
</tr>
<tr>
<td>Commercial</td>
<td>1651 gpd/Acre</td>
<td>2.00</td>
<td>1.9</td>
</tr>
<tr>
<td>Industrial</td>
<td>1651 gpd/Acre</td>
<td>1.32</td>
<td>1.9</td>
</tr>
<tr>
<td>Park</td>
<td>3060 gpd/Acre</td>
<td>2.85</td>
<td>1.9</td>
</tr>
</tbody>
</table>

*gpcd = Gallons Per Capita/Day

Fire flows may be required to be calculated from more than one hydrant for a subject site, providing the hydrants used are directly connected to the water main for which the hydraulics are under review. Minimum fire flow rates shall be as noted below and shall be confirmed with the Fire District:

- Residential: 1,500 GPM
- Industrial/Commercial: 3,500 GPM
4. Operating Pressure Requirements

All areas will be designed to have a maximum static head of 290 ft. (125 psi) and a minimum static head of 100 ft. (43 psi). Distribution systems will also be designed to maintain a 20 psi minimum residual pressure during required fire flow and a 45 psi residual minimum during peak residential flows. Pressures for irrigation systems in proposed Town parks shall meet the requirements of the Parks Department. The maximum pressure drop from static head to either fire flow or peak residential flow shall not exceed 30 psi.

Fire hydrant flow tests must be performed in order to determine existing system pressures. Flow testing must be performed by licensed and insured testing companies and shall be accompanied by Town Personnel when operating valves and hydrants on Town water mains. The Fire District shall review flow data and comment on system pressures, and safety factors that are applied.

Water pressure and flow rates shall be compared with modeling resulted after construction of water mains have been completed. Hydrant flow testing shall be performed for this purpose and test results shall be submitted to the Town for approval.

5. Fire Hydrant Spacing

In residential areas, fire hydrants will be spaced a maximum of 500 ft. apart, as measured along street curb line and at an overall spacing that will not average less than one hydrant to 200,000 sq. ft. throughout an individual subdivision. Where blocks are over 800 ft. in length, intermediate hydrants will be placed in the center of the blocks. Fire hydrants will not be allowed at the ends of cul-de-sacs. Fire hydrants will be located in accordance with the Lochbuie Fire Department.

In commercial and industrial areas, hydrants will be spaced not greater than 300 ft. apart.

6. Fire Service

The Developer will own and maintain all fire service lines extending from the valve on the Town water main. Valves on newly constructed fire service lines will be located on the tee at the main line. Fire service lines are to be used exclusively for fire protection. Domestic water taps and/or irrigation taps will not be allowed on the fire service line unless written approval to do so is given by the Town.

7. Distribution System Layout

Distribution mains and lateral lines will be located as indicated on the accepted plans. Lateral lines will normally be 8 in. diameter pipe. Where the length of the line between
branches is less than 300 ft. and in cul-de-sacs less than 300 ft. long (provided that a permanent blow-off or fire hydrant is installed at the dead end), 6 in. diameter pipe may be used. When approved by the Town, 6 in. diameter lines may also be installed on permanent dead ends less than 300 ft. long when a permanent blow-off or fire hydrant is provided.

Dead ends will be minimized by looping whenever possible. Lines at ends of ling cul-de-sacs shall be looped along lot lines to adjacent streets. Permanent dead ends shall be provided with a permanent blow-off or fire hydrant and temporary dead ends such as phasing within developments, shall have temporary blow-off (see Standard Details).

On new developments, mains and laterals shall be extended to the boundaries of Filings and completely across the frontage of individual lots.

8. Valve Spacing

Valves will be placed with a maximum spacing of 500 ft. in all distribution mains and lateral lines. Where Town blocks exceed 600 ft. in length; an intermediate valve shall be installed. Valves will also be placed on each fire hydrant lateral and permanent blow-off.

Four-way and three-way street intersections shall require at least 3 and 2 valves respectively, 1 located on each extended property line. For a succession of short blocks perpendicular to the direction for the distribution main and without residential or commercial services between, one or more intersection(s) may have the valve in that direction omitted, but must maintain the 50 ft. 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.

9. Air and Vacuum Relief Valves

Combination air and vacuum 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.

Air and vacuum relief valves shall be installed in precast manholes or vaults fitted with air vents open to the atmosphere in accordance with the Standard Drawings.

10. 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. 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 4 – 6 in. below grade in accordance with the Standard Drawing.

Permanent dead ends shall be provided with a permanent blow-off or fire hydrant and temporary dead ends such as phasing within developments, shall have temporary blow-offs (see Standard Details).

11. Pipe

All pipe used for distribution mains and lateral lines having a diameter of 12 in. or less may be either ductile iron pipe or PVC pipe. Distribution mains in excess of 12 in. in diameter through 36 in. in diameter shall be ductile iron pipe unless otherwise approved in writing by the Town. In certain uses steel pipe may be approved in accordance with this section. Larger pipe sizes will be as directed by the Town. The design engineer shall specify the pipe class as required for specific project conditions (see Section 4.11.1).

12. Hydraulic Design

All pipes will be designed to have a maximum velocity of 10 ft per second. New distribution mains and lateral lines shall be designed using the Hazen-Williams friction coefficients and maximum head losses noted below:

<table>
<thead>
<tr>
<th>Pipe Size</th>
<th>Hazen-Williams Friction Coefficient</th>
<th>Maximum Head Loss</th>
</tr>
</thead>
<tbody>
<tr>
<td>6” – 12”</td>
<td>C-100</td>
<td>2' per 1,000'</td>
</tr>
<tr>
<td>14” – 16”</td>
<td>C-100</td>
<td>2' per 1,000'</td>
</tr>
<tr>
<td>20”</td>
<td>C-130</td>
<td>1.5' per 1,000'</td>
</tr>
<tr>
<td>Over 20”</td>
<td>As directed by the Town</td>
<td></td>
</tr>
</tbody>
</table>

13. Location (Typical)

Unless approved otherwise by the Town, water mains shall be installed West or South of the center line of the street beneath asphalt. Water mains shall not be located closer than 5 ft from the lip of the curb. Service connections will not be permitted to cross an arterial street.

Water mains will be located a minimum of 10 ft., horizontally, from existing or proposed sewer lines (center line distance). A clear distance of 18 in. shall be maintained between water mains and other utility crossings. Where sewer lines cross water mains, the sewer pipe will be a minimum of 18 in., clear distance, below the water main. If this clear distance is not feasible, the water main must be lowered to at least 18 in. below the sewer line. The Town Engineer must approve any deviation from this crossing design.
In all cases, where utilities are crossing within 18 in. of one another, compacted squeegee or flow fill shall be provided to preclude settling and/or failure of the higher pipe. If a water main cannot be lowered, an alternative will be to install water quality pressure pipe for the sewer with joints 10 ft. minimum each side of the crossing.

Where mains are installed in easements they will ordinarily be located in the center of the easement.

At street intersections, valves will be located at extension of the property lines. Fire hydrant gate valves will be placed near the main beneath asphalt. All fire hydrants will have a restrained connection directly to the tee off the main (see Standard Drawings).

In all instances, the water mains will extend to the boundary line of the property or subdivision served. A main serving one lot will extend the entire way across the frontage for that lot. Mains serving subdivision will 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.

14. Water Main Joint Deflection

The maximum allowable water main joint deflection for various pipe materials and lengths is listed in the following tables. If these offsets conflict with the pipe manufacturer’s recommendation, the more stringent requirement will apply.

The maximum allowable pipe deflection for factory belled polyvinyl chloride pipe shall be as follows:

**Polyvinyl (PVC) Pressure Pipe**

<table>
<thead>
<tr>
<th>Pipe Size</th>
<th>Maximum Offset</th>
<th>Minimum Radius of Curvature for 20’ Lengths</th>
</tr>
</thead>
<tbody>
<tr>
<td>Inches</td>
<td>Inches</td>
<td>Feet</td>
</tr>
<tr>
<td>4”</td>
<td>24”</td>
<td>100’</td>
</tr>
<tr>
<td>6”</td>
<td>17”</td>
<td>145’</td>
</tr>
<tr>
<td>8”</td>
<td>12”</td>
<td>190’</td>
</tr>
<tr>
<td>10”</td>
<td>11”</td>
<td>230’</td>
</tr>
<tr>
<td>12”</td>
<td>9”</td>
<td>270’</td>
</tr>
</tbody>
</table>

The maximum allowable pipe deflection for push-on type joint and mechanical joint pipe shall be as follows:

**Ductile Iron Pipe (DIP)**

<table>
<thead>
<tr>
<th>Pipe Size</th>
<th>Deflection Angle</th>
<th>Push-On Type DIP Joint</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Degrees</td>
<td>Maximum Offset Inches</td>
</tr>
<tr>
<td></td>
<td>18’ Length</td>
<td>20’ Length</td>
</tr>
<tr>
<td>Inches</td>
<td>Degrees</td>
<td>Inches</td>
</tr>
<tr>
<td>4” – 12”</td>
<td>2.5°</td>
<td>9”</td>
</tr>
<tr>
<td>14” – 24”</td>
<td>1.5°</td>
<td>6”</td>
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<td>765’</td>
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15. **Pipe Depth**

All pipe will be installed with a minimum of 4 ft. 6 in. and a maximum of 5 ft. of cover from finished grade of street to the top of the pipe barrel, unless approved otherwise.

16. **General Provisions**

All water main construction within the Town and all water service line construction connecting to the Town’s water mains will be done in accordance with these Standards and Specifications and the accepted plans and will 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, and such changes are in the best interests of the Town, the decision for the Town will be final.

17. **Permits Required**

A public improvement permit will not be issued until the water main plans have been accepted by the Town. A preconstruction meeting with the Town Inspector and Town, the Developer and the Contractor will be scheduled and completed prior to the commencement of any construction. The Town will be notified 2 working days – (48 hours) before the planned construction is to begin.

18. **Maintenance of Traffic**

When street cuts are required for water main installation construction, conditions will be met so as to avoid interference with traffic. A Traffic Control Plan (TCP) must be prepared in accordance with these Standards and Specifications and the Manual for Uniform Traffic Control Devices (MUTCD) and submitted to the Town for approval prior to the commencement of construction.
4.02 UTILITY EXTENSION POLICY

No water and/or sanitary sewer utility service shall be extended to anyone or any area until such area is annexed into the Town. To determine whether or not a property qualifies for sanitary sewer service, the property must lie within the current Town limits.

4.03 STREET CUTS

The removal of pavement, sidewalks, driveways, or curb and gutter shall be performed in a neat and workmanlike manner. Pavement mix design, thickness and replacement shall conform to the requirements of Chapter 2.

4.04 PROTECTION OF EXISTING FACILITIES

The Contractor shall notify the electric and gas utility, telephone company, cable TV, and all other interested parties prior to commencement of work and have their facilities staked and located in the field in order to ensure that there will not be interruption of these services during progress of the work. Existing power lines, telephone lines, trees, shrubbery, fences, water mains and services, gas mains, sewer mains and services, cables, conduits, drainage and irrigation ditches and pipes, embankments and other structures in the vicinity of the work not authorized to be removed shall be supported and protected from injury by the Contractor during the construction and until completion of the work affecting them. The Contractor shall preserve intact any underground pipes or other utilities encountered during construction. The Contractor shall be liable for all damage done to such existing facilities and structures as herein provided and he shall save the Town harmless from any liability or expense for injuries, damage, or repairs to such facilities. The type, size approximate location and number of all known underground utilities shall be shown on all drawings. It shall be the responsibility of the Contractor to verify the existence and location of all underground utilities along the route of the work.

In the event that during construction it is determined that any underground utility conduit, including sewers, water mains, gas mains and drainage structures or any above ground utility facilities are required to be relocated, the Contractor shall notify the owner of that utility well in advance of his approach to such utility so that arrangements with the utility owner can be made without delay to the work. All relocations will be done at the Contractor’s expense and upon approval by the Engineer.

4.05 OUTAGES

In the event loss of service is necessary, the Contractor shall coordinate with the Water Department and Inspector to determine the extent of outages. Customers shall be notified personally by the Town Department of Public Works at least 48 hours in advance and ensure that the loss of service shall in no case continue for more than 4 hours unless
approved by the Public Works Department. Outages for schools, medical clinics and various commercial businesses must be conducted at approved times as specified by the Public Works Department. If outages for more than 4 hours are necessary, they must be conducted at times to cause the least amount of inconvenience to customers and only after approval by the Town. Under all circumstances, work must be continuous until all customers are back in service. If in the process of installing a connection there exists an industry or building that cannot be without water as designated by the Town, such as a hospital, appropriate temporary means shall be taken to provide and convey water. The Town shall approve the water and means of conveyance.

4.06 SAFETY

Machinery, equipment, materials and all hazards shall be guarded or eliminated in accordance with the “Manual of Accident Prevention in Construction” of the Associated General Contractors of America and all applicable Federal regulations, including OSHA (Occupational Safety and Health Act), State, County and municipal laws. No blasting shall be done without the approval of the Fire District Inspector and the Town. Safety equipment, devices, and clothing shall be utilized by personnel where required by Federal, State and local laws.

4.07 BONDING

Developers and/or Contractors will be required to post bond to the Town to provide protection against the following situations:

A. Repairs or work performed by the Town caused by the Contractor
B. Repair or work by the Contractor
C. Necessary repairs caused by installing defective material
D. Costs incurred by the Town due to the Contractor’s failure to perform in accordance with these standards

Maintenance shall be guaranteed for a minimum of 1 year.

4.08 ACCEPTANCE OF WORK

Water and sewer utilities shall be inspected throughout installation. All utility testing must be completed and accepted in writing by the Inspector prior to any paving.

Prior to any building permits being issued, a punch list shall be formulated and sent to the Developer. Once this punch list has been completed and accepted, and as-built drawings for all utility lines and street improvements have been submitted to the Town, the 1 year guarantee period shall begin. The Town shall send a letter to the Developer stating this. No water meters shall be installed prior to initiating the 1 year guarantee period.
CHAPTER FOUR  STANDARDS AND SPECIFICATIONS  WATER SUPPLY FACILITIES

Once the 1 year guarantee period begins, the Developer shall be responsible for regular maintenance and repairs. The Town shall be informed in writing of all maintenance and repairs that have been performed.

Just prior to the end of the 1 year guarantee period, a second inspection and punch list shall be formulated and sent to the Developer. Upon completion of this punch list by the Developer to the satisfaction of the Town, the Town shall then send a letter to the Developer stating the acceptance of responsibility for perpetual maintenance of the water and sewer utility lines by the Town. Any deviations from this format shall be supported in writing by the Town Engineer.

4.09 MATERIALS

SCOPE

The purpose of this section of the specifications is to set forth the general criteria to be used in the construction of water mains and appurtenances in the Town service area. Any deviation from these standards must be supported in writing by the Engineer.

• All materials furnished shall be new and undamaged.
• Everything necessary to complete all installations shall be furnished and installed whether shown on approved drawings or not, and all installations shall be completed as fully operable.
• Acceptance of materials or the waiving of inspection thereof shall in no way relieve the Developer of the responsibility for furnishing materials meeting the requirements of the specifications.
• The Department of Public Works reserves the right to direct or deny use of certain types of materials in specific circumstances.
• All materials delivered to the job site shall be adequately housed and protected so as to ensure the preservation of their quality and fitness for the work.

1. Ductile Iron Pipe

• All ductile iron pipe shall be manufactured in accordance with AWWA Standard C-151, “Ductile Iron Pipe, Centrifugally Cast in Metal Molds or Sandlined Molds for Water or Other Liquids”, with the following additional requirements or exceptions.
• “Push-on single gasket” type conforming with applicable requirements of AWWA Standard C-111, “Rubber Gasket Joints for Cast-Iron and Ductile Iron Pressure Pipe and Fittings”. Joint types other than “push-on single gasket” are acceptable if specifically approved by the Engineer.
• The grade of iron shall be 60-42-10 having a minimum tensile strength of 60,000 psi, minimum yield strength of 42,000 psi and a minimum percent of elongation of 10%.
Pipe furnished under this specification shall conform to the pressure classifications recommended by the manufacturer.

Pipe furnished shall be nominal laying lengths of either 18 ft. or 20 ft. Random lengths are not acceptable.

Pipe furnished shall have standard thickness cement mortar linings in accordance with AWWA Standard C-104, “Cement Mortar Lining for Cast-Iron and Ductile Iron Pipe and Standards for Water”, and the exterior coating shall be the standard outside bituminous coating as specified in AWWA C-151.

The manufacturer shall furnish a certified statement that the inspection and all of the specified tests have been made and the results thereof comply with the requirements of the applicable standards herein specified. A copy of the certification shall be sent to the Engineer upon request.

Corrosion protection shall be covered in Section 4.12 of these specifications.

In general, ductile iron water pipe shall be installed per AWWA C-600.

2. Polyvinyl Chloride Pressure Pipe

All polyvinyl pipe shall be manufactured in accordance with AWWA Standard C-900, “Polyvinyl Chloride (PVC) Pressure Pipe”. Plastic water pipe shall be blue in color. Minimum pipe requirements shall be DR-18 Class 150 and if required by the Town DR-14 Class 200 pipe.

Pipe joints shall be made using an integral bell with an elastometric gasket “push-on type” joint meeting the requirements of ASTM D-1869 and E-477. Solvent cement joints are strictly prohibited.

Each length of pipe will be a standard laying length of 20 ft. Random length shall not be acceptable unless specifically approved by the Engineer. Under no circumstances shall the random length be less than 10 ft. long.

PVC must conform with cast-iron outside diameters. Pipe stored outside and exposed to sunlight for more than 30 days shall be covered with an opaque material such as canvas. Clear plastic sheets shall not be used to cover the pipe. Air circulation shall be provided under the covering.

The manufacturer shall furnish a certified statement that the inspection and all of the specified tests have been made and the results thereof comply with the requirements of the applicable standards herein specified. A copy of the certification shall be sent to the Engineer upon request. Tracer wire shall be required on PVC and other non-metallic water mains and other water line stub-outs. The type wire shall be coated 12-gauge solid copper wire. The wire will be installed on top of the pipe and run full length of the main. It shall be secured to the water line at least every 5 to 6 ft. Tracer wire shall come to grade in a 4 in. cathodic protection box placed directly behind each fire hydrant. Tracer wire shall extend a minimum of 1 ft. above grade. All connections shall be tight, and then coated and wrapped. The Town shall approve connection methods.

All fire hydrant feed lines shall be ductile iron pipe (Class 52) and fittings shall conform to the specifications of this Section. All connections and materials shall be approved and accepted by the Town.
CHAPTER FOUR  STANDARDS AND SPECIFICATIONS  
WATER SUPPLY FACILITIES  
01-01-04  

- All fittings shall be manufactured in accordance with the following standards: C-153/A21.53 and ANSI/AWWA C111/A21.11 cement lined and seal coat per ANSI/AWWA C104/A21.4, “Cement Mortar Lining for Ductile Iron Pipe and Fittings for Water”, C-110, “Ductile Iron Fittings” and C-153, “Rubber Gasket Joints for Cast-Iron and Ductile Iron Pressure Pipe and Fittings”, with the following additional requirements or exceptions.  
- All fittings shall be furnished with a cement mortar lining of standard thickness as defined in referenced specifications and given a seal coat of bituminous material or fusion bonded epoxy coated.  
- All fittings shall be furnished with mechanical joint or flanged ends conforming to referenced specifications and, in addition, the tee-head MJ bolts and hexagon nuts shall be fabricated from Ductile Iron Cor-Ten or approved equal.  
- All fittings shall be of the 350 psi pressure rating and shall conform to the dimensions and weights shown in the tables of referenced specifications. All fittings shall be made from ductile iron.  
- Restraining for all fittings shall be in accordance with the Standard Details using concrete kick blocks and joint restraints.  
- The manufacturer shall furnish a certified statement that the inspection and all of the specified tests have been made and the results thereof comply with the requirements of the applicable standard(s) herein specified. A copy of the certification shall be sent to the Engineer upon request.  
- Corrosion protection shall be covered in Section 4.12 of these Specifications. 

3. Steel Pipe (AWWA C200, MODIFIED)  

A. General  
The Contractor shall provide mortar-lined steel pipe coated as specified herein, complete, in accordance with the Contract Documents. Materials, welding procedures, linings, coatings and certifications shall meet or exceed the requirements of the most current ANSI, ASTM, AWWA, and API standards. 

B. Submittals  
Fabrication Information: 

a. Pipe/fitting wall construction details which indicate the type and thickness of cylinder; the position, type, size and area of reinforcement; manufacturing tolerances; maximum angular joint deflection limitations; and all other pertinent information required for the manufacture and installation of the product. 

b. Welded joint details shall be submitted for all joint types, including beveled ends for alignment conformance and deep bell or butt strap joints required for control of temperature stresses.
c. Rubber gasket joint design and details complete with dimensions, tolerances, and performance or test data.

d. Pipe Fabricator's Credentials: Submit the credentials of the pipe manufacturer/fabricator. Credentials shall include reference names, telephone numbers, and descriptions of projects for pipe conforming to AWWA C200 that is of similar diameter, length and wall thickness to the pipe in this project. Project description shall include length, diameter, wall thickness, steel metallurgy, location of facility where pipe was manufactured/fabricated, and names of key plant personnel responsible for the manufacturing process. Submit names and qualifications of current plant personnel to be responsible for manufacture of the pipe in this project.

Materials

a. Material lists and steel reinforcement schedules which include and describe all materials to be utilized. Metallurgical test reports for steel proposed for use on the project. Submit chemical and physical test reports from each heat of steel that indicate the steel conforms to the Project Specifications.

Line Layout Information

a. Line layout and marking diagrams compatible with the requirements of AWWA Manual 11 (M-11) and which indicate the specific number of each pipe and fitting and the location of each pipe and the direction of each fitting in the completed line. In addition, the line layouts shall include: the pipe station and center line elevation at all changes in grade or horizontal alignment; the station and center line elevation to which the bell end of each pipe will be laid; all elements of curves and bends, both in horizontal and vertical alignment. The location of all metered pipe sections, beveled ends for alignment conformance, and deep bell or butt strap joints for temperature stress control shall be clearly indicated on the diagrams.

b. Drawings showing the location and details of bulkheads for hydrostatic testing of the pipeline, and details for removal of test bulkheads and repair of the lining.

c. Details and locations of closures for length adjustment, temporary access manways, vents, and weld lead pass holes as indicated and as required for construction convenience.
CHAPTER FOUR  STANDARDS AND SPECIFICATIONS
WATER SUPPLY FACILITIES

01-01-04

Welding Information

a. Information regarding location, type, size, and extent of all welds with reference called out for Welding Procedure Specifications (WPS) numbers shall be shown on the shop drawings. The shop drawings shall distinguish between shop and field welds. Shop drawings shall indicate by welding symbols or sketches the details of the welded joints, and the preparation of parent metal required to make them.

b. Written welding procedures for shop and field welds, including Welding Procedure Specifications (WPS) and Procedure Qualification Records (PQR).

c. Written nondestructive testing procedure specifications, and nondestructive testing personnel qualifications for shop and field welds.

d. Current Welder Performance Qualifications (WPQ) shall be submitted for each welder used prior to its performing any Work either in the shop or field.

e. Submit the credentials of the Contractor’s Certified Welding Inspectors (CWI) and quality control specialist for review prior to starting any welding in the shop or field. The credentials shall include, but not be limited to, American Welding Society QC-1 Certification.

f. Submit a welder log for field and shop welding. Log shall list all welders to be used for the Work and the types of welds each welder is qualified to perform.

g. Submit a written rod control procedure for shop and field operations demonstrating how the Contractor intends to maintain rods in good condition throughout the Work. The rod control procedure shall also demonstrate how the Contractor intends to ensure that the proper rods are used for each weld.

Field Lining

a. Submit field lining Contractor’s credentials.

b. Submit a description of lining equipment and personnel to be used.

c. Submit written procedures for pipe surface preparation, lining application, and curing.

d. Submit cement mortar mix design.
Certifications

Furnish a certified affidavit of compliance for all pipe and other products, materials, or related work provided under this Section, as specified in ANSI/AWWA C200, C205, C602 and C206 respectively, and the following supplemental requirements:

a. Compliance with the additional requirements included in these Contract Documents.

b. Hydrostatic test reports.

c. All materials are NSF approved for use with potable water.

d. All welds were performed in conformance with these documents.

e. All expenses incurred in making samples or collecting data for certification of tests shall be borne by the Contractor at no increased cost to the Town.

C. Quality Assurance

a. Inspection: All pipe, linings, welds, coatings, and related work shall be subject to inspection at the place of manufacture and/or the place the Work is performed in accordance with the provisions of ANSI/AWWA C200, C205, C206, C602, C209, C214 and C215, as applicable, as supplemented by the requirements herein.

b. Tests: Except as modified herein, all materials used in the manufacture of the pipe shall be tested in accordance with the requirements of ANSI/AWWA C200, C205, C206 and C602, as applicable.

1. After the joint configuration is completed and prior to lining with cement-mortar, if applicable, each length of pipe of each diameter and pressure class shall be shop-tested and certified to a pressure of at least 80% of the yield strength of the pipe steel. Test pressure shall be maintained for a minimum of 5 minutes. Any leaks shall be repaired and the pipe retested.

2. Perform said material tests at no additional cost to the Town. The Town shall have the right to witness all testing conducted by the Contractor; provided that the Contractor’s schedule is not delayed for the convenience of the Town.

3. In addition to those tests specifically required, the Town may request additional samples of any material including mixed concrete and lining and coating samples for testing by the Town. The additional samples shall be furnished at no additional cost to the Town.
c. Welding Procedure Specifications: All welding procedures used to fabricate and install pipe shall be in accordance with the ASME Boiler and Pressure Vessel Code (BPVC) for shop welds and ANSI/AWS D1.1 for field welds. Written welding procedures shall be required for all welds, both shop and field. Welds qualified per the ASME BPVC shall include Supplementary Essential Variables for notch-tough welding. All provisions of ANSI/AWS D1.1 pertaining to notch-tough welding shall apply.

d. Welder Performance Qualifications: All welding shall be done by skilled welders, welding operators, and tackers who have had adequate experience in the methods and materials to be used. Welders shall be qualified by the Contractor under the provisions of ASME BPVC for shop welds and ANSI/AWS D1.1 for field welds. Furnish all material and bear the expense of qualifying welders.

1. Butt Joint Welds: Spot radiographically examine pipe in accordance with Paragraph UW-52 of the ASME Boiler and Pressure Vessel Code Section VIII, Division 1. If, in the opinion of the Town, the welds cannot readily be radiographed, they shall be 100% ultrasonically examined.

2. Fillet Welds: 100% examine all fillet welds using the magnetic particle inspection method.

3. Groove Welds: 100% ultrasonically examine all groove welds that cannot be readily radiographically spot examined.

4. All Welds: Contractor’s certified welding inspector shall 100% visually examine all welds as a minimum.

e. Onsite Observation: The pipe fabricator shall provide an experienced staff member to be onsite while the pipe and fittings are being installed. The staff member’s duties shall include, but not be limited to, the following:

1. Observe the installation and welding of the pipe and fittings.

2. Report any concerns to the Town’s onsite observer.

f. Certified Welding Inspector: Furnish the services of a certified welding inspector(s) for all shop and field welding as specified in AWWA C200 and C206. The certified welding inspector(s) shall 100% visually inspect all welds, verify proper procedures are being followed using qualified welders, supervise Contractor’s nondestructive testing, and witness Town’s nondestructive testing. The welding inspector(s) shall submit written certification that all welds were performed in conformance with these documents. All shop weld tests shall be reviewed and signed buy the inspector(s).
CHAPTER FOUR  STANDARDS AND SPECIFICATIONS  WATER SUPPLY FACILITIES

D. Products

a. General

1. Steel pipe, linings and coatings shall conform to ANSI/AWWA C200, C205, C602, C209, C214 and C215, as applicable, subject to the following supplemental requirements. The pipe shall be of the diameter and wall thickness shown, shall be furnished complete with welded joints, as indicated in the Contract Documents. For pipe larger than 24 in. in diameter, the inside diameter after lining shall not be less than the nominal diameter indicated unless otherwise shown. Pipe 24 in. in diameter and smaller may be provided in standard outside diameters.

2. Pay the cost of replacement or repair of pipe which is damaged at no increased cost to the Town.

3. Laying Lengths: Maximum pipe laying lengths shall not be limited unless specifically required by the Drawings. Contractor shall select lengths to accommodate the Contractor’s operation.

4. Lining: The pipe lining shall have smooth dense interior surfaces and shall be free from fractures, excessive interior surface crazing and roughness.

5. Cathodic Protection System: Cathodic protection systems shall be applied to pipelines as required.

6. Shop-Welded Surfaces: All weld seams on pipe surfaces that will have a flexible tape coating. Do not grind into, or gouge, the adjacent pipe wall material.

E. Materials

a. Cement: Cement for mortar shall conform to the requirements of ANSI/AWWA C205; provided, that cement for mortar coating shall be Type V, and mortar lining shall be Type II or V, per ASTM C150. Fly ash or pozzolan shall not be used as a cement replacement.

b. Pipe shall be manufactured as fabricated pipe per AWWA C200 as modified herein. ASTM pipe manufacturing standards referenced in AWWA C200 shall not be used. Pipe sections shall be fabricated by either of the following methods:
1. Pipe sections may be spirally welded or fabricated from short cylindrical
courses joined circumferentially by complete penetration butt joint welds
with not more than 2 longitudinal seams per course. Longitudinal seams
shall be staggered on both sides of the pipe.

2. Pipe sections may be rolled or pressed from no more than 3 sheets the
length of the pipe and welded with no more than 3 longitudinal seams.
Patch insert, overlays, or pounding out of dents will not be permitted.
Repair of notches or laminations on second ends will not be permitted.
Damaged ends shall be removed as a cylinder and the section end properly
prepared. Distorted or flattened lengths shall be rejected. A buckled section
shall be replaced as a cylinder.

F. Specials and Fittings

a. Unless otherwise required, all specials and fittings shall be in accordance with
Section 02572 – Steel Pipe Fabricated Specials and shall conform to the
dimensions of ANSI/AWWA C208.

G. Design of Pipe

a. General: The pipe shall be steel pipe, mortar-lined and flexible, with field
welded joints as indicated. The pipe shall consist of a steel cylinder, lined with
portland cement-mortar as indicated, with an exterior coating of polyethylene
tape.

b. Pipe Dimensions: The pipe shall be of the diameter and wall thickness shown
on the Drawings. The minimum steel cylinder thickness for each pipe size shall
be as indicated.

c. Joint Design: Unless otherwise shown, the standard field joint for steel pipe
shall be butt-welded or a double-welded (fully circumferential) lap joint.
Mechanically coupled, or flanged joints shall be required where indicated on the
Drawings. Butt-strap joints shall be used only where required for closures
where indicated. The joints furnish shall have the same or higher pressu.
rating as the abutting pipe.

d. Lap joints prepared for field welding shall be in accordance with
ANSI/AWWA C200. The method used to form, shape and size bell ends shall be
such that the physical properties of the steel are not substantially altered. Unless
otherwise approved by the Town, bell ends shall be formed by an expanding press
or by the pipe being moved axially over a die in such a manner as to stretch the
steel plate beyond its elastic limit to form a truly round bell of suitable diameter
and shape. The ends shall not be rolled. Faying surfaces of the bell and spigot
shall be essentially parallel, but in no case shall the bell slope vary more than 2 from the longitudinal axis of the pipe.

e. Shop-applied interior linings and exterior coatings shall be held back from the ends of the pipe as indicated or as otherwise acceptable to the Town. Holdback areas shall be coated as hereinafter specified.

f. Joint Shop Coating: All holdback areas for welded joints, all butt straps, and all bell and spigot joint rings for rubber-gasketed joints shall be thoroughly cleaned and given a shop coat of rust-inhibitive primer.

H. Cement-Mortar Lining of Steel Pipe

Cement-Mortar Lining for Shop Application: Where indicated on the Drawings, interior surfaces of all steel pipe, fittings, and specials shall be cleaned and lined in the shop with cement-mortar lining applied centrifugally in conformity with ANSI/AWWA C205. During the lining operation and thereafter, the pipe shall be maintained in a round condition by suitable bracing or strutting. The lining machines shall be of a type that has been used successfully for similar work and shall be approved by the Town. Every precaution shall be taken to prevent damage to the lining. If lining is damaged or found faulty at the delivery site, or after installation, the damaged or unsatisfactory portions shall be replaced with lining conforming to these Specifications at no additional cost to the Town.

The minimum lining thickness shall be as follows, with a tolerance of plus 1/8 in. or minus 1/16 in.

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<tr>
<th>Nominal Pipe Diameter (in.)</th>
<th>Lining Thickness (in.)</th>
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<tr>
<td>4 – 10</td>
<td>1/4</td>
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<tr>
<td>11 – 2</td>
<td>5/16</td>
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<tr>
<td>24 – 36</td>
<td>3/8</td>
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<tr>
<td>over 36</td>
<td>1/2</td>
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The pipe shall be left bare where field joints occur as indicated. Ends of the linings shall be left square and uniform. Feathered or uneven edges will not be permitted.

Defective linings, as determined by the Town, shall be removed from the pipe wall and shall be replaced to the full thickness required. Defective linings shall be cut back to a square shoulder in order to avoid feather edged joints. Temperature and shrinkage cracks in the mortar less than 1/16 in. wide need not be repaired. Pipe, specials, or fittings with cracks wider than 1/16 in. shall be rejected.
Protection of Pipe Lining/Interior: For all pipe and fittings with plant-applied cement-mortar linings, provide a polyethylene or other suitable bulkhead on the ends of the pipe and on all special openings to prevent drying out of the lining. All bulkheads shall be substantial enough to remain intact during shipping and storage until the pipe is installed.

I. Exterior Coating of Steel Pipe

Exterior Coating of Buried Piping: All buried piping shall be coated with a flexible coating.

Flexible coatings shall be Polyethylene Tape Coatings per AWWA standards.

Joint Diapers: Joint diapers for buried pipe with rigid mortar protective coat shall be as specified in this Section, as applicable. Grout bands or heavy-duty diapers for protection of joints on cement-mortar coated pipe shall be polyethylene foam-lined fabric with steel strapping of sufficient strength to hold the fresh mortar, resist rodding of the mortar and allow excess water to escape. The foam plastic shall be 100% closed cell, chemically inert, insoluble in water and resistant to acids, alkanes and solvents and shall be Dow Chemical Company Ethafoam 222 or equal. The fabric backing of joint diapers shall be cut and sewn into strips wide enough to overlap shop-coated areas by 4 in. on either side. Strips shall have slots for the steel strapping on the outer edges. The polyethylene foam shall be cut into strips wide enough to match the uncoated field joint area and slit to a thickness of 1/4 in. which will expose a hollow or open cell surface on one side. The foam liner shall be attached to the fabric backing with the open or hollow cells facing towards the pipe. The foam strip shall cover the full interior circumference of the grout band with sufficient length to permit an 8 in. overlap of the foam at or near the top of the pipe joint. Splices to provide continuity of the material will be permitted. The polyethylene foam material shall be protected from direct sunlight.

4. Gate Valves

- Gate valves located at tees in the water main shall be located a minimum of 50 ft. apart.
- All valves shall be manufactured in accordance with AWWA Standard C-500, "Gate valves for Water and other Liquids" with the following additional requirements or exceptions.
- Valves shall be resilient wedge, ductile iron body, fully bronze mounted with non-rising stem and parallel seats. Solid wedge valves are not acceptable. Acceptable valves include the Mueller 2360-23, American Flow control, U.S. Pipe Metrotoul 250 MJ only resilient wedge valves or approved equal. All valves shall be suitable for frequent operations, as well as service involving long periods of inactivity. The design working pressure shall be 350 psi for all valves.
• Valve stems shall be threaded so that valves shall open by turning COUNTERCLOCKWISE. Each valve shall be furnished with a 2 in. sq. operating nut. The operating nut shall have an arrow showing the direction of opening and the word “OPEN” cast on the nut. The stem seal shall consist of 2 O-rings; 1 positioned above the thrust collar with the valve under pressure in the full open position.

• Bolts and hex nuts used on the bonnet of the valve shall be the manufacturer’s standard fabricated from a low alloy steel for corrosion resistance.

• Gaskets shall be full face with holes to pass bolts or cut to fit inside of bolts. Gaskets shall be used on all flanged joints intended to be watertight.

• Flanges shall be sized and drilled in accordance with ANSI B-16.1 Class 125 specifications. Flanges shall be machined to a flat face or machined to a flat surface with a serrated finish in accordance with AWWA Standard C207 “Steel Pipe Flanges”.

• After approved factory assembly, each valve shall be given the operation and hydrostatic tests in accordance with the referenced specifications.

• The manufacturer shall furnish a certified statement that the inspection and all of the specified tests have been made and the results thereof comply with the requirements of the applicable standard(s) herein specified. A copy of the certification shall be sent to the Engineer upon request.

• Corrosion protection shall be covered in Section 4.12 of these Specifications.

• Valves shall be restrained in accordance with this Section.

5. Valve Boxes

• Valve box parts shall be a 2 piece 6850 series manufactured by Tyler, Castings, Inc., or an approved equal and made of gray cast-iron. A 5-1/4 in. screw type shaft shall be adjustable from 39 to 60 in. Valve box lids shall be marked with the word “WATER” and shall have a lip or flange extending into the valve box shaft. No slip type boxes will be allowed. The valve box shall be of design which will not transmit shock or stress to the valve and shall be centered and plumb over the operating nut of the valve with the box cover 1/4 in. below the surface of the pavement. This must be inspected prior to paving.

• The manufacturer shall furnish a certified statement that the inspection and all of the specified tests have been made and the results thereof comply with the requirements of the applicable standard(s) herein specified. A copy of the certification shall be sent to the Engineer upon request.

• Valve boxes should meet minimum weights and dimensions as shown in the Standard Details.

6. Butterfly Valves

• All valves larger than 16 in. shall be butterfly valves, Class 150B and shall conform to Sections AWWA C504. All butterfly valves shall be furnished with flanged end connections and shall be suitable for buried service installation. Butterfly valves used for buried service shall be similar to the “Groundhog”
manufactured by the Henry Pratt Company or an approved equal. Shafts shall be a one-piece unit constructed of stainless steel and shall extend completely through 
the valve disc body. Shaft bearing material shall have a proven record of service 
of not less than 5 years. Shaft seals may be designed for the use of standard split-
V packing or for standard “O” ring seals. Valves shall be fitted with a 2 in. 
operating nut and shall open to the left (counterclockwise). All butterfly valves 
shall be installed in manholes. All valves shall have extended shaft to top of 
valves boxes with indication (Pratt Diviner) for direction of open, number of 
turns, and make and model of valve. (See Standard Detail)

- The manufacturer shall furnish a certified statement that the inspection and all of 
  the specified tests have been made and the results thereof comply with the 
  requirements of the applicable standard(s) herein specified. A copy of the 
  certification shall be sent to the Engineer upon request.

- Corrosion protection shall be covered in Section 4.12 of these Specifications.

7. Pressure Reducing and Regulating Valves

- All pressure reducing valves shall be Clayton 90-01 series or an approved equal. 
The pressure reducing valve shall be hydraulically operated with a free floating 
guided piston having a seat diameter equal to the size of the valve. The valve 
shall be fully bronze mounted and all packing shall have rubber seals to provide 
tight closure and prevent metal to metal friction. An indicator rod shall be 
furished as an integral part of the valve to show the position of the piston within 
the valve body. The valve shall be designed to provide an access opening in the 
valve body for removing the piston and other internal parts without removing the 
main valve body from the line.

- Material shall be cast-iron for valve body; flanges and covers shall conform to 
  ASTM Standard Designation A-48. Bronze castings or parts for internal trim 
  shall conform to ASTM Standard Designation B-61.

- All valves shall be furnished with flanged ends and drilled in accordance with 
  ANSI B-16.1 Class 125 specifications. Flanges shall be machined to a flat face of 
  machined to a flat surface with a serrated finish in accordance with AWWA 
  Standard C207.

- The pilot valve for controlling operations of the main valve shall be a single 
  seated, diaphragm operated and spring loaded type. The pilot valve shall be 
  attached to the main valve with piping isolation valves so arranged for easy access 
  in making adjustments and also for its removal from the main valve while the 
  main valve is under pressure. Pilot control system shall be cast under pressure. 
  Pilot control system shall be cast bronze ASTM B-62 with 303 stainless steel 
  trim.

- The needle valve shall be all bronze and included with the main valve to control 
  the speed of piston travel.

- The operating pressure shall be 150 psi minimum.

- The body of the pressure reducing valve shall be given a hydrostatic test of 50% 
  more than the operating pressure specified herein. A second test to check seating 
  of the cylinder shall be made at the operating pressure.
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- All pressure reducing and regulating valves shall be installed in concrete vaults as specified in the standard details.
- The manufacturer shall furnish a certified statement that the inspection and all of the specified tests have been made and the results thereof comply with the requirements of the applicable standard(s) herein specified. A copy of the certification shall be sent to the engineer upon request.

8. Air Valves

Air valves shall be of 2 types as follows:

1.) An Air Valve called for on the plans shall mean an air and vacuum valve of the ball type designed to permit the escape of air from a pipeline when the line is being filled and to permit air to enter the pipeline when the line is being emptied.

2.) A Combination Air Valve called for on the plans shall mean a combination air and vacuum and air release valve designed to fulfill the functions of an air and vacuum valve and also designed to permit the escape of air accumulated in the line at the high point when the line is under pressure while in operation. The valve shall be self-contained in 1 unit, not a combination of 2 valves. This type would normally be used.

Air valves shall be installed at each high point in all water mains of 12 in. diameter and larger or as specified by the Town Engineer. Two-inch air valves shall be installed as shown in the Standard Details. Maximum spacing between air valves shall be 1,320 ft. Installation shall include 2 in. gate valves between saddie and air valve for maintenance purposes. They shall be installed in precast concrete manholes or vaults as specified in the Standard Details and fitted with air vents of adequate cross section open to the atmosphere as designed by the Engineer. A minimum of 1 ft. of 1 and 1-1/2 in. rock shall be placed under the pipe in air valve manholes. When air valves are required, specifications shall be submitted to the Engineer for review and approval. (See Standard Details)

9. Blow-off Assemblies

All water mains installed having dead-ends where stagnant water may collect shall be provided with blow-off devices which will allow flushing of the main without interruption of water service. Refer to blow-off assembly detail in these Specifications for water mains 12 in. or less in diameter. All water mains larger than 12 in. in diameter shall have blow-off assemblies of at least 6 in. in diameter. A temporary blow-off assembly may be used on 12 in. diameter or smaller water mains where water main construction has temporarily terminated between phases in a development (see Standard Details). Design for installation of blow-offs 6 in. and larger shall be approved by the Engineer.
10. Vaults

All valve vaults shall be designed to adequately house the valves and fittings therein contained, as well as to withstand all external loadings imposed by earth, thrust, and AASHTO H-20 highway live loading. Vaults shall be furnished with removable roof slabs to allow removal of all valves and fittings. They shall also be sized so as to allow sufficient room for valve maintenance and minor repair and shall be furnished with manhole rings for easy access. They shall be constructed in such a manner as to allow operations of all valves from above ground and shall be fitted with air vents open to the atmosphere. Vaults shall be made waterproof after construction by use of sealants, epoxies, or other approved methods. If the vault is not to be in a street, the roof shall be designed to support the overhead earth fill and any other reasonable loading that may occur and shall have aluminum steps fitted and secured in concrete. Concrete floors shall have 12 in. diameter by 18 in. deep sump holes in corner with access to outside of vault. The Design of any vault shall be approved by the Engineer prior to any installation.

11. Precast Concrete Manholes

Refer to Standard Drawings of these Specifications.

12. Concrete

- All cement used shall be portland cement acceptable under ASTM Designation C150 “Standard Specifications and Tests for Portland Cement”. Cement used shall be Type II. The design mix of portland cement, fine aggregate, course aggregate, water and admixtures shall be submitted along with test results of the design mix to the Engineer for approval upon request. The mix design shall conform to CDOT Class B, 3500 psi concrete. Hand mixed concrete will not be permitted unless it is “sackrete” 5000 in. 5000 psi concrete or approved equal.

- Concrete shall not be placed on frozen subgrade. Concrete shall be placed only in the presence of the Inspector unless inspection has been waived prior to the placement. When concrete is deposited against ground without the use of forms, the ground shall be thoroughly moistened or other provisions made to prevent the ground from drawing water from the concrete. Newly placed concrete shall be allowed to set undisturbed for a minimum curing time of 24 hours. When concrete is placed at temperatures below 40°F and rising, the Contractor shall provide satisfactory methods, as determined by the Engineer, and means to protect the mix from injury by freezing and comply with all America Concrete Institute (ACI) standards or latest revisions. After placement of concrete, an 8 mil. polyethylene covering shall be required for 24 hours in order to allow for proper curing. No trucks shall be permitted to place concrete, if placement does not begin prior to 90 minutes from when the truck left the plant. Allowable slump shall be 3 in., + or − 1 in.
13. Concrete Reinforcement

All deformed reinforcing bars shall conform to ASTM Standard A-615, Grade 50 or 60, or ASTM Standard A-617, Grade 40 or 60. All welded steel wire fabric shall conform to ASTM Standard A-185.

14. Galvanized Materials

Under no circumstances shall any galvanized fittings or material be used unless specifically approved by the Engineer.

15. Fire Hydrants

- All fire hydrants shall conform to and be tested in accordance with AWWA Specification C502. Fire hydrants shall be made of cast iron with full bronze mountings. Inlet shall fit 6 in. pipe with barrel length sufficient for a 5 ft. trench. Hydrants shall have one 4-1/2 in. pumper connection and two 2-1/2 in. hose connections, and the main valve opening in the fire hydrant shall be not less than 5 in. in diameter. Threads on all nozzles shall be National Standard. All fire hydrants shall OPEN CLOCKWISE (right hand). Only compression type main valves that close with the water pressure will be accepted. Valves will open counterclockwise (left hand).

- A traffic breakaway feature shall be incorporated into the barrel of the hydrant at the ground line. The operating nut shall be national Standard pentagon measuring 1-1/2 in. from point to opposite flat. Nozzle covers shall have the same size and shape nut as the operating nut. The hydrant shoe will have a mechanical joint fitting with the tee-head bolt and hexagon nut made of Cor-Ten.

- Each hydrant shall have drain holes with a minimum 18 in. of 1-1/2 in. rock beneath them. (Refer to Drawings) A sheet of 8 mil. polyethylene should be placed over the rock to prevent dirt from filling the rock. Hydrant color shall match existing Town hydrant color (Safety Yellow). All hydrants shall stand plumb and shall be connected to the street main by a 6 in. branch line. The branch line shall be ductile iron (Class 52) pipe only. An independent 6 in. gate valve shall be installed on each fire hydrant branch, using a mechanical joint swivel tee. Thrust blocks under and behind the fire hydrant base shall be placed per fire hydrant detail in these Specifications. Megalugs shall be used on all hydrant branch lines in place of rodding. RODDING WILL NOT BE ALLOWED. Fire hydrant base shall be adjusted to not more than 3 in. or less than 2 in. from the bottom of the hydrant flange to the top of finished grade, when finished grade has been established. All hydrant extensions needed to place hydrant at correct grade shall be considered essential to the project and not a separate pay item. Maximum height of extensions of hydrant is 12 in. No hydrant base shall be installed any deeper than 6 ft. from the top of the finished grade.

- No part of the fire hydrant assembly shall protrude over the edge of sidewalks. Minimum distance from driveways shall be 5 ft. Depending upon hydrant's
CHAPTER FOUR  
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location, the use of steel posts filled with concrete might be required for protection, as specified by the Inspector. Fire hydrants shall be placed on property lines at corners or in the middle of the block in residential areas. Fire hydrants shall not be placed in cul-de-sacs. All hydrants shall be located within the right-of-way on public streets or in an unfenced utility easement coordinated with the Fire District. No obstruction in front of hydrant, 5 ft. to the sides and 3 ft. to the back. New fire hydrants shall be re-painted.

- Corrosion protection shall be covered in Section 4.12 of these Specifications.

Fire hydrants shall be limited to the following manufacturers only:

- Mueller Company 5-1/4 Centurion
- MH Style 129
- Waterous WB 250

For additional information refer to fire hydrant detail of these Specifications.

4.10 MISCELLANEOUS

Where special conditions not covered by these Specifications exist, detailed drawings and specifications shall be submitted to the Town for approval before contracts are awarded or Work is begun. Written approval from an authorized representative of the Town Department of Public Works must be obtained before any materials other than those materials specified in the Standard Specifications may be employed in the construction of water and sewer lines connected to or made a part of the water and sewer system of the Town.

4.11 RESTRAINED JOINTS/THRUST PROTECTION

Restrained joints/thrust protection shall be provided in locations where thrust forces may cause pipe joints to separate. Harness lugs and rods are not an acceptable method of joint restraint unless accepted by the Town in special circumstances. Acceptable methods of thrust restraint include the following:

a. Megalugs or bell and spigot restrained joints
b. Welded joints for steel pipe
c. Concrete thrust blocks

For pipe larger than 12 in. in diameter, thrust protection calculations and methodology shall be completed by a Professional Engineer and submitted to the Town for review.

Thrust blocks shall be constructed at all bends and fittings which result in unbalanced line thrust. 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 fitting and the thrust block to aid in case of future removal. The vertical sides of the concrete thrust blocks shall be formed to allow for symmetrical thrust. All concrete thrust blocks
shall be designed for shape and size as required by internal pressure and load bearing capacity of the soil and shall in every instance bear against undisturbed earth. If soil bearing strength is unknown, soil bearing capacities used in design must be approved by the Engineer. When it is impossible through over excavation or other causes to pour a thrust block against undisturbed earth, megalugs shall be required to anchor the fittings to the main upon approval of the Engineer. Backfill may be placed over the thrust block once the surface has set sufficiently to resist the weight of the backfill. However, no tamping or compacting shall be allowed above the thrust block for a minimum of 24 hours after placement. Refer to thrust block details in these Specifications.

4.12 CORROSION PROTECTION

Ductile Iron Pipe

- All ductile iron pipe, fittings and valves shall be protected as specified in this Section.
- All ductile iron pipe, fittings and valves shall be hand wrapped using polyethylene with a minimum wall thickness of 2 layers of 8 mil and a 2 in. wide, 10 mil thick polyethylene pressure sensitive tape to close seams or hold overlaps.
- All polyethylene encasement material shall be manufactured in accordance with AWWA Standard C105. The raw material used to manufacture polyethylene film shall be Type I, Class A, Grade E-1 in accordance with ASTM Standard Designation D-1248.
- In all cases, the polyethylene shall be so applied as to prevent the contact of backfill material with the fitting.
- Soil resistivity tests may be required at the sole discretion of the Town. Other means of corrosion protection must be specifically approved by the Town. The Developer/Contractor shall incur the costs of all soil testing if required.

Steel Pipe

- Soil resistivity tests shall be taken then analyzed by a corrosion specialist to determine the need for and extent of corrosion protection. In most cases it is assumed that the 3 layer tape wrap system will protect the pipe in normal soils. However, the Town desires to have each case analyzed. Refer to the City of Aurora Standards, Section 16 for corrosion control requirements for steel pipe.

4.13 EXCAVATION

All excavations shall be made to the lines and grades as established by the approved drawings in open cut, through whatever material encountered. Pipe trenches shall be excavated to the bottom of the pipe. All areas shall be excavated in such a manner as will afford adequate drainage. Where material encountered within the limits of the Work is considered unsuitable by the Inspector, such material shall be excavated below the grade shown on the drawings to a depth necessary to ensure a stable, firm foundation and refilled with approved native backfill material to provide a firm foundation. All
CHAPTER FOUR       STANDARDS AND SPECIFICATIONS
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excavated materials which are considered unsuitable and any surplus of excavated material shall be disposed of by the Contractor.

All existing asphalt or concrete surfacing shall be cut vertically in a straight line as specified in Chapter 2 and removed from the job site prior to starting the trench excavation. This material shall not be used in any fill or backfill.

The trench shall be excavated so that a minimum clearance of 12 in. is maintained on each side of the pipe for proper placement and compaction of the bedding or backfill material. The maximum trench width measured at the top of the pipe shall be the outside diameter of pipe plus 24 in.

The trench shall be adequately supported and the safety of workers provided for as required by the most recent standards adopted by the Occupational Safety and Health Act.

Trench excavation shall not advance more than 300 ft. ahead of pipe laying and backfilling work.

Excavation for structures shall be of such dimensions as to allow for the proper installation and to permit the construction of the necessary pipe connections.

4.14 DEWATERING

All pipe trenches or structure excavation shall be kept free from all water during pipe laying and other related work. The method of dewatering shall provide for a completely dry foundation at the final lines and grades of the excavation. All water shall be disposed of in a suitable manner without being a menace to public health or causing a public inconvenience. The dewatering operation shall continue until such time as it is safe to allow the water table to rise in the excavations. Pipe trenches shall contain enough backfill to prevent pipe floatation.

4.15 PIPE BEDDING

After completion of the trench excavation and proper preparation of the foundation, bell holes shall be dug deep enough to provide a minimum of 2 in. of clearance between the bell and the bedding material. All pipe shall be installed in such a manner as to ensure full support of the pipe barrel over its entire length. After the pipe is adjusted for line and grade and the joint is made, the backfill material shall be carefully placed and tamped under the haunches of the pipe up to spring line and in the previously dug bell holes.

4.16 INSTALLATION OF PIPE

Pipe and fittings shall be loaded and unloaded by lifting so as to avoid shock or damage. Under no circumstances shall such material be dropped. Before the placing of pipe in the
CHAPTER FOUR  STANDARDS AND SPECIFICATIONS
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Trench, each pipe or fitting shall be thoroughly cleaned of all foreign material, kept clean at all times and examined for cracks or defects before installation.

Joint lubricant is required and shall be a product approved by the pipe manufacturer.

When laying pipe on curves, the pipe shall be kept in alignment by deflecting joints. (See Section 4.01.14) Pipe shall be laid with the bell ends facing in the direction of laying unless directed otherwise by the inspector.

Whenever the pipe is left unattended, temporary plugs shall be installed at all openings. Temporary plugs shall be watertight, Standard Cast Iron and of such design as to prevent children and animals from entering the pipe. All temporary plugs shall be approved by the Inspector.

No pipe or appurtenant structure shall be installed upon a foundation into which frost has penetrated or at any time when the Inspector deems there is a danger of ice formation or frost penetration at the bottom of the excavation. No pipe or appurtenant structure shall be installed unless backfilling can be completed before the formation of ice and frost.

Immediately before joining 2 lengths of pipe, the inside of the bell and the outside of the spigot end of the gasket shall be thoroughly cleaned. Caution shall be exercised to ensure the correct type of gasket is used. A thin film of gasket lubricant shall be applied to either the inside face of the gasket or the spigot end of the pipe or both.

The spigot end of the pipe shall be placed in the socket with care to prevent the joint from contacting the ground. The joint shall be completed by pushing the pipe home with a slow steady pressure, without jerky or jolting movements. Stabbing shall not be permitted. Pipe furnished without a depth mark shall be marked before assembly to ensure insertion to the full depth of the joint.

Extra care should be used in handling PVC pipe during cold weather due to the reduced flexibility and impact resistance as temperatures approach and drop below freezing.

4.17 INSTALLATION OF VALVES AND VALVE BOXES

All valves shall be handled in such a manner as to prevent any injury or damage. A. valves shall be thoroughly cleaned before installation. Valves shall be set in such a manner that the valve stems are plumb. Valves shall be located at points as shown on the approved construction plans. Whenever possible, valves shall be located near the property line extension where applicable, or near the intersection PC.

Valve boxes shall be installed plumb. Valve boxes which have shifted during backfill operations and are no longer plumb shall be re-excavated and realigned to the satisfaction of the Inspector.
4.18 CHLORINATION AND CLEARWATER TESTS

Under no circumstances shall a non-disinfected main which cannot be isolated be connected to an existing, disinfected main. The Contractor will assume any and all responsibility for damage done by heavily chlorinated water entering existing facilities due to negligence on his part. All water mains shall adhere to the following sequence of tests: (1) chlorine; (2) pressure tests; and (3) clearwater test (see Sections 4.35, 4.36 and 4.37).

4.19 TRENCH BACKFILL

It is expected that the trench excavation will provide suitable backfill material. Wet, soft or frozen material, pieces of asphalt or concrete or other undesirable substances shall not be used for backfill. The backfill material shall be free from rubbish, stones larger than 5 in. in diameter, and frozen lumps of soil. If the excavated material is not suitable for backfill as determined by the Inspector, suitable material shall be hauled in and utilized and the rejected material hauled away and disposed of.

Backfilling shall be conducted at all times in a manner to prevent damage to the pipe or its coating and shall be kept as close to the pipe laying operation as possible.

All backfill around structures shall be consolidated by mechanical tamping.

Backfill in areas where existing pavement is to be cut and replaced, unsuitable material excavated shall be removed from the site and the trench backfilled with gravel road base to finished or existing grade as specified in this Section. Excess material to be removed prior to surfacing.

- **Bedding Zone** shall consist of squeegee material placed below the pipe invert, 6 in. in depth minimum.

- **Pipe Zone** shall consist of squeegee material placed above the pipe invert to a minimum of 6 in. above the pipe.

- **Backfill Zone** shall consist of material above pipe zone.

- Flowable Fill may be substituted for pipe zone material when approved by the Town.
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The bedding zone and pipe zone shall be backfilled with clean squeegee well graded
meeting the following gradation:

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<th>Sieve No.</th>
<th>Percent Passing</th>
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<tr>
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</tr>
<tr>
<td>8</td>
<td>80 – 100</td>
</tr>
<tr>
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<td>50</td>
<td>10 – 30</td>
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<tr>
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<td>0 – 5</td>
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4.20 TRENCH BACKFILL COMPACTION

Compaction shall be obtained by placing material in horizontal layers brought up
uniformly within the trench and compacted throughout the depth of the trench. If
material other than squeegee is used for backfilling around pipes, lift thickness shall not
exceed 6 in. In the “Backfill Zone” above the “Pipe Zone”, lift thickness shall not exceed
12 in.

Trench backfill in the right-of-way shall be compacted to at least 97% of the maximum
density and within plus or minus 3% of optimum moisture content as determined by the
Standard Proctor ASTM 698D. Trench backfill in field excavations shall be compacted
to at least 95% of the maximum density and within plus or minus 3% of optimum
moisture content as determined by the Standard Proctor ASTM 698D.

If, in the judgement of the Inspector, the trench shows signs of being improperly
backfilled or if settlement occurs, the trenches will be reopened to a depth required for
proper compaction, refilled and recompacted, all in accordance with these Specifications.
If a special backfill material is encountered, the recommendation of a Geotechnical
Engineer shall be required in order to attain the necessary trench compaction.

Compaction tests, taken by an independent commercial laboratory, shall be taken every
100 ft. or at the discretion of the Inspector. The Inspector shall pick the location and the
depths at which all compaction tests will be taken. The Inspector shall be present when
each test is taken and the results shall be forwarded to the Department of Public Works.
The Contractor shall bear the costs of all compaction testing.

4.21 TRENCH MAINTENANCE

For a period of 1 year after completion of the installation (1 year warranty period), the
Contractor shall maintain and repair any trench settlement which may occur and shall
make suitable repairs to any pipe, fittings, valve, valve box, pavement, sidewalks or other
structures which may be damaged as a result of backfill settlement as determined by the Engineer.

4.22 HYDROSTATIC TESTING

- No hydrostatic tests shall be made on any portion of the pipeline until all field placed concrete has had adequate curing time.
- The pipeline shall be tested with water only at double normal operating pressure or a pressure of 150 psi, whichever is greater.
- The Department of Public Works shall be notified 24 hours in advance of testing. All acceptance testing shall be made in the presence of the Inspector.
- The Contractor shall furnish the calibrated meter for testing. The pipeline shall be in a state of readiness for testing. (Gauge must read to within 5 psi)
- All air in the line shall be properly purged. Where blow-offs or hydrants are not available or effective in purging air from the line, the Inspector shall require a tap to purge the line. The location and size of the tap shall be at the Inspector's discretion.
- No leakage is allowed through the bonnet of the line valve. Any valve leaking through the bonnet shall be removed and replaced.
- The pressure test shall be a 2 hour test taken at the high point in the line. Every time the water line pressure drops 5 psi, the pump will be started to bring the line pressure back to the initial pressure.
- Polyvinyl chloride or ductile iron pipe shall be considered to have passed the pressure test when the total leakage per hour is less than:

\[ L = \frac{SD}{133,200} \left( \frac{P}{P_{gauge}} \right)^{1/2} \]

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

The Inspector shall direct the Contractor to repair specific leaks regardless of test results, if in his opinion they are serious enough to endanger the future service of the pipeline. Pipelines shall be tested in sections as rapidly as such section may be isolated. Should any leakage of the pipeline become apparent during the 1 year guarantee period, the Developer or their authorized representatives shall perform the necessary repairs. Blow-offs, pressurizing pump, corporation stops and water measuring apparatus shall be provided by the Contractor.

The Town utilities Department shall not be held responsible for water tightness of its valves on existing facilities. If existing valves leak, the Town will assist in exercising
valves, but the Contractor must use methods at his own disposal to work with the resulting leakage.

Contractor will be required to go around and check all water valves to ensure they are fully open after the water line has been completed, prior to it being released to the Town.

All fire hydrant lines shall be pressure tested. It is recommended that the fire hydrant be dry. All fire hydrants shall be tested by flushing each hydrant a minimum of 5 minutes before they will be accepted.

4.23 REPAIR FITTINGS

The use of repair clamps, repair sleeves, joint clamps and similar devices is permitted to repair existing mains not under warranty. Repair clamps shall be of stainless steel construction in the band, lugs, nuts, and stainless steel bolts. These devices should not be considered substitutions for careful installation of mains. Repair clamp design and make shall be submitted to the Engineer for approval prior to installation.

4.24 SERVICE PIPE GENERAL INFORMATION

All water service line construction connecting to the Town water system shall be done in accordance with these Specifications. These Specifications shall cover all new water service line construction from the water main to the building plumbing. Any deviations from these Standards must be supported in writing by the Engineer.

4.25 SERVICE PIPE MATERIALS

All materials furnished shall be new and undamaged. Everything necessary to complete all installations shall be furnished and installed whether shown on the approved drawings or not and all installations shall be completed as fully operable.

Acceptance of materials or the waiving of inspection thereof shall in no way relieve the Developer of the responsibility for furnishing materials meeting the requirements of these Specifications.

The Department of Public Works reserves the right to direct or deny use of certain types of materials in specific circumstances.

All materials delivered to the job site shall be adequately housed and protected so as to ensure the preservation of their quality and fitness for the work.

The minimum size allowable for a service line shall be 3/4 in. diameter
1. Copper Service Pipe

Type "K" copper shall be used for service lines 3/4 inches through 2 inches in diameter.

2. Ductile Iron Service Pipe

Ductile iron pipe used for service pipe shall conform to section 4.09 of these Specifications. Ductile iron pipe shall be used for all service lines larger than 2 inches.

3. Curb Stops/Ball Valves

Ball valves are used for 1 in. and smaller service lines and shall be installed 4 in. below the meter yoke as shown in the Standard Details. Ball valves shall be compression to compression connections and shall meet the following requirements:

<table>
<thead>
<tr>
<th>Size</th>
<th>Make</th>
<th>Catalog Number</th>
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<tbody>
<tr>
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<tr>
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</tbody>
</table>

Curb Stops are used for service lines 1-1/2 in. and larger and are set in the service line on the inlet side, approximately 2 ft. upstream of the meter pit or vault, as shown in the Standard Details and provide a means to shut off the service line for repairs inside the meter vault. Curb stops shall be a stop and waste type valve and shall be a Mueller H10284 or Ford 67B11666SW or B11777SW.

Curb stop service boxes for 1-1/2 in. and larger service lines shall be cast iron Tyler 95E or Castings, Inc. CI95E, or an approved equal. The curb stop box shall be installed exactly center over the curb stop valve and in a vertical position. The top lid of the curb stop box shall be installed level with the final grade.
4. Corporation Stops and Saddles

Corporation stops shall be AWWA taper thread to copper connection of pack joint and shall be a Ford Type F1000Q, Mueller H15008 or A.Y. McDonald 4701Q, or an approved equal. Taps up to 2 in. shall be made by the Town Utilities Department personnel for existing water mains. New water main taps shall be performed by the Contractor.

Saddles for PVC C900 pipe shall be Ford S90, S902 or S912 non-hinged, Mueller H13000 series or A.Y. McDonald 3805 or an approved equal. Saddles for ductile iron pipe shall be double strap bronze Ford 202B, Mueller B2B series or A.Y. McDonald 3825 or an approved equal.

4.26 SERVICE PIPE LOCATION

That portion of the service pipe between the main and the ball valve/curb stop must be continuous and straight with no joints and perpendicular, if possible, to the main. Service line stubbed into the property line shall be of sufficient length to allow direct connection to the ball valve/curb stop.

The main to be tapped must extend along the entire length of the front lot line of the property to be served.

If service is requested for a lot at the end of a cul-de-sac street, the main to be tapped must be not more than 25 ft. from the curb line or the proposed curb line at the end of the cul-de-sac. The service pipe between the main and the property line in cul-de-sacs shall be in a continuous straight line and shall enter the property a distance of 2 to 4 ft. from the nearest lot corner. No service line may be constructed through or in front of any adjoining property. When possible, the service line shall be located 5 ft. toward the low side of the lot from the center line of the lot. Service lines are not to extend beneath driveways unless otherwise approved by the Engineer. Sewer and water service lines must by a minimum of 10 ft. apart horizontally or concrete encasement or special protection of the sewer line will be required. Service locations will also be marked with a “V” on the curb. Markings shall be stamped or chiseled, not painted.

4.27 SERVICE PIPE DEPTH

All service pipe must be laid 4-1/2 to 5 ft. below the established grade of the street in which they shall be laid and all other places at least 4-1/2 ft. below the surface of the ground. If, in the judgement of the Engineer, the topography indicated the advisability thereof, service pipe shall be laid to a lower depth as required by the Engineer on the basis of then existing information.

If, after a service pipe has been installed, the grade of the surface of the ground is lowered, the service pipe must be lowered to provide at least 4-1/2 ft. of cover.
4.28 SEPARATE TRENCHES

Except as hereinafter provided, service pipe may not be installed in a trench containing other conduits which conduct any substance other than potable water. The trench containing the service pipe shall be separated laterally from any trench containing other conduits by at least 10 ft. of undisturbed compacted earth.

4.29 SERVICE PIPE CONNECTIONS

- Service pipe 2 in. or less in diameter shall be connected to the main by means of a bronze corporation stop.

- Service pipe larger than 2 in. in diameter shall be connected to the main by tee connection (wet tap).

- No underground joints are allowed in the copper service pipe between the corporation stop and the ball valve/curb stop. Meters shall be of the same size as that portion of the service pipe between the meter and the main unless otherwise stated by the Engineer. All meters shall be placed a minimum of 10 ft. apart.

- 3/4 and 1 in. meters shall be set by Town Utilities Department personnel or their duly authorized representatives. Larger meters which require vaults and by-passes must be installed by the Contractor.

- No meter will be set until the service line and copper setter (on residential) or curb stops (on commercial) have been installed.

- Taps will not be made on a water main until the main has passed the pressure tests and clearwater tests. No flaring of service lines will be allowed.

- Care should be taken to properly install water service lines so that enough slack is in the service lines to protect against pullout problems.

- Water mains will be tapped at a 45° angle from the horizontal center line of the water main on the same side of the pipe as the water meter.

- Tapping mains may require digging out bedding materials and cutting or removing part of the corrosion protective wrapping. After the taps are made, the wrap shall be repaired or replaced by the installing Contractor in such a manner as to protect both the pipe and the main. Taps shall be backfilled with squeegee and hand tamped to fill any voids.

- Service taps on the main shall have minimum separation of 24 in. and be no closer than 24 in. to a coupling.
• Service lines form the meter to the building must be the same size as the line from the main to the meter, unless approved otherwise by the Town.

4.30 PUMPS

Except when specifically authorized by the Engineer, the installation of pumps on service pipes designed to increase water pressure inside the premises receiving service is prohibited.

4.31 LAWN SPRINKLERS

Lawn sprinkler systems must be tapped on the outlet side of the meter pit or a direct tap on the main line with a meter setting. All devices utilized for cross connection control must meet the minimum requirements of AWWA, the Uniform Plumbing Code, as well as the approval of the Building Department. All devices for cross connection control shall be inspected by the Town Building Department.

4.32 RETAP AND RELOCATION CHARGES

Only one domestic tap is allowed per single family residence. If the water main has been tapped once, and for any reason another service tap is required, a retap charge will be assessed prior to the retap unless waived by the Engineer for a good cause shown. If it is necessary to abandon an existing water tap, it shall be turned off and disconnected at the tap at the main. Such charge shall also be assessed if it is necessary to relocate the water meter pit out of a driveway area with a Ford or Mueller compression fitting.

Contractors and/or Developers guilty of flagrant violations of these Standard Specifications, as determined by the Town Engineer, shall be subject to revocation of bonds and loss of Contractor’s license.

4.33 FIRE LINE WITH DOMESTIC SERVICE CONNECTIONS

No domestic water service may be tapped from a fire line or fire hydrant lateral. All fire lines and water services must be tapped separately from the existing main.

4.34 NEW AND REPAIRED MAINS

This procedure is to be followed prior to the Town accepting:
1. a newly installed water main or
2. a repaired pre-existing water main

It covers disinfection, bacteriological sampling and reporting of results.

Installation will be in accordance with established AWWA Standards (AWWA C600) with particular attention paid to the provision for cleanliness within the pipe itself. Flushing and disinfection will be performed by the Contractor in accordance with
CHAPTER FOUR  STANDARDS AND SPECIFICATIONS  WATER SUPPLY FACILITIES

AWWA Standard C651 (more detailed instruction will be found below. Sampling (bacteriological and chlorine residual) will be performed by personnel from a certified testing lab. Chlorine residual analysis will be performed using precision chlorine test papers (BASF Wyandotte Corp.); bacteriological testing will be performed by qualified technicians from a certified testing lab. The release form will be required from the testing lab with copies to Public Works Department, and the Contractor prior to the Town accepting new mains for service.

After a main has been repaired and flushed, personnel from the Town Utilities Department shall inspect the water for color, turbidity and chlorine residual prior to restoring the repaired main into service.

4.35 DISINFECTION

Disinfection will be accomplished using tablet form Hypochlorite. These will be affixed to the inside top with an approved adhesive (i.e., Permatex #1 or equivalent). Dosage will be calculated for a 200 mg/l (ppm) chlorine concentration for volume of installed pipe (this is to allow for the refilling of pre-existing pipe attached to the installed sections). The chlorine solution will remain in contact with the piping for a minimum of 24 hours, and a maximum of 48 hours. Chlorine content will be checked by the Town.

4.37 FLUSHING

After chlorination or disinfection of the pipeline, flushing will commence to remove the chlorine solution. Flushing will continue for a minimum of 5 minutes beyond the time when chlorine is no longer detectable.

4.37 BACTERIOLOGICAL SAMPLING

After flushing, personnel from a certified laboratory will sample for bacteriological contamination. If the samples show no bacteriological growth and are free from excessive turbidity, the Town Utilities Department will release the main for service and will initiate the required forms. If samples show bacterial growth, the entire system shall be disinfected and flushed according to the procedures described in this Chapter. Per the Tri County Health Department, samples should be taken every 1000 ft. of pipe, or each fire hydrant, which ever is more frequent. A minimum of 2 samples will be analyzed.
Meters:
1. Inside Installation
   Water meter installations inside any buildings are specifically prohibited.

2. Jumper Pipes
   Jumper pipes are prohibited. If required, the town will provide a temporary meter.

3. Warranty
   A 1 year warranty which covers materials and workmanship will be in effect upon final acceptance of any meter pit or vault.

4. Water Meters
   All water meters, regardless of size, connected to the Town’s utility system shall be furnished by and remain the property of the Town Water Department. Under no circumstances shall anyone other than Town Water personnel remove a water meter once the pit or vault has been inspected and approved, unless otherwise specified by the Engineer.

5. Special Meter Installations
   In any installation where special or unusual conditions might exist, detailed drawings, accompanied by a letter of explanation shall be submitted to the Town Utilities Department. Approval by the town’s engineer is required prior to construction of a special meter.

6. Water Meters Over 4” in Size
   For any water meter installation over 4 in. in size, detailed drawing of the proposed installation shall be submitted to the Engineer for approval.

7. Easements
   The Town shall be provided with easements for water meter installation if the meter is located out of the right-of-way.
8. Electrical Wiring

There shall be no electrical wiring allowed in any water meter pit or vault unless otherwise authorized by the Engineer, except remote meter head wiring as per Town specifications.

9. Inspection of Residential Pits and Commercial Vaults

Inspection of all residential pit and commercial pit or vaults shall be conducted by personnel from the Town Utilities Department. Locations for commercial pits or vaults shall be determined by personnel from the Town Water Department.

10. Meter Sizes

All meter sizes for residential, commercial or industrial use shall be determined by the consulting engineer and submitted to the Town’s engineer for review and approval. If water pressures in a building are determined to be inadequate for that facility, the Town shall not be held responsible.

4.39 WATER METER SPECIAL INFORMATION

1. 24” Pit Installation

Copper Setters

Copper setters of the proper laying length to accommodate the water meter are required on all installation of ¾ and 1 in. water meters. A list of the laying length is provided:

- 5/8 x 3/4 in. water meter = 7 13/16 in.
- 1 x 1 in. water meter = 11 3/32 in.

Cutting of the copper setter for the purpose of increasing or decreasing the span of the copper setter is specifically prohibited.

2. Meter Sizes for Duplexes

The minimum allowable meter size for a duplex is 1 in.

4.40 WATER METER INSTALLATIONS

1. Meter Pits for 3/4” and 1” Services

Meter pits shall be constructed of a solid, white, DFW 48 in. high, and 20 in. inside diameter and 1/2 in. wall thickness or equivalent (must be pre-approved by the Town). The trench floor under the masonry base shall be compacted earth. Copper service pipe entering and leaving the pit shall be of sufficient length so as
to meet the depth specifications as outlined in the Standard Details when the copper setter is installed. The meter pit shall not bear on the service pipe. No flared connections will be allowed.

2. Meter Manholes for 1-1/2" and 2" Services

Meters shall be installed in 48" diameter precast concrete manholes with a hinged type lid (REXUS RE62X4KD). All ring and covers shall be 24 in. and a 2 1/8 in. diameter hole for RF Sensor. Curb stops shall be located 2 ft. upstream of the manhole. (See Standard Details) Precast concrete vaults shall be used for 3 in. and larger services.

3. Copper Setter Installation

The copper setter shall be of an all copper and brass construction and shall have an angled ball valve on the inlet side of the copper setter and a double check valve on the outlet side. The copper setter, when installed, shall be 4 in. below the top of the meter pit for 1 in. and smaller services. (See Standard Details) A variance of more than 1 in. will not be accepted. A bypass shall be required for 1-1/2 in. and larger services.

Following is a list of acceptable copper setters:

<table>
<thead>
<tr>
<th>Size</th>
<th>Make</th>
<th>Catalog Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>5/8&quot;x3/4&quot;</td>
<td>Ford</td>
<td>VBHH83W-44-33Q</td>
</tr>
<tr>
<td></td>
<td>Mueller</td>
<td>B-2474-2A</td>
</tr>
<tr>
<td></td>
<td>A.Y. McDonald</td>
<td>31D209WDQQ33</td>
</tr>
<tr>
<td>1&quot;</td>
<td>Ford</td>
<td>VBHH84W-44-44Q</td>
</tr>
<tr>
<td></td>
<td>Mueller</td>
<td>B-2474-2A</td>
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<tr>
<td></td>
<td>A.Y. McDonald</td>
<td>31-4-WDQQ44</td>
</tr>
<tr>
<td>1-1/2&quot;</td>
<td>Ford</td>
<td>VBH76-12B-11-66</td>
</tr>
<tr>
<td></td>
<td>Mueller</td>
<td>B-2423-2</td>
</tr>
<tr>
<td></td>
<td>A.Y. McDonald</td>
<td>20B612WDDFF665</td>
</tr>
<tr>
<td>2&quot;</td>
<td>Ford</td>
<td>VBH77-12B-11-77</td>
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<tr>
<td></td>
<td>Mueller</td>
<td>B-2423-2</td>
</tr>
<tr>
<td></td>
<td>A.Y. McDonald</td>
<td>20B712WDDFF775</td>
</tr>
</tbody>
</table>

4. Curb Stops/Ball Valves

Ball valves are used for 1 in. and smaller service lines. Ball valves shall be compression to compression connections and shall meet the following requirements:
### CURB STOPS/BALL VALVES

<table>
<thead>
<tr>
<th>Size</th>
<th>Make</th>
<th>Catalog Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>3/4&quot;</td>
<td>Ford</td>
<td>B44-333Q</td>
</tr>
<tr>
<td></td>
<td>Mueller</td>
<td>B-25209</td>
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<tr>
<td></td>
<td>A.Y. McDonald</td>
<td>6100Q</td>
</tr>
<tr>
<td>1&quot;</td>
<td>Ford</td>
<td>B44-444Q</td>
</tr>
<tr>
<td></td>
<td>Mueller</td>
<td>B-25209</td>
</tr>
<tr>
<td></td>
<td>A.Y. McDonald</td>
<td>6100Q</td>
</tr>
<tr>
<td>1-1/2&quot;</td>
<td>Ford</td>
<td>B44-666Q</td>
</tr>
<tr>
<td></td>
<td>Mueller</td>
<td>B-25209</td>
</tr>
<tr>
<td></td>
<td>A.Y. McDonald</td>
<td>6100Q</td>
</tr>
<tr>
<td>2&quot;</td>
<td>Ford</td>
<td>B44-777Q</td>
</tr>
<tr>
<td></td>
<td>Mueller</td>
<td>B-25209</td>
</tr>
<tr>
<td></td>
<td>A.Y. McDonald</td>
<td>6100Q</td>
</tr>
</tbody>
</table>

### ¾" through 1" Services

The upper section shall be installed with 5601 Erie Pattern with 1" upper section, complete with shut-off rod. The lid shall be installed with 5601L-2 hole Erie Pattern, threaded 1". The curb stop shall be installed 1 foot behind the walk and the riser must be installed at finished grade. The curb stop shall be set on a 4x6 brick.

### 1 ½" through 2" Service

The upper section shall be installed with 5603 Erie Pattern with 1" upper section, complete with shut-off rod. The lid shall be installed with 5601L-2 hole Erie Pattern, threaded 1". The curb stop shall be installed 1 foot behind the walk and the riser must be installed at finished grade. The curb stop shall be set on a 4x6 brick.

### 5. Water Meter Pit covers (Typical Installation)

The dome and top lid shall be AL7020D-R-PIL aluminum meter pit cover with RF recess lid and plastic inner lid. When installed, the dome shall be 1-2 in. above the final grade in landscape areas and shall be flush with grade for installation in concrete areas. The center of the dome’s top lid when installed shall be between 2 and 3 ft. behind sidewalk or curb and gutter. Meter pits shall be located a minimum of 10 ft. apart. On new installations, meter pits shall not be installed in driveways.

### 6. Water Meter Pipe covers in Traffic Areas

Meter pit covers shall be cast iron heavy duty rated for traffic loads and shall be Castings, Inc. CIW3, Ford W3 or approved equal.
The following Denver Water standard drawings have been adopted by the Town of Lochbuie for construction of water distribution systems.

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<td>Reference Post Typical Detail</td>
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</tbody>
</table>
"A"—STRAIGHT LINE
CUL-DE-SAC:
Lay pipe to 18'
Beyond the center
(Radius point)
of cul-de-sac.

"B"—OFFSET
CUL-DE-SAC:
Lay pipe to 5'
Beyond P.I. Then
to 18' beyond the
Center (Radius point)
of cul-de-sac.

TYPICAL PLAN FOR CUL-DE-SACS
NOTES:

1. LAY PIPE FROM FITTING TO P.L.

2. INSTALL VALVE AT P.L.

3. STUB OUT TWO FULL PIPE LENGTHS FROM VALVE. PLUG END OF PIPE INSTALL BLOWOFF AND KICKBLOCK.

4. ALTERNATIVE TO NOTE 3: PROVIDE RESTRAINED JOINTS FROM VALVE TO FITTING AND ELIMINATE THE TWO FULL LENGTHS OF PIPE OUT OF VALVE AND TEMPORARY BLOW-OFF.
TYPICAL TRENCH SECTION

NOTES:

1. PAVING SHALL COMPLY WITH LOCAL AUTHORITY JURISDICTION.
2. TRENCH WALLS TO BE SUPPORTED AS REQUIRED BY O.S.H.A.
3. MINIMUM COVER TO BE BELOW OFFICIAL STREET GRADE.

<table>
<thead>
<tr>
<th>PIPE DIAMETER</th>
<th>MINIMUM WIDTH</th>
<th>MAXIMUM WIDTH</th>
</tr>
</thead>
<tbody>
<tr>
<td>4&quot;</td>
<td>1'-4&quot;</td>
<td>2'-4&quot;</td>
</tr>
<tr>
<td>6&quot;</td>
<td>1'-6&quot;</td>
<td>2'-6&quot;</td>
</tr>
<tr>
<td>8&quot;</td>
<td>1'-8&quot;</td>
<td>2'-8&quot;</td>
</tr>
<tr>
<td>12&quot;</td>
<td>2'-0&quot;</td>
<td>3'-0&quot;</td>
</tr>
<tr>
<td>16&quot;</td>
<td>2'-4&quot;</td>
<td>3'-4&quot;</td>
</tr>
<tr>
<td>20&quot;</td>
<td>2'-8&quot;</td>
<td>3'-8&quot;</td>
</tr>
<tr>
<td>24&quot;</td>
<td>4'-0&quot;</td>
<td>5'-0&quot;</td>
</tr>
</tbody>
</table>
TYPICAL TRENCH SECTION

NOTES:

1. MINIMUM COVER TO BE 4.5' BELOW OFFICIAL STREET GRADE.
2. TRENCH WALLS TO BE SUPPORTED AS REQUIRED BY OSHA.
3. PIPE SHALL BE BEDDED FROM 18" BELOW THE BOTTOM OF THE PIPE TO 12" ABOVE THE TOP OF THE PIPE.
4. TRENCH WIDTH SHALL NOT BE MORE THAN 18" NOR LESS THAN 12" WIDER THAN THE LARGEST OUTSIDE DIAMETER OF PIPE.
5. COMPACTION SHALL BE IN ACCORDANCE WITH CHAPTER 7.
6. TAPPING SADDLES REQUIRED IN AREAS WHERE THE BEDDING SECTION IS USED.
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

3" GALVANIZED PIPE
CAP IN A 6" VALVE
BOX

2" BLOW-OFF
PIPE

2" DRAIN &
WASTE VALVE,
OPERATING
NUT & DRAIN

BRASS STREET ELBOW

CONCRETE KICKBLOCK

90'

12" PIPE
OR SMALLER

PLUG WITH
2" TAP

BOND BREAKER

PLAN

3" GALVANIZED CAP

GROUND LINE

2" MALE I.P. THREAD
SOLDER ADAPTER,
COVERED w/ 3" CAP

6" FULL VALUE
BOX (3 SECTIONS,
TOP, CENTER & BASE)

6" VALVE BOX (3 SECTIONS,
TOP, CENTER & BASE)

2" DRAIN & WASTE VALVE,
OPERATING NUT & DRAIN

2" BLOW-OFF
PIPE

KICKBLOCK NOT SHOWN

1 CU. FT. 6" #
ROCK OR EQUAL

ELEVATION

NOTES:
1. BLOW-OFF PIPE TO BE TYPE K SOFT COPPER
   OR BRASS.
2. ALLOWED IN MASTER METER AND
   READ AND BILL DISTRICTS ONLY.

REVISED 5-2002

DENVER WATER
1600 W. 15th Ave.
Denver, Colorado 80204
Phone (303) 893-2000
Telemeter (303) 893-8231

BLOW-OFF INSTALLATION
FOR 12" AND SMALLER PIPE

Scale: NONE Date: JUNE 1995
Drawn: C.B.B. Tr: Ck:
Approved: Dr. 127 No. 35

SHEET 12
NOTES:

1. THIS INSTALLATION MAY BE REPLACED BY A FIRE HYDRANT WHERE APPROVED BY DENVER WATER FOR 16" AND 20" MAINS.

2. MEA-A-LEG IS AN ACCEPTABLE ALTERNATIVE TO RODDING.

3. THE DISTANCE BETWEEN RUNGS, CLEATS, AND STEPS SHALL NOT EXCEED 12 INCHES AND SHALL BE UNIFORM THROUGHOUT THE LENGTH OF THE LADDER.
NOTE:
PLUG SHALL BE EITHER MECHANICALLY RESTRAINED OR USED WITH A KICKBLOCK. LENGTH OR SIZE PER DENVER WATER ENGINEERING STANDARDS.

ELEVATION

NOTE:
WITH PRIOR APPROVAL OF DENVER WATER, A FIRE HYDRANT MAY BE SUBSTITUTED FOR THE PERMANENT 2" BLOWOFF. SEE SHEET 15 FOR EXTENSION GUIDE.
CONCRETE EXTENSION COLLARS
GROUND LINE

24" MANHOLE RING & COVER

80" PRECAST CONC FLAT M.H. COVER (ASTM C476)

80" PRECAST CONC M.H. (ASTM C476)

APPROVED MASTIC (Typ)

2-2" 90° GALVANIZED STREET ELLS
2-2" THD'G AIR/VACUUM VALVES
2-2" THD'G BALL VALVES
2-2" CORP. STOPS THD'G BOTH ENDS ON DJ. PIPE ONLY
2-2" L.P. THD'G OUTLETS

ELEVATION

FOOTING DETAIL

PLAN

CONC. M.H. BASE BEAMS
9" X 1'-0" X 8'-0" REINF.
WITH BAR STEEL AS SHOWN.

NOTES:

1. USE 2" AIR VALVE ASSEMBLY ON 30" OR SMALLER PIPE.

2. THE DISTANCE BETWEEN RUNGS, CLEATS, AND STEPS SHALL NOT EXCEED 12 INCHES AND SHALL BE UNIFORM THROUGHOUT THE LENGTH OF THE LADDER.

3. LADDER RUNGS ARE REQUIRED IN PRECAST CONCRETE MANHOLES.

REvised 5-2002

DEnVER WATER
1500 TELD, 13TH AVENUE GARDEN, DENVER 80204
Phone (303) 629-6000 Telex 159328-3811

2" AIR/VACUUM VALVE INSTALLATION

Scale: _NONE_ Date: JUNE 1995
Drawn: C.B.B. Tr: _ _ _ _ _ _ _ Ck: __ __
Approved: _ _ _ _ _ Dr. _127_No. _35_

SHEET 16
NOTE:
USE 12" AIR VALVE ASSEMBLY OF 30" OR SMALLER PIPE.

NOTES:
1. SEE SHEET NO. 10 FOR CONCRETE MANHOLE BASE BEAMS AND AIR/VACUUM VALVE DETAILS.
2. LADDER RUNGS ARE REQUIRED IN PRECAST MANHOLES. THE DISTANCE BETWEEN RUNGS, CLEATS, AND STEPS SHALL NOT EXCEED 12" INCHES AND SHALL BE UNIFORM THROUGHOUT THE LENGTH OF THE LADDER.
**NOTES:**

1. Bearing surfaces shown in chart are minimum.

2. Based on 150 PSI internal pipe pressure plus water hammer.
   4", 6", 8", and 12" water hammer = 110 P.S.I.
   16", 20", and 24" water hammer = 70 P.S.I.

3. See Section 6.42 and Sections 8.19 of the engineering standards.

4. Based on 3,000 psf soil bearing capacity.

5. NA = Not Applicable.

---

### CONCRETE KICKBLOCKS

**BEARING SURFACES & INSTALLATION**

<table>
<thead>
<tr>
<th>Size of Pipe</th>
<th>Bends</th>
<th>TEE or DEAD END</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>11 1/4'</td>
<td>22 1/2'</td>
</tr>
<tr>
<td>4&quot;</td>
<td>1.00</td>
<td>1.00</td>
</tr>
<tr>
<td>6&quot;</td>
<td>1.00</td>
<td>1.25</td>
</tr>
<tr>
<td>8&quot;</td>
<td>1.00</td>
<td>2.00</td>
</tr>
<tr>
<td>12&quot;</td>
<td>2.25</td>
<td>4.50</td>
</tr>
<tr>
<td>16&quot;</td>
<td>3.75</td>
<td>7.50</td>
</tr>
<tr>
<td>20&quot;</td>
<td>5.00</td>
<td>10.00</td>
</tr>
<tr>
<td>24&quot;</td>
<td>7.00</td>
<td>14.00</td>
</tr>
</tbody>
</table>

DENVER WATER
1890 West 12th Avenue Denver, Colorado 80204
Phone: 303-292-6000 Telecopier: 303-292-9851

CONCRETE KICKBLOCKS
BEARING SURFACES & INSTALLATION

Scale: NONE Date: JUNE 1995
Drawn: C.B.B Tr: Ck:  
Approved: Dr. 127 No. 35

REVISED 5-2002
### ROD DIAMETER, GRADE & LENGTH OF RESTRAINED PIPE

<table>
<thead>
<tr>
<th>PIPE SIZE</th>
<th>4&quot;</th>
<th>6&quot;</th>
<th>8&quot;</th>
<th>12&quot;</th>
<th>16&quot;</th>
<th>20&quot;</th>
<th>24&quot;</th>
</tr>
</thead>
<tbody>
<tr>
<td>FITTING</td>
<td>D</td>
<td>L</td>
<td>G</td>
<td>D</td>
<td>L</td>
<td>G</td>
<td>D</td>
</tr>
<tr>
<td>90° BEND,</td>
<td>L</td>
<td>D</td>
<td>G</td>
<td>L</td>
<td>D</td>
<td>G</td>
<td>L</td>
</tr>
<tr>
<td>TEE, PLUG</td>
<td>L</td>
<td>D</td>
<td>G</td>
<td>L</td>
<td>D</td>
<td>G</td>
<td>L</td>
</tr>
<tr>
<td>VALVE</td>
<td>L</td>
<td>D</td>
<td>G</td>
<td>L</td>
<td>D</td>
<td>G</td>
<td>L</td>
</tr>
<tr>
<td>45° BEND</td>
<td>L</td>
<td>D</td>
<td>G</td>
<td>L</td>
<td>D</td>
<td>G</td>
<td>L</td>
</tr>
<tr>
<td>22° BEND</td>
<td>L</td>
<td>D</td>
<td>G</td>
<td>L</td>
<td>D</td>
<td>G</td>
<td>L</td>
</tr>
<tr>
<td>11° BEND</td>
<td>L</td>
<td>D</td>
<td>G</td>
<td>L</td>
<td>D</td>
<td>G</td>
<td>L</td>
</tr>
</tbody>
</table>

**NOTES:**

1. LENGTH OF RESTRAINED PIPE MEASURED EACH WAY FROM VALVES AND BENDS.
2. CLAMPS, RODS & MEGALUGS NOT ALLOWED FOR 24" & LARGER PIPE.
3. D=DIAMETER, L=LENGTH, G=GRADE, M.S.=MILD STEEL, H.S.=HIGH STRENGTH.
4. MINIMUM 4½' GROUND COVER REQUIRED.
5. BASED ON 150 PSI INTERNAL PRESSURE, FOR L AND Pressures Listed ON SHEET 21 OF 76 FOR D AND G.
8. NUTS SHALL BE ASTM A307 GRADE A OR B HEXAGON HEAVY SERIES. HIGH STRENGTH NUTS SHALL CONFORM TO MS-22.
9. SEE THE ROD DETAIL DRAWING ALSO, THE ROD COUPLING DETAILS, CLAMP DETAILS AND SET CLAMP DETAILS.
10. LENGTH REFERS TO THE AMOUNT OF PIPE WHICH MUST BE RESTRAINED TOGETHER AND IS NOT NECESSARILY THE LENGTH OF THE RODS.
11. LENGTH OF RESTRAINED PIPE CHART IS ALSO FOR THE LENGTH OF JOINT RESTRAINT FOR MEGALUGS.
12. CROSSES MUST BE RESTRAINED IN ALL APPLICABLE DIRECTIONS.
13. 12" AND SMALLER IN LINE VALVES AND TEES SHALL HAVE A MECHANICAL JOINT RESTRAINT DEVICE ON EACH SIDE OF THE FITTING OR VALVE. MECHANICAL JOINT RESTRAINT DEVICE SHALL BE PER MS-5 OF THE ENGINEERING STANDARDS.
14. A SECOND Valve WILL BE REQUIRED TO BE CLOSED WHEN EXCAVATING NEXT TO A EXISTING Valve.
Notes:

1. Use two high strength steel tie rods at end of casing.
2. Tie rod hole diameter 1/8" larger than stud diameter.
3. Bottom edge of all plates shaped to fit O.D. of pipe.

<table>
<thead>
<tr>
<th>W/O Flanged Lugs</th>
<th>Carrier Pipe Nominal Dia</th>
<th>Stud Dia D</th>
<th>A</th>
<th>W</th>
<th>Z</th>
<th>T</th>
<th>H</th>
<th>E</th>
<th>H1</th>
<th>Y</th>
<th>X</th>
</tr>
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<tbody>
<tr>
<td></td>
<td>4&quot; to 12&quot;</td>
<td>3/4&quot;</td>
<td>5&quot;</td>
<td>1 1/2&quot;</td>
<td>3 3/4&quot;</td>
<td>3/8&quot;</td>
<td>4 1/8&quot;</td>
<td>3 1/8&quot;</td>
<td>2&quot;</td>
<td>4 1/2&quot;</td>
<td>5&quot;</td>
</tr>
<tr>
<td></td>
<td>16&quot;</td>
<td>1&quot;</td>
<td>5 3/4&quot;</td>
<td>1 3/4&quot;</td>
<td>4 1/2&quot;</td>
<td>1/2&quot;</td>
<td>4 1/2&quot;</td>
<td>3 1/4&quot;</td>
<td>2&quot;</td>
<td>RING</td>
<td>0&quot;</td>
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<tr>
<td></td>
<td>20&quot;</td>
<td>1 1/4&quot;</td>
<td>7 1/2&quot;</td>
<td>2&quot;</td>
<td>5 3/4&quot;</td>
<td>5/8&quot;</td>
<td>5&quot;</td>
<td>3 3/4&quot;</td>
<td>2 1/2&quot;</td>
<td>RING</td>
<td>7 1/2&quot;</td>
</tr>
</tbody>
</table>
# Mechanical Joint Restraint

## Wedge Detail

## Bolt Hole Detail

### Dimensions

<table>
<thead>
<tr>
<th>Nominal Pipe Size</th>
<th>No. of Bolts</th>
<th>No. of Wedges</th>
<th>K2 Inches</th>
<th>J Inches</th>
<th>F Inches</th>
<th>M Inches</th>
</tr>
</thead>
<tbody>
<tr>
<td>4&quot;</td>
<td>2</td>
<td>2</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6&quot;</td>
<td>6</td>
<td>3</td>
<td>11.12</td>
<td>9.50</td>
<td>7.00</td>
<td>0.88</td>
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<tr>
<td>8&quot;</td>
<td>6</td>
<td>4</td>
<td>13.37</td>
<td>11.75</td>
<td>9.15</td>
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<td>8</td>
<td>17.88</td>
<td>16.25</td>
<td>13.30</td>
<td>1.25</td>
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<tr>
<td>16&quot;</td>
<td>12</td>
<td>12</td>
<td>22.50</td>
<td>21.00</td>
<td>17.54</td>
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<td>14</td>
<td>27.00</td>
<td>25.50</td>
<td>21.74</td>
<td>1.60</td>
</tr>
</tbody>
</table>

### Notes:

1. Refer to MS-27 or Section 8.05 Paragraph D.
2. Dimensions for 18" and 20" D.I. pipe not shown.
3. Other mechanical joint restraint devices must be approved before installation.

---

**DENVER WATER**

1600 Broadway, Denver, Colorado 80210

Phone: (303) 836-6800 Fax: (303) 836-6881

### Mechanical Joint Restraint Details

- **Scale:** NONE
- **Date:** JUNE 1995
- **Drawn:** C.B.B.
- **Tr.:** __________
- **Ck.:** __________
- **Approved:** __________

---

**REVISED 5-2002**

**SHEET 26**
NOTES:
1. THE BOLT SHALL BE MANUFACTURED OF "COR-TEN" OR APPROVED EQUAL.
2. THE BOLT MAY BE HEAT TREATED.

<table>
<thead>
<tr>
<th>ALLOWABLE PIPE DIAMETER INCHES</th>
<th>BOLT SIZE</th>
<th>NO. OF BOLTS REQUIRED</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>3/4&quot;</td>
<td>2</td>
</tr>
<tr>
<td>6</td>
<td>3/4&quot;</td>
<td>2</td>
</tr>
<tr>
<td>8</td>
<td>3/4&quot;</td>
<td>2</td>
</tr>
<tr>
<td>10</td>
<td>3/4&quot;</td>
<td>4</td>
</tr>
<tr>
<td>12</td>
<td>3/4&quot;</td>
<td>6</td>
</tr>
</tbody>
</table>
NOTES:

1. FINAL APPROVAL OF BORING AND CASING METHOD AND MATERIALS SHALL BE OBTAINED FROM THE ENGINEER PRIOR TO CONSTRUCTION.

2. SOIL AT ENDS OF CASING SHALL BE STABLE AT ALL TIMES.

3. CATHODIC PROTECTION SHALL BE PROVIDED FOR STEEL CASING AS REQUIRED BY THE ENGINEER.

4. CASING PIPE SHALL BE ONE PIECE, STRAIGHT, ROUND AND OF NEW MATERIAL.

FORMULA FOR FINDING C:

\[ C = B + (2)(1.5) \left( \frac{B}{2} + A + F \right) \]

C - CASING LENGTH

B - CASING O.D.

A - VERTICAL DISTANCE BETWEEN CASING AND DENVER WATER CONDUIT

F - 1/2 O.D. DENVER WATER CONDUIT

FORMULA FOR FINDING L:

\[ L = \frac{C}{\tan \beta} \]
**STEEL CASING PIPE**
- (size table below for size and wall thickness)

**1" STEEL BAND**

**CARRIERT PIPE**

**OVERALL PIPE JOINT DIMENSION**

**TREATED REDWOOD RUNNER**

**NOTES:**
1. RUNNER LENGTH TO BE 75% OF LAYING LENGTH
2. SEE SHEET 25 FOR CASING LENGTH
3. HARNESS LUGS TO BE INSULATED FROM D.I. PIPE

**PIPE CASING DETAIL**

<table>
<thead>
<tr>
<th>CARRIER PIPE NOMINAL Dia</th>
<th>CASING PIPE MIN. O.D.</th>
<th>MIN. WALL THICKNESS</th>
<th>MINIMUM RUNNER SIZE</th>
</tr>
</thead>
<tbody>
<tr>
<td>4&quot;</td>
<td>12&quot;</td>
<td>0.188&quot;</td>
<td>2&quot; x 4&quot;</td>
</tr>
<tr>
<td>6&quot;</td>
<td>16&quot;</td>
<td>0.23&quot;</td>
<td>2&quot; x 4&quot;</td>
</tr>
<tr>
<td>8&quot;</td>
<td>18&quot;</td>
<td>0.282&quot;</td>
<td>2&quot; x 4&quot;</td>
</tr>
<tr>
<td>12&quot;</td>
<td>22&quot;</td>
<td>0.344&quot;</td>
<td>2&quot; x 4&quot;</td>
</tr>
<tr>
<td>16&quot;</td>
<td>28&quot;</td>
<td>0.405&quot;</td>
<td>2&quot; x 6&quot;</td>
</tr>
<tr>
<td>20&quot;</td>
<td>32&quot;</td>
<td>0.469&quot;</td>
<td>2&quot; x 6&quot;</td>
</tr>
</tbody>
</table>

**NOTES:**
1. NITRILE OR PVC RUNNERS MAY BE USED AS AN ALTERNATIVE TO TREATED REDWOOD.
2. TRENCH LAD CASINGS SHALL BE DESIGNED AND INSTALLED TO CONFORM TO STANDARDS.
NOTES:

1. LENGTH OF EXTENSION OF PIPE AND RESTRAINED JOINTS SHALL BE IN ACCORDANCE WITH THESE ENGINEERING STANDARDS.

2. ALL WATER MAINS TWELVE (12"") INCHES OR SMALLER, WHICH CROSS UNDER DENVER WATER CONDUITS SHALL BE DUCTILE IRON.

3. CATHODIC PROTECTION SHALL BE AS REQUIRED IN ACCORDANCE WITH THESE ENGINEERING STANDARDS.

4. A BORED CROSSING MAY BE REQUIRED BY THE ENGINEER.
NOTE:
Any subsurface under the sewer shall be replaced such that no flow shall enter the waterline trench.

SEWER CROSSING UNDER
WITH "D" LESS THAN 2

NOTE:
All existing sewer damaged during installation must be replaced with PVC pipe.
IDENTIFICATION MARKS ON POSTS SHALL BE 3" CIRCLES BROKEN IN VERTICAL CENTER (O) POINTING TO APPURtenANCE, WITH 1" STENCILS INSIDE CIRCLE INDICATING TYPE OF APPURtenANCE (WH, 12" GATE VALVE, Etc.) AND THE DISTANCE IN FEET AND INCHES FROM POST.
NOTE:
The location relative to the canal, height and length of the cutoff wall will be determined by the Denver Water Inspector, or owner.

UNITED STATES OF AMERICA
UNITED STATES POSTAL SERVICE
DENVER WATER
1500 West 13th Avenue Denver, Colorado 80204
Phone: (303) 939-6000 Telecopier: (303) 832-4300
TYPICAL CUTOFF WALL
FOR DITCH OR CANAL CROSSING
Scale: ___ NONE ___ Date: JULY 1995
Drawn: ___ C.B.B. ___ Tr: ___ Ck: ___
Approved: ___ Dr._127_No._35 ___
REVISED 5-2002
SHEET 33
FIRELINE OR DOMESTIC CONNECTION WITH MAIN EXTENSION

FIRELINE OR DOMESTIC CONNECTION

1. EXISTING MAIN
2. TAPPING SLEEVE
3. TAPPING VALVE
4. DOUBLE SPIGOT PIPE
5. PROPERTY LINE VALVE
6. MEGALUG
7. CONCRETE KICKBLOCK
8. M.J. ANCHORING TEE (SWIVEL TEE WHERE APPLICABLE)
9. M.J. VALVE
10. POLYETHYLENE WRAPPED

DENVER WATER
1600 West 15th Avenue Denver, Colorado 80204
Phone: (303) 893-6000 Telefax: (303) 893-6661

2" AND LARGER DOMESTIC AND FIRELINE CONNECTIONS

Scale: NONE Date: JULY 1995
Drawn: C.B.B. Tr: ___ Ck: ___
Approved: ___ Dr. 127 No. 35

REVISED 5-2002 SHEET 34
NOTE: 4" FIRELINE CONNECTION WITH 1-1/2" UP TO 2" DOMESTIC SERVICE SHALL USE A 4" M.I. X 1 1/2" UP TO 2" THREADED TEE.

FIRELINE CONNECTION WITH DOMESTIC SERVICE TEE UP TO 3"

FIRELINE CONNECTION WITH DOMESTIC SERVICE TEE 4" AND LARGER

1. EXISTING MAIN
2. TAPPING SLEEVE
3. TAPPING VALVE
4. DOUBLE SPIGOT PIPE
5. PROPERTY LINE VALVE
6. MEGALUG
7. CONCRETE RICK BLOCK
8. DOMESTIC SERVICE TEE
9. POLYETHYLENE WRAPPED
10. 90° FITTING
11. VALVE AS REQUIRED OWN CONTINUE PER APPLICABLE METER DETAIL (SEE SHEETS 46-49)
12. PLUG TAPPED TO DOMESTIC SIZE (UP TO 3"
13. CORP STOP (UP TO 3"
14. COPPER TUBING (UP TO 3"

DENVER WATER
1800 West 12th Avenue-Denver, Colorado 80204
Phone: 303/893-6000-Telecopier No. (303) 893-4851

FIRELINE CONNECTION WITH DOMESTIC SERVICE TEE

Scale: NONE Date: JULY 1995
Drawn: C.B.B. Tr: Ck: 
Approved: Dr. 127 No. 35

REVISED 5-2002 SHEET 34A
INSULATED JOINT

FIELD COAT WITH JOINT WRAP PER AWWA C206 TYPE II (ELASTOMERIC TAPE) MINIMUM 2 LAYER WRAP AS PER SPECIFICATION

ONE PIECE INSULATING SLEEVE & WASHER

INSULATING GASKET

OPTIONAL WASHER

NUT

FLANGED JOINT

STEEL WASHER (F436)

FLANGED JOINT

THREADING ROD

OPTIONAL WASHER

THREADED ROD

INSULATING ROD

FIELD COAT WITH JOINT WRAP PER AWWA C206 TYPE II (ELASTOMERIC TAPE) MINIMUM 2 LAYER WRAP AS PER SPECIFICATION

ONE PIECE INSULATING SLEEVE & WASHER

INSULATING GASKET

OPTIONAL WASHER

STEEL WASHER (F436)

NUT

INSULATED BOLTED SLEEVE TYPE COUPLING

BOLTED SLEEVE TYPE COUPLINGS (SEE MS-28)

RUBBER BOCT

INSULATED JOINTS, RODS AND BOLTED SLEEVE TYPE COUPLINGS

Scale: NONE

Date: JULY 1995

Drawn: C.B.B.

Tr: 

Ck: 

Approved:  Dr._ 127 No._ 35

REVISED 5-2002

SHEET 35
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 shall 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.
ADJUSTABLE SUPPORT
(STANDARD)

ADJUSTABLE SUPPORT
(HEAVY DUTY)
NOTES:
1. VENT PIPES TO BE LOCATED IN FIELD AT THE NEAREST INTERSECTION OF THE STREET PROPERTY LINE AND THE SIDE LOT LINE.
2. FOR RESIDENTIAL INSTALLATIONS SEE SHEET NO. 40.

VENT PIPE INSTALLATION

VENT PIPE AND BLACK IRON COUPLING DETAILS

DENVER WATER
1600 West 12th Avenue Denver, Colorado 80204
Phone (303) 803-6000 Telecopier No. (303) 893-6581

VENT PIPE INSTALLATION AND DETAILS

Scale: NONE Date: JULY 1995
Drawn: C.B.B. Tr. Ck.
Approved: Dr._127_No._35

REVISED 5-2002 SHEET 38
ELEVATION
SCREEN FOR 6" VENT PIPE

METAL SCREEN

DENVER WATER
1400 W. 12th Ave./Denver, Colorado 80204
Phone: 303/625-4000 Telex: 243853

6" DIAMETER VENT PIPE SCREEN
Scale: _NONE_ Date: JUNE 1995
Drawn: _C.B.B._ Tr: _ _ _ _ Ck: _ _ _ _
Approved: _ _ _ _ Dr: 127 No: 35

REVISED 5-2002 SHEET 39
6" VENT PIPE
CONCRETE PAD
20 GA. VENT BODY

BASE DETAIL

6" VENT BODY
3/4" x 3/4" x 3/4"
CONCRETE PAD

POP RIVETS

2 1/2" x 2 1/2" x 1/8" STEEL OR ALUMINUM ANGLE
(SEE DETAIL THIS SHEET)

GROUNDED LINE

6" VENT PIPE PVC SCHEDULE 40

ROUND VENT SCREEN

NOTE:
COLOR SHALL BE OLIVE GREEN OR FLAT BLACK TO MATCH SURROUNDINGS.

1/8" x 1" STEEL OR ALUMINUM
(3 REQUIRED)

RESIDENTIAL VENT ASSEMBLY

Scale: _NONE_ Date: JUNE 1995
Drawn: _C.B.B._ Tr: _Ck: _
Approved: _Dr._127_No._35_

REVISED 5-2002

SHEET 40
NOTES:

1. A RECTANGULAR VAULT IS REQUIRED WHERE TELEMETRY OR ELECTRICAL EQUIPMENT IS ANTICIPATED INSIDE THE VAULT.

2. ACCESS STAIRS WITH DOOR OUTSIDE OF PRECASTMENT MAY BE REQUIRED ON STREETS WITH HEAVY TRAFFIC.

3. FOR CROSS SECTION VIEW, SEE CROSS SECTION DWG. SHEET NO. 42.

4. DO NOT PLACE SUMP DIRECTLY UNDER MANHOLE.

5. THIS MANHOLE IS SUITABLE FOR CHECK VALVE INSTALLATIONS.


7. LADDER RUNGS ARE REQUIRED IN PRE-CAST MANHOLE. THE DISTANCE BETWEEN RUNGS, CLEATS, AND STEPS SHALL NOT EXCEED 12" AND SHALL BE UNIFORM THROUGHOUT THE LENGTH OF THE LADDER.

DENVER WATER
1600 West 126th Avenue, Denver, Colorado 80241
Phone: 303-893-2995-Telecopier No. 303-893-2991

PRESSURE REGULATING VALVE MANHOLE INSTALLATION TYPICAL PLAN

Scale: NONE Date: JULY 1995

Drawn: C.B.B. Tr: ___ Ck: ___

Approved: ___ Dr.: 127_No.: 35

REVISED 5-2002 SHEET 41
NOTE:
SEE SHEET 41 FOR PLAN
VIEW AND ADDITIONAL NOTES.
NOTES:
1. A RECTANGULAR VAULT IS REQUIRED WHERE TELEMETRY
   OR ELECTRICAL EQUIPMENT IS ANTICIPATED INSIDE
   THE VAULT.
2. ACCESS STAIRS WITH DOOR OUTSIDE OF PAVEMENT MAY
   BE REQUIRED ON STREETS WITH HEAVY TRAFFIC.
3. FOR CROSS SECTION VIEW, SEE CROSS SECTION DRAWING
   SHEET 44.
4. SUMP PUMP AND VENT FAN REQUIRED IN VAULTS WITH
   ELECTRICAL OR TELEMETRY EQUIPMENT.
5. THIS MANHOLE IS SUITABLE FOR CHECK VALVE
   INSTALLATIONS.
6. PIPING FOR PRV AND CHECK VALVE INSTALLATIONS
   SHALL BE D.I.
7. LADDER RUNGS ARE REQUIRED IN VAULT. THE DISTANCE
   BETWEEN RUNGS, CLEATS, AND STEPS SHALL NOT EXCEED
   12" AND SHALL BE UNIFORM THROUGHOUT THE LENGTH
   OF THE LADDER.
NOTES:

1. APPROVED PRECAST CONCRETE VAULTS:
   AMCOR CONC. INC., 10' x 10' x 7' 7080M, 7080-12.
   ADAMS CITY MDP-11' x 12' x 8' - 6", 7' x 12' - 6"

2. SEE SHEET 43 FOR PLAN VIEW AND ADDITIONAL NOTES.
NOTES:

1. PLACEMENT OF STOP BOX CAN VARY FROM A MAXIMUM OF 5 FEET OUTSIDE THE PROPERTY LINE TO A MAXIMUM OF 5 FEET INSIDE THE PROPERTY LINE. PLACEMENT OF THE STOP BOX OUTSIDE THE PROPERTY LINE IS PREFERRED.

2. OWNER'S RESPONSIBILITY FOR LEAK REPAIR SHALL BE UP TO AND INCLUDING THE TUBE NUT WHICH THREADS ONTO THE CURB STOP. OWNER'S RESPONSIBILITY FOR REPAIRS OTHER THAN LEAK REPAIR EXTENDS TO THE CORPORATION STOP.

3. DENVER WATER WILL REPAIR LEAKS ON SERVICE LINES WHEN NOTIFIED, FROM THE CORPORATION STOP TO CURB STOP.

SHOULD ANY SITUATION ArISE OTHER THAN SHOWN CONCERNING THE DEPTH OR OBSTRUCTION OF SERVICE LINE OR THE PLACEMENT OF METER PIT OR STOP BOX CALL FIELD INSPECTOR OR FIELD SUPERVISOR.
GENERAL NOTES:

1. FOR INSTALLATION IN ROADWAYS, DRIVEWAYS, SIDEWALKS, OR PARKING AREAS PRIOR APPROVAL REQUIRED. ROAD LID MAY BE REQUIRED.

2. NO CONCRETE FLOOR ALLOWED IN METER PIT.

3. ACCORDING TO SECTION 6.27, METER PIT SHALL BE CONSTRUCTED OF ANY COMBINATION OF CONCRETE RINGS TOTAL 48" IN LENGTH.

4. ADJUSTMENT RINGS OF APPROVED PLASTIC & CONCRETE SHALL BE 2", 3", 4", OR 6" IN HEIGHT AND SHALL BE INSERTED BETWEEN THE DOME AND TOP RING.

5. 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, EXCEPT WHEN NEEDED TO COMPLY WITH SECTION 6.15.

6. LAWN SPRINKLER CONNECTIONS SHALL BE A MINIMUM OF FIVE FEET FROM THE METER PIT WALL ON THE OUTLET SIDE.

7. ALTERNATIVE TO CONCRETE IS AN APPROVED ONE PIECE PLASTIC METER PIT.

8. METERS REQUIRE AN ELECTRONIC DIGITAL CODER OR MECHANICALLY ENCODED REGISTER WITH AN ITRON EXT MODEL 4991.

<table>
<thead>
<tr>
<th>METER SIZE</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
</tr>
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<tbody>
<tr>
<td>3/4&quot;</td>
<td>14</td>
<td>1/4</td>
<td>9</td>
<td>5/16</td>
</tr>
<tr>
<td>1&quot;</td>
<td>17</td>
<td>1/4</td>
<td>11</td>
<td>1/8</td>
</tr>
</tbody>
</table>

OUTSIDE SETTING FOR 3/4" & 1" METERS

Scale: _NONE_ Date: AUGUST 1995
Drawn: _C.B.B._ Tr: _ _ Ck: _ _
Approved: _ _ Dr: _127_ No: _35_

REvised 5-2002
NOTES:

1. PLACEMENT OF STOP BOX CAN VARY FROM A MAXIMUM OF 5 FEET OUTSIDE, THE PROPERTY LINE TO A MAXIMUM OF 5 FEET INSIDE THE PROPERTY LINE. PLACEMENT OF THE STOP BOX OUTSIDE THE PROPERTY LINE IS PREFERRED.

2. OWNER'S RESPONSIBILITY FOR LEAK REPAIR SHALL BE UP TO AND INCLUDING THE TUBE NUT WHICH THREADS ONTO THE CURB STOP. OWNER'S RESPONSIBILITY FOR REPAIRS OTHER THAN LEAK REPAIR EXTENDS TO THE CORPORATION STOP.

3. DENVER WATER WILL REPAIR LEAKS ON SERVICE LINES WHEN NOTIFIED, FROM THE CORPORATION STOP TO CURB STOP.

4. DENVER WATER IS NOT RESPONSIBLE FOR ANY DAMAGE THAT MAY OCCUR DUE TO A LEAK ON A SERVICE LINE. THIS IS THE RESPONSIBILITY OF THE OWNER OF THE PROPERTY TO WHICH THE SERVICE LINE IS CONNECTED.

DENVER WATER
1900 West 12th Avenue
Denver, Colorado 80204
Phone: (303) 837-5500
Fax: (303) 837-5515

SERVICE LINE, STOP BOX AND INSIDE METER INSTALLATION FOR 3/4" AND 1" METER

Scale: NONE Date: AUGUST 1995
Drawn: C.B.B. Tr: Ck:
Approved: Dr. 127 No. 35

REVISED 5-2002 SHEET 48
NOTES:

1. MANHOLE BASE BEAMS SHALL BE REQUIRED FOR INSTALLATIONS IN DRIVEWAYS, OR PARKING AREAS.

2. A 48" # MANHOLE PIT WILL ACCOMMODATE 1 1/2" AND 2" SPLIT CASE METERS.

3. JOINTS INSIDE METER VAULT SHALL BE EITHER THREADED OR SOLDERED WITH 95—5 TIN—LEAD SOLDER, IN ACCORDANCE WITH ASTM B33.

4. SEE DETAIL SHEET NO. 45 FOR ADDITIONAL NOTES.

5. NO CONCRETE TO BE LAI IN FLOOR OF METER MANHOLE.

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 OTHER THAN COPPER SETTER.

7. THE DISTANCE BETWEEN RINGS, CLEATS, AND STEPS SHALL NOT EXCEED 12 INCHES AND SHALL BE UNIFORM THROUGHOUT THE LENGTH OF THE LADDER.

8. VAULT WALL PENETRATIONS MUST BE GROUNDED WITH CONCRETE.

9. COPPER SETTER OR COPPER METER YOKE FOR 1 1/2" AND 2" WILL BE NO HIGHER THAN 12" WITH A BY-PASS AND BOOT FOR BY-PASS PROVIDED WITH SETTER.

10. 1 1/2" AND 2" REQUIRE AN ELECTRONIC DIGITAL ENCODER OR MECHANICALLY ENCODED REGISTER WITH AN ITRON ERT MODEL 400W-1

DETAILS:

1. CURB STOP
2. TYPE K COPPER TUBING
3. 12" COPPER SETTER / METER YOKE
4. METER UNIT
5. 3" NIPPLE BETWEEN COPPER SETTER AND CHECK VALE
6. 1" X 23" PIPE
7. MECH. IRON PIPE TO FLARE COUPLING FROM INLET SIDE OF COPPER SETTER AND OUTLET SIDE OF CHECK VALVE
8. BY-PASS WILL BE 1" FOR 1 1/2" COPPER SETTERS AND 1 1/2" OR 1 1/4" FOR 2" COPPER SETTERS.
9. CHECK VALVE (CHECK VALVES ARE NOT REQUIRED WHERE A BACKFLOW PREVENTION DEVICE IS INSTALLED.)
10. 48" CONCRETE MANHOLE WITH 24" LTD.
11. CONCRETE BLOCK SUPPORTS 4" X 4" X 24"
12. ELECTRIC CABLE TO ITRON ERT.

REVISED 5-2002
TAPPING SLEEVE AND TAPPING VALVE

2" TEMPORARY BLOW-OFF

VALVE WITH 2" TEMPORARY BLOW-OFF SHALL HAVE RESTRAINED JOINTS BACK TO TAPPING VALVE

TEE, ANCHOR COUPLING AND VALVE

2" TEMPORARY BLOW-OFF

PLUG WITH 2" TEMPORARY BLOW-OFF SHALL HAVE RESTRAINED JOINTS BACK TO VALVE

DENVER WATER
1800 East 12th Avenue, Denver, Colorado 80206
Phone (303) 330-5200 - Telecopier No. (303) 330-9841

STUB-OUT CONFIGURATIONS FOR FUTURE MAIN EXTENSIONS

Scale: NONE Date: AUGUST 1995
Drawn: C.B.B. Tr: _ _ _ _ Ck: _ _ _ _
Approved: _ _ _ _ Dr. 127 No. 35
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<td>15</td>
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5.21 LOCATION AND ALIGNMENT OF SERVICE
5.22 SERVICE STUB-INS TO PROPERTY LINE
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5.24 COMMERCIAL AND/OR INDUSTRIAL FACILITIES
5.25 INFILTRATION
5.26 RETAP CHARGE
5.27 SEWAGE LIFT STATIONS
1. General
2. Design Criteria

FIGURES
CHAPTER FIVE  STANDARDS AND SPECIFICATIONS
SANITARY SEWER

5.01 DESIGN CRITERIA

All extensions of and/or additions to the Town sewer systems will comply with the requirements of these Standards and Specifications for sewer main and service line construction. The requirements set forth in the latest edition of the Denver Wastewater Standards shall apply for information omitted in these Standards and Specifications. Any discrepancies shall be evaluated by the Town.

1. Design Flow

The design will include consideration of providing service for the entire area tributary to the outfall point. The following wastewater flow rates, which include infiltration, shall be used:

<table>
<thead>
<tr>
<th>User Type</th>
<th>Unit Wastewater Flow Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Residential Single Family – Detached</td>
<td>310 gallons/day</td>
</tr>
<tr>
<td>Residential Single Family – Attached</td>
<td>240 gallons/day</td>
</tr>
<tr>
<td>Residential Multifamily</td>
<td>210 gallons/day</td>
</tr>
<tr>
<td>Industrial</td>
<td>1,500 gallons/acre/day</td>
</tr>
<tr>
<td>Commercial</td>
<td>1,000 gallons/acre/day</td>
</tr>
<tr>
<td>Park/Recreation</td>
<td>50 gallons/acre/day</td>
</tr>
<tr>
<td>Elementary Schools</td>
<td>13 gallons/student/day</td>
</tr>
<tr>
<td>Jr. and Sr. High Schools</td>
<td>20 gallons/student/day</td>
</tr>
</tbody>
</table>

Household density and land usage shall be as noted on an approved PUD and/or Plat, or as determined by the Town Planner. One-hundred gallons per day per capita is assumed for residential usage.

Wastewater flow peaking factors shall be computed using the following equation:

\[
PF = \frac{3.8}{(ADF)^{0.17}}
\]

Where ADF = annual average daily flow in cfs.

The peaking factor will not be less than 2.5 or greater than 5. Infiltration shall be added to the peak flow at the rate of 500 gallons/acre/day.

2. Hydraulic Design

Sewers 12 in. in diameter and smaller shall carry the peak design flow at a maximum flow depth of 50% of the pipe diameter. Sewer mains larger than 12 in. in diameter shall carry the peak design flow at a maximum flow depth of 70% of the pipe diameter.

The minimum velocity at the peak design flow rate shall be 2.5 ft. per second. Where actual flow will be considerably below the design flow for several years, the
Town may require that the minimum velocity be attained by suitable grades at the partial peak design flow rate. Maximum allowable velocity shall not exceed 10 ft. per second at 80% peak flow depth in the pipe.

Care will be taken to design invert elevations at manholes in such a manner that the energy gradient is consistently falling in the direction of flow. In addition, when the velocity of an upstream sewer entering a manhole at peak flow is above critical velocity, the hydraulic gradient shall be computed to insure that a surcharge will not occur at a service connection, and that the energy gradient will remain level across the manhole.

3. Design Details

3.1 Sewer Mains

Gravity sanitary sewer mains will be 8 in. in diameter or larger. Any 6 in. sewer line installed will be considered a service line and will not be maintained by the Town. The following minimum grades (based on a Manning's formula n = 0.015) will apply:

<table>
<thead>
<tr>
<th>Sewer Diameter (Inches)</th>
<th>Minimum Grade (Percent)</th>
</tr>
</thead>
<tbody>
<tr>
<td>4</td>
<td>2.0 or 1/4in./ft.</td>
</tr>
<tr>
<td>6</td>
<td>1.0 or 1/8in./ft.</td>
</tr>
<tr>
<td>8</td>
<td>0.45</td>
</tr>
<tr>
<td>10</td>
<td>0.33</td>
</tr>
<tr>
<td>12</td>
<td>0.27</td>
</tr>
<tr>
<td>15</td>
<td>0.20</td>
</tr>
<tr>
<td>18</td>
<td>0.17</td>
</tr>
<tr>
<td>21 or larger</td>
<td>As approved by the Town</td>
</tr>
</tbody>
</table>

When approved by the Town for specific areas, a Manning’s formula of n = 0.011 may be used and the above grades adjusted accordingly to maintain a minimum velocity of 225 ft. per second.

Sewer mains will ordinarily have a minimum of 8 ft. of cover to finished ground surface. Where this will provide less than 9 ft. 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 ft. of cover, provisions will be made to protect the pipe from impact and loading.

Sewer mains will be extended at least 10 ft. 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. Six-inch sewer services shall require a manhole where they connect to the main. Service connections less than 6 in. in diameter will not be made at
manholes but will be provided above or below the manhole, as required, unless otherwise approved by the Town.

Manholes will be stubbed out with suitable size pipe wherever future extension of the sewer is anticipated.

3.2 Location Details

Unless approved otherwise by the Town, sanitary sewer mains will be located West or South of the center line of streets beneath asphalt pavement. A clear distance of 7 ft. minimum shall be maintained between sanitary sewer and storm sewer mains. A clear distance of 7 ft. minimum shall also be maintained between sanitary sewer and lip of gutter, unless approved otherwise by the Town. Service connections will not be permitted to cross an arterial street.

Where mains are installed in easements they will ordinarily be located in the center of the easement.

3.3 Relation to Water Mains

Sewer lines will be located a minimum of 10 ft., horizontally, from existing or proposed water mains (center line distance). Where sewer lines cross water mains, the sewer pipe will be a minimum of 18 in., clear distance, below the water main. If this clear distance is not feasible, the water main must be lowered to at least 18 in. below the sewer line. Any deviation from this crossing design must be approved by the Town Engineer.

In all cases, where utilities are crossing within 18 in. of one another, compacted squeegee or flowfill shall be provided to preclude settling and/or failure of the higher pipe. If a water main cannot be lowered below a sewer line, an alternative will be to install water quality pressure pipe for the sewer with joints 10 ft. minimum each side of the crossing.

4. Underdrain Pipe

Underdrain installations are not recommended and will require prior approval of the Town.

Should the Developer/Contractor 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. Any such system shall NOT be tied into the sanitary sewer or storm sewer collection systems but shall be required to discharge overland in any manner. Clean outs may not be installed within a sanitary sewer manhole and will NOT be maintained by the Town. Any
such system will require the approval of the Town and must meet all applicable portions of Sections of the Standards and Specifications.

5. General Provisions

All sanitary sewer main construction within the Town system and all service line construction connecting to the Town’s sewer mains will be completed in accordance with these Standards and Specifications and the accepted plans. These Standards and Specifications will cover new sanitary sewer service line construction and repairs to existing facilities within the town.

6. Maintenance of Traffic

When street cuts are required for sanitary sewer facilities construction, conditions will be met so as to avoid interference with traffic. A Traffic Control Plan (TCP) must be prepared in accordance with these Standards and Specifications and the Manual for Uniform Traffic control Devices (MUTCD) and submitted to the Town for approval prior to the commencement of construction.

5.02 UTILITY EXTENSION POLICY CONTRACTS

No water and/or sanitary sewer utility service shall be extended to anyone or any area until such area is annexed into the Town. To determine whether or not a property qualifies for sanitary sewer service, the property must lie within the current Town limits.

5.03 STREET CUTS

The removal of pavement, sidewalks, driveways, or curb and gutter shall be performed in a neat and workmanlike manner. Pavement mix design, thickness and replacement shall conform to the requirements of Chapter 2.

5.04 PROTECTION OF EXISTING FACILITIES

The Contractor shall notify the electric and gas utilities, telephone company, cable TV and all other interested parties prior to commencement of work and have their facilities staked and located in the field in order to ensure that there will not be interruptions or these services during progress of the Work. Existing power lines, telephone lines, trees, shrubbery, fences, water mains and services, gas mains, sewer mains and services, cables, conduits, drainage and irrigation ditches and pipes, embankments and other structures in the vicinity of the Work not authorized to be removed shall be supported and protected from injury by the Contractor during the construction and until completion of the Work affecting them. The Contractor shall preserve intact any underground pipes or other utilities encountered during construction. The Contractor shall be liable for all damage done to such existing facilities and structures as herein provided and he shall save the Town harmless from any liability or expense for injuries, damage or repairs to such facilities. The type, size, approximate location and number of all known underground
utilities shall be shown on all drawings. It shall be the responsibility of the Contractor to verify the existence and location of all underground utilities along the route of the Work. In the event that during construction it is determined that any underground utility conduit, including sewers, water mains, gas mains and drainage structures or any above ground utility facilities are required to be relocated, the Contractor shall notify the utility owner well in advance of his approach to such utility so that arrangements with the Town and/or owner of the affected utility can be made without delay to the Work. All relocations will be done at the Contractor’s expense and upon approval by the Engineer.

5.05 OUTAGES

In the event loss of service is necessary as determined by the Town Engineer, customers must be notified by the Contractor at least 24 hours in advance and provided further that the use of such services shall in no case be interrupted for more than 2 hours. Otherwise, a Town approved system capable of transferring all flows to a downstream section of the line shall be in place prior to work that may interrupt service. Outages for schools, medical clinics and various commercial businesses must be conducted at approved times as specified by the Town. Under all circumstances, work must be continuous until all customers are back in full service.

5.06 SAFETY

Machinery, equipment, materials and all hazards shall be guarded or eliminated in accordance with the “Manual of Accident Prevention in Construction” of the Associated General Contractors of America and all applicable Federal regulations, including OSHA (Occupational Safety and Health Act), State, County and municipal laws. No blasting shall be done without the approval of the Fire District Inspector and the Town. Safety equipment, devices, and clothing shall be utilized by personnel where required by Federal, State and local laws.

5.07 BONDING

Developers and/or Contractors will be required to post bond to the Town to provide protection against the following situations:

A. Repairs or work performed by the Town caused by the Contractor.
B. Repair or work by the Contractor.
C. Necessary repairs caused by installing defective material.
D. Necessary repairs caused by poor installation techniques.
E. Costs incurred by the Town due to the Contractor’s failure to perform in accordance with these Standards.
F. Maintenance shall be guaranteed for 1 year minimum.

5.08 ACCEPTANCE OF WORK

Water and sewer utilities shall be inspected throughout installation. All utility testing must be completed and accepted in writing by the Inspector prior to any paving.

Prior to any Building permits being issued, a punch list shall be formulated and sent to the Developer. Once this punch list has been completed and accepted, and as-built drawings for all utility lines and street improvements have been submitted to the Town, the one-year guarantee period shall begin. The Town shall send a letter to the Developer stating this. No water meters shall be installed prior to initiating the 1 year guarantee period.

Once the 1 year guarantee period begins the Developer shall be responsible for regular maintenance and repairs. The Town shall be informed in writing of all maintenance and repairs that have been performed.

Just prior to the end of the one year guarantee period, a second inspection and punch list shall be formulated and sent to the Contractor and Developer. The Developer shall also supply a TV inspection for all sewer mains prior to final acceptance. Upon completion of this punch list to the satisfaction of the Town, the Town shall then send a letter to the Developer stating the acceptance of responsibility for perpetual maintenance of the water and sewer utility lines by the Town. Any deviations from this format shall be supported in writing by the Director of Public Works.

Contractor shall warranty sewers beginning on the day of final acceptance by the Town. Once the one year guarantee period begins the Town shall be responsible for locating water and sewer utilities and for regular maintenance. Any repairs needed on any installations after the lines have been approved for utility service shall be performed by the Town Utility Maintenance Personnel or their authorized representative. The Contractor or Developer shall be invoiced for all work performed during the one year guarantee period. All payment for work performed shall be received by the Town Department of Public Works prior to the acceptance of responsibility for perpetual maintenance of the water and sanitary utility lines.

5.09 MATERIALS

The purpose of this Section of the Specifications is to set forth the general criteria to be used in the construction of sanitary sewer mains and appurtenances in the Town service area. Any deviation from these Standards must be supported in writing by the Town and approved by the Town.

All materials furnished shall be new and undamaged. All sanitary sewers shall be green in color in accordance with the latest version of the American Water Works Association Standards. Everything necessary to complete all installations shall be furnished and
installed whether shown on approved drawings or not and all installations shall be complete as fully operable.

Acceptance of materials or the waiving of inspection thereof shall in no way relieve the Developer of the responsibility for furnishing materials meeting the requirements of the Specifications.

The Town reserves the right to direct or deny use of certain types of materials in specific circumstances.

All materials delivered to the job site shall be adequately housed and protected as so to ensure the preservation of their quality and fitness for the Work.

1. Polyvinyl Chloride Pipe

All pipe materials and fittings buried less than 20 ft. shall meet extra strength minimum of SDR-35 of the requirements of ASTM D-3034 or latest revision thereof. Pipe buried over 20 ft. shall be SDR-26.

The bell shall consist of an integral wall section with a solid cross section rubber ring factory assembled, securely locked in place to prevent displacement. Standard laying lengths will be as supplied by manufacturer.

Pipe shall be subjected to drop impact test in accordance with ASTM D-2444.

All fittings and accessories shall be a manufactured and furnished by the pipe supplier or approved equal and have bell and/or spigot configurations compatible with that of the pipe.

Pipe stiffness for all pipe sizes shall be tested in accordance with ASTM D-2412, while joint tightness shall be tested in accordance with ASTM D-3212.

Installation shall be in accordance with Ring-Tite PVC Gravity Sewer Pipe Installation Guide TR-614A published by Johns-Manville.

If deflection limits exceed manufacturer's recommendations or Industry Standards, the Contractor shall be responsible for removing the existing pipe and installation of new pipe material under the direction of the Town.

The manufacturer shall furnish a certified statement that the inspection of all the specified tests have been made and the results thereof comply with the requirements of the applicable standard(s) herein specified. A copy of the certification shall be sent to the Town upon request.
2. Manholes

Manholes will be a minimum of 48 in. in diameter and will be provided at every change in direction or grade, or at a connection with another sewer main. Maximum spacing will be 400 ft. for lines 15 in. in diameter or smaller or 500 ft. for lines 18 in. or greater. Sewer lines will be straight and not curved between manholes, both in line and grade. Manholes shall provide an elevation drop of 0.1 ft. through straight reaches of pipe and 0.2 ft. of drop through bends in pipe reaches.

Manholes will be 48 in. in diameter for lines 8 in. to 15 in. in diameter; 60 in. for lines 18 in. to 21 in. in diameter, and 72 in. for lines 24 in. to 30 in. in diameter. Special designed vaults are required for pipes greater than 30 in. in diameter.

Manholes shall be constructed of precast concrete. Ring and cover shall be cast iron, 24 in. cover diameter, with a combined weight of not less than 400 pounds, similar and equal to the "Denver Heavy" pattern. Manhole covers shall have "Town of Lochbuie" cast into them shown in the standard details. Manhole steps shall be aluminum, Alcoa No. 12653B, as manufactured by the Aluminum Company of America or Copolymer polypropylene reinforced as manufactured by M. A. Industries, spaced 12 in. typical, 16 in. maximum on center, aligned away from invert. All cones shall be eccentric.

Precast manhole risers and cones shall be manufactured in accordance with ASTM Designation C-478.

Manhole rings and covers shall be 24 in. for 48 in. diameter manholes and 30 in. for 60 in. and 72 in. diameter manhole barrels.

Increase manhole barrel size whenever more than a two-way manhole of maximum pipe diameter is required.

The pre-forming flexible plastic joint sealing compound shall be “Ramnekk” as manufactured by K.T. Snyder Company or equal. The application of the priming compound and the sealing compound shall be accomplished in strict conformance with the manufacturer’s instruction as to the quantity of material, the grade of the materials and the application temperatures. This plastic joint compound shall be applied to all manhole joints.

The cone section shall not extend closer than 12 in. to the top of the manhole cover. Precast concrete adjustment rings (12 in. or less) shall be used on top of the cone to support and adjust the manhole from to the required final grade. The manhole barrels shall be watertight at all joints and riser sections. Manhole exteriors shall be coated with bituminous waterproof coating.
Flat top sections must be used when height from flow line to top of cover is 6 ft. or less on shallow lines where cone section is impractical to use or as specified by the Town.

Concrete bases shall be poured in place, Class “B” 4000 psi concrete, with a minimum thickness of 18 in. Manhole inverts shall be formed as indicated in the detail drawings, at the end of the Chapter, of these Specifications to ensure smooth flow through the manhole. Pipe must enter no more than 4 in. past manhole wall to a formed concrete invert. (See Standard Drawings)

Precast bases may be used when specifically authorized by the Town. Pipes extended through manholes and cut to form an invert are not acceptable without written permission from the Town.

For detail of sewer manholes refer to the Standard Drawings of these Specifications.

3. Drop Manholes

Inside drop manholes will be provided for a sewer entering a manhole at an elevation 24 in. or more above the manhole invert. Where the difference in elevation is less than 24 in., the invert will be filleted to prevent solids deposition. Outside drop manholes will not be allowed, except with written permission of the Town. Refer to Denver Wastewater Standards for Drop Manholes.

4. Concrete

CDOT Type II, 3/4”, Class “B” 3500 psi

5.10 MISCELLANEOUS

Where special conditions not covered by these Specifications exist, detailed drawings and specifications shall be submitted to the Town for approval work to begin. Written approval from an authorized representative of the Town Department of Public Works must be obtained before any materials other than those materials specified in the standard specifications may be employed in the construction of water and sewer lines connected to or made a part of the water and sewer system of the Town.

5.11 EXCAVATION

All excavation shall be made to the lines and grades as established by the approved drawings in open cut, through whatever material encountered. A typical trench section is shown at the end of this Section.

All areas shall be excavated in such a manner as will afford adequate drainage. Where material encountered within the limits of the work is considered unsuitable by the
inspector, such material shall be excavated below the grade shown on the drawings to a depth necessary to ensure a stable, firm foundation and refilled with approved backfill uniformly graded to provide a firm stabilized foundation. All excavated materials which are considered unsuitable and any surplus of excavated material shall be disposed of by the contractor.

All existing asphalt or concrete surfacing shall be cut vertically in a straight line as specified in Chapter 2, and removed from the job site prior to starting the trench excavation. This material shall not be used in any fill or backfill.

The trench shall be excavated so that a minimum clearance of 12 in. is maintained on each side of the pipe for proper placement and compaction of the bedding or backfill material.

Excavation in paved streets shall be confined to a minimum practical width. The pavement shall be saw cut as specified in Chapter 2. Any paving that is damaged by the contractor outside the above stated limits shall be replaced at the contractor’s expense.

The trench shall be adequately supported and the safety of workers provided for as required by the most recent standards adopted by the Occupational Safety and Health Act (OSHA).

If the inspector is of the opinion that at any point the trench walls are not properly supported, he may request the placement of additional supports by and at the expense of the contractor, compliance with such request shall not relieve or release the contractor from his responsibility for the safety of the work. The Town is not responsible for the safety of any party or parties involved in the construction of the utility project.

Trench excavation shall not advance more than 300 ft. ahead of pipe laying and backfilling work and shall be backfilled completely at the end of each workday. Excavation for structures shall be of such dimensions as to allow for the proper installation and to permit the construction of the necessary pipe connections.

5.12 POINT REPAIR

All point repairs on existing lines where rubber collar couplings are used will be encased in a concrete collar.

5.13 DEWATERING

All pipe trenches or structure excavation shall be kept free from all water during pipe laying and other related work. The methods of dewatering shall provide for a completely dry foundation at the final lines and grades of the excavation. All water shall be disposed of in a suitable manner without being a menace to public health or causing a public inconvenience. The dewatering operation shall continue until such time as it is safe to
allow the water table to rise in the excavations. Dewatering shall be maintained until pipe trenches contain enough backfill to prevent pipe floatation.

5.14 PIPE BEDDING

After completion of the trench excavation and proper preparation of the foundation, bell holes shall be dug deep enough to provide a minimum of 2 in. of clearance between the bell and the bedding material. All pipe shall be installed in such a manner as to ensure full support of the pipe barrel over its entire length. After the pipe is adjusted for line and grade and the joint is made, the bedding material shall be carefully placed and tamped under the haunches of the pipe up to spring line and in the previously dug bell holes.

Bedding material will follow the requirements in Chapter 2.

5.15 INSTALLATION OF PIPE

Pipe and fittings shall be loaded and unloaded by lifting so as to avoid shock or damage. PVC pipe shall be unloaded by means of nylon sling. Under no circumstances shall such material be dropped. Before the placing of pipe in the trench, each pipe or fitting shall be thoroughly cleaned of all foreign material, kept clean at all times and examined for cracks or defects before installation. Joint lubricant shall be as supplied by the pipe manufacturer.

Pipe shall be laid upstream with spigot ends pointing downstream. All pipe is to be placed true to line and grade with ends abutting, carefully centered and with a smooth invert at the joint. The joint shall be made in a workmanlike manner so as to be watertight.

Whenever the pipe is left unattended, temporary plugs shall be installed at all openings. Temporary plugs shall be watertight of such design as to prevent children and animals from entering the pipe. All temporary plugs shall be approved by the inspector.

No pipe or appurtenant structure shall be installed upon a foundation into which frost has penetrated or at any time when the inspector deems there is a danger of ice formation or frost penetration at the bottom of the excavation. No pipe or appurtenant structure shall be installed unless backfilling can be completed before the formation of ice and frost.

Immediately before joining 2 lengths of pipe, the inside of the bell, the outside of the spigot end and the gasket shall be thoroughly cleaned. Caution shall be exercised to ensure the correct type of gasket is used. A thin film of gasket lubricant shall be applied to either the inside face of the gasket or the spigot end of the pipe or both.

The spigot end of the pipe shall be placed in the socket with care to prevent the joint from contacting the ground. The joint shall be completed by pushing the pipe home with a slow, steady pressure. Stabbing shall not be permitted.
CHAPTER FIVE  STANDARDS AND SPECIFICATIONS  SANITARY SEWER  01-01-04

Under no circumstances should sewer mains be installed beneath any permanent concrete structures, such as sidewalks, driveways, curbs or gutters unless approved by the Town.

Sewers shall be laid in a straight line between manholes. No deflection will be allowed. All Sanitary Sewer services must be marked with “X” notch in curb face.

5.16 TRENCH BACKFILL

It is expected that the trench excavation will provide suitable backfill material. Wet, soft or frozen material, pieces of asphalt or concrete or other undesirable substances shall not be used for backfill. The backfill material shall be free from rubbish, stones larger than 5 in. in diameter, and frozen lumps of soil. If the excavated material is not suitable for backfill as determined by the inspector, suitable material shall be hauled in and utilized and the rejected material hauled away and disposed of.

Backfilling shall be conducted at all times in a manner to prevent damage to the pipe or its coating and shall be kept as close to the pipe laying operation as possible.

All backfill around structures shall be consolidated by mechanical tamping.

Backfill in areas where existing pavement is to be cut and replaced, unsuitable material excavated shall be removed from the site and the trench backfilled with gravel road base to finished or existing grade as specified in this Section. Excess material to be removed prior to surfacing.

- **Bedding Zone** shall consist of squeeze material placed below the pipe invert, 6 in. in depth minimum.

- **Pipe Zone** shall consist of squeeze material placed above the pipe invert to a minimum of 6 in. above the pipe.

- **Backfill Zone** shall consist of material above pipe zone.

- **Flowable Fill** may be substituted for Pipe Zone material when approved by the Town.
The bedding zone and pipe zone shall be backfilled with clean squeegee well graded meeting the following gradation:

<table>
<thead>
<tr>
<th>Sieve No.</th>
<th>Percent Passing</th>
</tr>
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<tbody>
<tr>
<td>3/8</td>
<td>100</td>
</tr>
<tr>
<td>4</td>
<td>95 – 100</td>
</tr>
<tr>
<td>8</td>
<td>80 – 100</td>
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<tr>
<td>30</td>
<td>25 – 60</td>
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<tr>
<td>50</td>
<td>10 – 30</td>
</tr>
<tr>
<td>200</td>
<td>0 – 5</td>
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5.17 TRENCH BACKFILL COMPACTION

Compaction shall be obtained by placing material in horizontal layers brought up uniformly within the trench and compacted throughout the depth of the trench. If material other than squeegee is used for backfilling around pipes, lift thickness shall not exceed 6 in. In the “Backfill Zone” above the “Pipe Zone”, lift thickness shall not exceed 12 in.

Trench backfill in the right-of-way shall be compacted to at least 97% of the maximum density and within plus or minus 3% of optimum moisture content as determined by the Standard Proctor ASTM 698D. Trench backfill in “Field” excavations shall be compacted to at least 95% of the maximum density and within plus or minus 3% of optimum moisture content as determined by the Standard Proctor ASTM 698D.

If, in the judgement of the Inspector, the trench shows signs of being improperly backfilled or if settlement occurs, the trenches will be reopened to a depth required for proper compaction, refilled and recompacted, all in accordance with these Specifications. If a special backfill material is encountered, the recommendation of a Geotechnical Engineer shall be required in order to attain the necessary trench compaction.

Compaction tests, taken by an independent commercial laboratory, shall be taken every 100 ft. or at the discretion of the Inspector. The Inspector shall pick the location and the depths at which all compaction tests will be taken. The Inspector shall be present when each test is taken and the results shall be forwarded to the Department of Public Works. The Contractor shall bear the costs of all compaction testing.

5.18 TRENCH MAINTENANCE

For a period of 1 year after completion of the work and final acceptance (1 year warranty period), the Contractor shall maintain and repair any trench settlement which may occur and shall make suitable repairs to any pipes, fittings, manholes, pavement, sidewalks or
other structures which may be damaged as a result of backfill settlement as determined by the Engineer.

5.19 TESTING

Alignment of sewer lines will be checked by sighting with the aid of lightsand pipes and shall be visibly straight. Sewers which are misaligned shall be rejected and the installer required to correct the alignment at his own expense.

Prior to construction acceptance of new sewer mains, a TV camera inspection shall be performed in accordance with Section 5.19.6. Lines shall be flushed by the Developer prior to the TV camera inspection and any obstructions which are found to be present shall be corrected. Contractor must use a Jet Rodder or other method approved by Town. An inspection for puddling shall be performed during the video review and all lines shall be free draining.

Should the Town find that the completed line or part thereof fails either on the lamping test or any other test so specified by the inspector, he may halt construction of any new sewer line until such time as previously place sewer line meet specifications. If the sewer line is completed, he will require that the contractor repair the line until it meets specifications before the line is released by the Town.

The following tests may be required to be performed at the contractor’s expense at the discretion of the Town.

1. Exfiltration Test

The exfiltration test shall be performed in the following manner using methods and materials approved by the inspector. After completing a reasonable length of sewer line, the downstream end of a manhole section shall be plugged and water introduced into the sewer from the upstream manhole to fill the entire line. After a reasonable waiting period to allow for all air to be expelled from the line, the rate of exfiltration shall be determined by measuring the depth of water in the upstream manhole and the time between depth measurements or pressure test. If the exfiltration rate exceeds the rate of 200 gallons per day per inch of pipe diameter per mile of pipe, the line shall be unacceptable and the contractor shall repair or replace all defective materials and/or workmanship at his additional cost to the Town.

2. Smoke Test

A smoke test may be required to determine the extent and location of exfiltration.
3. Infiltration Test

Visible leaks in manholes should be repaired or plugged regardless. Infiltration is the ground water that leaks through the walls of the sewer line or manhole and drains down from manhole. The infiltration rate shall be measured with a V-notch weir as manufactured by NB Products or an approved equal. Infiltration rates exceeding 200 gallons per day per inch of pipe diameter per mile of pipe, the line shall then be considered unacceptable and the contractor shall repair or replace all defective material and/or workmanship at no additional cost to the Town.

4. Deflection Test for Flexible Pipe

All sanitary sewers constructed of flexible pipe shall be deflection tested not less than 30 days after the trench backfill and compaction has been completed. The test shall be conducted by pulling a solid pointed mandrel with a diameter equal to 95% of the pipe diameter through the completed pipeline. Testing shall be conducted on a manhole to manhole basis and shall be done after the line has been completely flushed out with water.

5. Low Pressure Air Test per ASTM F 1417

This test shall be performed at 4.5 psi for 5 minutes with no more than 1/2 psi leakage. The contractor shall be responsible for supplying all water, plugs, compressors and other equipment, materials and labor to perform all acceptance testing.

6. TV Camera Testing

The Developer shall perform a mandatory TV Camera inspection of sanitary sewer mains, at his expense, prior to the construction acceptance by the Town. An additional video inspection shall be performed just prior to the end of the 1 year warranty period. The video tape shall be submitted to the Public Works Department.

7. Manhole Testing

Manholes will be vacuum tested at 10 psi for 1 minute with no more than 1/2 psi leakage.

5.20 SERVICE GENERAL INFORMATION

All sanitary sewer service line construction connecting to the Town sanitary sewer system shall be done in accordance with these Specifications. These Specifications shall cover all new sanitary sewer service line construction and repairs to existing lines from the sewer main to the property line or edge or utility easement. Any deviations from these Standards must be approved in writing by the Town.
5.21 LOCATION AND ALIGNMENT OF SERVICE LINES

Sanitary sewer service lines shall be constructed on the shortest and straightest route possible. At no time shall the service line by any closer than 5 ft. to the side property line and no service line may be constructed through or in front of any adjoining property. When possible the service line shall be near the high side of the lot and 5 ft. from the center line of the lot. Service lines are not to extend beneath driveways. Sewer and water service lines must be a minimum of 10 ft. apart horizontally or special protection will be required unless specifically approved by the Town.

5.22 SERVICE STUB-INS TO PROPERTY LINE

Service stub-ins shall be extended at least 10 ft. into property and shall be plugged with a watertight compression stop. Adjacent to the end of the service stub-in, a steel post painted green shall be placed in a vertical 1' below grade prior to backfilling. The contractor shall take measurements of distances from manholes to service taps and provide this information on as-built drawings. Service locations will also be marked with an “X” on the curb. Markings shall be stamped or chiseled, not painted.

5.23 CONNECTIONS

Where wyes have not been installed in the main sewer, the contractor shall excavate around the main and prepare the main for tapping. The main shall then be tapped by Town personnel or a duly authorized representative. The connection shall be watertight and at a 45° angle above the pipe horizontal center line. No projection of the sewer service pipe into the sewer main shall be permitted. Approved sewer service saddles shall be used to connect the service line to the sewer main. After Town personnel have completed the sewer tap, pipe laying and all other work shall be performed by the Contractor.

No aluminum saddles shall be permitted. Plastic saddles shall be strapped to the sewer main using 2 stainless steel bands. The inspector shall inspect the main and saddle at every tap prior to backfilling. In the event the tap is covered before it is inspected, it shall be dug out by the contractor and any concrete or mortar around the fitting shall be removed to allow visual inspection of the tap and the main. If the main sewer line is cracked or broken during the process of locating and tapping, it shall be repaired immediately by replacing the broken section. Lines in service must be machine tapped. Two taps on the same joint of pipe will not be permitted for existing Vitrified Clay pipe.

A manhole shall be installed instead of a service tap when a 6 in. or larger connection is to be made on all sewer lines. Service taps to existing manholes shall not be permitted, unless otherwise authorized by the Town.

Sewer mains shall be laid through manholes at the end of cul-de-sacs. One joint of pipe and plugged wyes shall be installed in order that the end of the cul-de-sac may be
serviced without tapping into the manhole. Refer to the Standard Drawings of these Specifications.

No more than 2 45° bends (90° total bend) shall be permitted in any sanitary sewer service line. Where service lines are longer than 100 ft., cleanouts will be required.

5.24 COMMERCIAL AND/OR INDUSTRIAL FACILITIES

A manhole may be required where so specified by the Town in order to have samples taken if industrial wastes are suspected. Such a manhole would be located on the commercial service line, so samples could be taken before such fluids could reach the sanitary sewer main line.

Any facility where the possibility exists that a foreign substance may be initiated into the sewer system will be required to install an approved pretreatment system. Sand and grease traps shall be required at any facility likely to introduce sand or grease products into the sewer system. Such facilities include car washes and restaurants. All installations shall be approved by the Town so that all substances introduced into the Lochbuie sewer system shall conform to all requirements of the Town Municipal code to install an approved pretreatment system.

5.25 INFILTRATION

The joints shall be made in a workmanlike manner so as to ensure a maximum infiltration of not more than 16 gallons per inch of diameter per hour per 100 ft.

Service lines to be abandoned shall be dug and plugged at the main with an approved watertight plug, unless otherwise specified.

5.26 RETAP CHARGE

Only one tap is allocated per single family residential structure. If the sanitary sewer main has been tapped once, and for any reason another service tap is required, a retap charge will be assessed prior to the retap, unless waived by the Town for good cause shown.

Contractors and/or Developers guilty of flagrant violations of the Standard Specifications as determined by the Town, shall be subject to revocation of bond and contractor’s license.
5.27 SEWAGE LIFT STATIONS

1. General

It is the policy of the Town to avoid lift stations at all costs. In those locations that cannot be served by gravity into the existing Town system, the Town may approve the construction of a sewage lift station. The sewage lift station, as determined by the Town, may be either a temporary or a permanent facility. The Developer must provide the Town with a complete set of design calculations and Mylar drawings for review and acceptance by the Town in compliance with Standards and Specifications. Design of lift stations shall be completed by and certified by a registered professional engineer. Documentation of the design shall be provided to the Town for review and acceptance.

The sewage lift station must satisfy all of the requirements of the Colorado Department of Public Health and the Environment (CDPHE), Denver Regional Council of Governments (DRCOG) and these Standards and Specifications. The Town will require that the Developer’s engineer prepare the “Application for Site Approval” for the submittal to the Colorado Department of Health and to prepare a set of “as built” drawings. Upon completion of the lift station, the Developer shall also provide the Town with 2 copies of an “Operation and Maintenance Manual” for the lift station. Approvals from all agencies must be in place prior to the Town accepting the lift station for service.

2. Design Criteria

2.1 Wet Well Construction

The wet well will consist of a cast-in-place reinforced concrete structure divided into 2 compartments. The 2 compartments will be interconnected with a valve or gate. The dual compartments will allow the draining of 1 compartment for cleaning or maintenance without affecting the operation of the station. A diversion box will be provided upstream of the wet well to allow the sewage lift station flows to be directed into either or both of the wet well compartments. A removable basket screen will be provided in the inflow into each wet well compartment to collect debris.

2.2 Pumps and Pump Stations

Pumps will either be vertical, close-coupled, vacuum primed, non-clog pumps installed directly above the wet well, or centrifugal pumps of an acceptable design installed in an above ground pump room adjacent to the wet well. Submersible pumps will not be allowed unless site conditions specifically warrant. The use of submersible pumps will require the written approval of the Town. The station will be designed utilizing a minimum of 2 pumps and shall be capable of pumping the peak design flow with one pump out of service. All pump equipment will be manufactured and supplied by the same company.
The Station will be an above ground structure sized to accommodate all of the other pumps, electrical equipment and controls required to operate the facility.

The Station will be lighted, heated and well ventilated, and will be designed for easy expansion if required by the Town. The architectural finish of the station will blend with that of the surrounding architecture as much as possible.

A STANDBY GENERATOR, CAPABLE OF OPERATING THE ENTIRE STATION IN ALL OPERATION MODES FOR A MINIMUM OF 8 HOURS, SHALL BE PROVIDED AND SHALL BE LOCATED OUTSIDE OF THE BUILDING IN AN ALL WEATHER ENCLOSURE.

2.3 Controls and Telemetry

Pump operation will feature automatic sequencing of the pump operation to balance pump wear. Pumps will be controlled by predetermined wet well levels measured by mercury float switches.

A radio telemetry system will be incorporated into the system to automatically contact the Town in case of an emergency. The telemetry system will be equipped with several channels so it will be capable of differentiating between a variety of emergency conditions including high and low wet well level, pump failures and power failure. The telemetry system shall be compatible with the Town’s system and will be reviewed and accepted by the Town prior to installation.

The controls, telemetry equipment, miscellaneous electrical equipment and automatic power switch will be installed in a control room located on the above ground floor of the pump station.

2.4 Site Improvements

A 6 ft. high fence as approved by the Town will be installed around the perimeter of the sewage lift station site. Upon completion of the lift station construction, all disturbed areas within the site will be fertilized, seeded and mulched in accordance with these Standards and Specifications.

Depending on site location, landscaping improvements may be required by the Town.
WATER AND SANITARY SEWER MUST BE SEPARATED BY 10' MINIMUM DISTANCE.

UTILITIES MUST BE LOCATED A MINIMUM OF 7' FROM LIP OF GUTTER PAN.
Service locations may vary to meet various house configurations.

Water service shall be placed on the down hillside of sanitary sewer service and with 10' min. separation.

No more than two 1/8 bends (90° total) shall be permitted in any sanitary sewer service.

There shall be at least 10' separation between water meter pits.

Services shall enter lots at a perpendicular angle from the mains except in cul-de-sacs.

Place "V" on the curb face to mark water service locations and place a "X" on the curb face to mark sanitary sewer service locations.
Typical Notes:
1. LIGHTLY BRUSH FINISH BENCHES.
2. SMOOTH TROWEL, OPEN GUTTER.
3. CENTER MANHOLE BASE AT PIPE CENTERLINE INTERSECTION.
4. SLOPE BENCHES APPROXIMATELY 1/2" PER FOOT.

Slight Angle
θ ≤ 15°
0° ≤ θ ≤ 20°

Intermediate Angle
θ = 45°
30° < θ < 90°

Sharp Angle
θ = 45°
0° ≤ θ ≤ 90°

Angled Laterals

Opposed Laterals

Pipe Size Barrel Size
8" to 15" 48"
18" to 21" 60"
24" to 30" 72"

TOWN OF LOCHBUIE
PUBLIC WORKS

TYPICAL SANITARY SEWER MANHOLE DETAIL PLAN

DRAWING NUMBER
5.04
8" HIGH-400LB. CAST IRON RING AND COVER
H2O LOAD RATING "CITY OF BRIGHTON SEWER" ON COVER

RING AND LID PARRELL AND FLUSH OR ½" BELOW STREET GRADE

PRECAST GRADE RINGS

BITUMINOUS COATING TO BE PROVIDED ON OUTSIDE OF MANHOLE PRIOR TO BACKFILLING

PREFORMED JOINT GASKET FULLY BED SHIPLAP JOINTS

FULLY BED BASE JOINT WITH PREFORMED JOINT GASKET MATERIAL

GROUT EXTERIOR OF BASE JOINT

¾ PIPE DIA

12"

 underwent a gravity flow.

INSTALL PIPE BELL WITHIN 12" MAX OF MANHOLE BARRELL

CAST-IN-PLACE CONCRETE BASE WITH NO. 4 BARS AT 12" CTC EACH WAY

BED MANHOLE BASE WITH ¾" CRUSHED ROCK OR ASTM GRADATION NO. 67

0.1' ELEVATION DROP REQUIRED THROUGH MANHOLE WITH NO DIRECTION CHANGE

0.2' ELEVATION DROP REQUIRED THROUGH MANHOLE WITH DIRECTION CHANGE
NOTES:
1. RING & COVER-SET TO PARALLEL FINISHED GRADE.
2. RING & COVER GRADE ADJUSTMENT-PRECAST RINGS OR BRICK LEVELING COURSE.
3. PRECAST ECCENTRIC CONE
4. PRECAST BARREL RISER SECTION WITH STEPS.
5. FOR PVC & ABS COMPOSITE PIPE, USE EXPANDABLE WATER STOP OR SPECIAL SLEEVE PER MANUFACTURERS SPECIFICATIONS.
6. JOINT SEALANT RUBBERNECK
7. BASES CAST IN PLACE CONCRETE.

SECTION A

STANDARD MANHOLE

N.T.S.
NOTES:
1. RING & COVER-SET TO PARALLEL FINISHED SURFACE.
2. RING & COVER GRADE ADJUSTMENT-PRECAST RINGS OR BRICK LEVELING COURSE.
3. PRECAST MANHOLE RISER SECTION WITH STEPS.
4. FOR PVC & ABS COMPOSITE PIPE, USE EXPANDABLE WATER STOP OR SPECIAL SLEEVE PER MANUFACTURERS SPECIFICATIONS.
5. JOINT SEALANT RUBBERNECK
6. BASES CAST IN PLACE CONCRETE.
7. REINFORCED CONCRETE TIP

SECTION A

SHALLOW MANHOLE
N.T.S.
NOTES:
1. RING & COVER—SET TO PARALLEL FINISHED SURFACE.
2. RING & COVER GRADE ADJUSTMENT—PRECAST RINGS OR BRICK LEVELING COURSE.
3. PRECAST ECCENTRIC CONE
4. PRECAST MANHOLE RISER SECTION WITH STEPS.
5. FOR PVC & ABS COMPOSITE PIPE, USE EXPANDABLE WATER STOP OR SPECIAL SLEEVE PER MANUFACTURERS SPECIFICATIONS.
6. JOINT SEALANT, RUBBERNECK
7. BASES CAST IN PLACE CONCRETE.
8. BACKFILL WITH GRAVEL OR CONCRETE.

HOLE THRU WALL TO BE 1" LARGER THAN O.D. OF PIPE, FILL WITH GROUT REVERSE 60° WYE 4'-0" LONG

SECTION A
DROP MANHOLE
N.T.S.
CAST IRON 24" MANHOLE, RING AND COVER
N.T.S.
NOTES:
1. SCREW TYPE VALVE BOX TOP AND COVER.
2. SAND
3. 4" PVC PIPE
4. 4- 22 1/2" ELBOWS
5. BACKFILL & COMPACT TO SPECIFICATIONS
6. BELL TYPE PLUG
7. WYE WITH 45° ELBOW (ALL BELL FITTINGS)
8. SEWER LINE, SEE PLAN FOR SIZE
9. END 4" PVC 3" FROM FINISH GRADE

FINISH GRADE

SEWER CLEAN-OUT DETAIL
N.T.S.
NOTES:
1. SCREW TYPE VALVE BOX TOP AND COVER.
2. SAND
3. 4" PVC PIPE
4. 2-22 1/2' ELBOWS
5. BACKFILL & COMPACT TO SPECIFICATIONS
6. WYE WITH 45° ELBOW (ALL BELL FITTINGS)
7. SEWER LINE, SEE PLAN FOR SIZE
8. END 4" PVC 3" FROM FINISH GRADE

SEWER CLEAN-OUT DETAIL
N.T.S.
NOTES:
1. 22 1/2' LONG RADIUS BEND
2. SEWER LINE
3. FOR SEWER SERVICE TAPS TO EXISTING LINES USE A 45° WYE SADDLE.
4. "PERMA-JOINT STOP OR EQUAL. 6" STEEL FENCE POST AT END OF LINE TO
   2'-0" ABOVE GROUND.
5. 1'-0" OR AS STAKED.
6. SERVICE LINE. SEE SPECIFICATIONS. GRADE 1/4" DROP PER FOOT.
7. CENTER OF WYE BRANCH TO BE PLACED IN UPPER THIRD OF SEWER MAIN.

SECTION A-A

SEWER SERVICE CONNECTION
N.T.S.
INSTALL 2 STEEL HOOKS FOR HOLDING CHAINS WHICH WILL HOIST PUMPS TO ACCESS OPENING

CAST-IN-PLACE CONCRETE BASE

LIFTING CHAINS

INSTALL BILCO MODEL #U-3AL ACCESS HATCH OR EQUAL 2'-6"x3'-6"

JUNCTION BOX

4" VENT PIPE W/ #15 MESH SCREEN

4" INVERT OUT

ECCENTRIC PLUG VALVE (TYP.)

4" CHECK VALVE (TYP.) SWING TYPE, LEVER & SPRING OPERATED

6" PVC INFLOW LINE BAFFLED INLET

6' DIA. REINFORCED PRECAST CONCRETE WETWELL WITH H2O LOADING

3"x4" REDUCER (TYP.)

12"

GROUT FILLET (TYP.)

SLOPE FLOOR 1/2"/FT TO CENTER

SECTION A-A

LIFT STATION

NTS
TYPICAL TRENCH PATCH SECTION
N.T.S.

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<td>2'-6&quot;</td>
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4" SQUARE LUMBER, PRESSURE TREATED W/WATERBARNE PRESERVATIVE IN ACCORDANCE W/AWPACZ & AWPB LP-22

LINE SIZE
PIPE MATERIAL
DISTANCE TO MANHOLE

NOTE: IDENTIFICATION MARKS SHALL BE 3" CIRCLES BROKEN IN VERTICAL CENTER FACING MANHOLE W/1" LETTERING INSIDE

CONCRETE
UNDISTURBED SOIL

MANHOLE MARKER POST
N.T.S.
# Table of Contents

## Chapter Six

**Standards and Specifications**

**Erosion and Sediment Control**

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6.01 SEEDING

Check weights, seed species, and purities prior to planting the seed. Prior to permanent seeding, prepare soil and, if required, incorporate topsoil, amendments, and fertilizer. Perform all drill seeding operations at right angles to the slope. Seeded areas should be inspected frequently. Areas with failures must be repaired and reseeded.

6.02 MULCHING

Hay should consist of native grasses free of noxious weed seeds (certified weed-free hay or straw may be required in designated areas of the State). Straw should consist of clean cereal shafts. Tackifiers (for anchoring) should consist of a free flowing non-corrosive powder. This material shall not contain any mineral filler, recycled cellulose fiber, clays, or other substances which may inhibit germination or growth of plants.

Hay and straw mulch should be spread at a rate of 3.7 to 4.9 tons per hectare (1.5 to 2 tons per acre). A minimum, 50% of the mulch, by weight, should be 250 mm (10 in.) or more in length. Applied mulch depth should not be less than 25 mm (1 in.) and not more than 50 mm (2 in.). The mulch should be uniformly applied so that no more than 10% of the soil surface is exposed.

Hay and straw mulch should be anchored to the soil surface using tackifiers, blankets, or nets, or with a mulching crimping machine. Mechanical anchoring, or crimping, is preferred and recommended for slopes flatter than 2:1. Tackifiers (for anchoring) shall be applied in a slurry with water and wood fiber (45 kgs (100 lbs) of powder and 68 kgs (150 lbs) of fiber per 2650 lts (700 gal) of water). Application rate of the powder should be between 90 to 336 kgs per hectare (80 to 200 lbs per acre).

Mulch should be applied immediately after seeding. Inspect frequently and reapply mulch when necessary.

6.03 SODDING

Sod shall be nursery grown and 99% weed free. Soil thickness of sod cuts shall not be less than 20 mm (3/4 in.) nor more than 25 mm (1 in.). Cut sod in uniform strips with minimum dimensions of 0.45 m (18 in.) in width and 1.2 m (48 in.) in length. Sod shall not be excessively dry or wet. Transplant sod within a period of 24 hours.

During high temperatures, lightly irrigate the soil prior to laying the sod. Sod should be laid over soil with smooth grades and previously prepared and fertilized.

Sod must be laid on straight lines with joints staggered, parallel to and tightly wedged against each other. On sloping areas, lay sod with the long edges parallel to the contour. Secure the sod by rolling, tamping and pegging, or other approved method. After completing sodding on one section, roll or tamp the entire section and water the sod. The laying, rolling and irrigating for any piece of sod shall be completed within 8 hours.
In the absence of rainfall, watering shall be performed daily during the first week after installation. Soil must be maintained moist to a depth of 100 mm (4 in.). Do not attempt mowing until sod is firmly rooted. Grass height shall be between 50 to 76 mm (2 – 3 in.).

6.04 EROSION CONTROL BLANKETS

Properly prepare, fertilize, and seed areas where the blanket is to be used. In ditches and on slopes, blankets shall be unrolled in the direction of the flow of water. Place the blanket smoothly but loosely on the soil surface without stretching.

Bury the upslope end of the blanket in a trench 150 mm (6 in.) wide by trench 150 mm (6 in.) deep beyond the crest of the slope to avoid undercutting. For slope applications, there shall be at least a trench 150 mm (6 in.) overlap wherever one roll of blanket ends and another begins, with the uphill blanket placed on top of the downhill blanket. There shall be at least a 100 mm (4 in.) overlap wherever two widths of blanket are applied side by side.

In channels, bury the blanket at terminal ends and every 10 m (35 ft.) in trench 150 mm (6 in.) deep by 100 mm (4 in.) side (check slots). Before backfilling, place staples across the width of the trench spaced at 150 mm (6 in.) on center in a zigzag pattern. The trench shall then be backfilled to grade and compacted by foot tamping.

Pins and staples shall be made of wire 4.2 mm (0.162 in.) or larger in diameter. “U” shaped staples shall have legs 200 mm (8 in.) long, and a 25 mm (1 in.) crown. “T” shaped pins shall have a minimum length of 200 mm (8 in.). The bar of the “T” shall be at least 100 mm (4 in.) long. Triangular survey stakes can also be used. Insert staples in a pattern according to the manufacturer’s recommendation. Re-anchor loosened matting and replace missing matting and staples are required.

6.05 SURFACE ROUGHENING

Horizontal depressions must be created approximately 50 mm (2 in.) to 100 mm (4 in.) deep, and spaced 100 mm (4 in.) to 150 mm (6 in.) apart. Use stair-step grading, grooving or tracking. Roughening of ridges and depressions should follow along the contours of the slope. Use machinery to create a series of ridges and depressions which run perpendicular to the slope (on the contour). Operate the machinery up and down the slope to leave horizontal depressions in the soil. As few passes as possible should be made to minimize compaction.

Seed and mulch roughened areas as soon as possible. Do not drive vehicles or equipment over areas that have been roughened.
6.06 EROSION BALE

The erosion bale barrier must be entrenched, anchored and backfilled. A trench should be excavated the width of a bale and the length of the proposed barrier to a minimum depth of 100 mm (4 in.). After the bales are staked, the excavated soil must be backfilled against the barrier. Backfilled soil should conform to the ground level on the downhill side and should be built up to 100 mm (4 in.) against the uphill side of the barrier.

Each bale must be securely anchored by at least two wood stakes driven toward the previously laid bale to force the bales together. Stakes should be driven 0.3 m (1 ft.) minimum into the ground. Stakes should have a minimum diameter or cross section of 50 mm (2 in.). Re-bars shall not be used in place of the wood stake.

All bales must be either wire-bound or string-tied. Fill gaps between bales by wedging with straw. Along toe fills, install the erosion bales along a level contour and leave enough area behind the barrier for runoff to pond and sediment to settle. A minimum of 1.5 m (5 ft.) away from the fill toe recommended. Inspect frequently during construction. Repair or replacement should be made promptly as needed.

Remove sediment accumulated against the erosion bale barrier when it reaches half the exposed barrier height. Remove bales after they have served their usefulness. Trenches where erosion bales were located should be graded and stabilized.

Channel Flow Application

The maximum spacing between barriers should be such that the toe of the upstream barrier is at the same elevation as the top of the downstream barrier. Place bales in rows, lengthwise, oriented perpendicular to the contour, with ends of adjacent bales tightly abutting one another.

6.07 SILT FENCE

The filter fabric shall conform to the requirement described in Section 4.20 of CDOT’s Standard Specifications for Road and Bridge Construction. Minimum filter fabric height shall be 0.9 m (36 in.). The use of joints should be minimized. Posts for silt fences shall be metal or hard wood with a minimum length of 1.05 m (42 in.). Wood posts shall have a minimum diameter or cross section of 50 mm (2 in.). Metal posts shall be “studded tee” or “U” type with minimum weight of 1.98 kgs/m (1.33 lbs/ft), and they shall be protected against corrosion.

Drive posts vertically into the ground to a minimum depth of 0.45 m (18 in.) and excavate a trench approximately 0.15 m (6 in.) wide and a 0.15 m (6 in.) deep along the line of posts and upslope from the barrier. Not less than the bottom 0.3 m (1 ft.) of the fabric shall be buried into this trench. The trench shall be backfilled and the soil compacted.
When joints are necessary, filter cloth shall be spliced together only at a support post and securely sealed. The filter materials shall be fastened securely to metal or wood posts using wire ties, or to the wood posts with 20 mm (3/4 in.) long #9 heavy duty staples. The filter fabric shall not be stapled to existing trees.

Posts shall be spaced a maximum of 3 m (10 ft.) apart. For channel flow applications, the posts shall be spaced a maximum of 0.9 m (3 ft.) apart. Silt fences installed across a ditch line or swale must have the bottom of the end fence at a higher elevation than the top of the fence at the center of the ditch. The maximum spacing between the silt fence barriers must be such that the toe of the upstream silt fence barrier is at the same elevation as the top of the downstream silt fence barrier.

When used, wire fence reinforcement of the filter fabric should be a minimum of 0.9 m (36 in.) in height, and a minimum of 14 gauge with a maximum mesh spacing of 0.15 m (6 in.). The wire mesh support fence shall be fastened securely to the upslope side of the posts using heavy duty wire staples at least 20 mm (3/4 in.) long, tie wires or hog rings. The wire shall extend into the trench a minimum of 50 mm (2 in.) and shall not extend more than 0.9 m (36 in.) above the original ground surface.

Along the toe of fills, install the silt fence along a level contour and provide area behind the fence for runoff to pond and sediment to settle. A minimum of 1.5 m (5 ft.) away from the toe of the fill is recommended. The height of the silt fence from the ground surface shall be a minimum 0.6 m (24 in.) and shall not exceed 0.9 m (36 in.).

Silt fences shall be periodically maintained. Remove sediment accumulated behind the silt fence when it has reached half the exposed fabric height. Damaged silt fence should be promptly repaired. Remove silt fences after they have served their usefulness.

6.08 BERM/DIVERSION

Berms shall have a minimum height of 450 mm (18 in.), side slopes of 1.5:1 or flatter, and a minimum base width of 1.4 m (4.5 ft). The minimum freeboard shall be 150 mm (6 in.). Berms and divisions should be constructed of compacted soil or coarse aggregate.

All berms shall have an uninterrupted positive grade to a stabilized outlet. Division channels shall be excavated or shaped to line, grade, and cross section as indicated in the plans and as required to meet the criteria specified. Berms and division channels should be stabilized within 14 days of their construction. Inspect periodically and after each rain event. Remove sediments accumulated against the berm.

6.09 SLOPE DRAIN
The slope drain shall consist of heavy duty material designed and suitable for the purpose. Slope drain sections shall be securely fastened together, have watertight fittings, and be securely anchored to the slope. Minimum pipe size for slope drains shall be 300 mm (12 in.). Height of berm at the inlet of the pipe shall be at least 150 mm (6 in.) higher than the pipe diameter measured from the invert of the pipe. Soil around and under the entrance section shall be compacted in 200 mm (8 in.) lifts.

The inlet and outlet of the drain shall be protected to prevent erosion. A pipe end section with a short section of pipe through a berm creates the most satisfactory inlet. A geotextile may also be used. The filter cloth shall extend 1.5 m (5 ft.) in front of the inlet and be keyed in 150 mm (6 in.) on all sides. Rock is recommended at the outlet. Do not use erosion bales at the outlet. Inspect periodically and execute immediately any required repairs or maintenance.

6.10 STORM DRAIN INLET PROTECTION

Construct as indicated below. Inspect storm drain inlet protection structures periodically and after each rain event, repair when necessary, and remove accumulated sediment. Remove the inlet protection structures after they have served their useful purpose.

Drop inlet erosion bale filter

Construct a barrier around the storm drain inlet using erosion bales. Silt fence can be used in lieu of erosion bales. Use only if the area adjacent to the inlet consists of soil. Do not install on top of pavement.

Drop inlet block and gravel filter

Construct according to Figure 11 using concrete blocks, 12 mm (1/2 in.) wire screen, and 38 mm (1.5 in.) maximum size gravel.

Drop inlet gravel and wire mesh filter

Construct according to Figure 12 using 12 mm (1/2 in.) wire screen, and 38 mm (1.5 in.) maximum size gravel.

Excavated drop inlet sediment trap

Construct according to Figure 13.

Curb inlet block and gravel filter

Use on pavement or bare ground. Construct according to Figure 14 using concrete blocks and a 50 x 100 mm (2 in. x 4 in.) wood stud for support, 12 mm (1/2 in.) wire screen, and 38 mm (1.5 in.) maximum size gravel.

Curb inlet gravel and wire mesh filter
CHAPTER SIX  STANDARDS AND SPECIFICATIONS  EROSION AND SEDIMENT CONTROL

Construct according to Figure 15 using 12 mm (1/2 in.) wire screen, and 38 mm (1.5 in.) maximum size gravel. Use only where ponding in front of the structure is not likely to cause inconvenience or damage to adjacent structures and unprotected areas.

Culvert erosion bale inlet protection
Construct using erosion bales according to Figure 16.

6.11 CHECK DAMS

Standard check dams are 600 mm (2 ft.) high with 2:1 side slopes and a weir section at the center of the dam at least 150 mm (6 in.) lower than the outer edges. The maximum height of the check dam at the center should not exceed 600 mm (2 ft.) of 1/2 the depth of the ditch or swale.

As a rule of thumb, the maximum spacing between dams should be such that the toe of the upstream dam is at the same elevation as the top of the downstream dam. Check dams should be constructed of 100 to 150 mm (4 to 6 in.) stone.

The flow across the check dam must remain concentrated near the center, therefore the ends of the dam must be well above the center. Remove sediment accumulated from behind the check dam when it has reached half the original dam height. Temporary check dams should be removed when their useful life has been completed.

6.12 OUTLET PROTECTION

Grade of apron shall be 0.0%. The apron shall be located so as to avoid bends in the horizontal alignment. The apron may be lined with riprap, grouted riprap, concrete or gabion baskets. Gradation, quality and placement of riprap shall conform to Section 506 of CDOT’s Standard Specifications for Road and Bridge Construction.

Stone shall be placed homogeneously and to the full course thickness in one operation; displacement of underlying materials shall be avoided. A geotextile, or a granular filter should always be included and placed between the riprap and the underlying soil. The geotextile material to be used shall conform to Section 420 of CDOT’s Standard Specifications for Road and Bridge Construction. The geotextile shall be protected from punching, cutting or tearing. Overlaps between 2 pieces of geotextile shall be minimum 0.3 m (1 ft.).

See details for a rock outlet protection example. Inspection shall be performed after high flows for scour and dislodged stones. Repairs shall be made immediately.

6.13 CHANNEL STABILIZATION (OR CHANNEL LINING)
Channel side slopes shall be 2:1 or flatter in the case of rock riprap lining. Vegetated channel side slopes shall be 4:1 or flatter. Materials for rigid linings include concrete, stone masonry, pave stone, soil cement or grouted riprap. For flexible linings, typical materials include vegetation, soil retention blankets, gravel or riprap. All unsuitable material, such as trees, brush, roots or other obstructions shall be removed prior to installation.

The channel shall be shaped to proper grade and cross section, as shown in the plans, with no abrupt deviations from design grade or horizontal alignment. When using riprap as a liner, a filter blanket of one or more layers of granular filter, or a geotextile, should be placed before placing the riprap. The thickness and gradation of the granular filter, or specifications for the geotextile, should be included in the plans. Lining shall be maintained.

6.14 SEDIMENT TRAP

Traps should be located at points of discharge from disturbed areas. Traps should not be located closer than 6 m (20 ft.) from a proposed building foundation or highway alignment. A rectangular and shallow trap, with a length to width ratio of 2:1 or greater is recommended. Maximum embankment height shall be 1.5 m (5 ft.) measured on the downstream side. The minimum top embankment width shall be 1.2 m (4 ft.). Side slopes for the embankment and the excavated areas shall be 2:1 or flatter.

The outlet structure shall consist of a stone section in the embankment formed by a combination coarse aggregate/rip rap to provide for filtering/detention capability. Riprap shall be 100 to 200 mm (4 to 8 in.) rock while the coarse aggregate shall be 12 to 18 mm (1/2 to 3/4 in.). The outlet crest shall be at least 300 mm (1 ft) below the top of the embankment. The minimum outlet length in meters (feet) shall be 1.1 (1.5) times the contributing drainage area to the trap.

Sediment traps, along with other perimeter controls, shall be installed before any land disturbance takes place in the drainage area. A geotextile can be placed at the stone-soil interface to act as a separator. Sediment shall be removed from the trap when the wet storage volume is reduced by 1/2. Outlet structure should be regularly inspected; rocks clogged with sediments shall be cleaned or replaced.

6.15 SEDIMENT BASIN

The basin shall be long and narrow with a length to width ratio of 2:1 or greater. Appropriate basin shape may be attained by properly selecting the site of the basin, by excavation, or by the use of baffles. If the 2:1 ratio cannot be achieved, baffles should be placed halfway between the inflow point and the outflow. Figure 20 shows recommended baffle locations.
CHAPTER SIX  STANDARDS AND SPECIFICATIONS  EROSION AND SEDIMENT CONTROL

A plywood (or equivalent) fence can be used for the baffle. Posts for this fence should be buried at least 0.9 m (3 ft.) into the ground. The fence should be at least 1.2 m (4 ft.) high. In large basins, CDOT Type IV concrete barriers can be used as baffles.

Maximum embankment height shall be 4.5 m (15 ft.). For embankment heights of 3 m (10 ft.) or less, the minimum top width shall be 2.4 m (8 ft.) and the side slopes shall be 2:1 or flatter. For embankment heights greater than 3 m (10 ft.), the minimum top width shall be 3 m (10 ft.) and the side slopes shall be 2:5:1 or flatter.

The crest of the principal outlet shall be set at an elevation at least 300 mm (1 ft.) below the crest of the emergency spillway. Minimum bottom width of the emergency spillway shall be 2.4 m (8 ft.). The emergency spillway shall be located so as to avoid sharp turns or ends, and it shall return the flow of water to a defined channel downstream from the embankment.

Design elevations, widths, entrance and exit channel slopes are critical to the successful operation of the spillway and must be constructed within a tolerance of +/- 60 mm (2.4 in.). The emergency spillway shall be constructed on undisturbed ground.

For earth-fill embankments, a cutoff trench shall be excavated along the center line of the embankment. The trench shall have a minimum depth of 600 mm (2 ft.), a minimum bottom width of 1.2 m (4 ft.), and shall extend up both abutments to the riser crest elevation. All embankment compaction requirements shall be the same as those for roadway embankments.

The riser and barrel of the principal outlet shall be placed on a firm compacted soil foundation. The base of the riser shall be firmly anchored according to design criteria to prevent flotation.

Sedimentation shall be removed from the basin when the wet storage volume has been reduced by 1/2. The elevation of the sediment cleanout level shall be calculated and clearly marked on the riser. Inspection of the basin shall take place at the end of each working day and the damages shall be repaired immediately.

6.16 DEWATERING STRUCTURE

Construct as shown in Figure 21. The excavated basin should be lined with a filter fabric. The entire inside face of the erosion bales shall be covered with an impermeable geotextile. The outlet structure shall have a minimum width of 0.9 m (3 ft.) and shall be minimum 150 mm (6 in.) below the top of the embankment.

Remove sediments once they have accumulated to 1/2 of the excavated depth.
6.17 TEMPORARY STREAM CROSSING

Temporary bridges shall be of wood, metal or other appropriate material. Pipes can be of reinforced concrete, corrugated metal, or plastic. The crossing should be at right angles to the stream.

When pipes are used, aggregate should be used to form the crossing. Depth of the stone cover over the pipe shall be equal to 1/2 the pipe diameter, and in no case less than 300 mm (12 in.). The pipe diameter shall be selected to convey the flow from a 2 year frequency storm. If the structure will stay in place for 30 days to a year, consider using the 5 year frequency storm. Minimum size that may be used is 450 mm (18 in.). Whenever possible, the slope of the pipe shall be at least 2%.

If multiple pipes are used, they must be separated by a length equal to 1/2 the diameter of the pipes. Minimum separations shall be 300 mm (1 ft.) and maximum separation shall be 900 mm (3 ft.). Aggregate shall be placed between the pipes.

Bridge shall be constructed to span the entire channel at or above bank elevation and they shall be securely anchored using steel cable or a chain. When using pipes, the invert elevation of the pipe shall be installed on the natural streambed grade. A geotextile should be placed on the streambed and streambanks prior to placing the pipe and the aggregate. The geotextile should extend 300 mm (12 in.) beyond the end of the culvert. The pipe length shall not exceed 12 m (40 ft.) and shall extend at least 0.3 m (1 ft.) beyond the upstream and downstream toe of the aggregate around the pipe.

Inspect after each storm event and repair damages immediately. Assess foundation during the inspection. Replace lost aggregate. After removing pipes, the channel shall be restored to its original cross section.

6.18 STABILIZED CONSTRUCTION ENTRANCE

The entrance must extend the full width of the ingress/egress area and have a minimum width and length of 3.6 m (12 ft.) and 21 m (70 ft.). Area of the entrance must be excavated a minimum of 75 mm (3 in.). The geotextile will then be placed and covered with a 150 mm (6 in.) minimum layer of aggregate. The aggregate shall be 50 to 75 mm (2 to 3 in.).

An optional wash rack can be constructed as part of the structure. The structure shall be maintained daily. Stone shall be added and repairs shall be performed as required. Any mud or dirt tracked onto paved surfaces should be cleaned up within 24 hours.

6.19 LEVEL SPREADER
The grade of the level spreader channel shall be 0.0%. Minimum level spreader depth measured from the lip shall be 150 mm (6 in.). Width of the lower side of the level spreader shall be 150 mm (6 in.). Grade of the channel discharging into the level spreader shall be less than, or equal to, 1% for the last 6 m (20 ft.) of the channel.

The release lip should be leveled at uniform height and at 0.0% grade over the length of the spreader. The lip should be of non-erodible material. Material used can be an erosion control blanket, pressure treated timbers, or concrete curbing.

Shape entrance to the spreader in such a manner that the runoff enters directly on the 0.0% grade channel. Inspect after every rainfall and repair as required. Prevent construction traffic across the structure.

6.20 BRUSH BARRIER

The barrier shall be constructed according to Figure 24 by piling brush, stone, root mat and other material from the clearing and grubbing process into a mounded row on the contour. Height of a brush barrier shall be 0.9 m (3 ft.) minimum. The width of a brush barrier shall be a minimum of 1.5 m (5 ft.) at its base.

The filter fabric shall be cut into lengths sufficient to lay across the barrier from its upslope base to just beyond its peak. Where joints are necessary, the fabric shall be spliced together with a minimum 150 mm (6 in.) overlap and securely sealed.

Remove when they have served their usefulness. Remove sediment accumulated behind the barrier when it has reached half the exposed barrier height.

6.21 SANDBAG BARRIER

When building a barrier wall, stack the sandbags using an alternately layered method. Cover sandbags with a plastic lining when waterproofing is desired. The base of the barrier should be at least 1.2 m (48 in.) wide and 0.45 m (18 in.) high.

Sandbag barriers shall be periodically maintained, and any breaks in the barrier shall be promptly repaired. Remove sediments behind the barrier when they accumulate to a height of 150 mm (6 in.).

6.22 SPILL PREVENTION

Select a designated area for storage. All containers must be tightly sealed and labeled. Storage areas should be surrounded by a berm. Construct berms to provide a storage volume of no less than 1.5 times the total volume of the stored material. Cleanup procedures should be clearly posted and cleanup material should be readily available.
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EROSION AND SEDIMENT CONTROL

Storage area should be covered and lined with an impermeable liner. If spill occurs, the source of the spill should be stopped as soon as practicable. The spill should be covered with an absorbent material.

Dispose of any contaminated material in accordance with state or local requirements. Do not store chemicals or hazardous substances within less than 15 m (50 ft.) of any receiving water.

6.23 WASTE DISPOSAL

Select a designated area for waste collection. Provide an adequate number of containers with lids or covers. Locate containers in a covered area.

Schedule frequent waste collection, and ensure that waste is disposed of at authorized disposal areas. Check with local solid waste management agency for specific guidelines.

6.24 PROTECTION OF TREES

Mark trees to be protected at a height visible to equipment operators. Equipment operators shall not clean their equipment by slamming it against the trees to be protected.

Roots, trunk and tops of trees can be protected by fencing. The fence shall be erected at the tree dip line. Limits for clearing must be located at the tree dip line. Trenching shall always be performed as far away from the tree trunks as possible. Consider tunneling as an option.

Damaged trees should be repaired. Appropriate repairs should be prescribed by a forester or a tree specialist.
USE 2 PIPE SIZES 1 1/4" x 1 1/2" x 12" AT ALL EROSION LOG STAGES OR Joints Otherwise USE A single piece to B size and CORRODE to ALLOW EROSION LOG STREET TO FUNCTIONAL LENGTH OF THE EROSION LOG

PLAN VIEW

TYPICAL STAKING PATTERN AND EROSION LOG APPLICATION

Ø SECTION VENNER SHALL BE PERFORMED CONTINUOUSLY FOR PROPER FUNCTION

DROP INLET EROSION LOG FILTER

NOTE: LOCATE EROSION LOGS IN NATURAL GROUND AT THE CURVE EDGE DESIGN SPECIFICATIONS

SECTION A-A

SECTION B-D

SECTION D-D

EROSION LOG DETAIL
DITCH INSTALLATION

TEMPORARY EROSION CONTROL

STANDARD PLAN NO. M-208-1

Sheet No. 7 of 7
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## CHAPTER SEVEN

STANDARDS AND SPECIFICATIONS
STREETLIGHT INSTALLATION POLICY

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<td>7.04</td>
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<td>7.05</td>
<td>DEFINITIONS</td>
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7.01 STREETLIGHT INSTALLATION POLICY

Under this policy, the Town will regulate the design and installation of the streetlights within its right-of-ways and public grounds. The Public Works Department will implement the streetlight installation and maintenance through the electric power service supplier under the provisions of this policy.

7.02 DEFINITION OF STREETLIGHT

A luminescent device consisting of a pole and base, mast arm, light fixture, cables and conduits and transformer (if necessary) to provide adequate illumination for public streets and public grounds.

7.03 STREETLIGHT FUNCTION

A streetlight must illuminate travel lanes, sidewalks, pedestrian cross walks, public entrance drives and Town owned and maintained parking lots. Unless designated and installed for additional purpose(s), no other uses shall be provided by the streetlights. Prohibited uses imposing safety hazards and possible damage to streetlights are:

1. Attachment of large banner hangers spanning the Town streets or highways, rope supports, facility anchor cables, etc.
2. Outlets overloading the power feed lines, except for the approved holiday ornamental lights.
3. Attachment of overhead phone cables, cable TV lines, etc. on metal or fiberglass poles.
5. Attachment of postal and news stands.

7.03.1 LIGHTPOLE BANNER PROVISIONS

All streetlight poles over 20 feet in height shall have provision for banner installation at locations as directed by town and shall be provided and installed by the owner. Brackets for banner installation shall be Kalamazoo Banner Works (KBW), Bannerflex or approved equal. Brackets shall be installed such that the bottoms of the installed banners are a uniform 12 feet above final grade, and the top bracket adjusted to accommodate the banners to be installed. Brackets shall be installed perpendicular to the traveled way. Light poles in medians shall have provision for banner installation on both sides of the pole.

Brackets for banner installation shall not be installed in the following areas:

1. Lightpoles at a controlled intersections.
2. Special streetlight categories as described in section 7.04.1 below.
3. Any location where banner installation would result in a sight-distance hazard.
7.04 STREETLIGHT INSTALLATION PROCEDURES

Generally, there will be 6 categories under which street lights can be installed. They are:

1. Residential and local street intersections, road curves, and mid-blocks located at a 400 ft. minimum distance from the nearest intersection, qualifies for 1 light per location. Mid-block is defined as a point between 2 consecutive street intersections with 400 ft. minimum distance from the middle of an intersection.
2. Town maintained public facility entrance drives qualifies for 1 light per location.
3. “Collector Street” intersection qualifies for 2 lights per location, installed diagonally.
4. “Arterial Street”, “Divided Street”, and/or signalized street intersections will qualify for 4 lights per location.
5. “Principal Arterial” intersection qualifies for 2 illuminated street signs, 1 for each intersecting street.
6. Major street corridor illumination, designed by the Developer’s Engineer, in accordance with the American National Standards Institute/Institute of Electrical Engineers (ANSI/IES) Standards, approved by the Town and Electrical Service provider.

7.04.1 SPECIAL STREETLIGHT CATEGORIES

All other streetlights not qualified by these categories will be considered a special request for individual or single user group.

Special streetlight categories include:

1. Neighborhood illumination
2. Cul-de-sac
3. Turnaround
4. Dead end
5. Alley
6. Area
7. Curb cut or entry
8. Security

Additionally, applicants with special needs will have the opportunity to request area lighting through their electric service provider. These extra lights must be installed outside of the public right-of-way and the cost of installation and maintenance for these devices must be borne by the owner.

7.05 DEFINITIONS

1. Streetlighting
   “Streetlighting” includes all lights on and installed fixtures specifically designed to support a streetlight. If the pole is direct buried, it is referred to as a pole; if the pole
is mounted on a foundation, it is referred to as standard. The lights are fed either by
an overhead or underground distribution system.

2. Standards and Poles
"Standards and Poles" are stocked in 3 lengths to provide the necessary mounting
heights. Mounting height affects the spacing required to provide uniform and
adequate lighting with higher mounting heights generally yielding greater spacing and
better uniformity. The luminaire mounting height is measured vertically from the
surface to a point even with the center of the light source. For post top luminaires
used in residential areas, this distance is 20 ft. Lighting along town thoroughfares
uses 40 ft. luminary mounting height. Thirty-six, eight inch aluminum standards are
used. Fiberglass poles are available in 2 mounting styles: a 24 foot post top mounting
luminaire via post top tenon, typical of residential design, and 45 foot similar to
aluminum standards with luminaires supported on 10 foot arm.

3. Luminaire
The "Luminaire" is the entire assembly that makes up a streetlight and consists of a
housing, lamp socket, reflector, refractor (glass), ballast and photo-control receptacle.
M-400AZ luminaires are used as the typical installation, which includes 45 ft. poles
with high-pressure sodium 250W or 400W luminaires. For residential areas, PM17
ornamental luminaires are used with 100W high-pressure sodium lamps.

4. Brackets
"Brackets" are also referred to as "arms". They provide a mount for the luminaires, a
raceway for the feed wire from the pole or standard to the luminaire and horizontal
displacement from the pole. Ten foot truss brackets will be used.

5. Breakaway
"Breakaway Devices" are used in areas where occupant injury can occur when
vehicles come into contact with lighting standards. Aluminum transformer bases will
be utilized for breakaway applications.

6. Foundations
Precast concrete "Foundations" are used for mounting streetlight standards, although
special instances may require field-poured foundations.
<table>
<thead>
<tr>
<th>Unit</th>
<th>Description</th>
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<tbody>
<tr>
<td>M26-70F</td>
<td>70 watt HPS black carriage-type post top st lt on 24’ fiberglass direct buried pole</td>
</tr>
<tr>
<td>M26-70SD</td>
<td>70 watt HPS black carriage-type post top st lt on 24’ aluminum pole with concrete base</td>
</tr>
<tr>
<td>M26-100CB</td>
<td>100 watt HPS Cobra head st lt with 10’ arm (for mounting on wood pole)</td>
</tr>
<tr>
<td>M26-100C</td>
<td>100 watt HPS black contemporary post top st lt on 24’ fiberglass direct buried pole</td>
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<td>M26-100ORN</td>
<td>100 watt HPS black ornamental post type st lt on 12’ black pole with concrete base</td>
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<td>M26-100KAR</td>
<td>100 watt HPS gray Archtype cutoff st lt on 24’ gray fiberglass direct buried pole</td>
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<td>M26-150KAR</td>
<td>150 watt HPS black Archtype cutoff st lt on 24’ black fiberglass direct buried pole</td>
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<td>M26-250BRM</td>
<td>250 watt HPS gray Archtype cutoff st lt on 28’-6” gray steel pole with concrete base</td>
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<tr>
<td>M26-250CB</td>
<td>250 watt HPS Cobra head st lt with 10’ arm (for mounting on wood pole)</td>
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<tr>
<td>M26-250AP</td>
<td>250 watt HPS Cobra head st lt on 36’-9” aluminum pole with concrete base</td>
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<td>M26-250F</td>
<td>250 watt HPS Cobra head st lt on silver arm on 40’ black fiberglass direct buried pole</td>
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<td>M26-250FB</td>
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<td>M26-250KAR</td>
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<td>M26-400F</td>
<td>400 watt HPS Cobra head st lt on 40’ black fiberglass direct buried pole</td>
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</table>

If Agency desires installation of other than United Power Standard Street Lighting Assemblies, the following applies:

1. Light fixtures, arms, standards and bases shall be furnished by the Agency, or by the Developer on behalf of the Agency, and installed and maintained by United Power; however, replacement parts inventories must be maintained on Agency’s premises.

2. United Power will furnish, trench and install all electrical equipment and wires necessary to provide electric service to the street lighting system at the expense of the Agency or the developer. United Power will perform ordinary maintenance (glass cleaning, re-lamping,) repairs and ordinary replacement
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**United Power**

P.O. BOX 929 • BRIGHTON, CO. 80601

**Revisions**

08/02 KWB General Revision

ENG. APPROVAL: [Name]  DATE: [Date]  ISSUED BY: [Name]

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**REVISIONS**

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**UNITED POWER**

UNITED POWER, INC.
P.O. BOX 929 • BRIGHTON, CO. 80601

**ENG. APPROVAL:** DATE: ISSUED BY: ORNAMENTAL LIGHT FIBERGLASS POLE

**OPER. APPROVAL:** DATE: ISSE DT: M26-70SD
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**100W COBRA HEAD LUMINAIRE WITH 10' ARM**

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Issued

Approval

Date by

Revisions

11/01

Ins. F.S. Revision

08/02

General Revision

10/02

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LIGHTPOLE WITH 100W

ORNAMENTAL LUMINAIRE

M26-1000RN
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P.O. BOX 929 • BRIGHTON, CO. 80601

100 W ARCHE-TYPE ST LT
DIRECT MOUNT, 24' DB POLE  M26-100KAR
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<tr>
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<td>Fuseholder, In-line, #12-B AWG</td>
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<td>5</td>
<td></td>
<td>Hand hole</td>
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</table>

**UNITED POWER**

UNITED POWER, INC.
P.O. BOX 929 - BRIGHTON, CO. 80601

150 W ARCHE-TYPE ST LT
DIRECT MOUNT, 24' DB POLE

M26-150KAR
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<td>Concrete Foundation</td>
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<td>Photoelectric Eye</td>
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<td>Ground Rod</td>
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</table>

**Revisions**

- **Date**
- **By**
- **Description**

**United Power**

P.O. Box 929 - Brighton, CO 80601

DWN BY: H. Ross

**Engineer Approval**

- **Date**

**Operator Approval**

- **Date**

**Issue Date**

- **250 W Arche-Type ST LT M26-250BRM**

- **10' Arm, 28' Pole W/Base**
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<td>1</td>
<td>10' Truss Arm</td>
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<td>1</td>
<td>Lag screw 1/2&quot; x 4&quot;</td>
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<td>2</td>
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<td>Photoelectric Eye.</td>
<td>6</td>
<td>1</td>
<td>Bolt, machine, 5/8&quot; x req'd length</td>
</tr>
<tr>
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<td>Washer, 2–1/4&quot; square x 3/16&quot; flat</td>
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<td>1</td>
<td>Washer, 5/8&quot;, double coil springlock</td>
</tr>
<tr>
<td>6</td>
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<td>Faucet holder, In–line, #12–8 AWG</td>
<td>8</td>
<td>1</td>
<td>Locknut</td>
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**REVISIONS**

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**250W COBRA HEAD**

**UNITED POWER**

P.O. BOX 929 • BRIGHTON, CO. 80601

**M26-250CB**
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<tr>
<th>ITEM</th>
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<td>2</td>
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<td>6</td>
<td>1</td>
<td>Light pole, Fiberglass, 45'</td>
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<td>1</td>
<td>Photoelectric Eye</td>
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<tbody>
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**DWN BY:** K. Ree

**ENG. APPROVAL:**

**OPER. APPROVAL:**

**ISSUED BY:**

**FIBERGLASS LIGHTPOLE WITH 250W LUMINAIRE**

**M26-250F**
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<td>10' Arch Arm with bolts</td>
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<td>2</td>
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<td>The Archetype Luminaire</td>
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**UNITEDPOWER**

UNITED POWER, INC.
P.O. BOX 929 • BRIGHTON, CO. 80601

LIGHTPOLE WITH 250W ARCHETYPE LUMINAIRE AND 10' ARM

M26-250KAR
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<tbody>
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<td>10' Arm</td>
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<td>2</td>
<td>1</td>
<td>Luminaire, 250W Curvilinear, Green</td>
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<td>1</td>
<td>Lightpole, 33'-6&quot;, Green</td>
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<td>1</td>
<td>Lamp HPS, 250W</td>
<td>8</td>
<td>1</td>
<td>Ground Rod Clamp</td>
</tr>
<tr>
<td>4</td>
<td>1</td>
<td>Photoelectric Eye</td>
<td>9</td>
<td>1</td>
<td>Ground Rod</td>
</tr>
<tr>
<td>5</td>
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<td>Fuseholder, In-line, #12-8 AWG</td>
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**250 W CURVILINEAR ST LT**

**35' POLE W/BASE, 10' ARM**

**M26-250RLA**
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<td>3</td>
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<td>Photoelectric Eye.</td>
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<td>4</td>
<td>1</td>
<td>Fusetholder, In-line, #12-8 Awg</td>
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<td></td>
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<td>5</td>
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<td>Hand hole</td>
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**Issued:** 10/22/03

**United Power, Inc.**

P.O. Box 929 • Brighton, CO. 80601

250 W Curvilinear St Lt
25' DB Fiberglass Pole

M26-250RLC
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<td>M-400A2 Luminaire</td>
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<td>3</td>
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<td>1</td>
<td>Photoelectric Eye.</td>
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<tr>
<td>5</td>
<td>1</td>
<td>Bolt, machine, 5/8&quot; x req'd length</td>
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<tr>
<td>6</td>
<td>1</td>
<td>Washer, 2-1/4&quot; square x 3/16&quot; flat</td>
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<td>7</td>
<td>1</td>
<td>Washer, 5/8&quot;, double coil springlock</td>
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<td>8</td>
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<td>Fuseholder, in-line, #12-8 AWG</td>
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<td>Lag screw 1/2&quot; x 4&quot;</td>
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<td>1</td>
<td>1</td>
<td>Locknut, MF type, 5/8&quot;</td>
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**400W COBRA HEAD LUMINAIRE WITH 10' ARM**

M26-400CB
<table>
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<tr>
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<td>10' Truss Arm</td>
<td>6</td>
<td>1</td>
<td>Base</td>
</tr>
<tr>
<td>2</td>
<td>1</td>
<td>Luminaire, 400W HPS</td>
<td>7</td>
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<td>Concrete Foundation</td>
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<tr>
<td>3</td>
<td>1</td>
<td>Lamp HPS, 400W</td>
<td>8</td>
<td>1</td>
<td>Lightpole</td>
</tr>
<tr>
<td>4</td>
<td>1</td>
<td>Photoelectric Eye</td>
<td>9</td>
<td>1</td>
<td>Ground Rod Clamp</td>
</tr>
<tr>
<td>5</td>
<td>1</td>
<td>Fuseholder, In-line, #12-8 AWG</td>
<td>10</td>
<td>1</td>
<td>Ground Rod</td>
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<tr>
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**Revisions**

**Date: 08/01**

**Description**: General Revision

**800-929**

**United Power, Inc.**

P.O. Box 929 • Brighton, CO. 80601

**M26-400AP**

**Lightpole with 400W Cobra Head Luminaire and 10' Arm**

**Engineer Approval Date**: 800-929

**Operator Approval Date**: ISSUED BY: DWN BY: H. Reno
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<td>FINAL ACCEPTANCE PROCEDURES FOR PUBLIC IMPROVEMENTS</td>
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<tr>
<td>8.03</td>
<td>PROCEDURES FOR FINAL INSPECTION OF COMMON FACILITIES</td>
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8.01 CONSTRUCTION IMPROVEMENTS  

1. Construction Acceptance Inspection  

Upon completion of all construction and prior to requesting Town approval, the Contractor and/or owner’s representative should conduct their own inspection and make all necessary corrections.  

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

a. Written request from the Developer/Contractor to the Town outlining which facilities are ready for construction acceptance inspection, or  

b. The Town may inform the Developer that a construction acceptance inspection will be made, and outline those facilities which will be inspected.  

The Town will then schedule a date and time for inspection with members of the Town staff within 1 week of request. Prior to inspection for construction acceptance of the work the Town requires that:  

a. A complete and accurate set of Record Drawings shall be submitted to the Town for approval. Changes to the original design drawings must be supported by documentation which contains the signature and seal of a Colorado Registered Professional Engineer.  

b. All relative testing certifications and documentation shall be submitted to the Town. All required certifications must contain the signature and seal of a Colorado Registered Professional Engineer.  

Within 2 weeks after the final inspection, a list of deficiencies will be prepared by the Town and presented to the Developer/Contractor.  

Should the deficiencies not be corrected in a reasonable time period, the Town has the right to prepare another list of deficiencies and/or draw upon the performance guarantee as specified in the CIP or subdivision agreement to complete the improvements.  

2. Construction Acceptance Procedures  

After the Public Improvements have passed the construction acceptance inspection as certified by written notice from the Town, the Developer/Contractor shall request acceptance by the Town. The following items must be submitted with the request:  

a. A full set of Record Drawings, permanent, reproducible Mylars (4 mil thickness, double matted reverse film, 24” x 36”), and 1 signed and sealed set of blueline
CHAPTER EIGHT  
STANDARDS AND SPECIFICATIONS

ACCEPTANCE PROCEDURES

prints with the accuracy attested to by a Registered Professional Engineer licensed to practice in Colorado.

b. A diskette of Record Drawings utility plan drawings in AutoCAD compatible format.

c. A final sworn affidavit of construction cost; and

d. Any other items required under the Subdivision/Construction Contract Agreement.

The Town will review the application for accuracy and completeness. At the time of acceptance of any portion of the improvements for a Subdivision/Public Improvements Contract, the Town may release any portion of the performance guarantee, provided that Town determines the balance of the performance guarantee will be sufficient to fund improvements specified in the Subdivision Agreement/Public Improvements Contract and which have not been completed. A minimum of 15% of the “total improvement cost” shall be held by the Town during the 2 year warranty period after construction acceptance, unless otherwise approved by Town Council or otherwise stated in Subdivision Agreement.

8.02 FINAL ACCEPTANCE PROCEDURES FOR PUBLIC IMPROVEMENTS

Approximately 1 year following acceptance, the Developer/Contractor must request an inspection for consideration of completion of the warranty period. Prior to the final inspection the developer shall accomplish the following:

a. All temporary structures, debris, mud and waste materials shall be removed from all public property.

b. All other supporting documentation as may be required shall be submitted to the Town for approval.

Following inspection, a list of deficiencies will be prepared. Within 1 week of receipt of this list, the Developer/Contractor shall submit a satisfactory time schedule for correction of the deficiencies. **THE DEFICIENCIES MUST BE CORRECTED WITHIN 45 DAYS OF THE RECEIPT OF THE LIST.**

After the Developer/Contractor has corrected the deficiencies, the Developer/Contractor must inform the Town that repairs have been made, and a follow-up final inspection will be scheduled. **The warranty period is not over until all warranty repairs have been made.**

After the final inspection has been passed, the Town will send written notification to the owner that the public improvements have been completed in accordance with these Standards and Specifications.
CHAPTER EIGHT

STANDARDS AND SPECIFICATIONS

ACCEPTANCE PROCEDURES

8.03 PROCEDURES FOR FINAL INSPECTION OF COMMON FACILITIES

1. Final Inspection

All applicable portions of Section 8.01 AND 8.02, of these Standards and Specifications shall apply.

If schedules are not met or extended by approval of the Town, the Town may withhold building permits or Certificates of Occupancy for the lots served by the common facility.

2. Notification of Completion

After the final inspection has been passed, the Town will send written notification to the owner that the common facility has been completed in accordance with these Standards and Specifications.
THIS COLLECTOR TO BE USED:

HOUSING FACING OR ACCESSING THE STREET.
INTERNAL COLLECTOR GREATER THAN 2650 LF.
10 FOOT TRAIL ON ONE SIDE.