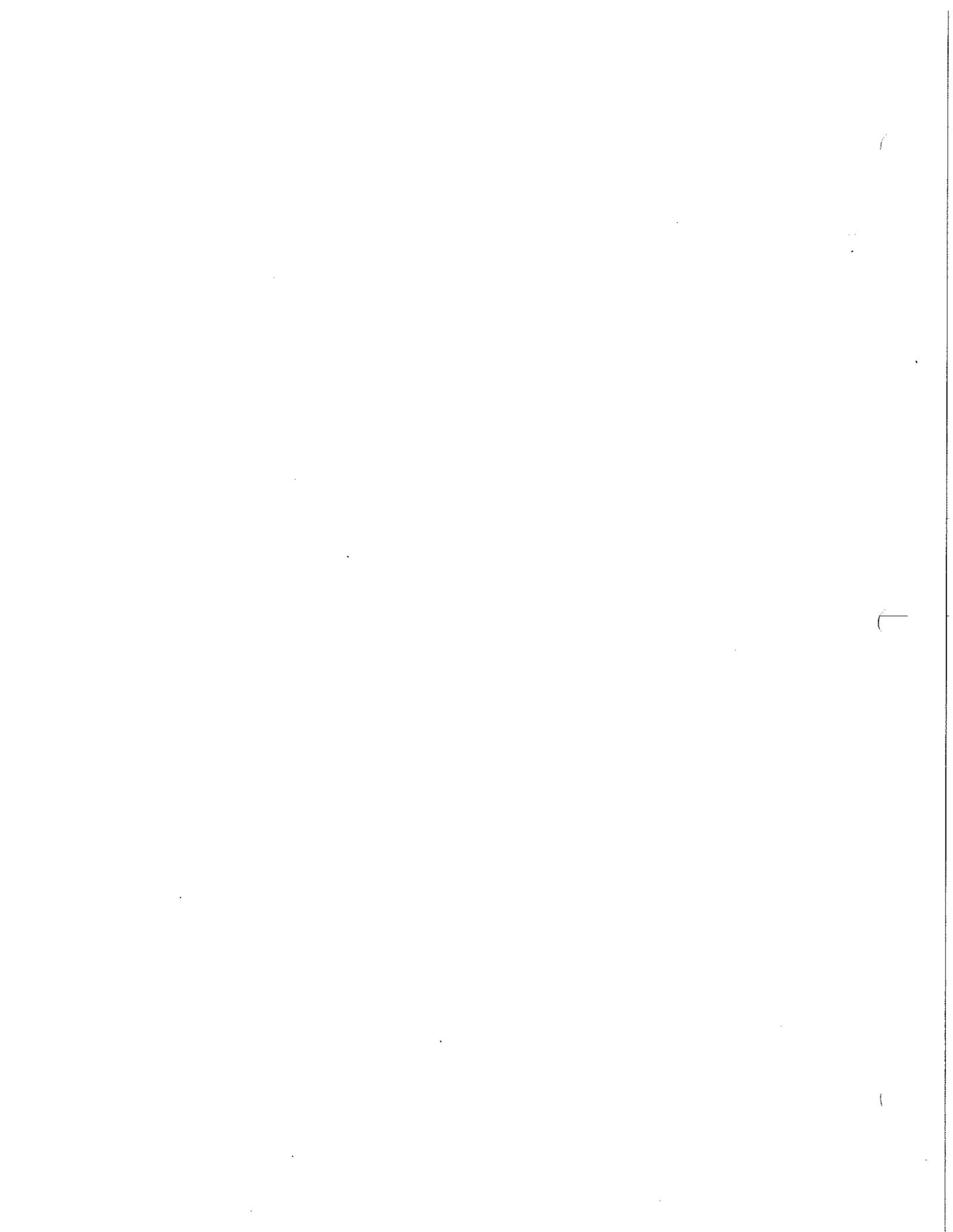


CHAPTER 12

UTILITY LOCATIONS & ROADWAY  
APPURTENANCES

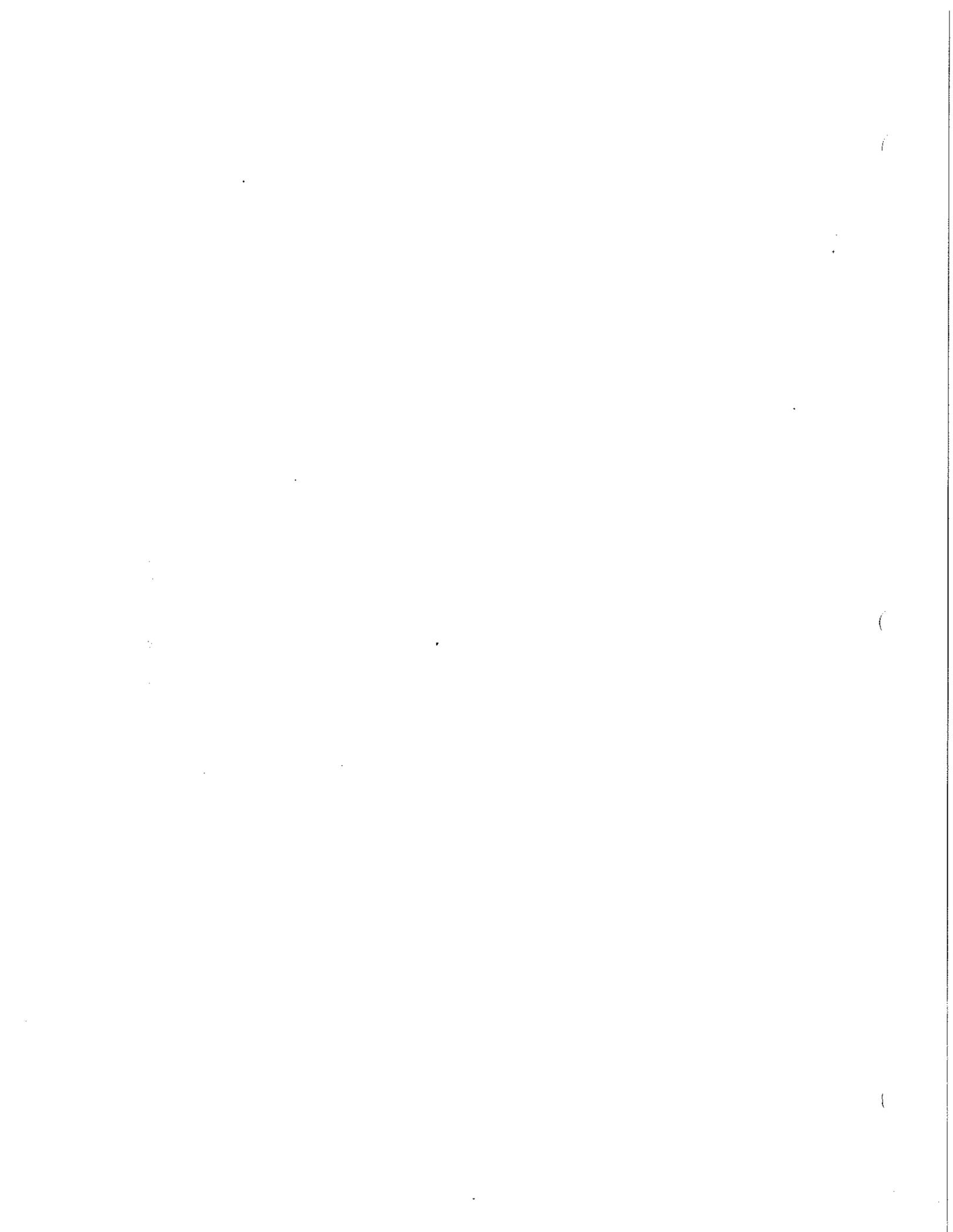


## CHAPTER 12

### UTILITY LOCATIONS & ROADWAY APPURTENANCES

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## CHAPTER 12

### UTILITY LOCATIONS & ROADWAY APPURTENANCES

#### 12.0 Utilities

##### 12.1 Plans Required

Any utility or other facility constructed in Town R.O.W. shall have construction plans submitted and approved in accordance with requirements of Chapter 3 of these STANDARDS. No construction permit shall be issued for construction of new utilities or extension of existing utilities (except service taps or lateral to individual properties) without prior review and approval of the construction plans by the Town of Bennett. Permits are required in all cases.

##### Exceptions:

1. Minor maintenance projects may be exempt from submitting formal construction plans. In such cases however, sketch plans must accompany the permit application. Utility companies may be exempt from the requirement of a professional engineer's signature and stamp on the construction plans if the project is of a nature that would not warrant design by a registered professional engineer.
2. To avoid delays and redesigns on large projects and in areas where future road improvements are expected, plan and profile sheets may be requested. A pre-design meeting must be held with the Town Engineer or authorized representative to discuss the requirements of the plan submittal. The Town will assist the utility company in determining what future roadway profiles and improvements are expected to minimize future utility relocations. Requirements for submitting plan and profile sheets may be waived upon written request of the utility company. This exception does not apply to water and sewer line projects.

- 12.1.1 If formal plans are required, the Town will notify the applicant of such within 48 hours after the pre-design meeting.

12.1.2 The applicant's completed facility shall be in conformance with the drawings or sketches referred to above, unless a deviation has been requested and approved by the Town of Bennett.

12.1.3 When the proposed facility involves pressure pipe lines, the following additional data is required:

- a. Design pressure of pipe.
- b. Normal operating pressure.
- c. Maximum operating pressure.
- d. Nominal composition of material in pipeline.

This information is for reference only.

## 12.2 Design Standards

12.2.1 All work in connection with the facility authorized by the permit shall be done in a neat and workman like manner to the satisfaction of the Town Engineer. The details of construction of the same shall conform to the requirements in effect at the time of permit issuance.

12.2.2 All utilities including water, sanitary sewer and storm sewer shall be stubbed out to the R.O.W. at all locations that are planned for future tie-ins. Other reasonable stub-outs may be requested by the Town based on sound judgment and knowledge of adjacent development.

12.2.3 All manhole lids, utility access covers and range box access covers shall be depressed 1/4" to 1/2" below the adjacent finished street surface.

12.2.4 At least one 8" (min.) Schedule 40 PVC sleeve shall be installed by the Developer across all streets at all intersections at the time of initial construction to facilitate unforeseen future utility crossings. Sleeves shall be installed at a minimum depth of 42" to the top

of the pipe from the tip of curb. Sleeve location shall be determined on a case-by-case basis.

### 12.3 Locations

(Also see Drawing No.'s 44, 45, & 46.)

#### 12.3.1 Water

Water mains shall be located on the North and East sides of streets. Provide minimum 10' horizontal separation from sanitary sewer. Fire hydrants will be located 3' minimum from back of curb, 1' minimum from back of attached walk, or 10' minimum from edge of pavement if no curb is present.

#### 12.3.2 Sanitary Sewer

Sanitary sewer shall be located on the South and West sides of streets.

#### 12.3.3 Storm Sewer

Storm sewer shall be located on the street centerline or three (3) feet either side of centerline for adequate utility separation or the alternate locations shown on Drawing No.'s 44 & 45. Other locations may be considered if given written approval by the Town Engineer.

#### 12.3.4 Natural Gas

Gas mains shall be located either within the right-of-way or in an adjacent easement on the South and West sides of the street or three (3) feet either side of centerline adequate utility separation. For utility companies that wish to run double mains (a main on each side of the street), the requirement of North and East/South and West may be waived by the Public Works Department. The Public Works Department generally recommends double mains.

#### 12.3.5 Power and Telephone

Generally, power and telephone lines shall be located in the North and East sides of the street either within the right-of-way or in an adjacent easement. For utility companies that

wish to run double mains (a main on each side of the street), the requirement of North and East/South and West may be waived by the Public Works Department, or as directed by the National Electrical Safety Code.

12.3.6 Cable TV

Cable TV lines shall be located in the North and East sides of the street either within the right-of-way or in an adjacent easement. For utility companies that wish to run double mains (a main on each side of the street), the requirement of North and East/South and West may be waived by the Public Department.

12.3.7 Additional Structures

Poles, signs and any other above-ground streetscape (except regulatory signs) shall be generally located within five feet of the right-of-way line or ten feet from the travel lane, whichever is most restrictive. Light poles may be placed a minimum of two feet behind a vertical curb line, or two feet behind the sidewalk for attached sidewalk conditions with prior written approval by the Town. Poles placed within Town right-of-way's having a posted speed limit of 40 m.p.h. may be required to be breakaway, per CDOH Roadway Design Manual, Section 1002.6 Specifications for ALL poles within Town right-of-way's must be accepted by the Public Works Department prior to the permit application for installation.

**CAUTION:** Trees or large shrubs shall not be planted over buried utilities, within the sight distance triangle at intersections or accesses, or within 10' of the flowline of the public street. On low speed (posted 30 m.p.h. or less) minor collectors and local streets, trees may be planted to within six (6) feet of the flowline (except within 150' in either direction from an intersection, where the trees must be a minimum of 10' back from the

flowline). In no case shall landscaping over 30" above the adjacent flowline be allowed to encroach into the sight-distance triangle.

#### 12.4 Signing and Striping Plans

- 12.4.1 Because the Town will maintain the traffic control devices on public right-of-way, all traffic control devices shall be fabricated and installed in accordance with the Town's Standards. The Town's signage and striping details in this document shall be included in all sets of construction plans.

Permanent signage and striping shall be complete and in place before any new roadway is opened to the public. These standards are to be used in conjunction with other applicable Town of Bennett Standards.

Traffic signal installation and equipment shall conform to the Colorado Department of Highways Standards and Specification. The manual on Uniform Traffic Control Devices Signal Warrants shall be met for signal installation.

All subdivisions, road improvement projects, and/or commercial developments must submit a separate signage and striping plan in accordance with the following criteria:

##### 12.4.1.1 Submittal

Separate signage and striping plans are to consist of an overall area map noting all specific use areas, such as schools, parks, recreation centers, library, commercial industrial, etc. The pages following the area map are to be broken down into road segments, for notation of signage and striping details.

##### 12.4.1.2 Review Process

There are two steps the plans must undergo for review.

12.4.1.2.1 The first step of review is a redline markup. Requirements will be marked where necessary and the plans returned to the Consultant.

12.4.1.2.2 Second, the revised plans and the marked preliminary plans must be resubmitted for final review with a signature box included for the Town Engineer and/or Director of Public Works. If the final submittal is acceptable, the Town Engineer and/or Public Works Director will notify the Consultant to send blue-line copies of the plans for signoff.

12.4.1.2.3 As these procedures require time to complete, all plans should be submitted along with the street construction plans and the Phase III Drainage Report.

**12.4.1.3 Variance**

Any variance from the Town's sign standards will require obtaining written permission from the Town's Engineering Division or Public Works Division. The Developer must also submit in writing to the Town's Public Works Department proof of responsibility for supplying and maintaining nonstandard signs and materials into perpetuity.

**12.4.1.4 Acceptance Procedure**

The acceptance procedures described in Chapter 11 of this document shall apply to signage and striping.

**12.4.1.5 General Provisions**

All traffic control devices shall conform to the Federal "Manual on Uniform Traffic Control Devices" (MUTCD)

and the "Colorado Supplemental to the MUTCD". Additional specifications and illustrations are located in the Colorado Division of Highways "M and S Standards".

12.4.1.5.1 Sign Warrants

Traffic Control devices which are not warranted by MUTCD shall not be installed. When MUTCD guidelines are not applicable for a given case, a traffic engineering study will be required. This study will address the existing conditions, safety issues, and the applicable warrants.

12.4.1.5.2 Utility Locations

Installers shall be responsible for locating all underground utilities.

12.4.1.5.3 Construction Areas

Type III lighted barricades shall be set at ends of roadways, separating finished and unfinished areas.

12.4.2 The signing plan should:

12.4.2.1 Show the general longitudinal location of each sign (horizontal offset and station):

12.4.2.2 Specify the sign legend and sign type (from MUTCD).

12.4.2.3 Specify the sign size.

12.4.2.4 Provide a "typical detail" of installation dimensions (height, distance from curb, etc.).

12.4.2.5 Specify design speed(s) used as basis for street design (or as constructed).

12.4.2.6 Detail post and base dimensions and installation plan (showing sleeves, depth below surface, and materials used). Breakaway posts shall be specified.

12.4.2.7 Specify the blank gauge of the sign.

12.4.2.8 Note the reflectorization provided.

All requirements must meet or exceed Town standards. A construction permit must be obtained for installation of the signs.

12.4.3 The striping plan must show:

12.4.3.1 Color.

12.4.3.2 Lane width.

12.4.3.3 Striping/skip.

12.4.3.4 Typical treatments for accel/decel lanes. Turning lanes, and crosswalks.

12.4.4 The following notes shall be on all signage and striping plans:

a. All traffic control devices shall conform to the Federal Manual on Uniform Traffic Control Devices (MUTCD), the "Colorado Supplemental MUTCD" and the Town of Bennett "Road Design and Construction Standards Manual". Further specifications and illustrations are located in the Colorado Division of Highways "M and S Standards".

b. A field inspection of location and installation of all signs shall be performed by the Town. All discrepancies identified

during the field inspection must be corrected before the two-year warranty period will begin.

- c. The Contractor installing signs is responsible for locating and protecting all underground utilities.
- d. Type III lighted barricades shall be set at ends of roadways, separating finished and unfinished construction areas.
- e. Special care shall be taken in sign location to ensure an unobstructed view of each sign.
- f. A 7' minimum post length shall be maintained from bottom of sign panel to the sidewalks in areas of pedestrian traffic. This requirement for vertical clearance is for all signs in areas of pedestrian traffic.
- g. Lateral offset shall be 8' minimum from flowline on collectors and arterials, and 6' minimum on interior roadways.
- h. Delineation of roadways shall be as specified in the Colorado "M and S Manual".
- i. Raised median islands shall be delineated.
- j. Signage and striping has been determined by information available at the time of review. Prior to initiation of the warranty period, the Town reserves the right to require additional signage and/or striping if they determine that an unforeseen condition warrants such signage according to the MUTCD or the CDOH M and S Standards. All signage and striping shall fall under the requirements of the two year warranty period for new construction.

## 12.5 Signing

### 12.5.1 Posts and Boots

12.5.1.1 Signs shall be mounted on 2.25"x2.25" square galvanized steel tubing, all four sides punched with 3/8" holes at one inch (1") centers. Refer to Drawing No. 56 in the Appendix of Section V of these Regulations. Posts must be of appropriate length to pass the MUTCD specifications for the location, must conform to CDOT specification Section 614, and must meet the Federal break-away standards. Installation boots are to be 2 1/4"x3' four (4) punch tubing, driven down flush to within 1" of ground level.

12.5.1.2 Sign boots are to be driven a minimum of three feet (3') into the ground and longer boots may be required because of soil composition and compaction.

12.5.1.3 The height to the bottom of the sign assembly shall be at least eight feet (8') above the adjacent roadway crown, when installed exclusively for street name posting. When combined with traffic control (STOP or YIELD) signs, the street name sign assembly shall be at least nine feet (9') above the adjacent roadway crown.

12.5.1.4 Post caps and crosses shall have 5"x1/4" slots for plates.

12.5.1.5 Street name assembly should be located at point of curvature of corner radius and should be placed according to the requirements as stated in 4.13.5 (Street Name Signs) of these Regulations. When

street name assembly is combined with regulatory signs, sign placement for the regulatory sign shall govern.

#### 12.5.2 Street Name Signs

12.5.2.1 Street names and 100-block (where applicable) designations should be obtained from the Town's Department of Public Works, Planning Department or Town Hall.

12.5.2.2 Six-inch plates, up to 30" long, may be used at all minor intersections, minimum two plates per street sign assembly. Nine-inch plates shall be used at all major intersections. All 9"x36" and 6"x30" plates will be installed, two for each road, minimum four plates per street sign assembly and shall be installed with end bolts on all plates. In the instance where a street changes names, such name changes should be designated on the street name assembly by using directional arrows and will require two additional plates.

12.5.2.3 Street name assembly should be located at the point of curvature of the corner radius and should be placed according to the following, as measured from the edge of the sign. When the street name assembly is combined with regulatory signs, sign placement for the regulatory sign shall govern.

Curb, Gutter and Sidewalk Combination:  
Two feet behind sidewalk.

Curb with no Sidewalk or Detached Sidewalk: Two to five feet behind curb on local streets. On collector street, 4' to 6' behind curb, and on arterials, 6' to 8' behind curb.

No Curb or Gutter:  
Six to Twelve feet from edge of  
pavement.

Gravel Road:  
Six to Eighteen feet from edge of travel  
lane and outside of ditch.

12.5.2.4 Sign assemblies shall be installed on  
standard 1-3/4", four (4) punch square  
tubing, (3/8" diameter holes on one inch  
centers, galvanized), or mounted on  
available utility poles with suitable  
hardware, when required lateral  
clearance can be achieved.

12.5.2.5 When street name sign assemblies are  
posted with the traffic control, posts  
must be standard 2" tubing, using 2  
1/4"x3' boots driven until flush with  
the grade. For exclusive street name  
installations, standard 1 3/4" tubing  
with 2"x3' boots may be used.

12.5.2.6 Backing Plates. Aluminum blanks of .080  
gauge is standard, except for signs  
larger than 36"x36", which shall be .100  
or .125 gauge aluminum.

12.5.2.7 All street signs will be high intensity  
white on reflectorized green. Lettering  
shall be Series C.

### 12.5.3 Criteria on Special Allowances for Street Name Sign Variations

12.5.3.1 Plans for any variances must be  
submitted to and reviewed by Public  
Works Department. List all specific  
variances from the Town Regulations in  
the special footnote box on the first  
page of the plans.

12.5.3.2 All street name signage size and reflectivity (red may not be used as background color) shall meet or exceed Town Standards.

12.5.3.3 See Drawing No.'s 49,50,51,52,53 and 56 within the Appendix Section of these Regulations for additional information.

#### 12.5.4 Designer's Responsibility

These plans are intended for typical applications of signage and striping for standard conditions. These Regulations do not alleviate the responsibility of the designer from sound engineering judgment or to exceed minimum standards in specific cases where conditions warrant.

### 12.6 Striping

#### 12.6.1 Pavement marking Standards

Unless otherwise directed by the Engineer or Director of Public Works, pavement markings are to be traced as per the approved striping plan or retraced in the position and locations as existing in the field at the time of the Notice to Proceed. Unless otherwise directed by the Engineer or Director of Public Works, lines shall not be carried through intersections. Standards for application concerning line configurations and color designations shall be as promulgated in the Manual on Uniform Traffic Control Devices for Streets and Highways (MUTCD), unless otherwise specifically authorized by the Engineer or Director of Public Works.

Yellow skip (dashed) lines shall be four inches in width; white skip lines shall be four inches in width. Where existing markings are no longer visible, the measurement of the line to skip shall maintain a uniform spacing of 10' line and 30' skip. Solid yellow lines shall be four inches in width; solid white edge lines shall be four inches in

width. Solid white lane lines shall be eight inches in width. Solid white bike lane lines shall be six inches in width. Solid yellow median lines for bike lanes shall be six inches in width.

All lines shall be 14-16 mil (.35-.41mm) thickness.

#### 12.6.2 Quality of Lines

All markings shall have clean, sharp-lined edges and clean beginnings and cutoffs. Line widths shall not vary more than 1/2" from the required line width. Line thickness shall be within the specified thickness range. Line color shall conform to FHWA requirements for standard highway colors.

When used with paint, glass beads shall be embedded in the paint and distributed uniformly throughout the line and shall provide retroreflectivity for the entire width and length of the line. When used with epoxy, glass beads shall be applied into the epoxy pavement marking by means of a pressurized bead applicator, and distributed uniformly throughout the line and shall provide retroreflectivity for the entire width and length of the line.

All lines shall present a clean worker-like appearance and present motorists with clear meaning.

#### 12.6.3 Condition of Pavement Surface and Weather Conditions

Under no circumstances shall markings be laid upon pavement surfaces which have not been cleaned or are not in a condition to retain such markings. The Contractor shall be responsible for providing all necessary pavement surface preparation to ensure that markings are applied only to clean, debris-free pavement. As a minimum, surface preparation shall include a compressed air treatment at all times. When recommended by the marking material manufacturer, a high-pressure water blast integrated into the gun carriage shall be used to clean the pavement surface prior to epoxy application. The

water blast shall be followed by a high-pressure air blast to remove all residual water, leaving only a damp surface.

Pavement markings shall not be applied unless the roadway surface is sufficiently dry and free of the threat of rain prior to drying. The pavement shall be 50 degrees and rising, and the air temperature shall be 50 degrees and rising, prior to starting or continuing pavement marking operations. Operations shall also be suspended if other conditions develop which affect the ability of the pavement to retain the markings, as determined by the Engineer or Director of Public Works.

Painting shall not be done under windy conditions. Windswept lines will not be accepted. Lines will be considered windswept if paint is scattered outside the specified line width and/or less than 50 percent of the line is covered with glass beads.

#### 12.6.4 Inspection of Pavement Markings

All work will be inspected by the Engineer or Director of Public Works for conformance to these Specifications. Lines will be checked for proper location, proper width (including checking for windswept lines), thickness, color and retroreflectivity.

Thickness measurement shall be accomplished by placing tape of known and uniform thickness in the area to be marked. Once the marker has passed, the sample will be removed. Measurements of the marking plus tape shall be made with a micrometer or vernier calipers with a proper correction for the tape thickness. The line thickness shall be considered as the average of 2 or more measurements made in a three-foot distance.

Color will be checked by comparison with a standard highway color chip.

Retroreflectivity will be checked by visual inspection of lines to determine that glass beads

are properly embedded and distributed.

Inspections will be made on a regular basis at time intervals as determined by the Engineer or Director of Public Works.

## 12.7 Pavement Marking Procedures

### 12.7.1 General

The vehicles used for application of pavement markings shall have a gross vehicle weight greater than 10,000 pounds and be capable of:

- a. Producing combinations of dashed and solid double center lines during one run of the equipment.
- b. Sufficient maneuverability and flexibility to trace or retrace all existing lines which are found on the roadway.
- c. Sequential warning arrow board with controls available to the paint gun operator and driver.
- d. Painting from either the right or the left side of the vehicle. Wrong way painting will not be allowed.
- e. Equipment will be capable of applying paint or epoxy and glass beads within acceptable rates.
- f. Spraying the pavement surface with compressed air immediately prior to paint application.
- g. Heating paint or epoxy to appropriate temperatures prior to application.

In addition, vehicles used for application of epoxy pavement markings will have the following features as well:

- a. The ability to precisely meter the two components of the epoxy material in the ration given by the epoxy manufacturer.

- b. The ability to automatically shut off the epoxy applicator or warn the operator if the components are not being mixed properly.
- c. The ability to heat the epoxy to appropriate temperatures prior to application at the mixing head and gun tip to provide and maintain the temperature specified.
- d. The ability to apply glass beads via a pressured bead applicator.

12.7.2 The Contractor shall submit to the Engineer or Director of Public Works, at least one week prior to installation, information from the manufacturer and supplier on paint and glass beads to be used for review and approval.

12.7.3 Paint

All paint used shall conform to the Colorado Department of Transportation, Staff Materials Branch, Specification of Acrylic Waterborne Traffic Paint. Paint shall be a waterborne paint. The paint shall not contain mercury, lead, hexavalent chromium, toluene, chlorinated solvents, hydrolyzable chlorine derivatives, ethylene-based glycol ethers and their acetates, nor any carcinogens, as defined in 29 CFR 1910.1200. The volatile organic compound content for paint shall be a maximum of 150 grams per liter using ASTM D3960.

12.7.4 Epoxy

All epoxy used shall conform to the Colorado Department of Transportation Epoxy Pavement Marking Material Specification and to Section 713.16 in the Standard Specifications for Road and Bridge Construction.

12.7.5 Glass Beads

Glass beads used shall conform to AASHTO Standard M

247 Type 1, non-flotation type only. Flotation beads are not acceptable. Glass beads used with epoxy shall be silane coated.

#### 12.7.6 Application Rates

The Contractor shall apply paint and epoxy at a maximum rate of 110 square feet per gallon and a minimum rate of 100 square feet per gallon. When used with paint, glass beads shall be applied at a maximum rate of 6 lbs. 3 oz. per gallon of paint and a minimum rate of 5 lbs. 13 oz. of beads per gallon of paint. When used with epoxy, glass beads shall be applied at a minimum rate of 25 lbs. per gallon of epoxy.

Epoxy shall be heated and installed according to manufacturers' recommendations.

#### 12.8 Lighting

12.8.1 It shall be the responsibility of the Developer of new or upgraded street improvements to install street lighting fixtures and the associated power sources to adequately light the public improvements. Street lighting installed in accordance with this policy and acceptable to IREA shall be a condition of acceptance of public improvements by the Town.

Street lighting shall be installed with underground electric service on all "newly developed" dedicated public streets in the Town.

12.8.2 The purpose of street light installations shall be to illuminate the public traveled ways to a level that promotes for the safe passage of public traffic whether it be vehicle or pedestrian.

12.8.3 This Chapter only refers to lighting on public streets and rights-of-way. The Consultant Engineer shall design all street lighting as follows:

##### 12.8.3.1 Local Street and Minor Collectors.

The minimum lumens is 7000 at 100 watt

capacity. The maximum horizontal spacing within residential subdivisions should be about every 300' on alternating sides of the street.

12.8.3.2 Arterials, Major Collectors and Commercial. The minimum specification is 9500 lumens at 100 or 150 watt capacity. The maximum horizontal spacing is 150-200' on alternating sides.

12.8.4 The positioning of light standards at intersection streets is as follows:

*Major Collectors/Arterials	4 lights, one on each corner.
*Arterials/Arterials	4 lights, one on each corner.
*Collector/Collector	2 lights, one on opposite corners.
*Local/Collector	2 lights, one on opposite corners.
*Local/Local	1 light on one corner.

12.8.5 Distance behind back of walk for local streets is to be a minimum of 12", but must be within easements or right-of-way on local residential streets. For major collectors and arterials, the light must be offset a minimum of 24" from the curb face and yet leave at least 36" of clear space between the light pole and back of walk.

12.8.6 All lighting in residential areas shall be installed to minimize light shining on or negatively effecting the neighboring residents.

12.8.7 The Developer is responsible for coordinating all aspects of design and installation with IREA.

12.8.8 All existing and proposed street lighting shall be shown on the street plan and profile sheets.

## 12.9 General Traffic Signal Design Requirements

### 12.9.1 Scope

This Chapter describes general signal design requirements for use in the Town of Bennett.

- a. The Owner/Developer is required to provide separate 24"x36" drawings of all traffic signal installation as an integral part of the Construction Plan Set and its requirements.
- b. This plan shall include all existing signal improvements including traffic control boxes, pull boxes, signal poles, signage, striping and loops.

12.9.2 Signal Head Placement and Sizes

- a. For all installations, one signal head shall be provided centered over each exclusive left turn and through lane. If mast arms do not reach the left turn lane(s), the number and configuration of signal heads should be adjusted in consultation with the Town Engineer or Director of Public Works. Far left and far right pole-mounted signal heads shall also be provided.
- b. The need for one signal head per right turn lane should be determined on a site specific basis. Pedestrian signal heads should be provided for all marked crosswalks. Where pedestrian signal heads are provided, corresponding pedestrian push buttons shall be provided if normal vehicle phasing and timing do not guarantee sufficient pedestrian crossing time.
- c. Where left turn arrows are included, at least two signal heads with left arrow sections shall be provided, with one of these located on the far left pole.
- d. All mast arm and span wire mounted signal heads shall have aluminum louvered backplates, black in color.
- e. Red signal sections shall be 12" in all cases. All other signal sections shall also be 12" unless the signal is located in a residential area, in which case the other sections may be 8", with the approval of the Town Engineer or

Director of Public Works.

- f. Where mast arms extend over the left turn lane(s), left turn only sign(s) should be provided. Double lefts may be covered with one left turn only sign (R3-5) per lane, or one double left turn only sign located over the lane line between the double lefts.

#### 12.9.3 Pole and Cabinet Placement

All signal poles, pedestals and cabinets shall be placed a minimum of 3' from face of traffic signal item to face of curb where curbing is present, with a desirable separation of 5'. The traffic control cabinet shall be placed in a location such that guarantees adequate visibility of intersection and approaching traffic from all directions. The same separations apply from face of traffic signal item to outside edge of shoulder where pavement and shoulder exist with no curbing. Where only pavement exists without shoulder and curbing, a minimum of 5' from face of traffic signal item to edge of pavement shall be maintained, with a desirable separation of 7'.

#### 12.9.4 Signal Conduit

- a. All intersections undergoing initial development or construction that are anticipated to require signalization in the future shall include signal conduit at the time of initial road construction, in conformance with these Regulations. In this case, temporary plastic pull boxes colored green shall be used at termination points. Consultant Engineers should consult with the Town Department of Public Works to identify intersections to which this requirement applies.
- b. All conduit shall be Schedule 80 PVC.
- c. All electrical shall be separated from traffic signal conduit.

#### 12.9.5 Luminaries

Unless otherwise indicated, the Developer shall provide a luminaire extension and luminaire wiring. The final power hook-up and the actual luminaire shall be provided by the utility company.

#### 12.9.6 Vehicle Detectors

- a. Counting detectors shall be provided for each approach lane of traffic. These detectors shall be located 20' upstream of stopline detectors, or 10' upstream of the closest water type pull box where no stopline detector exists.
- b. On all approaches with free-flow speeds of 40-45 MPH and greater, consideration should be given to providing advance detection for dilemma zone protection. Site-specific conditions such as grades or sight distance obstructions may also justify use of advance detection. The potential need for advance detection in these cases should be reviewed with the Town Engineer or Director of Public Works.

#### 12.9.7 Signal Power

- a. In general, circuit breakers and power disconnects should be located internal to service meter assemblies and signal controller cabinets, and should not be readily accessible to the public.
- b. Typically a qualified signal installation and maintenance Contractor will be responsible for inspecting service installations and certifying acceptability to the utility company for hook-up.

#### 12.9.8 Traffic Pre-Emption System

- a. All traffic control signalization systems shall include a traffic pre-emption device controlled remotely by Fire and Rescue/Police units.

- b. The Developer shall provide two channel control at all intersections. System shall be capable of controlling direction of travel, including arrow direction.
- c. The Developer shall provide optical detectors for each direction of travel.
- d. The Developer shall provide one emitter to the Fire and Rescue Department and one emitter to the Police Department per new traffic signal.
- e. Any upgrade or directional addition to an existing traffic signal, shall include the installation of a traffic pre-emption system.

#### 12.9.9 Instructions and Wiring Diagrams

All equipment shall be provided with three sets of complete installation instructions, including a complete chart of field connections, as well as a manual for the controller, containing service instructions, wiring diagrams, trouble-shooting procedures, etc. Each and every component used shall be clearly referenced in the service manual, and its value, ratings and manufacturer part number shall be given.

#### 12.9.10 Guarantee

The Developer shall include all warrants and/or guarantees with respect to materials, parts, workmanship and performance of the product to be supplied. The minimum guarantee period for the product shall be two years from the date of final acceptance of the contract. The Developer shall attach a statement that all material to be supplied is either in exact accordance with the specifications, or shall list in detail any and all deviations therefrom. The supplying of equipment that is not in accord with the specification and on which the Developer has indicated no exception, shall be cause for rejection of the equipment and correction of the non-specification items entirely

at the Developer's expense.

## 12.10 Plantscaping

### 12.10.1 Sod and Seeding

#### 12.10.1.1 Sod Mix

Turf mix shall be approved by the Town, based on the activity to take place, planned irrigation method and maintenance to be performed in the area being sodded. In all cases, a drought tolerant mix shall be used that does not contain more than 20% bluegrass.

##### 1. Pre-approved Sod Mix:

60% Eldorado, Silverado and Monarch Turftype Tall Fescue.  
30% Manchar Smooth Brome.  
10% Bluegrass Mix (drought tolerant blends).

#### 12.10.1.2 Sodded Areas

Sod is required for landscaped areas on arterial rights-of-way, and at the bottom of detention ponds to be maintained by the Town. Other areas may require use of sod as determined by the Town Engineer or Director of Public Works.

#### 12.10.1.3 Submittals

Certificates showing State, Federal or other inspection, showing source and origin, if requested by the Town.

#### 12.10.1.4 Materials

##### 12.10.1.4.1 Sod

Sod shall have a clay-loam base that will not break or tear during sod installation. It shall have a

healthy, vigorous root system that has undergone a program of regular fertilization, mowing and weed control, to obtain thick turf free of objectionable weeds. It shall be free of nematodes, pests and pest larvae, as inspected by the entomologist of the State Department of Agriculture.

1. Thickness: 1" thick excluding top growth and thatch.
2. Thatch: Not to exceed 1/2" uncompressed.
3. Width: 18" wide strips.

12.10.1.5 Execution

12.10.1.5.1 Sod Cutting and Delivery

Cut no more than 24 hours prior to delivery, laid in place within 24 hours of delivery.

12.10.1.5.2 Transportation

Do not pile sod more than 2' deep. During delivery process, protect roots from exposure to drying sun, winds and heat. Store in shady area and keep moist or store covered with moistened burlap.

12.10.1.5.3 Timing

Install sod only between spring and fall. Do not install on frozen or saturated soil.

12.10.1.5.4 Watering

Lightly water area to be sodded.

12.10.1.5.5 Fertilizer

Distribute fertilizer uniformly at a rate of 50 lbs. per acre. Apply within 48 hours before laying sod.

Sodding:

1. Lay sod on slightly moist soil.
2. Lay with longest dimension parallel to contours in continuous rows.
3. Tightly butt ends of sod together. Stagger joints. Compact vertical joints between sod strips by rolling so sod will be in contact with the ground surface. Cut rows terminating on property lines to straight line.
4. When sod and soil are moist, roll sod lightly as soon as possible after laying with enough weight to ensure contact with soil for proper rooting.
5. Add topsoil along exposed edges to match existing grade; feather topsoil out approximately 1 foot.
6. Make sure filled sodded areas positively drain, so that no irrigation water or storm water will pond in sodded areas. Re-lay sod if necessary to correct.
7. Water thoroughly with fine spray immediately after planting.
8. Re-sod spots larger than 1 sq. ft. not having uniform stand of grass during warranty period.

12.10.1.6 Maintenance

12.10.1.6.1 Mowing

When grass reaches 3" in height, mow to 2" in height. Mow weekly and maintain grass between 2" and 2-1/2" in height. Do not cut off more than 1/3 of grass leaf in a single mowing. Remove grass clippings from all paved surfaces.

12.10.1.6.2 Fertilizing

Distribute fertilizer uniformly at a  
12.26

rate of 5 lbs. per 1000 sq. ft. of sodded area, three weeks after sodding is complete. Fertilizing thereafter is to be in accordance with standard maintenance practices for turf areas, and as needed to achieve and maintain a vigorous and healthy stand of grass.

12.10.1.7 Guarantee/Warranty

Warrant sodded areas for consistency and completion of coverage. Re-sod areas as needed to obtain acceptance by the Town. Once a vigorously growing stand of grass is achieved, the request for Construction Acceptance may be made.

12.10.2 Exterior Plants

12.10.2.1 General

12.10.2.1.1 Plant material to be designed and installed for ease of maintenance operations and safety. View triangles at intersection and offset of materials from edge of street curbing to comply with these regulations. Spacing between plant materials and vertical surfaces to allow for maintenance machinery requiring six-foot mowing berth. Trees to be spaced to accommodate the final canopy of the mature tree. Large trees to have minimum spacing of 40', mid-sized trees to have minimum spacing of 30', and small trees (ornamental) to have minimum spacing of 15'.

12.10.2.1.2 Principles of Xeriscaping to be followed in all landscape installation for publicly-owned and maintained areas.

- 12.10.2.1.3 Trees to be located 5' (min.) away from all utilities.
- 12.10.2.1.4 Certificates: State, Federal and other inspection certificates showing source or origin, (when requested by Town).
- 12.10.2.1.5 Samples: Mulch; canvas strap, or approved equal, (when requested by Town).

### 12.10.3 Materials

#### 12.10.3.1 Plants

Plants shall be first-class representatives of specified species or variety, in healthy condition with normal developed branch and root systems, free of objectionable features. Must conform to: American Joint Committee on Horticulture plant names; American National Standard Institute (ANSI); Colorado State Nursery Act of 1971.

1. Only plants grown in hardiness zones 2,3,4 and 5 are acceptable.
2. All material shall be free of disease, insects, eggs, larvae and parasites of objectionable or damaging nature.
3. Inspect plants to make sure they meet minimum size requirements of the Town and the plans, and for proper form including strong central leader and good branching pattern on trees and number and length of canes on shrubs:
  - a. Large deciduous trees (>30' mature height): 2" caliper measured 6" above ground.
  - b. Small deciduous trees (<30' mature height): 1 1/2" caliper measured 6" above the ground.
  - c. Evergreen trees: 6' in height.
  - d. Shrubs: 5 gallon container with deciduous shrubs approximately 2' high

and spreading shrubs having 18"-24" spread.

e. Groundcovers, vines, perennials: 1 gallon container.

12.10.3.2 List of Recommended Trees/Plants  
Common Name/Scientific Name

Alpine Currant	Ribes Alpinum M S
American Plum	Prunus Americana L S
Amur Corktree	Phellodendron Amurense LT
Annual Baby's Breath	Gypsophila Elegans VLA
Annual Coreopsis	Calliopsis Tinctoria VLA
Armstrong Juniper	Juniperus Chinensis "Armstrong" VLS
Armur Chokeberry	Prunus Maackii VLT
Asters, New York	Aster Novae-belgii LP
Austrian Pine	Pinus Nigra MT
Baby Cole Gaillardia	Gaillardia x Grandiflora "Baby Cole" VLP
Basket-of-Gold	Alyssum Saxatile LP
Bigtooth Maple	Acer Grandidentatum LT
Bishop's Weed	Aegopodium Podagraria MG
Blackeyed Susan	Rudbeckia Hirta Var. Pulcherrima LP
Blanket Flower	Gaillardia Aristata LP
Blood Red Geranium	Geranium Sanguineum VLP
Blue Chip Juniper	Juniperus Horizontalis "Blue Chip" LS
Blue Flax	Linum Lewisii VLP
Blue Pfitzer	Juniperus Chinensis-"Pfitzeriana Glauca" VLS
Blue Rug Juniper	Juniperus Horizontalis "Blue Rug" LS
Blue Spruce	Picea Pungens Glauca MT
Bluemist Spirea	Caryopteris Clandonensis LS
Bristlecone Pine	Pinus Aristata LT
Buffalo Grama	Bouteloua Gracilis VLL
Buffalo Grass	Buchloe Dactyloides VLL
Buffalo Juniper	Juniperus Sabina "Buffalo" VLS
Bugleweed	Ajuga Reptans MG
Bur Oak	Quercus Macrocarpa VLT
Burdandy Blanket Flower	Gaillardia x Grandiflora VLP
California Poppy	Eschscholtzia Californica VLA
Candytuff	Iberis Sempervirens MP
Canyon Maple	Acer Grandidentatum VLT
Carpathian Hairbell	Campanula Carpatica LP
Caucascus Geranium	Geranium Caucascus VLP
Columbine	Aquilegia spp. MP
Common Primrose	Primula Vulgaris "Julian Mix" MP
Compact Cranberrybush	Viburnum Trilogum "Compactum" MS
Cottage Pinks	Dianthus Plumarius LP
Cranberry Cotoneaster	Cotoneaster Apiculata MS
Cranberry Viburnum	Viburnum Trilobum MS
Creeping Baby's Breath	Gypsophila Repens LG
Creeping Grape-Holly	Mahonia Repens MG

Creeping Juniper	Juniperus Horizontails VLG
Creeping Phlox	Phlox Subulata LG
Creeping Potentilla	Potentilla Verna Nana MG
Creeping Red Penstemon	Penstemon Pinnafolius VLG
Creeping Veronica	Veronica Repens MG
Curleaf Mt. Mahogany	Cercocarpus Ledifolius VLS
Day Lily	Hemerocallis spp. LS
Dotted Gayfeather	Liatris Punctata VLP
Double Sunburst Coreopsis	Coreopsis Lanceolata "Sunburst" LP
Dwarf Arctic Willow	Salix Purpurea Nana MS
Dwarf Blue Rubber Rabbitbrush	Chrysothamnus Nauseosus Pumila VLS
Dwarf Indigo Bush	Amorpha Nana VLS
Dwarf Korian Lilac	Syringa Meyeri MS
Dwarf Winged Euonymus	Euonymus Alata Compacta MS
Euphorbia	Euphorbia Myrsinites LG
Evening Primrose	Oenothera spp. LPP
Evergreen Candytuft	Iberis Sempervirens LP
False Sunflower	Heliopsis Helianthoides "Summer Sun" VLP
Four O'Clock	Mirabilis Jalapa MA
Fringed Sage	Artemisia Frigida VLG
Garden Lily	Lilium spp. MP
Gayfeather	Liatris Punctata VLP
Globe Amaranth	Gomphrena Globosa MA
Goblin Gaillardia	Gaillardia x Grandiflora "Goblin" VLP
Gold Drop Cinquefoil	Potentilla Fruticosa "Gold Drop" MS
Golden Currant	Ribes Aureum LS
Golden Raintree	Koelreuteria Paniculata LT
Green Ash	Fraxinum Pennsylvanica LT
Green Mound Juniper	Juniperus Chinensis Procumbens "Green Mound" MS
Hardy Ice Plant (Blue)	Delosperma Nubigenum VLG
Hardy Ice Plant (Yellow)	Delosperma Cooperi VLG
Himalayan border Jewel	Polygonum Affine LG
Hughes Juniper	Juniperus Horizontalis "Hughes" VLS
Iceland Poppy	Papaver Nudicale LP
Jackman Cinquefoil	Potentilla Fruticosa "Jackmani" MS
Kalmia St. Johnswort	Hypericum var. Kalmianum MS
Kentucky Coffeetree	Gymnocladus Dioicus MT
Kinnickinnick	Arctostaphulos Uva-ursi MG
Lamb's Ear	Stachy's Byzantina LP
Littleleaf Mockorange	Philadelphus Microphyllus LS
Mexican Cliffrose	Cowania Mexicana VLS
Missouri Evening Primrose	Oenothera Missouriensis LP
Moneywort	Lysimachia Nummularia MG
Moss Rose	Portulaca Grandiflora LA
Mountain Alyssum	Alyssum Saxatile VLP
Mountain Bachelor Button	Centaurea Cyanus VLA
Mountain Snowberry	Symphoricarpos Oreophilus LS
Mugho Pine	Pinus Mugo Mughus LS
Nannyberry Bush	Viburnum Lentago MS
Narrowleaf Cottonwood	Populus Angustifolia LT
Native Blue Columbine	Aquilegia Caerulea MP

New Mexican Privet  
One Seed Juniper  
Pasque Flower

Forestiera Neomexicana VLS  
Juniperus monosperma VLT  
Anemone pulsatilla LP

Water Use

VL=Very Low  
L-Low  
M-Moderate

Plant Type

P-Perennial  
T-Tree  
S-Shrub  
G-Groundcover  
A-Annual

12.10.3.3 Backfill Mix

Mix shall consist of the following and be used in backfilling all plant materials:

1. One part premium-3 composted aspen humus, by A-i Organics, or approved equal; two parts topsoil; three parts native soil from planting pits; sulpherphosphate amendment.
2. All materials to be thoroughly blended.

12.10.3.4 Stakes and Guys

Shall be standard guying system unless previously approved.

1. Standard Guying System:
  - a. Stakes-6' long, heavy duty T-bar steel posts with white tops.
  - b. Guys-17 gauge galvanized steel wire.
  - c. Miscellaneous-White tee post caps; Canvas strap; White plastic flagging tape; 4" wide Kraft tree wrap, or approved equal.
2. Alternate Guying System (Conifers only):
  - a. Stakes-30" long, heavy duty T-bar steel posts with white tops.
  - b. Guys-17 gauge galvanized steel wire.

c. Miscellaneous-White tee post caps;  
Canvas Strap; White PVC 1/2" diameter  
pipe; 4" wide Kraft tree wrap, or  
approved equal.

12.10.3.5 Mulch

Aspen bark mulch, or approve equal.

12.10.3.6 Weed Barrier Fabric

Mirafi geotextile fabric, or approved equal.

12.10.3.7 Steel Edging

3/16"x4"x16" Ryerson steel edging, or  
approved equal.

12.10.3.8 Locate all utilities prior to trenching and  
protect from damage.

12.10.4 Execution

12.10.4.1 Delivery and Storage of Plant Materials

Spray broad-leaved trees with anti-  
transpirant prior to delivery. Balled (B&B)  
trees should have limbs bound to prevent  
injury during delivery. Keep root systems  
moist and protect plants from adverse  
climate and transportation conditions. B&B  
stock shall be heeled in immediately upon  
delivery to the site, unless it is planted  
within 4 hours. Store other plants in shade  
and protect from adverse weather and from  
drying out. When handling, do not lift  
plants by trunk or stem, handle only ball or  
container.

12.10.4.2 Layout

1. Stake plant locations or set out plants  
per plans. Verify prior to planting  
that plants when mature will not  
interfere with existing trees,  
irrigation, lighting, utilities and  
other equipment, both underground and  
overhead. Verify spacing between trees

and other hard surfaces to be a minimum of 6' for ease of maintenance operations. Notify Town for approval if plant locations must be changed.

#### 12.10.4.3 Excavation of Planting Pits

Excavate planting pits per Town of Bennett details; dispose of any rocks off site.

1. Trees: depth of pit shall be 2" (non-irrigated areas) to 4" (irrigated areas) less than the depth of the root ball so that water will drain away from trunk. Modify depth of pit if soil conditions warrant and per Town direction. Diameter of planting pit shall be 2 times the diameter of the root ball (min).
2. Shrubs: depth of the pit shall be the same (deciduous) or 2" (coniferous) less than the root ball so that water will drain away from the trunk. Modify depth of pit if soil conditions warrant and per Town direction. Diameter of the pit shall be 2 times the diameter of the root ball (minimum).

#### 12.10.4.4 Planting

1. B&B trees: (Do not plant if ball is cracked or broken before or during planting process):
  - a. Remove bottom 1/3 of wire basket from root ball grade, and plumb.
  - b. Face for best effect.
  - c. Cut and remove remaining wire and twine. Do NOT pull wrapping or wire from under ball as it may damage the root ball.
  - d. Backfill 2/3 of pit; remove top 1/3 of burlap; complete backfill. DO NOT compact backfill mix by tamping. DO NOT backfill over crown of root ball or exceed soil depth of root ball; crown must be at proper planting

depth. Install 5" high watering basin around trees.

1. Remove and grade out berm around basin after two thorough waterings in irrigated areas. Mulch after berm basin is removed.
  2. Mulch and leave basin in dry land areas.
2. Container-grown stock: (Do not plant if root ball is cracked or broken before or during planting process.)
    - a. Carefully remove plants from containers without injury or damage to root ball; do not cut cans with spade or ax.
    - b. Vertically score root ball using sharp knife, about 1/8" deep and about every 2-3" in circumference. If stock is root bound, butterfly root ball by cutting ball in half, halfway up from the bottom; flair root ball out to sides when planting.
    - c. Set plant plumb, make sure crown of root ball is at correct grade.
    - d. Backfill and install 4" high watering basin around planting pit. DO NOT compact backfill mix by tamping. DO NOT backfill over crown of root ball or exceed soil depth of container; crown must be at or slightly above finished ground level. Mulch after 2 thorough waterings.
  3. Completion of planting:
    - a. Shape slope of finish grade around root ball so water drains away from trunk or stems and to match flush grade at the edge of the planting pit.
    - b. Remove plant tags from trees and shrubs.

#### 12.10.4.5 Edging

Install so top of edging is 2" above finish grade and flush with the top elevation of curb or pavement which it abuts. Edging

shall meet pavement or curb at right angle. Stake at manufacturer's recommended intervals on smooth radius using steel stakes. Punch holes as needed for drainage.

#### 12.10.4.6 Mulching

1. Mulch depth:
  - A. Tree pits-4" deep, keep 2" from trunk.
  - B. Shrub pits-3" deep.
  - C. Remaining shrub bed-4" deep (min).
  - D. Groundcover beds-3" deep (min).
2. Place geo-textile landscape fabric under mulch in all areas except where specifically approved for omission. Lay straight and even with 8" overlap at edges. Staple along edges with steel U pins on 24" spacing. Staple folds in fabric to keep below mulch material.
3. Timing: Mulch within two days of planting or after specified number of waterings for individual trees and shrubs.

#### 12.10.4.7 Staking And Guying

1. Standard Guying System: Pound stakes into undisturbed soil beyond the planting pit so that stake is secure (2' deep minimum). Secure wire through metal grommets on canvas strap and wrap above first branch, or at mid-point of tree. Secure guy wire to stake so that it is taut, but not overly tight, and so that no sharp projections of wire are extending from post. Adjust tension on wire, if needed. Place caps on top of stakes and flag guy wire for visibility.
2. Alternate (Conifer) Guying System: Pound stakes into undisturbed soil beyond the planting pit, so that stake is secure (2' deep minimum), angling away from planting pit and so that top is flush with finish grade. Secure wire through metal grommets on canvas strap and wrap at mid-point of tree. Secure guy wire to stake so that it is taut but not overly tight

and so that no sharp projections of wire are extending from post. Adjust tension on wire if needed. Place PVC pipe on guy wire for visibility.

12.10.4.8 Pruning

Prune minimum necessary to remove injured twigs and branches, deadwood and suckers to insure healthy tree. Do not prune central leader.

12.10.5 Completion Services

12.10.5.1 Project Clean-Up

Remove all excess materials, tools, rubbish and debris from sites.

12.10.5.2 Construction Acceptance Inspection by the Town's Public Works Department

Schedule a project walk-through after all landscape installation is complete. Public Works will compile a punchlist of items for the Developer to resolve.

12.10.5.3 Request Construction Acceptance

After all punchlist items, as noted by the Town's Public Works Department are complete, request Construction Acceptance from the Town's Public Works Division.

12.10.5.4 Maintenance

Developer is responsible for continuous, on-going maintenance of project until Final Acceptance at the end of a two-year (typical) warranty period. Maintenance shall insure optimal health and vigor of plant materials, and include replacement and/or adjustment of mulch, staking, guying, weeding and other installations, as needed, to maintain specifications. Developer shall also install tree wrapping at the end of the growing season. Wrap trees with specified tree wrap and secure with flexible tape. Remove wrap in spring, prior to May.

12.10.5.5 Final Acceptance Inspection From The Town's Public Works Department

Town personnel will perform a final acceptance project inspection to ensure vigor of plant materials and other installations as applicable. Developer to complete punchlist of items requiring resolution prior to Final Acceptance.

12.10.5.6 Request Final Acceptance

Developer to request Final Acceptance from the Town's Public Works Department.

12.10.6 Irrigation

12.10.6.1 At the Town's discretion, applicable watering systems may be required.

12.10.7 Guarantee/Warranty and Replacement

For the period prior to Final Acceptance, all plant materials, landscape materials, workmanship and other appurtenances are to be guaranteed/warranted against defects. Setting of depressions, replacement of dead or diseased plant materials and other defects are to be corrected by the Developer at no cost to the Town. Plant materials that are in an unhealthy or unsightly condition, or that have lost their natural shape, due to dead branches or excessive pruning of dead branches, are to be replaced at no cost to the Town.

Guarantee/Warranty applies to all originally-installed materials, and to replacements made during the guarantee/warranty period.

12.11 Erosion control

12.11.1 Policy, Submittal and Review Specifications

12.11.2 Policy

It is of the Town to encourage maintenance of the natural balance between sediment supply and

transport. An undisturbed parcel of land is part of an overall erosion and sediment discharge system. For water erosion, the watershed above a stream contributes sediments that are transported downstream. Deviations from the natural watershed erosion rate will result in changes of topography, stream alignment and water quality.

The Town encourages wind and water erosion control by leaving land undisturbed as long as possible (project phasing) and re-establishment of dry land grass on disturbed lands. This is based on the desire to maintain and/or return disturbed terrain to its natural appearance and erosion control capabilities. Additionally, the Developer and the Town will derive the benefits of low maintenance ground cover and non-point source pollution control.

#### 12.11.3 Elements of an Erosion Control Plan

Erosion control plans shall consist of the elements noted below. For developments subject to the subdivision permitting process, these will be submitted with the Preliminary (Phase II) and Final (Phase III) Drainage Reports. All reports shall be typed on 8-1/2"x11" paper and bound. Drawings, figures, plates and tables shall be bound with the report. The report shall include a cover letter presenting the plan for review and shall be prepared by or supervised by an engineer licensed in Colorado or a Certified Professional Erosion and Sediment Control Specialist.

##### 12.11.3.1 Standard and Job Specific Construction Details of Erosion Control Measures.

- a. If structural measures identified in these Regulations are to be used, cite and/or provide accompanying specifications. If other types of structural measures are to be used other than from these Regulations, provide complete specifications.

- b. If non-structural measures identified in these Regulations are to be used, cite and/or provide accompanying specifications. If other types of non-structural measures are to be used other than from these Regulations, provide complete specifications.

#### 12.11.3.2 Detailed Schedule of Erosion Control Activities

A time schedule will be submitted as part of the erosion control plan for all major construction and erosion control activities, including overlot grading and construction of permanent drainage facilities. The schedule will be used by the Town to inspect construction sites for compliance with the plan.

Changes from this time schedule must be submitted in writing to the Town for approval prior to implementing changes. Major deviations from the original time schedule without Town approval may result in stoppage of work or calling of the security. Approval or disapproval of schedule change will be made in 20 working days.

The construction schedule will include at least the following:

- a. Overlot grading or land disturbing activity.
- b. Drainage construction.
- c. Sediment traps/basins, temporary channel stabilization.
- d. Seeding.
- e. Mulching.
- f. Required maintenance activities hay bale replacements.
  - ii. Expected sediment pond cleaning (based on sediment yield calculations).

g. Security default date.

If the Developer desires to overlot grade and implement an erosion control plan prior to approval of the Final Drainage Study, both a preliminary and final erosion control plan may be submitted under a separate cover. This does not imply an approval of subsequent submittals. Refinements of the erosion control plan will be required when final drainage plans are submitted.

#### 12.11.4 Security

Grading permits will not be issued without security to insure rehabilitation of the disturbed land. A letter of credit or cash escrow acceptable to the Town and naming the Town as the protected party, is required. The amount of the security will be based on 115% of the Developer's Consultant Engineer's estimate (sealed and signed) or 115% of the cost to plant the disturbed land into dry land grass based upon unit cost determined by the Town, whichever is greater. In no instance, shall the amount of security be less than \$2,500.

It is the Town's intention to not administrate construction of erosion control plans in the event of calling of securities. Therefore, cash escrows or letters of credit are to be in the favor of a bonding company. Should the provisions of approved erosion control plans not be complied with, the Town will call the security by requiring the bonding company to execute the erosion control plan. The Town reserves the right to enter upon the land to have the plan executed and make repairs as necessary.

The cash escrow or letter of credit, which will be in favor of a bonding company, will be returned to the land disturber within sixty days of completion of the land disturbing activity as defined below. Completion of the land disturbing activity means final stabilization of the land as contemplated by

the erosion control plan. Further, completion shall be determined by a representative of the Town, who will notify the applicant in writing. The warranty period for all erosion control measures shall be two growing seasons.

Three months prior to expiration of the warranty period, the applicant is required to schedule a walk-through with a Town representative. Warranty will not expire without compliance with this procedure.

#### 12.11.5 Submittal and Review Specifications

Control measures are necessary for each phase of development and it is understood that initial grading and construction will require certain control measures that will change or be replaced as development progresses into advanced stages. For example, temporary control measures such as straw bales or diversion structures might be used during initial grading and construction phase and later either be removed completely or replaced with grass or permanent sediment basins. The final control plan will include a schedule that illustrates all steps taken during the entire development period.

##### 12.11.5.1 Preliminary Submittal (PhaseII)

12.11.5.1.1 Drawings use same base map as that for drainage study. All drawings shall be 24"x36" in size. A general location map shall be provided in sufficient detail to identify drainage flow entering and leaving the development and general drainage patterns. The map shall be at a scale of 1"=500' to 1"=2000' and Show the path of all drainage from the upper end of any off site basins to major drainage ways. The map shall identify any major construction (i.e., development, irrigation ditches, existing detention

facilities, culverts, storm sewers) along the entire path of drainage. Basins and divides are to be identified and topographic contours are to be included.

The Erosion Control Plan drawings of the proposed development or redevelopment shall have a scale of 1"=20' to 1"=200' on 24"x36" drawings. Illustrations which identify the location of proposed erosion control measures will be placed on maps depicting proposed final contours.

12.11.5.1.2 Erosion Hazard - Discussion of how site characteristic (soils, vegetation erodibility) will influence both wind and water erosion.

12.11.5.1.3 General discussion of type of erosion control program necessary to prevent sediments from leaving the site.

12.11.5.1.4 General discussion on season of erosion causing activities, erosion control devices and effectiveness of establishing vegetation.

12.11.5.2 Final Submittal (Phase III)

Drawings-detailed drawing of construction of erosion control program of the size and meeting the criteria noted under Preliminary Submittal.

12.11.6 Standards

Erosion control measures shall be implemented on developing and redeveloping sites such that the following Standards of performance will be met.

#### 12.11.7 Emphasis

The emphasis of this Sub-Chapter is on erosion and sediment control from the surface of disturbed land by either wind or water.

During certain seasons, wind erosion may far exceed water erosion. Consequently, land disturbing activities must address both types of erosion.

An important concept of this Sub-Chapter is that erosion and sediment control options are available to the land disturber. Standard details and specifications are provided to streamline the design process. Where applicable, the designer of an erosion control plan has the option to utilize other approved details and specifications. A sound understanding of these concepts will provide the land disturber an opportunity to coordinate erosion control and other construction activities to minimize costs.

#### 12.11.8 Submittal Timing

A Grading Permit is required for most land disturbing activities, including clearing, grading, excavation and fill placement. An Erosion Control Plan **MUST** be approved prior to the granting of the Grading Permit.

#### 12.11.9 Responsible for Erosion Control

Erosion control plans are required for nearly all land disturbing activities in the Town. The following outlines the responsibility of different types of development.

##### 12.11.9.1 Developer

Any individual, company or corporation which engages in land development such that construction activities will result in disturbing one acre or more.

- a. Erosion control plans as described in these Regulations are required to be submitted to, and approved by, the Public Works or Engineering Division.
- b. Measures to protect inlets.

**12.11.9.2 Builder**

Any individual, company or corporation which constructs dwellings on land prepared by a developer.

- a. Maintain those erosion control methods implemented by the developer which are within the legal land boundaries on which dwellings are being constructed by the builder.
- b. Submit site specific erosion control plans to the Public Works or Engineering Division for approval. The plans must address maintenance of existing erosion control structures and identify how sediment associated with water will be retained on sites undergoing construction activities.
- c. Develop a maintenance plan for minimizing the tracking of sediment onto streets and roads due to traffic on and off sites undergoing construction activity.
- d. Develop a maintenance plan for frequent removal of sediment from streets and roads.

**12.11.9.3 Single Lot Owner**

Any individual, company or corporation which constructs a single residential structure on land within the Town's jurisdiction.

- a. Site specific erosion control plan which addresses how sediment from the lot being developed will be controlled such that minimal impact will occur to adjacent lot owner or downstream.
- b. Maintenance program which will minimize

sediment from lot being tracked onto public roads.

#### 12.11.9.4 Road/Street Construction Activities

Any action that results in building or altering of roads/streets and their accompanying drainage systems.

- a. Erosion control plans must be submitted to, and approved by the Public Works or Engineering Division. The plans will address all items presented in this Sub-Chapter.
- b. Detailed erosion control measures must be provided to protect at least the following:
  1. Inlets and culverts which discharge runoff onto downstream properties or into streams or other water body.
  2. Drainageways having channel flow lines which exceed one percent.
  3. Streams or other water bodies which are immediately adjacent to land disturbed by construction activity.
  4. Cut and fill areas where exposed soil exists.
  5. Properties adjacent to construction activity.

Additional erosion control measures beyond what is described above may be required by the Public Works or Engineering Division.

#### 12.11.10 Wind Erosion Control

##### 12.11.10.1 General Information

The direction of wind borne sediment is determined by the prevailing direction wind. Prevailing winds in Town are generally from the northwest, although

local physiographic conditions can significantly change the direction.

Wind erodes large quantities of soil from sites where protective vegetation has been removed. Fifteen tons/acre is generally accepted as the lowest rate at which erosion can be readily observed by the eye. Annual sediment loss due to wind erosion can easily exceed 30 ton/acre if no protection is provided. The Colorado Dust Blowing Act of 1954, as amended in 1981 and 1983, relates to damages caused by blowing soil.

The main factors affecting soil blowing are:

- \* The condition of the soil surface (i.e. moisture, texture, structure and roughness),
- \* Vegetative cover,
- \* Unprotected or unsheltered distance, and
- \* Wind velocity.

The potential for unprotected soil to blow varies greatly from year to year depending upon soil moisture and wind conditions. The highest potential exists in late fall through early spring because of two factors. First, protective vegetation cannot become established during this time period, and second, the highest sustained wind velocities occur during this time period.

The main method of dust abatement and wind erosion control during road construction is by means of regularly wetting the bare road surface with water or a water based emulsion.

For other denuded areas within the road right-of-way and for construction adjacent to it, there are three additional basic

methods of wind erosion control.

1. Protect the soil surface with vegetation, mulch and/or erosion control blankets.
2. Roughen the soil surface with implements.
3. Reduce surface velocity with wind barriers.

#### 12.11.10.2 Wind Erosion Control Criteria

12.11.10.2.1 Roadways under construction shall be watered regularly and to the full satisfaction of the Town Engineer or the Director of Public Works.

12.11.10.2.2 All other sites under development will be protected from wind erosion from November 1 through May 31 by one or more of the following methods:

- a. Live vegetation evenly distributed over 30 percent of the entire disturbed area. Covering 30 percent of the soil surface with non-erodible material will reduce soil losses by 80 percent. Roughening the soil surface with implements that produce ridges perpendicular to the prevailing wind can also reduce wind erosion by more than 80 percent.
- b. Standing cover crop stubble.
- c. Crop residue evenly distributed over 50 percent of the entire disturbed area.
- d. One half ton per acre of hay, straw, paper or wood fiber hydraulic mulch properly anchored or applied according to manufacturer's specifications.

- e. Surface binding materials applied according to manufacturer's specifications.
- f. Maintain a rough soil surface with ridges and wind barriers perpendicular to the prevailing wind direction. Wind barriers include snow fences, trees, shrubs, grasses, screens, natural terrain or other natural or manmade structures greater than one foot high and causes wind-suspended sediment deposition to occur. Barriers will be installed in a east-to-west direction with a maximum spacing of 200'. The most down wind barrier will be placed inside the site boundary at a distance of 10 times the barrier height.

Since, the erosive power of the wind varies with the cube of the velocity, even a small decrease in velocity can have a major impact in reducing wind erosion. In addition, nearly 85% of the sediment transported by wind travel at a height of less than 6" above the soil surface. Therefore, even low barriers can be effective in reducing wind borne sediment.

12.11.10.3 Sites excluded from wind erosion control requirements must meet at least on of the following criteria.

12.11.10.3.1 Thirty five percent or more of the unprotected surface is covered by coarse soil particles greater than 2mm in diameter (i.e. gravel, stones, etc.).

12.11.10.3.2 Site of 1 acre or less.

12.11.10.4 For exposed bare soil lengths of 100' or greater, one or more of the following measures shall be utilized within two days after overlot grading commences.

a. Soil sealant/stabilizer. Hydraulically applied liquids or dispersible powders which include synthetic emulsions, water soluble polymers, natural plant gums and petroleum resin emulsions.

b. Hydraulic mulches. Fiber mulches hydraulically applied consisting of wood fiber or recycled paper.

c. Planting of dryland grass and use of hay or straw mulch.

d. Asphalt and/or concrete cover.

#### 12.11.11 Structural Sediment Control

##### 12.11.11.1 General Information

Structural erosion control methods are used to reduce sediment which is moving with water. This section summarizes standard designs of the more commonly used structures. Other structures may be accepted if detailed plans and supporting information are submitted with the final erosion control plan.

##### 12.11.11.2 Sediment Traps

###### 12.11.11.2.1 Application

Sediment traps shall be sized and constructed as the first step in overlot grading. When a storm water

detention facility is required, it is suggested the sediment trap be placed in the same location. If detention outlet works are installed, they shall be modified so as to prevent short circuiting of the trap's ability to settle soil particles.

Sediment traps should be used for tributary drainage areas which do not exceed five acres. If the tributary drainage area is more than five acres, consideration should be given for development of a sediment basin that requires more detailed engineering design and hydraulic consideration.

#### 12.11.11.2.2 Design Data

Drawing No. EC-1 within the back of this Chapter illustrates a typical sediment trap. Sediment traps shall be designed to the following criteria:

- a. The sediment trap volume shall be calculated using  $V_p/A_b$  information found on Drawing No. EC-1.
- b. The basin length to width ratio of at least 2:1 should be achieved.
- c. Initial basin depth shall be no more than four feet from spillway flow line to bottom of the pond.
- d. Excavation of pond bottom for anticipated sediment will be based upon the sediment yield equation shown on Drawing No. EC-1.

- e. Embankments and spillways shall be properly designed and constructed with compaction control.

#### 12.11.11.3 Maintenance

Sediment shall be removed when one half of the trap design depth has been filled. Removed sediments shall be deposited in an area tributary to a sediment trap or other filtering device.

#### 12.11.11.4 Straw Bales

##### 12.11.11.4.1 Application

Straw bales may be used as a perimeter filter barrier or to stabilize temporary channel flow lines. Proper installation of straw bales is illustrated on Drawing No. EC-2.

##### 12.11.11.4.2 Perimeter Filter Barriers

When straw bales are used as a perimeter filter barrier, they are placed in a location to treat runoff from areas where water will not enter a sediment trap/basin or other means of treatment. They usually are limited to 0.25 acres per 100 feet of barrier.

##### 12.11.11.4.3 Channel Drop Structures

WHEN CHANNEL FLOW LINES EXCEED 1.0%, MITIGATION MEASURES WILL BE INSTALLED UNTIL FINAL RIGID OR VEGETATIVE LININGS ARE ESTABLISHED.

When used to stabilize channel flow lines, straw barriers shall be

installed according to Drawing No. EC-3 or EC-4. If the design does not allow for proper installation of straw barriers, other means of channel protection may be required (e.g., lining with an erosion control blanket).

#### 12.11.11.4.4 Rough Cut Roads

If rough-cut roads (i.e., prior to installation of the subbase and/or pavement) are to remain unpaved for more than 60 days, straw bale barriers will be installed. All rough-cut roads shall have straw bale barriers placed on alternating sides, perpendicular to the sides, extending to the road centerline and at 150 foot intervals. The maximum distance between barriers along the road will be 75'.

#### 12.11.11.4.5 Maintenance

Straw bales that have not been replaced for other reasons may have to be changed after they have been in use for one year since the maximum life of straw bales is typically 12 months. However, straw bale barriers may be used for a longer period if the Developer obtains approval from the Engineering or Public Works Division based on a field inspection.

Inspect and repair straw bale barriers after each storm event. Sediment should be removed when one half of the bale height has been filled. Removed sediment shall be deposited in an area tributary to a

sediment trap or other filtering device.

#### 12.11.11.5 Inlet Filters: Straw Bale and Gravel

##### 12.11.11.5.1 Application

All storm drainage system inlets will be filtered before water is discharged into streams or onto adjacent properties unless the same (or better) level of treatment is available downstream. The following methods are applicable to drain systems that will be operational before the drainage basin is stabilized. The maximum drainage area tributary to an inlet filter without downstream treatment is one acre.

##### 12.11.11.5.2 Drop (Area) Inlets

Water entering drop inlets in unpaved areas shall be filtered with straw bales anchored with wooden stakes (see Drawing No. EC-2) or by gravel filters (see Drawing No. EC-6). Installation of straw bales shall also follow the guidelines illustrated on Drawing No. EC-5. Drop inlets in paved areas shall have gravel filters only. Materials other than straw bales or gravel must be demonstrated to provide the same level of treatment before acceptance by the Town.

##### 12.11.11.5.3 Curb Opening Inlets

Curb-opening inlets shall be filtered with a combination of concrete blocks, 1/2" mesh wire

screen and coarse gravel (3/4") constructed according to Drawing No. EC-7.

#### 12.11.11.5.4 Maintenance

All inlet filters shall be inspected and needed repairs made after each storm event. Sediments shall be removed when one half the design depth has been filled. Removed sediments shall be deposited in an area tributary to a sediment basin. Sediment shall be removed immediately from the traveled way of roads and streets. Finally, periodic raking of the coarse gravel will be required to ensure proper infiltration and filtering efficiency.

#### 12.11.11.6 Filter Fence Barrier

##### 12.11.11.6.1 Application

Filter fences can also be used to control sediment which may flow directly onto adjacent property or into a stream. They may also be used within a site where such treatment is needed to achieve the required Performance Standard. The contributing drainage area should not be greater than 0.65 acres over 100 feet of fence. Actual limitation will be the barrier holding capacity which is dependent upon the contributing basins' sediment yield and maintenance requirements. Filter fences shall be installed according to Drawing No. EC-8 or as recommended by the manufacturer's specifications.

#### 12.11.11.6.2 Maintenance

Filter fences that have not been replaced for other reasons may have to be changed after they have been in use for one year since the maximum life is typically 12 months. However, filter fence barriers may be used for a longer period if the Developer obtains approval from the Engineering or Public Works Division based on a field inspection.

Inspect and repair (if required) filter fence barriers after each storm event. Sediment should be removed when one half the height of the fence has been filled. Removed sediment shall be deposited in an area tributary to a sediment trap or other filtering device.

#### 12.11.12 Non-Structural Erosion Control

##### 12.11.12.1 General Information for Vegetation Establishment

The best method to control erosion is to prevent initial sediment movement by establishing vegetation on disturbed lands. However, improper use of seed and mulch and planting at the wrong time of the year, may result in failure in establishing vegetation. Therefore, this section provides information and guidelines to assist in proper establishment of vegetation for control of rainfall erosion and wind erosion. To that purpose the following methods are to be used.

## 12.11.12.2 Permanent Controls

### 12.11.12.2.1 Soil Material/Top Soiling

Sites to be established in permanent dry land grass must have soils capable of supporting the type and quantity of cover needed for erosion control. Topsoil is frequently the determining factor in obtaining an adequate cover of dry land grass. Grading often exposes subsoil's that are susceptible to erosion, not fertile, low in organic matter and difficult to revegetate.

In general, 18" of soil material are needed to store enough moisture and nutrients to support dry land grass in the Town's semi-arid climate.

BEFORE APPLYING TOPSOIL, THE DISTURBED AND COMPACTED LAND MUST BE RIPPED OR SCARIFIED TO A MINIMUM DEPTH OF FOUR INCHES.

### 12.11.12.2.2 Fertilizer Requirements

Fertilization increases plant vigor and promotes deeper rooting. If, however, the native topsoil is replaced to an adequate depth, fertilizer use at the time of seeding ordinarily does not increase the percentage of emergence. In some instances, fertilizing at the time of seeding (e.g., spring) dramatically increases competitive weed growth. Consequently, if fertilizing results in increased weed growth, an adequate weed management program will also have to be implemented.

The following fertilizer guidelines shall be used in the erosion control plan seeding specifications:

- a. Sites will be fertilized according to laboratory soil analysis and recommendation, or
- b. If approved by the Engineering or Public Works Division in absence of a soil analysis, a minimum of 40 pounds of available nitrogen and 40 pounds of available phosphorus will be applied per acre.

#### 12.11.12.2.3 Seedbed Preparation

A good seedbed must be firm (well settled) and relatively free of competitive plants. Competitive vegetation should be controlled by shallow tillage or by herbicide application. The seedbed must be friable enough to allow placement of seed at the proper depth. Soils that have been over-compacted by traffic or heavy equipment should be ripped or tilled to break up restrictive layers and then harrowed or rolled to form the seedbed.

**IN NO CIRCUMSTANCES SHOULD THE SOIL SURFACE BE LEFT SMOOTH BEFORE PLANTING SEED.**

Rough soil surfaces reduce wind and water erosion, lessen wind damage to young plants and retain additional moisture for plant establishment.

#### 12.11.12.2.4 Depth of Seeding

Proper seeding depth is governed by two factors: seed size and soil

type. The general rules governing seeding depth are:

1. The larger the seed, the deeper it should be planted and, conversely, the smaller the seed, the shallower it should be planted.
2. The sandier the soil, the deeper the seed should be planted and the heavier the soil the shallower it should be planted.

Broadcast seed covered by harrowing or other method results in some seed being covered too deeply by soil and some seed not being covered with enough soil. A mixture of small and large seeds is often beneficial when broadcasting.

#### 12.11.12.2.5 Methods of Planting Seed

Because of increased accuracy of seeding depths and rates, seed should be planted with a grass drill whenever machinery operations are possible. Row spacing are not to exceed eight inches for the grass drill.

Sites that are small, too steep or not accessible for drill seed operations may be broadcast by hand or mechanical spreader. Seeds must be covered by soil to germinate and become established.

Broadcasting requires at least twice as much seed (see Table 12.1) as drill seeding since many seeds will be planted too shallow or deep to

allow for germination. In addition, the soil is often poorly compacted around the seed.

#### 12.11.12.2.6 Time of Seed Planting

To increase chances of rapid establishment, planting should be completed prior to the time when precipitation and soil moisture conditions exceed evaporation rates. Permanent dry land grass seeding can occur from October 1, when the seeds will lay dormant, until May 15 when the soil warms in the spring.

COOL SEASON GRASSES, WHICH MAKE THEIR MAJOR GROWTH IN THE SPRING, SHOULD BE PLANTED AS EARLY AS POSSIBLE BEFORE MAY 15. WARM SEASON GRASSES, WHICH MAKE THEIR MAJOR GROWTH IN LATE SPRING AND SUMMER, CAN BE PLANTED UP TO MAY 31 (SEE TABLE 12.4).

Late summer to early fall plantings have been successful for cool season plantings in Town. In such cases, seed often germinates and grows during the fall and becomes established prior to the winter dormancy period.

#### 12.11.12.2.7 Recommended Seed Mixtures and Application Rates

Planting rates are normally expressed in the quantity of viable seed in pounds per acre. The actual number of seeds per unit area is a critical factor. In Town, drilled rates on favorable sites should approximate 40 to 50 pure live seeds per square foot. Rates

significantly exceeding this amount lead to stands of grass that are too dense. As a result, competition for moisture during summer months often causes slow development in the newly seeded areas.

For the Town, Table 12.1 provides detailed information on the types of seed to be used for establishing perennial grass in the eastern plains of Colorado.

FOR ESTABLISHING PERENNIAL GRASSES, AT LEAST THREE SPECIES MUST BE USED. IF SEED IS PLANTED BY MEANS OTHER THAN A DRILL, THE APPLICATION RATE MUST BE DOUBLED FOR SLOPES 4:1 OR FLATTER AND QUADRUPLED FOR STEEPER SLOPES.

- a. Seed labeling, quality, and seed testing will be in accordance with the Colorado Seed Law.
- b. Seed tags will be attached to seed bags at time of delivery to a site and submitted to the erosion control specialist for verification and documentation of the seed used.

Seed mixtures for sites with distinctive soil problems (e.g., alkalinity, salinity or high water table) should be developed by a trained specialist. Table 12.2 illustrates the development of a perennial seed mix using values found in Table 12.1.

RECOMMENDED SPECIES AND APPLICATION  
 RATES OF PERENNIAL DRY LAND GRASS SEED  
 TABLE 12.1

Species	Variety <sup>1</sup>	Drilled <sup>2</sup> Pounds of PLS./Acre	Season <sup>3</sup>	Mature Height (in)	Form	Type
Sandy and Sandy Loam Soils (1/2" to 1")						
Sand bluestem	Elide, Woodwind	19.8	Warm	48	Sod	Native
Seediest grams	Vaughn, Butte	10.9	Warm	15	Bunch	Native
Switchgrass	Grenville	5.6	Warm	30	Sod	Native
Prairie sandreed	Goshen	8.0	Warm	48	Sod	Native
Little bluestem	Pastura	8.4	Warm	24	Bunch	Native
Blue grama	Lovington	3.0	Warm	12	Bunch	Native
Pubescent wheatgrass	Luna	21.8	Cool	30	Sod	Introduced

Loam, Silt Loam, Sandy Clay Loam, Clay Loam or Silty Clay Loam Soils

(1/4-3/4")<sup>4</sup>

Fairway wheatgrass		7.2	Cool	12	Bunch	Introduced
Crested Wheatgrass	Nordan	11.5	Cool	12	Bunch	Introduced
Western Wheatgrass	Arriba, Barton	19.8	Cool	12	Sod	Native
Pubescent wheatgrass	Luna	21.8	Cool	30	Sod	Introduced
Sideoats grama	Vaughn/Butte	10.9	Warm	15	Bunch	Native
Blue grama	Lovington	3.0	Warm	12	Bunch	Native
Switchgrass	Grenville	5.6	Warm	30	Sod	Native
Smooth brome	Manchar/Lincoln	16.1	Cool	24	Sod	Introduced
Little bluestem	Pastura/Camper	8.4	Warm	24	Bunch	Native
Green needlegrass	Lodorm	12.1	Cool	24	Bunch	Native

Clay, Silty Clay or Sandy Clay soils (1/4"-1/2")<sup>4</sup>

Fairway wheatgrass		7.2	Cool	12	Bunch	Introduced
Crested wheatgrass	Critana	11.5	Cool	12	Bunch	Introduced
Intermediate wheatgrass	Amur, Oahe	24.8	Cool	30	Sod	Introduced
Western wheatgrass	Arriba, Barton	19.8	Cool	12	Sod	Native
Blue grama	Lovington	3.0	Warm	12	Bunch	Native
Smooth Brome	Manchar/Lincoln	16.1	Cool	24	Sod	Introduced
Green needlegrass	Lodorm	12.1	Cool	24	Bunch	Native

1. For most species, other suitable varieties are available.
2. PLS-Pure Live Seed. Drilled rates are for slopes 4:1 or less and favorable rates of seed on 4:1 or smaller slopes will be doubled the drilled rates. 4:1, broadcast rates will be four times the drilled rates.
3. See Table 6.4 for planting dates.
4. Values within parenthesis represent depths seed is to be drilled into the soil.

TABLE 12.2  
EXAMPLE OF DEVELOPING A PERENNIAL SEED MIX

Species	Recommended Pounds of PLS/Acre		Percent Pounds Of Mix		Mixed Of PIS/Acre
Intermediate Wheatgrass	24.8	x	30	=	7.4
Switchgrass	5.6	x	25	=	1.4
Western Wheatgrass	19.8	x	25	=	5.0
Green Needlegrass	12.1	x	20	=	2.4
			Total		16.2

### 12.11.13 Temporary Control Measures

Temporary vegetation is effective for controlling wind and water erosion on relatively flat sites where earth moving and/or construction operations are completed in stages. Unless temporary vegetation is to be used as a cover crop (see paragraph 12.11.12.2.4), topsoil replacement is generally not required to produce adequate cover for erosion control. Drills for establishing temporary vegetation will have a cultipacker or other method of firming the soil over the seed and have row spacing of 20" or less. Table 6.3 provides information on establishing temporary vegetation.

TABLE 12.3  
RECOMMENDED SPECIES AND APPLICATION  
RATES FOR TEMPORARY GRASS AND/OR COVER CROPS<sup>a</sup>

Species	Season <sup>b</sup>	Drilled Pounds/Acre <sup>c</sup>
Barley	Cool	60
Millet	Warm	20
Oats	Cool	50
Regreen	Cool	40
Sorghum	Warm	20
Sudan (Hybrid)	Warm	20
Wheat-Spring	Cool	60
Wheat-Winter	Cool	60

a. For slopes 5:1 or flatter. Slopes steeper than 5:1 will require a mulch cover.

- b. See Table 12.4 for planting dates.
- c. The application rate for temporary grass is not expressed in PLS. This is different from perennial grass seed rates.

#### 12.11.13.1 Mulching

Mulching is used to conserve moisture, prevent surface crusting, reduce runoff and erosion and help establish vegetation. It is a critical treatment on sites with erosive slopes.

USUALLY, ALL DISTURBED AREAS TO BE ESTABLISHED IN PERMANENT GRASS WILL BE MULCHED IMMEDIATELY AFTER SEEDING OCCURS.

#### 12.11.13.2 Straw or Hay Mulch

Straw or hay is frequently used as a mulch due to its relatively inexpensive cost and effectiveness when properly installed. In most cases, grass hay is preferred over cereal grain straw for permanent dry land grass plantings for two reasons. First, cereal grain straw often contains large amounts of viable seed and can severely compete with the grass planted. Second, there is evidence that wheat and other cool season cereals produce toxins that limit germination of warm season grasses.

##### 12.11.13.2.1 1. Hay or straw mulch will be anchored to the soil by one of the following methods:

- a. A crimper which will anchor the fiber four inches or more into the soil. At least 50% of the fiber must be 10" or more in length.
- b. Manufactured mulch netting installed over the hay or straw according to manufacturers' instructions.
- c. Tackifiers sprayed on the mulch according to manufacturers' recommendations.

12.11.13.2.2 All straw or hay must be free of noxious weeds.

#### 12.11.13.3 Hydraulic Mulches

These products are typically cellulose (paper) or wood fibers which are mixed with water and a tackifying agent and sprayed uniformly over the soil surface.

Fertilizer may also be applied with the hydraulic mulch. Experience in Town has shown this method has a limited life span for controlling water erosion. However, they are effective for temporary control of wind erosion.

IF USED TO HELP ESTABLISH PERMANENT DRY LAND GRASS WITHOUT IRRIGATION, HYDRAULIC MULCHES MAY BE APPLIED ONLY BETWEEN JANUARY 1 AND APRIL 15.

#### 12.11.13.4 Netting's, Mats, Fabrics and Blankets

A large number of products have been developed for controlling erosion on steep slopes and drainage channels. Although high cost may prohibit extensive use, they are cost effective when used for their intended purpose. However, their use is recommended when conditions warrant.

#### 12.11.13.5 Cover Crops

Cover crops are a living mulch which may be utilized two different ways to assist with establishment of permanent grass.

- a. Plant a cover crop (see Table 12.3) with a grain drill in early spring to mid-summer to produce adequate vegetation by fall. Row spacings are not to exceed 20". In the fall, cut or harvest the crop (leaving at least an 8" high stubble) and plant the permanent seed in

amongst the stubble with a grass drill.

- b. Mix cover crop seed (using 1/2 of the rate identified in Table 12.3) with the permanent grass seed (using the full rate identified in Table 12.2) and plant both with a grass drill. Row spacings are not to exceed 8". Planting dates of the grasses have to be coordinated (see Table 12.4) to achieve optimal growth.

Periodic mowing of the vegetation will be required throughout the first growing season to prevent the cover crop from exceeding 8" in height.

TABLE 12.4  
DATES FOR PLANTING GRASS SEED IN TOWN  
AND FOR ACCEPTABLE MULCHING TECHNIQUES

Date	Perennial Grass		Temporary/Cover Crop Grass		Mulch
	Warm	Cool	Warm	Cool	
Jan 1-Apr 15	Yes	Yes	No	Yes	H/S Hydr
Apr 16-May 15	Yes	Yes	No	Yes	H/S
May 16-May 31	Yes	No	Yes	No	H/S
Jun 1-Jul 31	No	No	Yes	No	H/S
Aug 1-Aug 15	No	Yes <sup>2</sup>	No	Yes <sup>3</sup>	H/S
Aug 16-Sep 30	No	No	No	Yes <sup>3</sup>	H/S
Oct 1-Dec 31	Yes	Yes	No	Yes	H/S

1. H/S=Hay or straw mulch.

Hydr=Hydraulic mulch.

2. Cover crop cannot be substituted for a hay or straw mulch.

3. Must be used with a hay or straw mulch.

#### 12.11.13.6 Maintenance

THE SUCCESS OF A PERMANENT DRY LAND GRASS SEEDING CAN RARELY BE ACCURATELY EVALUATED PRIOR TO THE END OF ITS SECOND FULL GROWING Season.

Fertilization during the establishment period is often beneficial for increasing the vigor of the planted species. However, it will also increase the vigor of existing weeds. Fertilizing should be based upon laboratory soil analysis and recommendations along with a visual assessment of the stand.

#### 12.11.13.7 Acceptance

Seeded areas shall be evaluated after one growing season to determine whether additional maintenance and/or weed control will be required. Acceptance of seeded areas after the second growing season shall depend upon whether a satisfactory stand of grass is evident and weeds have been controlled. A satisfactory stand of grass is defined as where 90% of the planted area has an evenly distributed grass surface.

#### 12.11.14 Installation of Approved Erosion Control Measures

Approval of erosion control measures require they be clearly illustrated on construction plans for installation. An approved time schedule that clearly defines when measures will be installed and when inspections occur shall be part of the construction plans.

##### 12.11.14.1 Maintenance of Erosion Control Measures

After installation of erosion control measures, periodic maintenance of the erosion control measures shall be required. After each storm, or at least weekly, maintenance by the permit Developer shall consist of the following:

- a. Construction Staging Area: Construction staging pads shall be maintained in a condition that will prevent tracking of

sediment onto public right-of-ways. This may require periodic top dressing with 1-1/2" (minimum) crushed rock. Sediment and other material spilled, dropped or tracked from vehicles onto public right-of-ways shall be immediately removed.

- b. Temporary Sediment Traps: Gravel filters shall be cleaned by removing accumulated material and raking the rocks. Any disturbance of gravel resulting in unfiltered water entering the outlet shall be immediately repaired. Sediment shall be removed and the trap restored to its original dimensions when sediment reaches a level that is 1/2 the gravel filter height. Damage to the spillway or to the structure banks that render the trap ineffective shall be immediately repaired.
- c. Straw Bale Barriers, Straw Bale Drop Structures and Silt Fences: When sediment reaches 1/2 the structure height, accumulated sediment shall be removed. Structural damage shall be immediately repaired. If evidence exists that water has bypassed the structure (e.g., around or between bales), corrective measures shall be immediately implemented.
- d. Gravel Filters at Inlets: Sediment accumulated around gravel filters shall be immediately removed. Gravel filters shall be cleaned by removing accumulated material and raking the rocks. Disturbed gravel that allows unfiltered water to enter the inlet shall be immediately repaired.
- e. Wind Erosion Control Measures: When significant wind borne particles become

evident from areas where soil sealant/ stabilizer or hydraulic mulches have been disturbed, additional application of material shall be required. If permanent erosion control measures have not been installed within four months after temporary erosion control measures have been implemented, re-application of a soil sealant/stabilizer or hydraulic mulch may be required.

#### 12.11.15 Permanent Erosion Control Measures

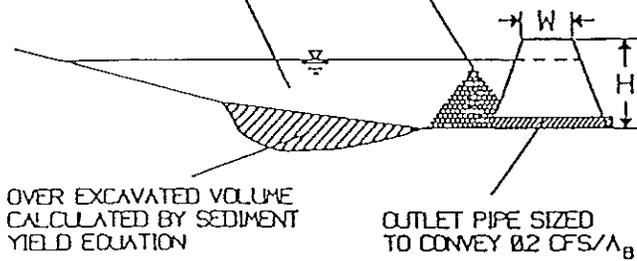
Before issuance of a Certificate of Acceptance or Occupancy (CO), all disturbed areas must be protected by some type of permanent erosion control measure. Permanent erosion control measures include construction of buildings, paving of parking lots, installing sidewalks and landscaping. Non-irrigated areas to be planted in dryland grass shall use criteria outlined this subchapter of the Erosion Control Criteria Chapter of these Regulations and shall require a two year warranty on vegetation establishment.

H (FT)	20	25	30	35	50	45	50
W (FT)	20	25	25	30	30	40	45

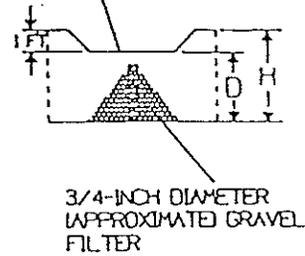
EMBANKMENT SIDE SLOPES ARE NOT TO BE STEEPER THAN 2:1

OPEN PERFORATED RISER PIPE SIZED TO CONVEY  $0.2 \text{ CFS}/\Lambda_B$  WITH THE TOP LOCATED AT LEAST 0.5 FEET BELOW THE SPILLWAY ELEVATION

VOLUME OF POND CALCULATED BY USE OF GRAPH

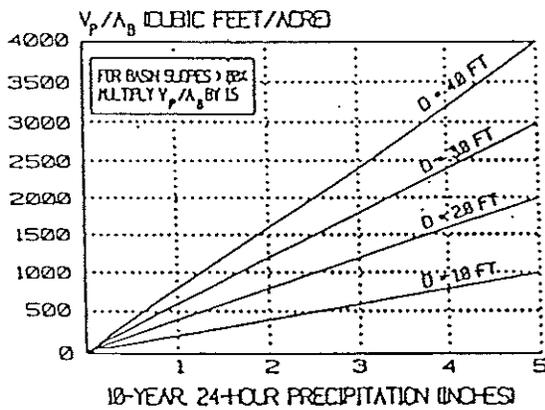


SPILLWAY DESIGNED TO PASS 10-YEAR PEAK FLOWS



NOTE: POND LENGTH SHOULD BE AT LEAST 2 X POND WIDTH

SEDIMENT TRAP POND VOLUME FOR BASIN SLOPES  $\leq 30\%$



POND VOLUME WHEN BASIN SLOPE IS  $\leq 30\%$

$$V_p/\Lambda_B = 200 \times \text{PPT} \times D$$

CUBIC FEET/ACRE

SEDIMENT YIELD WHEN SOIL DENSITY = 100 LBS/CU FT

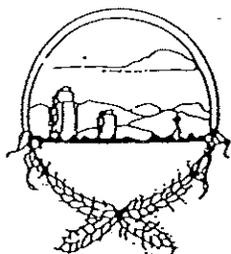
$$\text{SedY} = 0.74 \times \text{LR}_b \times \Lambda_B^{1.12}$$

CUBIC YARDS

PPT = PRECIPITATION (INCHES)  
 $\text{LR}_b$  = BARE GROUND LOADING RATIO

$V_p$  = VOLUME OF POND BELOW SPILLWAY (CUBIC FEET)  
 $\Lambda_B$  = AREA OF CONTRIBUTING BASIN (ACRES)  
D = DEPTH OF POND AT SPILLWAY (FEET)

IF THE CONTRIBUTING BASIN IS GREATER THAN 5 ACRES DEVELOPMENT OF A SEDIMENT BASIN SHOULD BE CONSIDERED



SEDIMENT TRAP

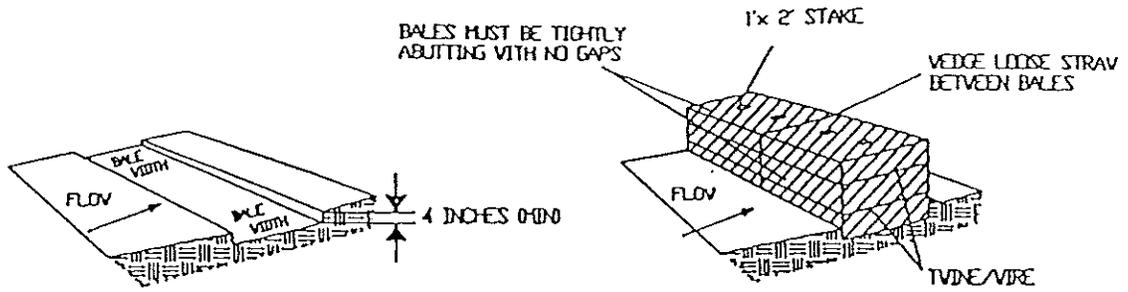
Town of Bennett  
12.69

Issued: \_\_\_\_\_

Revised: \_\_\_\_\_

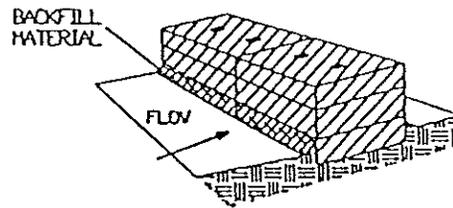
Drawing No.

EC - 1

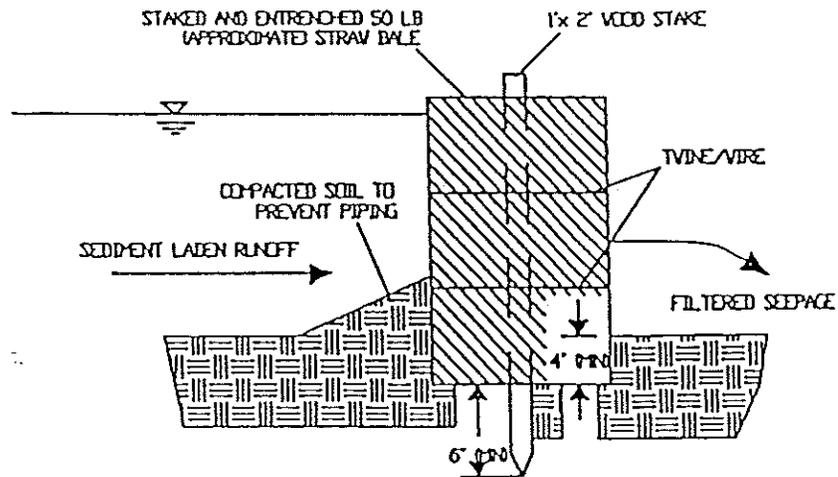


1. EXCAVATE THE TRENCH

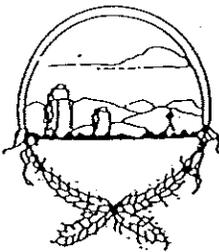
2. PLACE AND STAKE STRAW BALES



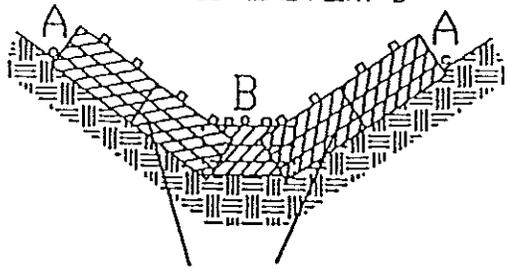
3. BACKFILL AND COMPACT EXCAVATED SOIL



CROSS-SECTION OF A PROPERLY INSTALLED STRAW BALE

	<p>INSTALLATION OF STRAW BALES</p>	<p>Issued: _____</p>
	<p>Town of Bennett</p> <p>12.70</p>	<p>Revised: _____</p>
		<p>Drawing No. EC - 2</p>

END POINTS 'A' MUST BE HIGHER THAN FLOW LINE POINT 'B'

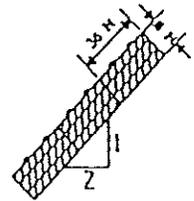
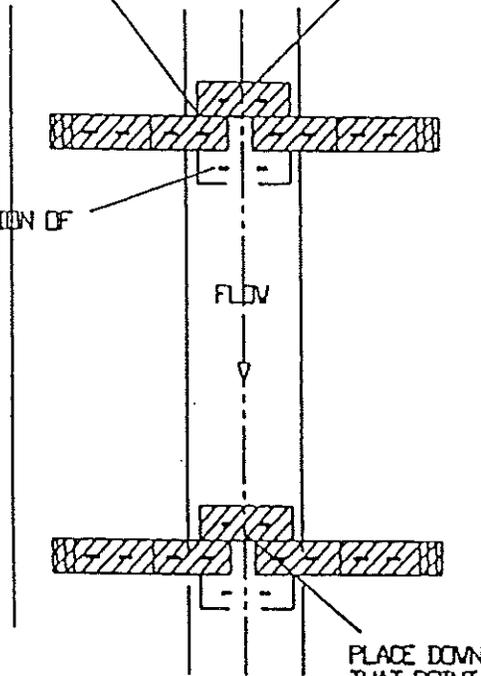


OVERLAP SIDE BALES ON FLOW LINE BALES(S) TO PREVENT GAPS

BALES MUST BE TIGHTLY ABUTTING WITH NO GAPS

ONE OR MORE BALES IN CHANNEL BED TIGHTLY ABUTTING EACH OTHER

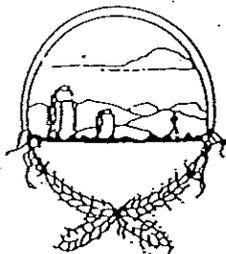
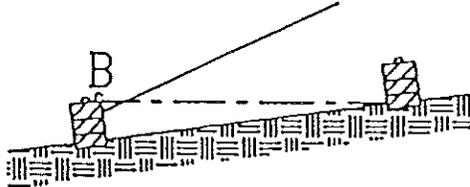
ALTERNATIVE LOCATION OF FLOW LINE BALES(S)



VALUE OF Z	MINIMUM NUMBER OF BALES
1.0 OR <	1**
1.0 - 3.5	2**
3.5 - 5.0	3**
5.0 - 7.0	4**
7.0 OR >	NOT NECESSARY

\*\* ASSUMES DEPTH OF WATER ABOVE POINT 'B' WILL NOT EXCEED 6 INCHES

PLACE DOWNSTREAM BALES SUCH THAT POINT 'B' IS APPROXIMATELY LEVEL WITH THE LOWEST GROUND ELEVATION OF THE UPSTREAM BALE



STRAW BALE DROP STRUCTURE FOR WIDE DRAINAGE SWALES

Town of Bennett

12171

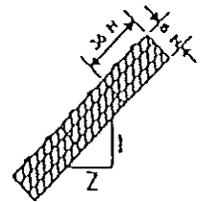
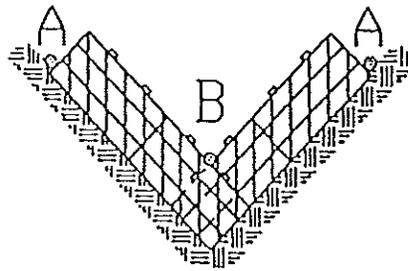
Issued: \_\_\_\_\_

Revised: \_\_\_\_\_

Drawing No.

EC - 3

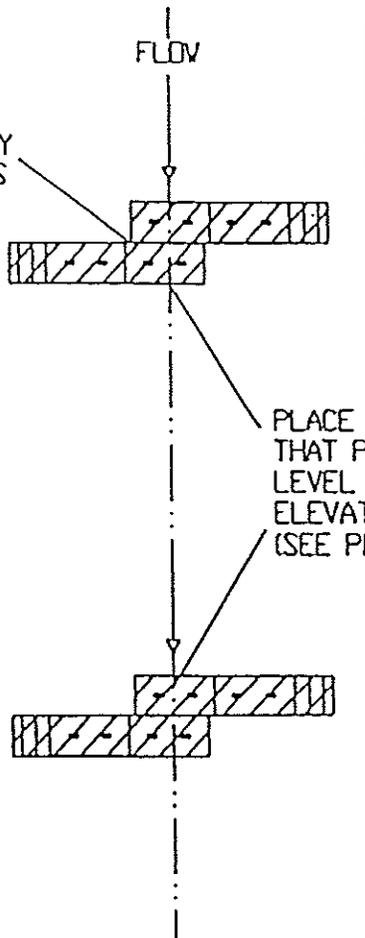
END POINTS 'A' MUST BE HIGHER  
THAN FLOW LINE POINT 'B'



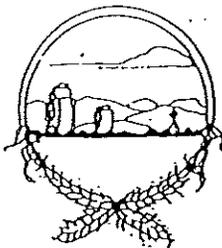
VALUE OF Z	MINIMUM NUMBER OF BALES
10 OR <	1**
10 - 35	2**
35 - 50	3**
50 - 70	4**
70 OR >	NOT RECOMMENDED

\*\* ASSUMES DEPTH OF WATER ABOVE POINT 'B' WILL NOT EXCEED 6 INCHES

BALES MUST BE TIGHTLY ABUTTING WITH NO GAPS



PLACE DOWNSTREAM BALES SUCH THAT POINT 'B' IS APPROXIMATELY LEVEL WITH THE LOWEST GROUND ELEVATION OF THE UPSTREAM BALE (SEE PREVIOUS FIGURE)



STRAW BALE DROP STRUCTURE  
FOR NARROW DRAINAGE SWALES

Town of Bennett

12.72

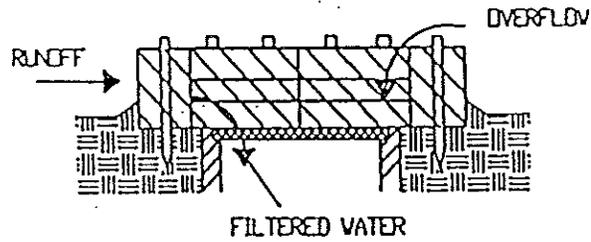
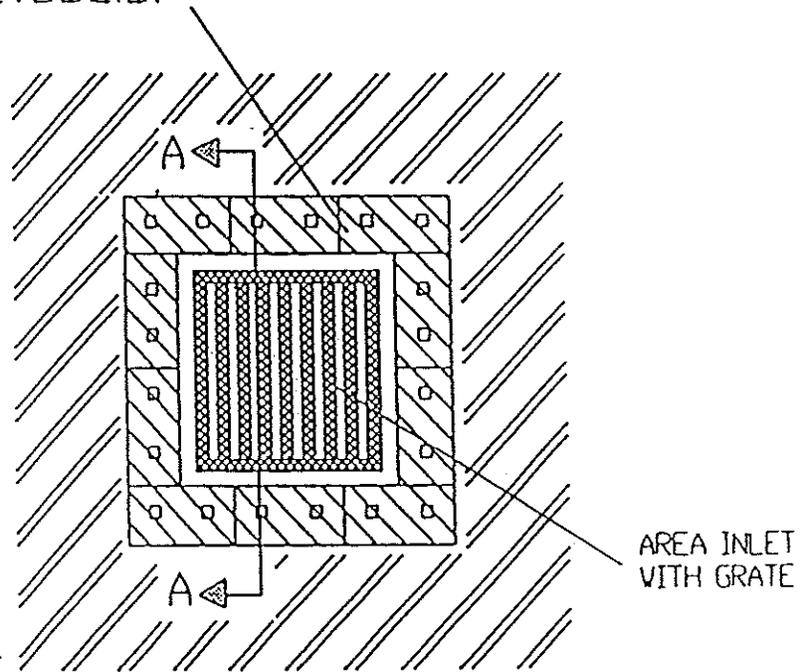
Issued: \_\_\_\_\_

Revised: \_\_\_\_\_

Drawing No.

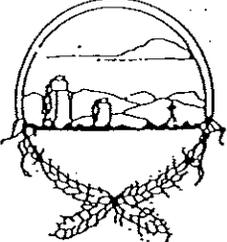
EC - 4

STRAW BALES ARE TO BE PLACED 4 INCHES  
 IN THE SOIL, TIGHTLY ABUTTING WITH NO  
 GAPS, STAKED AND BACKFILLED AROUND THE  
 ENTIRE OUTSIDE PERIMETER



## SECTION AA

NOTE: STRAW BALE FILTERS ARE NOT TO BE USED IF ADJACENT AREA TO  
 INLET IS PAVED

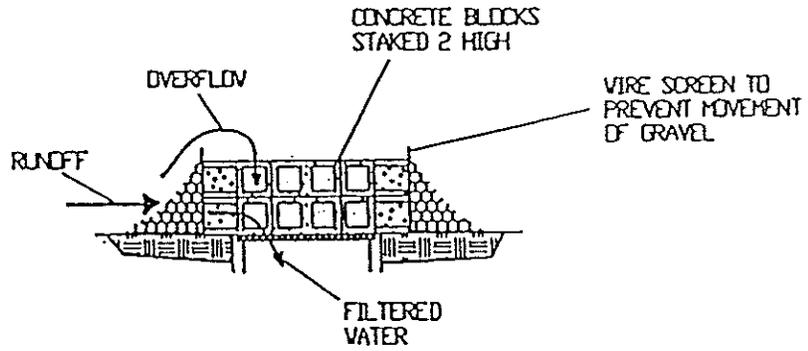
	<p>STRAW BALE FILTER          FOR AREA INLET</p>	<p>Issued: _____          Revised: _____</p>
	<p>Town of Bennett          12, 173</p>	<p>Drawing No.          EC - 5</p>

GRAVEL FILTER (APPROXIMATELY 3/4-INCH DIAMETER) PLACED TO TOP OF CONCRETE BLOCKS

CONCRETE BLOCKS PLACED AROUND DROP INLET PERIMETER

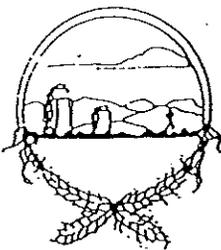
WIRE SCREEN PLACED AROUND CONCRETE BLOCK PERIMETER

AREA INLET WITH GRATE



CROSS-SECTION AA

NOTE: GRAVEL FILTER MAY BE USED ON PAVEMENT OR BARE GROUND



GRAVEL FILTER FOR  
AREA INLET

Town of Bennett

12.74  
12.53

Issued: \_\_\_\_\_

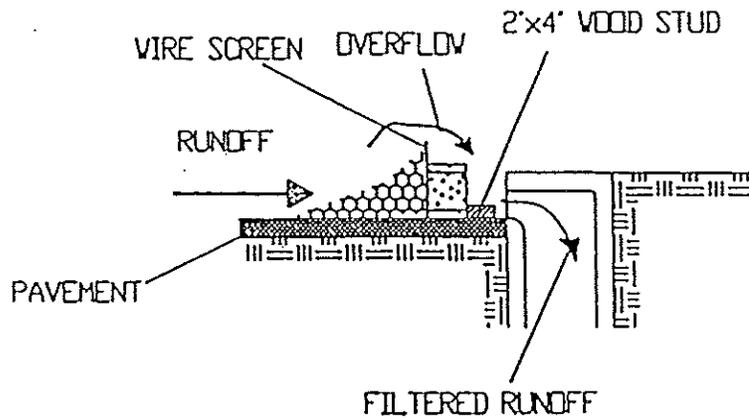
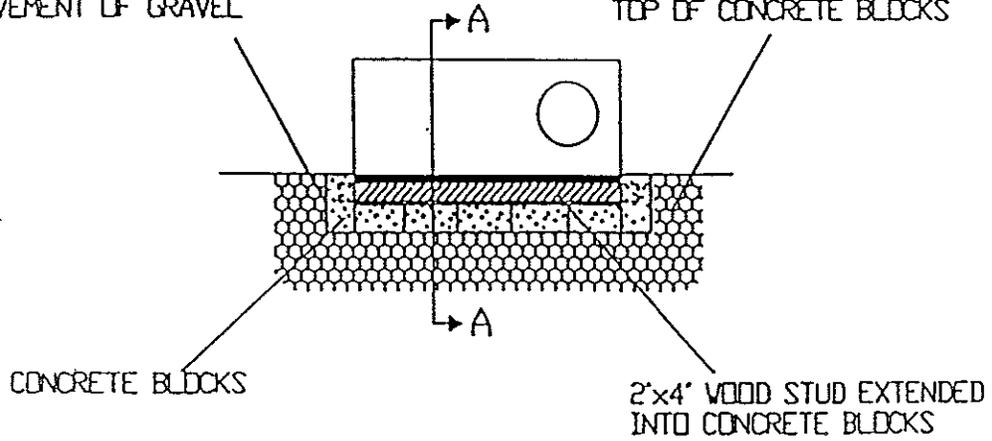
Revised: \_\_\_\_\_

Drawing No.

EC - 6

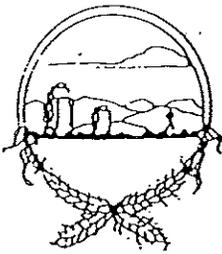
WIRE SCREEN AROUND PERIMETER OF CONCRETE BLOCKS TO PREVENT MOVEMENT OF GRAVEL

GRAVEL FILTER (APPROXIMATELY 3/4-INCH DIAMETER) PLACED TO TOP OF CONCRETE BLOCKS



## CROSS-SECTION AA

NOTE: GRAVEL FILTER CAN BE USED ON PAVEMENT OR BARE GROUND



CURB INLET  
GRAVEL FILTER

Town of Bennett

12.175

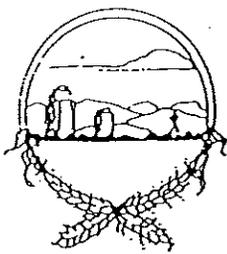
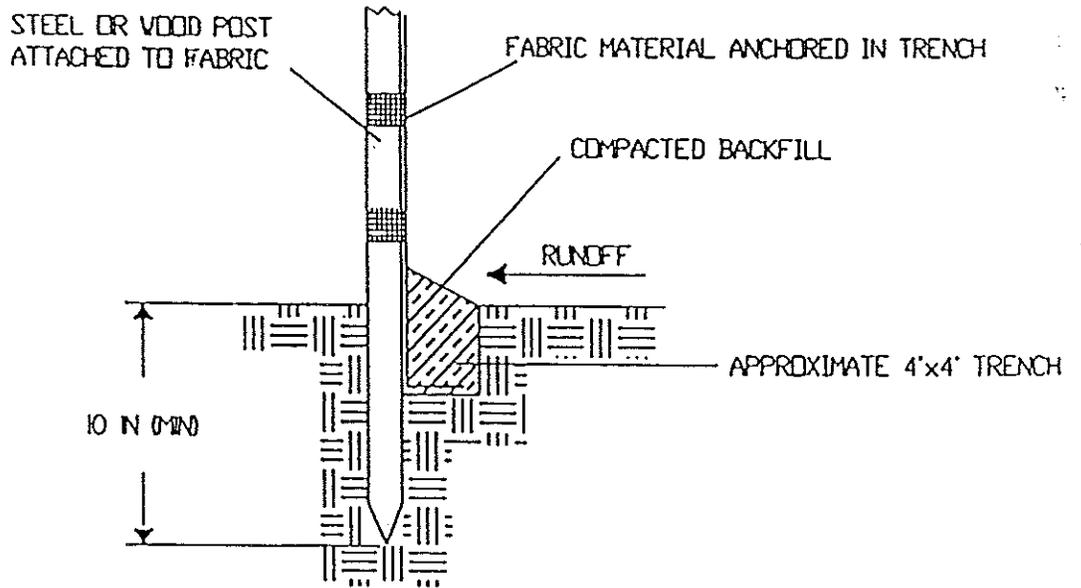
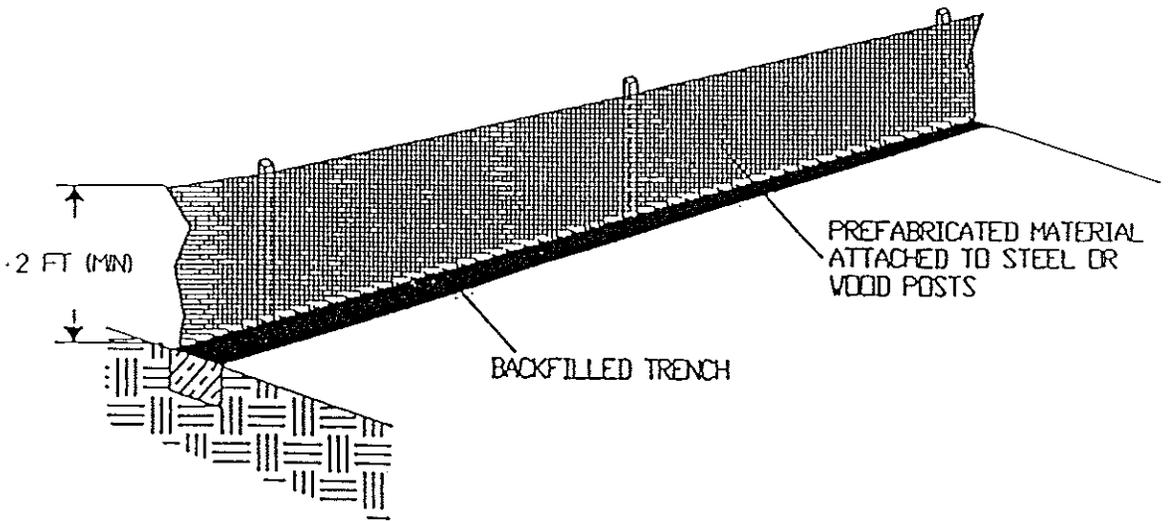
12.54

Issued: \_\_\_\_\_

Revised: \_\_\_\_\_

Drawing No.

EC - 7



INSTALLING A PREFABRICATED SILT FENCE

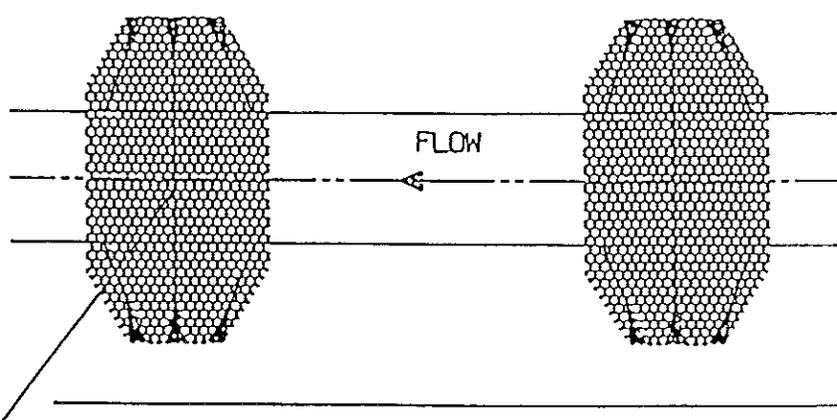
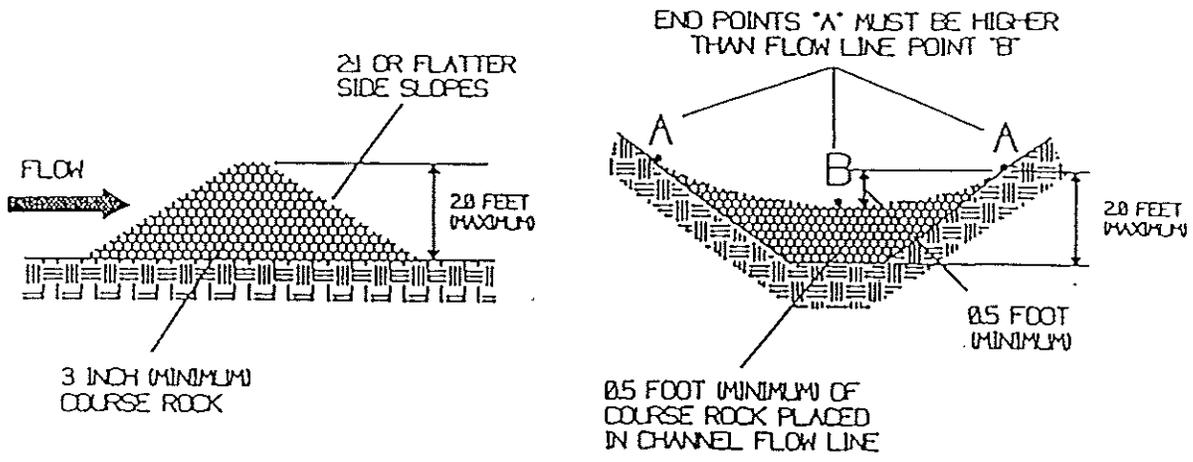
Town of Bennett  
12.76

Issued: \_\_\_\_\_

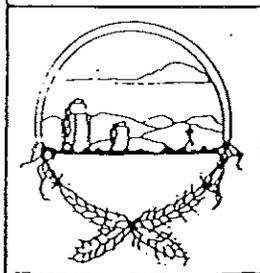
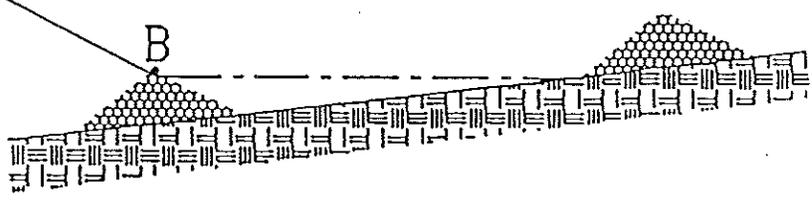
Revised: \_\_\_\_\_

Drawing No.

EC - 8



PLACE DOWNSTREAM STRUCTURE SUCH THAT POINT "B" IS APPROXIMATELY LEVEL WITH THE LOWEST GROUND ELEVATION OF THE UPSTREAM STRUCTURE



ROCK CHECK STRUCTURE FOR WIDE OR NARROW DRAINAGE SWALES

Town of Bennett  
12.177

Issued: \_\_\_\_\_  
Revised: \_\_\_\_\_

Drawing No.  
EC - 9

