

CITY OF BOULDER
DESIGN AND CONSTRUCTION STANDARDS

CHAPTER 10
STREETSCAPING STANDARDS

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10.01 General

(A) Intent

The Streetscaping Standards are intended to compliment the design standards specified in Chapter 3, “Streetscape Design and Tree Protection,” of these Standards, and provide minimum standards for the construction and planting of streetscapes in public rights-of-way.

(B) Scope

These Standards apply to streetscapes located, standing, or growing within or upon any City of Boulder public right-of-way. The streetscape requirements of this chapter are in addition to those set forth in Chapter 3, “Streetscape Design and Tree Protection,” and applicable streetscape drawings in Chapter 11, “Technical Drawings,” of these Standards and the B.R.C. 1981

(C) Reference Standards

Where not specified in these Standards or the B.R.C. 1981, in order to protect the public health, safety, and welfare, the Director of Public Works in consultation with the Director of Parks and Recreation will specify the standards to be applied to the design and construction of streetscapes and the planting of trees, and may refer to one or more of the references listed in the References Section of these Standards.

(D) City Approval Required

All work associated with the planting, maintenance, and removal of trees and landscaping materials located, standing, or growing within or upon any City of Boulder public right-of-way is subject to City of Boulder approval or permit issuance as set forth in Chapter 8-5, “Work in the Public Right-of-Way and Public Easements,” and Chapter 6-6, “Protection of Tree and Plants,” B.R.C. 1981.

(E) Water Conservation

All landscaping shall be designed for maximum water efficiency, as specified in Section 9-3.3-3, “Landscape Design Standards,” B.R.C. 1981.

(F) Public Lands Other Than Public Rights-of-Way

Landscaping construction activities on public lands other than public rights-of-way, such as parks, open space and greenway corridors, are exempt from the construction and planting requirements of these Standards. However, these Standards may be used as a basis for construction and planting activities on all public lands.

10.02 Site Preparation

(A) Description

Site preparation includes, without limitation, layout, tree protection, demolition, clearing, excavation, fill and backfill, topsoiling, and finish-grading.

(B) Materials

- (1) **Imported Fill:** Imported fill for landscaping shall be clean, fertile, sandy loam soil that is

free from turf, lime, ashes, debris, noxious weeds, roots, stones over 4 inches in diameter, harmful chemicals, or other materials that are detrimental to plant growth. Fill shall have a pH of 6.0 to 8.0, salt of less than 2 mmhos/cm, sodium absorption ratio of less than eight, and at least an 85 percent germination rate for narrow and broadleaf plants. Fill shall not be hauled in a frozen, wet, or muddy condition.

(2) **Topsoil**

- (a) Topsoil shall be fertile, friable, sandy loam topsoil. Topsoil shall be of any admixture of subsoil or slag and shall be free of stones over 1 ½ inches in diameter, lumps, refuse, plants or their roots, sticks, noxious weeds, salts, soil sterilants or other material that is detrimental to plant growth. If topsoil is delivered, it shall be obtained from a well-drained site that is free of flooding. Topsoil shall not be delivered or used while in a frozen or muddy condition.
- (b) Topsoil shall have an acidity range of pH 6.0 to 7.5 and contain not less than 5 percent organic matter as determined by loss on ignition of moisture-free samples dried at 100 degrees Centigrade. Topsoil shall have salt of less than 2 mmhos/cm and a sodium absorption ratio of less than eight.
- (c) Topsoil shall meet the mechanical analysis outlined in Table 10-1, “Topsoil Mechanical Analysis,” of these Standards:

Table 10-1: Topsoil Mechanical Analysis

	Passing percent	Retained percent
1-inch screen	100%	0 - 0%
½ inch screen	97 - 100%	0 - 3%
No. 100 mesh sieve	60 - 40%	40 - 60%

- (d) Topsoil shall have at least an 85 percent germination rate for narrow and broadleaf plants.

(C) Construction Requirements

(1) **Layout**

- (a) The contractor is responsible for:
 - (i) Establishing and recording all necessary boundary points, lines, elevations, grades, access points, and benchmarks onsite for proper control, landscape protection, coordination with subcontractors, and execution of the work.
 - (ii) Verifying all furnished survey and topographic data, all points, lines, and elevations.
 - (iii) Notifying the Director of any discrepancies between information on approved construction plans and actual site or field conditions or measurements and receive approval for required modification prior to

continuing work.

(iv) Staking all cuts and fills on the sites as shown on the grading plan.

(b) Shoulders and toes of slopes shall be smoothly blended to the flat areas.

(c) No cut or fill is allowed within the dripline of existing trees without the prior approval of the City.

(2) **Clearing of Project Site:** The contractor is responsible for:

(a) Removing from the site all trees and shrubs, brush and weed growth, stumps, and root systems designated on the approved construction plans for removal.

(i) All trees to be removed shall be marked with an "X" in blue permanent marking and approved by the City prior to removal.

(ii) All other plant material not designated for removal shall be protected and maintained.

(iii) Stripped-off brush and weed growth shall be hauled offsite. No burning or nesting of materials shall be permitted onsite.

(b) Maintaining adequate fire protection while clearing operations are underway.

(c) Replacing any existing sod damaged by construction operations. Replacement sod shall meet the standards of Section 10.04, "Seeding/Sodding," of these Standards.

(d) If specifically required on the approved construction plans, scalping the top of soil, including grasses and roots, to a depth specified in the plans and stockpile onsite or remove as indicated.

(3) **Excavation:** The contractor is responsible for:

(a) Stripping, stockpiling, and replacing existing topsoil in areas of fill on the finished grade to at least 4 inches deep.

(b) Excavating so as to provide adequate drainage of the site at all times.

(c) Using hand methods of excavation within the dripline of trees.

(4) **Fill and Backfill Operations:** The contractor is responsible for the following:

(a) Obtaining the Director's approval of the subgrade before commencing soil preparation, topsoiling, finish grading or planting, and obtaining the Director's approval of the finish grade before commencing planting, mulching or other subsequent operations. The following grading tolerances shall be applied:

(i) Tolerances shall not exceed 0.1 feet above or below desired subgrade elevations in planted areas, and no tolerance will be allowed on subgrades

prepared for paving or site improvements, or subgrades immediately adjacent to curbs or island pavements.

- (ii) Settling of finish grade shall not exceed 0.1 feet.
- (b) Completing clearing operations before beginning any filling or backfilling.
- (c) If sufficient suitable fill or backfill material is not available on the project site, furnishing additional materials according to standards for hauled-in fill or topsoil, as required in these Standards.
- (d) Placing fill and backfill in layers not to exceed 6 inches in compacted depth with the following compaction standards:
 - (i) Each layer shall be compacted to the specified density. Landscaping fill and backfill shall be compacted to no less than 80 percent and no more than 85 percent density in areas to be planted.
 - (ii) Compaction shall not occur when soil is wet.
- (e) Ensuring that filling and backfilling shall provide adequate site drainage at all times. Fill or backfill shall not be placed on wet ground.

(5) **Finish Grading**

- (a) Work in this section shall consist of cutting, filling, shaping, and grading according to the lines, grades, elevations and cross sections on the approved landscaping plans.
- (b) The contractor is responsible for the following:
 - (i) Completing all finish grading onsite. The top of the subgrade shall be the depth below the finished grade as required for pavements, sod, walks, mulches and other site improvements.
 - (ii) Protecting the finish grade areas and regrading to correct any irregularities caused by hauling materials or by other operations over the finished grade.
 - (iii) Repairing any erosion or other damage resulting from weathering action before final acceptance.
- (c) Excavated and filled sections and adjacent transition areas shall be smooth, properly compacted and free from irregular surface changes. The degree of finish grading shall be that ordinarily obtained from either blade, grader, or scraper operations. Where finishing cannot be satisfactorily completed with power equipment, hand methods shall be used.
- (d) Unless otherwise indicated, the subgrade shall be evenly sloped to provide drainage away from site improvements or the centerline of medians. Swales shall be cut as shown on the plans, but shall not reduce the thickness of the topsoil specified.

- (e) Finish grading shall conform to the grade elevations shown on an approved landscaping plan and shall be free from debris and other materials that would be detrimental to the subgrade. Settling of any finish grade shall not be more than 0.1 feet, and if settling is greater, the contractor shall bring the grade to specified elevations.

10.03 Planting

(A) Description

Planting includes, without limitation, the placement of live trees and shrubs, the placement of materials to protect and enhance plant growth, and the methods applied in planting and maintaining landscape plants.

(B) Materials

- (1) **Edger:** Ryerson or approved equivalent steel edger, 1/8-inch by 4-inch steel with steel stakes, painted with rust-inhibiting black paint. The edger shall have a rolled or folded edge or be capped with plastic safety-edged material.
- (2) **Filter Fabric:** 30.1-mil DeWitt Weed Barrier or approved equivalent.
- (3) **Pesticides:** Comply with the specifications of Section 6-10, "Pesticide Use," B.R.C. 1981.
- (4) **Tree Wrapping Material:** New, 4-inch wide, bituminous impregnated tape, corrugated or crepe paper, brown in color, specifically manufactured for tree wrapping. Tree wrapping shall be fixed with pliable or nonbinding tape. No wire shall be used.
- (5) **Compost:** Well-weathered and weed-free cow or sheep manure or other composted materials. No mountain peat shall be used.
- (6) **Stakes:** Green 8-foot steel tee posts with blade.
 - (a) Trees shall be secured to stakes using minimum 2 inch wide nylon and cotton blend webbing with heat sealed ends, a tensile strength of 1000 pounds and brass grommets for attachment of wire between strap and stake.
 - (b) Grommets shall be 1 1/4-inch in diameter with a 1/2-inch diameter eye that is set at least 1/2-inch from end of strap.
 - (c) Wire shall be 12-gauge galvanized steel covered with a PVC sleeve.
 - (d) Straps shall be of sufficient length in relation to tree caliper so that grommets do not touch trunk.
 - (e) A protective cap shall be secured to the top of all stakes.
- (7) **Mulch:**

- (a) Wood chip mulch shall be clean wood chips free of soil or man-made debris shredded into coarse pieces ranging in size from 1 inches to 3 inches. All median landscape plantings shall be mulched with 4 to 6 inches of wood chips. 2 to 4 inches of “Squeegee” (1/4-inch minus washed sand) may be substituted for wood mulch for street median applications only.
- (b) Rock mulch shall not be used in planting beds, except as a temporary mulch until full plant coverage is achieved, or as permanent mulch under shrubs. Rocks used in the public right-of-way or adjacent to sidewalks must be 1 ~~to~~ 3 inches in diameter. Gravel or cobblestone shall not be used as mulch.
- (c) For medians and bikeways, landscape fabric shall not be used as a weed barrier.

(8) **Plant Materials:**

- (a) All plants shall be “Colorado Grown,” “Colorado Fielded,” or “Northern Grown” as described below, unless otherwise specified in these Standards, except for plants of the genus *Juniperus*.
 - (i) Colorado Grown: plants grown in Colorado nursery fields for the major portion of their lives.
 - (ii) Colorado Fielded: plants shipped in or collected that have grown in Colorado nursery fields for at least two full growing seasons prior to delivery.
 - (iii) Northern Grown: plants grown in nurseries for at least two full growing seasons located in hardiness Zones 1 through 5, as shown on a United States Department of Agriculture map.
- (b) All plants shall be of species identified under and allowed by these Standards and shall conform to the following:
 - (i) Selected to meet the goal of maximum water efficiency and zoned or grouped according to their water requirements.
 - (ii) Individually identified on legible, weatherproof labels securely attached to the plants. Labels shall be durable and shall remain legible for at least 60 days from site delivery.
 - (iii) Labels shall include the correct genus, species, variety name and accepted common name of the plant as well as the size or grade of stock.
 - (iv) Labels shall remain until after City inspection and then shall be removed by the contractor.
- (c) Tree selection and placement shall be in accordance with Section 3.03, “Tree Selection and Placement,” of these Standards.
- (d) Trees shall conform to and have the following characteristics:

- (i) A well-developed branch structure typical of the size and species with no “V” crotches, codominate stems, or included bark. The height of branching should bear a relationship typical of size and species so that the crown of the tree will be in balance as the tree grows.
- (ii) Healthy buds, stems, and bark that are without mechanical, insect, or disease injury.
- (iii) Healthy, vigorous, and free from visual defects, mechanical injuries, plant diseases, and all forms of insect infestation until final acceptance.
- (iv) A well-branched and vigorous root system typical of size and species and free from bent or kinked roots, roots girdling the trunk, and other defects.
- (v) Root balls shall have a sufficient diameter for the fibrous and feeding root system necessary to provide for full recovery of the tree following planting. Minimum root ball sizes shall meet the following specifications outlined in Table 10-2,
- (vi)

Table 10-2: Minimum Root Ball Sizes

Caliper	Minimum Root Ball Diameter	Caliper	Minimum Root Ball Diameter
1 ½"	20"	3"	32"
1 ¾"	22"	3 ½"	38"
2"	24"	4"	42"
2 ½"	28"	4 ½"	48"

- (e) All trees and shrubs shall be freshly dug at time of delivery, unless they are container-grown. Plants other than bare root stock that have been heeled-in for more than 1 month or that exhibit roots outside the original ball shall not be accepted. Bare root stock placed in cold storage for more than 2 months or that exhibits new top growth will not be accepted.
- (f) Moss rock shall be sandstone boulders with 75 percent or more exposed surface covered with lichens. Boulders shall have rounded natural edges and a character and shape consistent with native landscape rock settings. No split, bruised face, slab-type, layered, or slide rocks shall be used without prior approval and acceptance by the .

(C) Construction Requirements

- (1) **Layout and Identification:** The contractor shall use stakes, flags, or containerized plants to locate all trees and shrubs according to an approved landscape plan.
- (2) **Schedule**

- (a) Nothing shall be planted between October 15 and March 1 without prior written approval of the City. Stock, other than container-grown stock, shall not be planted between June 1 and September 1 without prior written approval of the City. Bare root stock shall not be planted after April 30 or if plants have begun to leaf out.
- (b) Nothing shall be planted during freezing or excessively windy, hot, or wet weather or when the ground conditions cannot be properly worked for digging, mixing, raking, or grading.
- (c) Nothing shall be planted until the adjacent site improvements, pavements, irrigation installation and finish grading is completed. The contractor shall test the irrigation system in the presence of the Director. The irrigation system shall be in approved, operating condition prior to any planting.

(3) Plant Protection and Delivery

- (a) The contractor shall protect all installed plant material from injury, excessive drying or winds, improper ventilation, over watering, freezing, high temperatures, or any other condition damaging to the plant until final acceptance. Any plants showing evidence of poor care or that are molded, mildewed, wilted, or dried-out shall be rejected. Colored waxes or other materials that coat the aerial parts of plants, or the removal of primary buds and/or shoots, including terminal buds and first order leaders, of plants are not acceptable.
- (b) Plant materials shall be planted on the day of delivery if possible. All plants not planted on day of delivery shall be placed in a temporary nursery, kept moist, shaded and protected from sun and wind. If balled and burlapped plants are not planted on the day of delivery, they shall be heeled-in immediately in the temporary nursery, kept moist and protected with damp soil, moss, or other acceptable material. All plants shall be planted within 48 hours after delivery. Plants shall not be bound with wire or rope that may damage the bark or break branches. Plants shall be lifted and handled from bottom of ball or container, and shall not be dropped or lifted by the trunk, stem or foliage. Plants with balls that are loose, cracked, broken, man-made or completely dry or plants with trunks loose in the ball before or during planting operations shall not be accepted and shall be removed from the site at contractor's expense. The root collar is not to be deeper than 4 inches below the top of the soil ball.
- (c) The contractor shall deliver all packaged landscape materials to the site in original unopened containers bearing name, trade name, manufacturer, trademark, and conformance to State Law.
- (d) Existing trees shall be protected per Section 3.05, "Tree Protection for Construction Sites," of these Standards.

(4) Excavation of Planting Pit

- (a) All plant pits shall be centered on the plant location and excavated in a cylindrical shape with vertical sides and flat bottom. The depth of the plant pit shall be measured from the finished grade of the soil, not from the mulch. The base of all

soil balls shall be placed on undisturbed soil.

- (b) Trees: The diameter of all tree pits shall be at least two times the diameter of the ball or spread of the roots. Tree pits shall be excavated so that the top of the ball will be 3 inches above finished grade when irrigated and 2 inches when not irrigated.
- (c) Shrubs: The diameter of all shrub pits shall be at least two times diameter of the ball or spread of roots. Shrub pits shall be excavated so that the top of the ball will be 1 inch above finish grade.
- (d) Vines and Ground Covers: The diameter of all vine and ground cover pits shall be two times the spread of roots. The planting pit shall be excavated so that the top of the ball is 1 inch above finish grade.
- (e) All holes and pits shall be protected as specified in the General Conditions at all times when work is not being carried on at the site of excavation.

(5) Planting and Staking for Plant Installation

- (a) Plants shall be set in the center of the pit on the undisturbed subgrade. Immediately after setting in the pit, all materials shall be completely removed from the ball and trunk, including but not limited to plastic, metal, wire, wood, cardboard, paper, fiber, burlap, and twine. Container removal and plant handling shall minimize injury to the plant, the root system, and the soil ball. If the root system of a container grown plant has become container-bound, the roots shall be gently vertically cut on two sides of the root ball prior to planting.
- (b) All plants shall be placed and kept plumb and straight as the pit is filled with backfill. Any plant that is not plumb prior to final acceptance shall be rejected.
- (c) After placing plant in the pit, the hole around the plant root system shall be halfway backfilled and any large air pockets removed by hand with the blunt, handle end of a shovel or other such hand tool. If the ball is excessively dry, the contractor shall then insert a deep watering device into the ball at a 45 degree angle every 12 inches for 1 minute. The pit shall then be lightly filled with backfill mix and compacted again with the shovel. No mechanical compaction shall be allowed. The pit shall then be watered by thoroughly saturating the backfill with water to a minimum depth of 3 feet. No watering shall be done prior to this time. Watering shall be repeated once when all free water has disappeared; this second watering shall not be completed if the subgrade around the pit is already moist. After watering, the contractor shall add the necessary soil to establish the finish grade level before adding specified mulch. The contractor shall remove all surplus soil and debris, and stake and guy trees immediately after planting.
- (d) Unless otherwise specified, all areas designated for mass planting such as for ground covers or vines shall be amended with 6 cubic yards per 1,000 square feet of manure compost. The contractor shall first prepare the subgrade by discing or rototilling the subgrade to a depth of 8 inches. No ripping or chiseling shall be allowed. After preparing the subgrade, the amendments shall be thoroughly rototilled into the soil to a depth of 8 inches. The contractor shall remove any

rocks, debris or foreign matter in excess of 1 inch in length or diameter encountered to an 8-inch depth.

- (e) For all trees, the contractor shall drive stakes 3 feet vertically into firm soil outside the plant pit with blade on tree side. The contractor shall run a double strand of wire through one grommet in the strap, wrap the strap around trunk at no more than one-third the height of tree, and run wire through other grommet and back to stake. Strap and wire attachment between the stake and tree shall be adjusted so that straps are under just enough tension to avoid visible sag in lines. Rigid guying shall not be accepted. Straps and wires shall be placed so as to be perpendicular to the trunk. Stakes shall be parallel or slightly angled away from the trunk.
- (f) The contractor shall place stakes according to tree height or caliper as follows: deciduous trees 2 inches and under - one stake oriented northwest; deciduous trees larger than 2 inches but less than 3 inches and evergreen trees less than 5 feet in height - two stakes oriented northwest and southeast; deciduous trees 3 inches and larger and evergreen trees 5 feet and larger - three stakes with one oriented northwest and the other two oriented 120 degrees in either direction from northwest. All deciduous trees shall have a sod-free base at least 3 feet in diameter. All evergreen trees shall have a sod free base extending to the dripline. This sod free area shall be extended where necessary to include all stakes. The contractor shall return to the site and remove stakes between May 21 and June 7 the following spring.
- (g) The contractor shall remove all stakes and guy wires no more than one year from the date of tree installation.

(6) **Spraying, Wrapping, Pruning, Watering and Mulching for Plant Installation**

- (a) All deciduous trees shall be wrapped by the contractor from November 1 - 15 of the year in which they are planted. Specified tree wrap shall be cut in a continuous strip of sufficient length to wrap the tree. This wrapping shall begin at the ground line with overlapping wraps of 1½ inches terminating above the lowest main branch of the tree. Final wrap shall be secured with tape in at least three places. The contractor shall return to the site and remove wrap from April 1 - 15 of the following spring. The contractor shall notify the City at least 1 week prior to wrap removal.
- (b) After inspection, and with the approval of the City, the contractor shall prune plants as necessary to remove only dead, injured, diseased, or crossing branches. All cuts shall be made just outside of the flare (branch collar) of the branch base. All pruning shall be executed so as to preserve the natural form and character of the plant. The contractor shall return to the site between May 21 and June 7 the following spring and prune all dead, diseased or injured branches from plants as specified above. The contractor shall notify the City at least 1 week prior to commencing pruning.
- (c) After watering on the day of planting, and throughout the maintenance period, the contractor shall ensure that plants are not over watered.
- (d) Wood chip mulch shall be placed in all planting beds, shrub areas and the sod-free

area of a 3-foot radius at the base of each tree. The mulch shall be spread carefully and evenly to a depth of 4 inches. Shredded wood chip mulch shall be watered thoroughly two times to aid in matting the mulch in place. The mulched areas shall be graded so that the top of the mulch will be flush with the top of the curb, sidewalk, edging or sod.

- (e) Rock mulch shall be placed evenly to a minimum depth of 2 inches.
- (f) The contractor shall be responsible for damage to any underground utility, irrigation line, paving, adjacent structures or other improvements. In the event a pipe, line, rock formation, or other obstruction interferes with a plant location, the contractor shall notify the Director to receive approval for a new plant location.

(7) **Moss Rock Installation Procedure**

- (a) The contractor shall notify the Director prior to moss rock placement work in order to direct the contractor in a continuous operation of placing the rock with the designated quantities. The contractor shall provide manpower and equipment to place rock in 1 day and shall haul excess rock away from site.
- (b) The contractor shall install rock boulders according to the layout and configuration of the rock work as shown on the plans. Moss rock shall be set on a compacted base (to 90 percent Proctor Density within 2 percent optimum moisture content). Rockwork joints shall be made tight by butting natural faces together in place. Soil grades shall be adjusted to stabilize rocks in position and regraded in place to establish the placement of each rock so that they blend into adjacent terrain. Rocks are to be placed by terracing or stepped layers to achieve a naturalized effect. Finish grades shall be re-established as necessary.

10.04 Seeding/Sodding

(A) **Description**

- (1) Seeding/sodding includes, without limitation, the planting and installation of grasses, preparation of soils and grading, and the methods to be applied in planting and maintaining grasses.
- (2) Medians less than 12 feet wide shall be landscaped with materials other than irrigated turfgrass.

(B) **Materials**

- (1) **Fertilizer:** Specified fertilizer shall be supplied in the original supplier's containers with label and order form showing composition and quantity. Fertilizer shall be intact, free-flowing, dry and in quantity, as specified for sodded or seeded areas, as shown on the plans. Fertilizer for sod and seeding soil preparation shall be a compound equivalent to 0-46-0 applied at the rate of 10 pounds per 1,000 square feet.
- (2) **Bluegrass:** Bluegrass shall be Colorado-grown, 100 percent certified Kentucky Bluegrass,

of three improved bluegrass varieties complying with applicable Colorado and Federal regulations. Newport, Park, Delta and Common Kentucky Bluegrass are not acceptable varieties for the sod mixture. The sod shall have a vigorous and healthy root system and top growth and shall have been regularly fertilized, watered, mowed, sprayed and shall be free from objectionable weeds and/or grasses. Sod strip shall have from 5/8 inch minimum to 1 inch maximum thickness of soil adhering to root system, cut into strips 18-inch maximum width by 4 feet minimum length. Sod that has dried out, or sod with adhering soil that breaks, tears or crumbles away will not be accepted. Sod cut for more than 24 hours shall not be accepted. Sod rolls shall be kept moist, protected from sun, heat or wind in transport and after delivery. Prior to cutting, the sod shall be evenly mowed for a blade length of at least 1 inch but not more than 2 inches.

- (3) **Turf-type Tall Fescue:** Turf-type tall fescue seed or sod shall be purchased from a reputable seed dealer, complying with requirements specified. Seed mixture shall be of at least three varieties (a maximum of five) of dwarf type tall fescue (i.e., Monarch, El Dorado, Rebel Jr., Crew Cut, SR 8200, or other approved varieties).
 - (a) PLS shall not be less than 88 percent.
 - (b) Specified PLS shall be calculated as shown in Section (5)
- (4) **Buffalo Grass:** Buffalo grass shall be either seed, plugs, or sod.
 - (a) Buffalo grass seed shall be purchased from a reputable seed dealer, complying with the requirements specified. Seed mixture shall be “Texoka” or “Sharp’s Improved” or approved equivalent.
 - (i) PLS shall not be less than 75 percent.
 - (ii) Specified PLS shall be calculated as shown in Subsection (B)(5).
 - (b) Buffalo grass plugs or sod shall be 100 percent certified turf-forming variety 609, or approved equivalent. Buffalo grass imported from states south of Colorado may be approved due to the difficulty in establishing sod in the front range climate.
 - (i) All sod shall be healthy, in vigorous condition, of natural green color, free of disease and harmful insects. The sod shall be laid within 48 hours of harvest.
 - (ii) Plugs shall be cut from sod as described in this Section. Nursery grown plugs are acceptable with prior approval by the Director.
 - (c) If sod is to be used for medians larger than 12 feet wide, Buffalo grass is preferred.
- (5) **Native Seed:** Native grasses and wildflowers for median plantings are listed in tables 10-3 and 10-4. Native grass seed shall be purchased from a reputable seed dealer, complying with requirements specified. Seed mixture shall be “Foothills” mix as provided by Arkansas Valley Seed Company (303.320.7500), or approved equivalent.
 - (a) PLS shall not be less than 80 percent (average for the seed mix).

- (b) Quantity of bulk seed required to provide the specified PLS shall be calculated from purity and germination percentage rates listed on the lot tag of seed actually purchased, using the following two formulas:

$$\text{Purity Percentage} \times \text{Germination Percentage} = \text{PLS Percentage}$$

$$\frac{\text{lbs. PLS specified per 1000 square feet}}{\text{PLS percentage}} = \text{Bulk lbs. required per 1000 square feet}$$

Table 10-3: Wildflowers

Common Name	Latin Name
Blanket flower	<i>Gaillardia aristata</i>
Blue flax	<i>Adenolinum (Linum) lewisii</i>
Broom snakeweed	<i>Gutierrezia sarothrae</i>
Bush sunflower	<i>Helianthus pumilus</i>
Fringed sage	<i>Artemisia frigida</i>
Greenleaf penstemon (blue mist)	<i>Penstemon virens</i>
Nelson's larkspur	<i>Delphinium nelsonii</i>
One-sided penstemon	<i>Penstemon secundiflorus</i>
Prairie clover	<i>Dalea purpurea</i>
Prairie coneflower	<i>Ratibida columnifera</i>
Prairie sage (Sagewort)	<i>Artemisia ludoviciana</i>
Prickly pear cactus	<i>Opuntia macrorhiza (compressa)</i>
Rocky Mountain beeplant	<i>Cleome serrulata</i>
Scarlet globe mallow	<i>Sphaeralcea coccinea</i>
Spiderwort	<i>Tradescantia occidentalis</i>
Spiny goldenweed	<i>Machaeranthera pinnatifida</i>
Spotted gayfeather (Dotted gayfeather)	<i>Liatris punctata</i>
Sulphur flower	<i>Eriogonum umbellatum</i>
Western wallflower	<i>Erysimum asperum</i>
White evening primrose	<i>Oenothera caespitosa</i>
White yarrow (Woolly yarrow)	<i>Achillea lanulosa</i>
Wild bergamot (Horsemint or Beebalm)	<i>Monarda fistulosa</i>
Wild verbena	<i>Glandularia (Verbena) bipinnatifida</i>
Yellow stemless evening primrose	<i>Oenothera howardii (brachycarpa)</i>

Table 10-4: Grasses

Common Name	Latin Name	Type
Arizona fescue	<i>Festuca arizonica</i>	Turf
Big bluestem	<i>Andropogon gerardii</i>	Ornamental
Blue grama	<i>Chondrosium gracile (Bouteloua gracilis)</i>	Ornamental/Turf
Bluebunch wheatgrass	<i>Pseudoroegneria (Agropyron) spicatum</i>	Ornamental
Buffalograss	<i>Buchloe dactyloides</i>	Turf
Indian ricegrass	<i>Achnatherum (Orzyopsis) hymenoides</i>	Ornamental
Junegrass	<i>Koeleria macrantha</i>	Ornamental/Turf
Little bluestem	<i>Schizachyrium scoparium</i>	Ornamental
Mountain muhly	<i>Muhlenbergia montana</i>	Ornamental/Turf
Needle-and-thread	<i>Hesperostipa (Stipa) comata</i>	Ornamental
New Mexico feathergrass	<i>Hesperostipa (Stipa) neomexicana</i>	Ornamental
Prairie dropseed	<i>Sporobolus heterolepis</i>	
Prairie sandreed	<i>Calamovilfa longifolia</i>	Ornamental
Sand dropseed	<i>Sporobolus cryptandrus</i>	
Side-oats grama	<i>Bouteloua curtipendula</i>	Ornamental
Western wheatgrass	<i>Pascopyrum (Agropyron) smithii</i>	Turf

Table 10-5: Soil Amendment Mix Mechanical Analysis

	Percent (%) Passing	Percent (%) Retained
2" Screen	100	0
1" Screen	90-100	0-10
½Screen	50-80	20-50
#100 Mesh Sieve	0-15	85-100

- (4) **Soil Amendment:** Soil amendment for sod and seed areas, shall be manure compost, and shall contain at least 50 percent organic matter. The mixture shall be free from clay subsoil, sawdust, commercial wood products, stones, lumps, plants, roots, sticks, weed stolons and seeds, high salt content, and other materials harmful to plant life. The materials shall be coarsely ground and thoroughly mixed together to ensure an even composition. Cow manure or mushroom compost shall be free from lumps, debris or chemicals harmful to landscape plantings. The soil amendment mix shall have an acidity from pH 5.5 to 8.0, and meet the mechanical analysis outlined in Table 10-3, "Soil Amendment Mix Mechanical

Analysis,” of these Standards.

- (5) **Erosion Control Netting:** Jute mesh erosion control netting or approved equivalent shall be used.

(C) Construction Requirements

(1) Subgrade and Soil Preparation

- (a) The contractor shall lay out and stake the boundary of all areas to be sodded, seeded, or plugged prior to commencing any work. After Director approval of finish grades, the contractor shall prepare the subgrade of all seeded or sodded areas by discing or rototilling the soil to a depth of 6 inches. No ripping or chiseling shall be allowed. No rototilling or discing is to be done within the protection area of existing trees. After the subgrade has been completed, soil preparation shall begin by spreading the soil amendment evenly within the seeding or sodding limits at the rate of 3 cubic yards per 1,000 square feet. If topsoil is used as the subgrade for sod or seed, soil amendment will not be required. Soil amendment is not required in areas to be seeded with native grasses.
- (b) For sod, 0-46-0 fertilizer shall then be spread uniformly over the entire area at the rates as specified for soil preparation. The area shall again be disced or rototilled at right angles to the first tillage, then formed by rolling to provide a proper seed bed or sodding surface. The sod or seed bed shall be totally free from rock, debris, vegetable matter, noxious weeds or clay clods over ½ inch diameter, prior to any sodding or seeding operations.

(2) Finish and Fine Grading

- (a) **Positive Surface Drainage:** The contractor shall finish and fine-grade the project area to establish an even and well-matched grade over the entire surface. Positive surface drainage shall be assured, and there shall be no depressions, subsequent settling or irregularities in the finished grade.
- (b) **Transitional Areas:** At any transitional point or line where one plane intersects another, such as from a sloping area or berm to a level area, a smooth and gentle transition shall be made. There shall be no abrupt changes in grade. There shall also be a smooth transition between existing turf and the new sod. The grade elevations of the two areas shall be matching.

- (3) **Schedule:** All seeding shall be scheduled between March 1 and October 15 unless prior written approval from the Director has been obtained.

- (a) No sodding and seeding shall take place during inclement weather.
- (b) No sodding and seeding work shall commence until the adjacent site improvements, pavements, irrigation installation and finish grading is completed. The irrigation system shall have been tested and be in operating order prior to any seeding or sodding.

- (c) The contractor shall barricade sodded area immediately after sod installation as specified on the approved construction plans or in these Standards. The barricade shall include the following:
 - (i) Standard construction lath at 5 foot intervals connected with three tiers of colored plastic flagging.
 - (ii) "KEEP OFF THE SOD" signs attached to the barricading every 25 feet.

(4) Seeding

- (a) Following approval of the seed bed by the Director, seeding shall be done with a Brillion drill or approved mechanical seeder. Seed shall be evenly distributed on a still day into a slightly moist seed bed. Seed shall be drilled 1/8 inch into the prepared seed bed. If the slope is too steep to drill, seed shall be broadcast at double the application rate and covered with 1/8 inch of soil with a harrow or hand rake for small areas. The seeding shall be done in two separate applications crossing the area at right angles to guarantee proper coverage. Drill seed across slopes rather than up and down, following the contour to reduce erosion.
 - (i) Native grasses shall be seeded at a rate of 20 pounds PLS/acre when drilled and 35 pounds PLS/acre when broadcast.
 - (ii) Buffalo grass shall be seeded at a rate of 3 pounds PLS/1000 square feet when drilled and 5 pounds PLS/1000 square feet. when broadcast.
 - (iii) Turf type tall fescue shall be seeded at a rate of 6 pounds/1000 square feet when drilled and 9 pounds/1000 square feet when broadcast.
- (b) After seeding operations have been completed, the entire seeded area shall be hydromulched with "Conwed 2000" or approved equal hydro mulch material. The hydro mulch shall be applied by using mechanical hydromulcher, evenly distributed on a still day. The hydro mulch material shall be applied at the rates recommended by the manufacturer. Within 12 hours after seeding, the sprinkler system shall be activated to moisten seeded areas to a depth of 1 inch. All seeded areas shall be kept so moistened by frequent light watering until final acceptance of the project or as required by City Land Use Regulations, and such watering shall be the responsibility of the contractor.
- (c) Protect seeded slopes (greater than 2.5 horizontal to one vertical) with erosion control netting or other methods acceptable to the Director. Cover netting with straw or other acceptable mulch.

(5) Bluegrass Sodding

- (a) Sod shall be laid on a firm, premoistened bed with tight joints so that no voids occur under or between strips. All end joints shall be staggered and the sod roll length shall run perpendicular to all slope fall lines. Sod shall be tamped, rolled, and

watered immediately after sodding operations are completed.

- (b) No sod shall be installed within a radius of 3 feet around any tree within the project limits. Shredded wood chips shall be installed to a 3 inch depth in this 3 foot area. All rolls terminating at the project limits shall be cut in a straight line unless otherwise specified and the exposed edge covered with topsoil. All sod installed around planting beds shall be cut to conform to the shape of the bed as shown on plan or laid out onsite. Sod shall be laid flush with paving, curbs and irrigation heads and 1 inch below the top edge of steel edging.
- (c) In the event that sod dries or shrinks, a mixture of screened topsoil and specified bluegrass seed shall be brushed into the cracks and tamped flush. Excessively shrunk sod (over 3/4 inch shrinkage) shall be replaced with new sod. Any sod laid on slopes steeper than 3:1 (33 percent) shall be laid at a 90 degree angle to the slope and held in place with two wooden dowels per sod piece.
- (d) The contractor shall activate the sprinkler system to water sod immediately after each section of sod is laid. The contractor shall operate the sprinkler to soak all sod and the underlying soil to a depth of 2 inches and maintain this moisture level until final acceptance. The contractor shall water the sod in the early morning and late afternoon for the duration of this period.

(6) **Buffalo Grass Sod**

- (a) Prior to sodding, the site should be lightly irrigated to alleviate “sod-wicking” and desiccation. The sod shall be laid by staggering joints with all edges touching. Installation shall be performed between April 1 to August 31. Immediately following the laying of the sod, the sod should be rolled with a roller, weighing at least 150 pounds, heavy enough to imprint the sod into the soil.
- (b) The contractor shall irrigate immediately after any sod installation, so that the sod and underlying soil is completely wetted to a depth of 4 to 6 inches (saturated). Subsequent irrigation shall be applied as necessary as determined by daily inspection of the sod panels. Daily inspection should consist of manually raising several sod panels and testing the level of moistness in the soil by pinching the soil together. If the soil remains 'pinched' together, and is moist, and the panel's sod pad is also moist, then the sod does not require watering that day. If the soil, after being pinched, falls apart, the sod shall be irrigated to retain the required moisture level. The sod soil pad and underlying soil should be moist at all times.
- (c) Rainfall received during the establishment period may reduce the irrigation required. If temperatures exceed 95 degrees for periods of several days, the sod may have to be inspected more frequently and additional daily irrigation cycles may be required. If the soil that has been sodded is extremely hard, or compacted, and not easily saturated, or dries out quickly, the sod and soil shall be kept consistently moist the first ten days.
- (d) Normal establishment should display the following characteristics. Within 48 hours of installation the sod should turn a straw color, which is called a dormant stage, although the roots would continue to grow while the top growth is dormant. Within 5 to 7 days feeder roots should begin appearing. Within 14 to 21 days new green

top growth should be seen and the sod should be firmly rooted. Once this occurs, daily manual inspections would no longer be required. Sod should then be watered 1½ inches per week for 2 to three months, to prevent drought stress, until deeper rooting takes place.

- (e) The contractor is to thoroughly discuss required installation, establishment and post-establishment methods, irrigation, and maintenance requirements with the sod supplier (specifically for sod maintenance - weed control/removal, i.e., what chemical can safely be used, etc.).

(7) **Buffalo Grass Plugs**

- (a) Plugs shall be planted on 12 inch centers with a requirement of at least nine (9) plugs per square yard of ground. Plugging machinery must convert 16 x 24 inch sod panels into plugs and plant in one operation. Each 16 x 24 inch sod panel yields 24 4 inch square plugs, with a total of 81 plugs cut from a yard of sod. At least 80 percent of the plugs shall be a 4 inch square plug (4 x 4 inches); minimum acceptable size for the remainder of the plugs is 2 x 4 inches, nor maximum size any larger than 4 inch x 4 inch. Coordinate equipment passes to maintain parallel, evenly spaced rows. Immediately following plugging, the plugs should be rolled with a roller, weighing at least 150 pounds, heavy enough to imprint the plugs into the soil.
- (b) All plugs shall be planted within 48 hours of harvest of the sod. All plugs shall be healthy, in vigorous condition, of natural green color, free of disease and harmful insects. Water after any portion of the plugging is complete, within 4 hours of planting, so that the plugs are completely wetted and the underlying soil is wetted to a depth of 4 to 6 inches.
- (c) All buffalo grass sod establishment, irrigation, and maintenance requirements shall apply to plugs. Plugs will require more frequent manual inspection and more frequent watering. After the initial establishment period, plugs should be watered 1 inches per week until desired coverage is achieved.

10.05 Underground Irrigation System

(A) Description

Underground irrigation includes, without limitation, installing a complete underground irrigation system consisting of irrigation pipelines, sprinklers, valves, and controllers as part of any landscaping project.

(B) Materials

- (1) **Sprinkler System Components:** All sprinkler system components shall be those of the manufacturers specified in these Standards, or be an approved equivalent, and shall be installed in accordance with these Standards.
- (2) **Sprinkler Heads:** Pop-up rotary impact or stream spray sprinklers shall be used to water sod and shrub areas, using full and part circle heads as specified on any approved landscape plans. Requirements for the sprinklers include the following:

- (a) Sprinklers shall provide coverage as specified on any approved landscape plans, plus or minus 5 percent of the flow rate and 2 ½ feet within the design radius during a low wind situation.
 - (b) Sprinkler heads shall meet the following specifications:
 - (i) Minimum pop-up height of 2-5/16 inches with heavy retract spring;
 - (ii) Part circle sprinklers shall be adjustable for any arc between 20 and 340 degrees;
 - (iii) Have built-in check valves in the head to control low head drainage and reduce air compression in lines. The check valve shall be serviceable from the top of the head without requiring excavation and removal of the head from the riser.
 - (c) Sprinklers shall be vandal resistant, and shall have vandal-resistant cover screws or no exposed screws in the cover.
 - (d) Sprinklers shall be tamper resistant to prevent changing the direction of throws by means of locking friction collars, gear drives, and limited access features.
 - (e) Sprinklers shall have a drive mechanism that will ensure proper and even rotation and coverage on 4:1 slopes.
 - (f) Sprinklers shall have rubber covers or similar protective devices.
- (3) **Bubblers:** Requirements for bubbler heads shall include the following items.
- (a) Heads shall operate properly between 10 psi and 80 psi;
 - (b) Heads shall have a molded plastic body with a ½ inch female pipe thread;
 - (c) Heads shall have a nozzle flow adjusting screw, providing fully open to completely closed positions;
 - (d) Heads shall have a plastic basket screen to protect nozzles from clogging.
- (4) **Automatic Control Valves**
- (a) Automatic electric remote control valves shall be slow acting diaphragm-type electric solenoid valves. Solenoids shall be two-watt running, current 24 volt AC, 50/60 cycle operation. The valve shall be slow opening and closing by means of a “shunt” resistor to avoid damage from surge pressures. Valve flow range shall be 1 to 200 gallons per minute depending on size with a pressure range of 10 to 200 PSI.
 - (b) All valve bodies and bonnets shall be constructed of heavy case bronze with accurately machined valve seat surfaces and internal parts. Inlet part of diaphragm chamber shall have a removable screen for easy cleaning, accessible without

removing bonnet from valve body. Valve bonnets shall be equipped with a slotted plug or bleed screw for manual operation of valves at any time without energizing the solenoid, and a manual flow control stem.

- (5) **Isolation Gate Valves:** Isolation gate valves for installation on main lines shall be of brass construction, designed for 200 psi working pressures, and have solid disc, non-rising stems with a heel and screwed ends. Gate valves 3 inches or larger shall be brass or iron AWWA gate valves with rubber gaskets or mechanical joints.
- (6) **Quick-Coupling Valves:** Quick-coupling valves installed in main lines shall be of a cast brass body construction, and have a self-closing and locking protective cover. The throat shall incorporate a single keyway with positions for regulation of water flow, with a flow range of 10 to 70 gallons per minute and a pressure range of 5 to 125 psi. Replaceable seals shall be provided at the valve seat and throat, and the internal parts shall be removable for service. Installation on a main line shall include a 10-inch circular locking valve box over the coupler body. Size shall be 1 inch. Quick-coupling valve keys shall have 1 inch male top pipe threads. Swivel hose ells shall be 1 inch N.P.T. x 3/4 inch hose thread.
- (7) **Manual Drain Valves:** The system shall be equipped with 3/4 inch manual globe drain valves at all low points on main lines. Valves shall be of bronze construction with threaded connections, cross handles, and operating keys. Install valves in a locking valve box. Angle valves will not be accepted.
- (8) **Y-Strainers:** Y-Strainers for installation on main line shall be bronze “Y” type strainers with a screen mesh.
- (9) **Wire Connectors:** All wire connections at electric control valves and all splices of wire in the field shall be made using “snap-tits,” or an approved equivalent, wire connectors. Significant requirements for connectors include the following items:
 - (a) Connectors shall be rated at 600 volts for PVC insulated copper wire, Underwriters Laboratory listed, and water-resistant.
 - (b) Connectors shall consist of a PVC base socket, sealing plug, and wire crimping sleeve and shall provide a permanent waterproof joint by using a sealer for joint makeup.
- (10) **Controllers**
 - (a) Automatic sprinkler controllers shall be completely automatic in operation, and shall electrically start all sprinkler cycles and time the individual stations. Controllers shall have standard 117 volt power inputs, 24.0 volt, 60 cycle outputs with separate independent timing stations, 14 day programming, and be capable of automatically starting a watering cycle at the beginning of any hour for 23 hours per day. Each station shall have an “OFF” switch for “0” time and individual incremental timing control for 0 to 60 minute station timing. Each station shall have an “ON-Repeat” switch for eliminating one or more stations from initiating a repeat cycle on any or all stations after the normal watering cycle has been completed. A 14 day clock shall be provided for maximum programming versatility and any timer pins shall be of the captive type to prevent loss. It shall be possible to operate controller manually

and to select and operate manually any station. All controls shall be capable of being manipulated at any time in any sequence without damage to controller. The controller shall have the ability for dual programming and shall have soil moisture sensing equipment.

- (b) Soil moisture sensing equipment shall have an adjustable control module with an override function, and at least two in-ground sensors/tensiometers. Sensors must buffer salinity, and have the ability to withstand winter conditions without removal.
 - (c) A reset circuit breaker shall protect each controller from damage due to excessive current. A master "ON-OFF" switch shall provide for turning controller "OFF" during rainy weather, while allowing day and hour clocks to continue in operation. The controller shall have as standard built-in features an electrical circuit to operate a master valve and moisture sensor circuit to allow operation of controllers in conjunction with a moisture sensing device. Install valve output surge protection arresters for control wiring and common.
 - (d) All wiring to and from controllers shall be through color-coded plugs and sockets. Controller cabinets shall be locking, weatherproof type, constructed of heavy gauge steel with corrosion resistant enamel finish inside and out.
 - (e) Controllers shall conform to NEC Class 2 requirements of 24 volt valves. Controllers shall be for wall or pedestal mounting.
- (11) **Valve Boxes:** Valve boxes shall be sized to provide maintenance access to all valve and controller component. The underside of all control valve boxes shall be clearly marked to indicate controller numbers and valve numbers.
- (12) **Pipe**
- (a) **Main Line Pipes:**
 - (i) Main pressure line pipe shall be NSF approved virgin polyvinyl chloride pipe. Pipe shall be suitable for use at maximum hydrostatic working pressures of 200 PSI. Pipe shall be made from clean, virgin, NSF approved, type 1, grade 1 PVC, conforming to Astin Resin specification D1784-60 and project standard D2241 for PVC 1120 SDR 26 or SDR 21. PVC pipe is to be belled end and solvent weld. Solvent cement and primer shall be of the type prescribed by the manufacturer.
 - (ii) Gasket pipe and fittings shall be used for main lines 3 inches or larger. Gasketed pipe shall be of the type prescribed by the manufacturer. No insert gaskets or insert gasket fittings shall be accepted. Thrust blocks shall be provided in accordance with pipe manufacturer's recommendations.
 - (b) **Marking and Declaration of Compliance:** Pipe marking shall show the size, series, identification, and manufacturer's trade name at intervals of not more than 20 feet. Pipe shall include the seal of approval of the National Sanitation Foundation spaced at intervals required by NSF regulations.
 - (c) **PVC Fittings:** All pipe fittings shall be schedule 40 PVC (ASTM D2466 and D1784).

Solvent cement shall conform to ASTM D2564.

- (d) **Brass Pipe and Fittings:**
 - (i) Brass pipe shall be 85 percent red brass, (ANSI) Schedule 40.
 - (ii) Fittings shall be medium brass, 125 pound class, screwed type.
 - (iii) Dielectric unions shall be used wherever a copper based metal (copper, brass, bronze) is connected to an iron based metal (iron, galvanized and stainless steel).
 - (e) **Copper Pipe:** Copper pipe shall meet the requirements of Type K, ASTM B88. Fittings shall be copper or cast bronze. Silver solder shall be used for joints.
 - (f) **Lateral Line Pipes:** Pipe for rotary sprinkler laterals shall be NSF approved polyethylene, rated at 100 PSI, using nylon insert fittings and adjustable stainless steel clamps with stainless steel screws. All piping shall be CS-256-63 ASTM D2239, PE 2306-100. 3 inch or larger lateral piping shall meet the standards for main line pipes.
 - (g) **Static Pressure Reduction:** Static pressure on the main line shall be relieved by the installation of a “master” automatic control valve.
- (13) **Risers:** Rotary pop-up sprinklers shall have an adjustable swing joint riser assembly consisting of Schedule 80 PVC nipples, and marlex and Schedule 40 PVC ells.
 - (14) **Irrigation Sleeves:** All horizontal sleeves under paved areas and vertical sleeves shall be PVC Class 200 pipe, 4 inch diameter for lines 2 inches and smaller, and 6 inch diameter for lines 2 ½ inches to 3 inches. A separate 2 inch diameter sleeve for control valve wires shall be laid under any new pavements. This sleeve shall be placed next to the main line sleeve.
 - (15) **Backflow Prevention Device:** Backflow prevention devices shall be installed in accordance with these Standards and B.R.C. 1981.
 - (16) **Electrical Copper Wires:** Electrical copper wires from valves to controller shall be 14 gauge or larger PVC-insulated copper and UNDERWRITERS LABORATORY approved for direct burial. Use 10 inch valve boxes for all wire splice locations. Control wires shall be red and common wires shall be white.
 - (17) **Drip Valve Assemblies:** Drip valve assemblies shall have strainers with a 120 mesh nylon screen and ½ inch blow-out. Pressure reducing valves shall have manual adjusting nuts.
 - (18) **Drip Emitters and Tubing:** Drip emitters shall use drip tubing conforming to ASTM D1248 and ASTM D3350. Capillary tubing shall have 1/8 inch i.d.
 - (19) **Drip Line Blow Out Stubs:** Drip line blow out stubs shall be installed at all ends of drip tubing.

(C) Construction Requirements

(1) Applicable Standards

- (a) All work involving standard plumbing systems shall be executed by a licensed and bonded plumber. Electrical services to controllers shall be installed by a licensed electrician. All work shall be executed according to the B.R.C. 1981, and these Standards. The contractor shall schedule inspection of electrical services to controllers with the City and allow at least 7 working days for subsequent approval and connection to the power source by the Public Service Company. The contractor shall furnish any additional material and labor when required to comply with the B.R.C. 1981, and these Standards.
- (b) The contractor shall perform a leakage test on all systems on the site at normal working pressures.
- (c) The contractor shall guarantee irrigation application in accordance with any approved landscape plan; any unwatered areas due to poor layout, placement of or insufficient sprinklers shall be corrected by the contractor at their expense.
- (d) Work shall be in accordance with good practices prevailing in the piping trades.
- (e) All work shall be protected from vandals or flooding during construction.

- (2) **Layout of Work:** Before any installation operations are started, the contractor shall completely stake out the irrigation system on the site. Any discrepancies in irrigation water coverage shall be reported and corrected at this time.

(3) Schedule

- (a) No sprinkler system construction shall take place during wet weather or when temperatures are less than 40 degrees Fahrenheit.
- (b) All required sleeving shall be performed prior to any paving operations. All procedures necessary for the insertion and installation of irrigation pipe and wires into sleeves shall be performed after paving operations have been completed.
- (c) Installation of the system shall not take place until all earthwork has been substantially completed and compacted and all other site improvements, pavements, etc. have been completed.

(4) Trenching and Piping

- (a) The contractor shall perform all necessary excavation for installation of their work. Over-excavations shall be backfilled and hand tamped prior to installing pipe. Any pumping, shoring, or bracing shall be provided by contractor.
- (b) Manufacturer's specifications covering installation of their material shall be followed. Underground lines up to 2 inches shall have minimum horizontal clearance of 2

inches of each other, and larger lines shall have a clearance of 4 inches. No sprinkler lines shall be stacked vertically in a common trench. Lines shall have minimum horizontal clearance of 12 inches from the lines of other trades. There shall be a minimum 2 inch vertical clearance between any lines crossing 45 degrees - 90 degrees. Minimum cover over lateral piping shall be 12 inches, or to a depth to accommodate valves and other equipment, whichever is greater. All PVC main line shall be at 18-inch minimum depth of bury. PVC main line is to be encased in sand 4 inches on all sides.

- (c) Where trenches and lines run adjacent to existing irrigation lines and properties, damage to these shall be avoided and shall be restored to their original condition
- (d) When pipe laying is not in progress, or at end of each day, pipe ends shall be closed with tight plug or cap. All work shall be performed in accordance with good practices prevailing in the piping trades.
- (e) Tunneling will be permitted where the pipe must pass under any obstruction that cannot be removed. In backfilling the tunnel, the final density of the backfill must match that of the surrounding soil. It shall be acceptable to use a casing of suitable diameter that shall be installed first by tunneling or jacking, and the pipe shall then be laid through the casing, observing the same precautions as though it were installed in open trench.
- (f) Trenches shall be cut to true line and grade, and shall be excavated so that the pipe shall be supported uniformly. The contractor shall be responsible for staking the trench lines. Minimum grade of piping to drain shall be 3 inches/100 feet.
- (g) If ground water is encountered during trench excavation above the elevation of the bottom of the pipe grade, such water shall be drained until the pipe has been installed. Pipe joints and open ends shall be plugged to prevent ground water from entering the pipe.
- (h) Thrust blocks shall be installed behind all gasketed fittings, in line valves, and caps. Gasket pipe fittings shall be installed according to manufacturer's recommendations. Concrete for thrust blocks shall cure for 72 hours before pressure is applied to the system.

(5) **Threaded Joints**

- (a) Field-threading of plastic pipe or fittings shall not be permitted. Only factory-formed threads shall be used.
- (b) Factory-made nipples shall be used wherever possible. Field-cut threads in metallic pipe will be permitted only where absolutely necessary. When field threading, cut threads accurately on axis with sharp dies.
- (c) All threaded joints shall be assembled with pipe joint compound consisting of liquid Teflon. The compound is to be applied to male threads only.

- (d) Where assembling soft metal (brass or copper) or plastic pipe, strap type friction wrenches shall be used; metal-jawed wrenches shall not be used.

(6) **Sleeves**

- (a) The contractor shall furnish and install sleeves of appropriate size, depth, and location to accommodate all irrigation pipe beneath any paved surfaces prior to pipe installation as specified herein, unless they have been previously installed. Where irrigation lines run under proposed paved surfaces, the contractor shall sleeve the lines a distance 2 feet beyond the edge of the surface. Sleeves shall be PVC Class 200 pipe.
- (b) Installation of sleeves shall precede construction paving. Sleeves shall be encased in sand 4 inches on all sides, with backfill compacted to 95 percent of standard Proctor density. Sleeves shall be buried at a depth of 18 inches. Separate sleeves placed at the 18 -inch bury depth shall be provided for wires passing under paved sections.
- (c) All sleeves shall be marked by the placement of nylon rope, or an approved equivalent marking material.

(7) **Backfilling**

- (a) Trenches shall not be backfilled until all required tests on the system have been completed and until the line has been inspected and approved by the Director. Trenches shall be carefully backfilled with suitable materials, free from stones larger than 2 inches in maximum dimension, by depositing the material in 6 inch layers and thoroughly compacting the backfill to 95 percent of standard Proctor density.
- (b) Ponding and/or jetting may be used only if prior approval is obtained and only when the backfill material is sandy or gravelly. An excess of water shall be avoided in order to prevent disturbance of the earth under and around the pipe. Likewise the amount of water used shall be controlled so as not to risk "floating" the pipe out of position. Adequate dikes shall be constructed along the trench to retain and guide the water. When jetting is used, jets shall be of an approved design and of sufficient length to reach the bottom of each layer and the water supply shall be continuous.
- (c) Site excavation material will generally be considered satisfactory for backfill purposes provided that backfill materials are free from rubbish, vegetable matter, frozen materials, or stones larger than 2 inches in maximum dimension. Any material not meeting these specifications for backfill shall be removed from site.
- (d) Backfilling shall not be performed in freezing weather. All trenches shall be left slightly mounded to allow for settlement after the backfilling is completed. If sinking of the trenches occurs, it is the responsibility of the contractor to correct such conditions.

- (8) **Manual Drain Valves:** Manual drain valves shall be located, furnished, and installed by the contractor at all low points on sprinkler lines. A drain sump of not less than 6 cubic feet of

3/4 inch washed gravel shall be installed surrounding each drain valve. All manual drain valves are to be installed with drain valve sleeves.

(9) **Electric Control Valves**

- (a) Electric control valves shall be automatic and purchased from the manufacturer specified, or be an approved equivalent, matching size, model and quantity as listed on an approved landscape plan. All control valves shall be installed at the locations shown on the approved landscape plan.
- (b) Electric control valves shall be installed in accordance with the manufacturer's recommendations. All valves shall have sufficient clearance from adjacent obstructions to provide accessibility for maintenance. All valves shall be installed at sufficient depth to provide at least 6 inches cover to finished grade. Only one control valve per valve box shall be installed.
- (c) Control wire shall have an 18-inch expansion loop at each valve and elsewhere as necessary to prevent possible wire breaks. Where more than one control wire is located in the trench, the wires shall be taped together at 20 foot intervals to maintain orderly and efficient installation. All control wires shall be placed carefully alongside and slightly below the main line for protection. Control wires not protected by the irrigation main shall be laid in a 2 inch PVC class 200 sleeve. Electrical control wires shall be extended along the irrigation main and connected to the controller.
- (d) Electrical control wires shall be connected with snap-tits connectors. Splicing will be permitted only on runs exceeding 500 feet in length, and shall be located at valve locations. Wires shall be bundled and taped at 20 foot intervals. A minimum wire loop of 24 inches shall be provided at each control valve, splice, and every 100 feet of wiring. Two spare #14-1 wires, blue in color, shall be installed along the entire length of the main line from the controller to farthest control valve on each and every branch of the main line.

- (10) **Pressure Reducing Valves:** Pressure reducing valves (PRV) shall be installed to ensure proper operating pressures at sprinkler locations.
- (11) **Valve Boxes:** All automatic control valves, pressure reducing valves, backflow prevention devices, isolation gate valves, manual drain valves, and quick-coupling valves are to be installed in valve boxes. The valve box and cover shall be flush with the final grade and level. The valve box shall be installed with a 2 inch layer of washed gravel on the sides and below the box. If the box encloses a double check valve assembly, the gravel layer below the box shall be equal in volume to the volume of the box.
- (12) **Quick-Coupling Valves:** Quick-coupling valves shall be installed in conformance with these Standards. Additional quick-coupling valves shall be located every 200 feet along the main line. All valves shall be installed in separate 10-inch circular valve boxes placed flush with the final grade and level.
- (13) **Isolation Gate Valves:** Isolation gate valves on the main line shall be plumb with finished grade and installed in a valve box placed flush with the final grade and level. Extensions may

be added onto the valve box as necessary to level box with finish grade.

(14) **Sprinklers**

- (a) Installation of sprinklers includes furnishing, installing, and testing, risers, fittings, sprinkler heads, bubblers, and other sprinkler system components in accordance with an approved landscape plan. Sprinkler piping shall be thoroughly flushed before the installation of the sprinkler heads and bubblers.
- (b) Sprinkler heads shall be set plumb and level with finished grade at locations shown on an approved landscape plan. Sprinklers shall be set 3 inches behind concrete improvements such as curb and gutter or sidewalks. Sprinklers installed where grass has not been sodded shall be installed on temporary risers extending minimum 3 inches above grade. After finished grades are established and the ground has settled, the contractor shall lower sprinklers to finished grade.
- (c) Bubblers shall be set plumb and level before mulch is installed.
- (d) Rotary pop-up sprinklers on swing joint risers shall be installed as shown in these Standards and may be adjusted in the field as necessary.

(15) **Drip Valve Assemblies:** Installation of drip valve assemblies shall in conformance with these Standards.

(16) **Drip Emitters and Tubing:** Installation of drip emitters and tubing shall be installed in conformance with these Standards at a depth of 4 inches below top of grade. For this purpose, top of grade does not include mulch or rock layers. Drip line blow-out stubs are to be installed at all ends of drip tubing. Drip tubing may be installed in turf areas as lateral piping.

(17) **Controllers and Related Work:** The controller shall be mounted on three wolmanized CCA 6 inch x 6 inch ties, set at least 24 inches below grade and a maximum of 18 inches above grade. The controller shall be located as shown on an approved landscape plan, and be mounted inside a locking, weather-proof metal cabinet. The contractor shall provide and install a 15-amp electrical circuit breaker in a locking, weatherproof box. The contractor shall wire the circuit breaker and controller and run wire to the Public Service Company pull box, leaving an 18-inch tail of wire in the pull box or sleeve. After connection, the contractor shall notify the City's Inspection Services to inspect controller and circuit breaker wiring prior to notifying Public Service Company to connect power to the wiring. The contractor shall be responsible for manual operation of the sprinkler system until power is connected. All wiring shall be performed by a licensed electrician.

(18) **Testing and Adjusting**

- (a) All main lines having continuous pressure shall be tested at a minimum pressure of 100 psi. Visual inspection shall be performed and any leak shall be repaired. Repaired lines shall be retested until no leakage is occurring.
 - (i) Zone lateral lines shall be tested at the design operating pressure of the zone. Any leaks found shall be repaired and the zone retested. All sprinklers shall

be operating at the same pressure plus or minus 7 percent.

- (ii) The entire irrigation system shall be tested at normal working pressure for leaks in the system and retested until no leakage is occurring. The pressure test shall be performed under the observation of the Director for final approval.
 - (iii) After testing, the entire irrigation system shall be thoroughly flushed with at least 100 percent of operating flow passing through each pipe, beginning with larger mains and continuing through smaller lines in sequence.
 - (b) The entire system shall be “fine-tuned” by regulating valves, adjusting patterns and breakup arms, setting pressure reducing valves at proper pressure and similar, to provide optimum and efficient coverage.
 - (c) Final inspection shall include observation and approval by the Director of the performance, method of operation, and coverage of the irrigation system.
 - (d) The contractor shall furnish two sets of keys for all quick-couplers, manual drain valves, gate valves, and controllers as well as padlocks and keys for controller circuit breaker boxes, two sprinklers and nozzles of each type, hose ells for all quick couplers, and all related loose parts necessary to operate the system, as part of the final acceptance by the Director.
- (19) **Record Drawings (As-Built):** Upon completion of improvements and prior to final acceptance, the contractor shall submit as-built drawings of the irrigation system to the Director. The as-built drawings shall comply with the requirements of Subsection 1.03(G), “As-Built Drawings,” of these Standards, and shall include the location of following items:
- (a) Connection to existing water lines.
 - (b) Routing of sprinkler pressure lines (maximum 100 feet along routing).
 - (c) Sprinkler control valves.
 - (d) Quick coupling valves.
 - (e) Drain valves.
 - (f) Drip line blow-out stubs.
 - (g) Control wire routing if not with pressure main line.
 - (h) All gate valves.
 - (i) Other related equipment as directed by the City.
- (20) **Operation Instruction:** Prior to final acceptance of improvements, the contractor shall submit three written sets of operating instructions, with cut sheets of all products, and a

guideline summer watering program.

(21) **Controller Charts**

- (a) Controller charts shall be prepared for the Director once record (as-built) drawings have been accepted.
- (b) A controller chart shall be provided for each automatic controller installed.
- (c) The controller chart may be a reproduction of the record drawing, if scale permits fitting of the chart to the controller door. If photo reduction prints are required, the reductions shall be sized to ensure full legibility.
- (d) The controller chart shall represent the actual “as-built” system, showing the specific area covered by that controller.
- (e) The controller chart shall identify the area of coverage of each remote control valve, using a distinctly different pastel color on drawing over the entire area of coverage.