

EXHIBIT E

Native Seed and Plant Specifications: Bioswale and Stormwater Infiltration Zones

LCMG Demonstration Garden — City Planning Department, Site Plan Review

1. Purpose and Scope

This exhibit provides the native seed and plant specifications for the bioswale and stormwater infiltration system described in Exhibit C2 (Integrated Low Impact Development Stormwater Management System). It identifies the ten native grass and sedge species selected for the three-element bioswale network and associated transition plantings on Lots 1 and 2, defines planting zones by moisture regime, and establishes the installation schedule and long-term maintenance obligations that will be documented in LCMG's Operation and Maintenance Plan.

All species listed are native to Wyoming and to the High Plains ecoregion of southeastern Wyoming specifically. Species selection criteria are: (1) documented occurrence in Laramie County or adjacent counties; (2) tolerance of Cheyenne's alkaline clay soils and semi-arid climate (approximately 15 inches average annual precipitation); (3) demonstrated performance in bioswale, rain garden, or riparian restoration contexts in comparable western climates; and (4) availability as regionally sourced seed or plugs from suppliers serving the Wyoming–Colorado Front Range.

No non-native, cultivated, or ornamental varieties are specified. No supplemental irrigation is required after Year 1 establishment. LCMG volunteers assume full responsibility for installation, establishment watering, and ongoing maintenance. The City of Cheyenne incurs zero cost.

2. Site Conditions

The bioswale system occupies Lot 1 (primary swale network and dome cluster) and Lot 2 (orchard, forest sink, and overflow spillway). Relevant site conditions driving species selection are as follows.

2.1 Climate

Cheyenne, Wyoming is located at approximately 6,100 feet elevation in USDA Hardiness Zone 4b–5a. Mean annual precipitation is approximately 15 inches, with peak moisture in May–June. Prevailing winds are from the southwest and frequently exceed 40 mph, with gusts recorded above 60 mph. The frost-free growing season is approximately 128 days. Winters are cold and dry, with 40–50 inches of annual snowfall. All species specified are cold-hardy to Zone 4a or colder.

2.2 Soils

Soils on both lots are predominately silty clay loam to clay loam of the Kimball-Nunn association, with pH ranging from 7.8 to 8.4 (alkaline). Soil permeability is low to moderately low. The bioswale design (Exhibit C2, Section 3.2) is predicated on a 24–48-hour drawdown time in these native soils, confirmed by field observation of comparable swales in the region. All specified species tolerate alkaline pH and clay-dominant soils.

2.3 Hydrologic Zones

The bioswale system creates a moisture gradient from the permanently or periodically saturated swale channel bottom to the droughty upland fringe. Species are assigned to planting zones (Section 4) corresponding to this gradient. The transition from wet to dry occurs across a horizontal distance of approximately 3–5 feet on each swale side slope, creating opportunities for a diverse native plant community within a compact footprint.

3. Species List

The following ten native grass and sedge species are specified for the LCMG bioswale system. The table includes scientific name, plant type, mature height, moisture zone tolerance, soil preference, and primary bioswale function. Seven species are warm- or cool-season grasses; three are sedges. Together they cover the full moisture gradient from standing water to droughty upland.

Common name / scientific name	Type	Height	Moisture zone	Soil tolerance	Bioswale role and notes
Western wheatgrass <i>Pascopyrum smithii</i>	Grass	18–36 in	Wet–dry	Clay, alkaline	Primary swale matrix; deep rhizomes stabilize channel banks; tolerates both prolonged inundation and summer drought cycles; dominant native of Laramie County
Blue grama <i>Bouteloua gracilis</i>	Grass	8–18 in	Dry–moist	Clay, sandy, alkaline	Swale edge and upland fringe; low-growing mat prevents erosion on side slopes; dominant short-grass prairie native of the Cheyenne high plains; no supplemental irrigation once established
Little bluestem <i>Schizachyrium scoparium</i>	Grass	18–36 in	Dry–moist	Loam, clay, well-drained	Swale shoulder and buffer strip; dense bunchgrass clumps slow sheet flow; outstanding orange fall color adds seasonal interest; native to Wyoming's eastern plains
Switchgrass <i>Panicum virgatum</i>	Grass	36–72 in	Wet–dry	Clay, loam, sandy	Deep channel and inlet zone; fibrous root system exceeding 11 ft maximizes infiltration; tolerates ponding up to two weeks; high biomass provides excellent pollutant and nutrient uptake
Inland saltgrass <i>Distichlis spicata</i>	Grass	6–18 in	Wet–saline	Alkaline, saline, clay	Ideal for Cheyenne's high-pH, alkaline clay soils; stabilizes wet swale bottom; tolerates road salt spray from Airport Parkway; spreads by rhizome to fill bare zones
Indian ricegrass <i>Achnatherum hymenoides</i>	Grass	12–24 in	Dry–moist	Sandy, gravelly, alkaline	Swale shoulder and infiltration fringe; fine roots penetrate compacted soils; extreme drought tolerance once established; regional ecotype seed available from Wyoming suppliers
Prairie dropseed <i>Sporobolus heterolepis</i>	Grass	18–30 in	Moist–dry	Clay, loam, alkaline	Swale edge and transition zone; fine-textured mounding habit traps sediment; slow to establish but extremely long-lived; fragrant seed heads in late summer attract pollinators
Nebraska sedge <i>Carex nebrascensis</i>	Sedge	18–36 in	Wet–saturated	Clay, alkaline, wet	Swale bottom and overflow zone; tolerates prolonged saturation and alkaline conditions; spreads by rhizome to fill gaps; referenced in Exhibit C2 as primary bioswale sedge species

Common name / scientific name	Type	Height	Moisture zone	Soil tolerance	Bioswale role and notes
Beaked sedge <i>Carex utriculata</i>	Sedge	24–40 in	Wet–shallow water	Clay, mucky, seasonally flooded	Deep channel and ponding zones; forms dense stands in shallow standing water; excellent pollutant and nutrient uptake; native to Wyoming riparian systems and wet meadows
Plains oval sedge <i>Carex brevior</i>	Sedge	12–24 in	Dry–moist	Rocky, sandy, loam; wide range	Swale transition zone and side slopes; unusually versatile — thrives in both wet and dry microsites; spreads to suppress weeds; survives on fewer than 15 inches of annual precipitation

Seed source note: All species shall be sourced as High Plains or Rocky Mountain ecotypes. Acceptable regional suppliers include Western Native Seed (Coaldale, CO), Pawnee Buttes Seed (Greeley, CO), and High Country Gardens. Cultivated varieties and non-local ecotypes are not acceptable substitutes.

4. Planting Zones

The bioswale cross-section is divided into five planting zones based on moisture regime and position relative to the swale channel. Species assignments reflect each zone's hydrologic and edaphic conditions. Multiple species are specified per zone to provide redundancy and ecological diversity; not all species need be present in every linear foot of swale.

Zone	Hydrologic conditions	Specified species	Function
Zone A — Wet channel bottom	Permanently or seasonally saturated; ponding 0–12 in	Nebraska sedge, Beaked sedge, Switchgrass	Deepest infiltration zone; riparian sedge matrix holds channel shape and filters runoff
Zone B — Active flow channel	Intermittently wet; drains within 24–48 hr of storm event	Western wheatgrass, Switchgrass, Inland saltgrass	Primary conveyance zone; tolerates both scour velocity and dry intervals between events
Zone C — Transition slope	Moist after storms; dries to ambient within 72 hr	Prairie dropseed, Plains oval sedge, Western wheatgrass	Sediment capture and bank stabilization; species bridge wet and dry conditions
Zone D — Swale shoulder / edge	Ambient soil moisture; receives occasional overflow only	Little bluestem, Blue grama, Indian ricegrass, Prairie dropseed	Upland fringe; zero supplemental irrigation; wildlife and pollinator corridor
Zone E — ROW buffer / upland	Droughty; ambient Cheyenne	Blue grama, Indian ricegrass, Little bluestem	Ties bioswale plantings to surrounding ROW native perennial corridor described in Exhibit C2

Zone	Hydrologic conditions	Specified species	Function
	conditions (15 in/yr avg precip)		

5. Seeding and Installation Specifications

5.1 Seed Mix Rates

Broadcast seeding in Zones B through E shall be performed at the following pure live seed (PLS) rates, consistent with NRCS and Western Native Seed recommendations for high-plains restoration seeding:

Grasses (Zones B–D): 8–12 PLS lb/acre broadcast, or 4–6 PLS lb/acre drill-seeded. Sedges (Zone A supplement): 16–32 PLS oz/acre broadcast into moist Zone A soils after plug installation. Total mix by weight: 60% warm-season grasses (switchgrass, little bluestem, prairie dropseed), 30% cool-season grasses (western wheatgrass, Indian ricegrass, blue grama), 10% sedge seed supplement.

5.2 Plug Installation (Sedges, Zone A)

Nebraska sedge (*Carex nebrascensis*) and Beaked sedge (*Carex utriculata*) shall be installed as 4-inch plug transplants at 18-inch on-center spacing in Zone A. Plugs shall be sourced from a nursery propagating Wyoming or Colorado Front Range ecotypes. Install immediately after swale grading in early April while soils retain spring moisture. Water in with Gator bags (10–15 gallons per 10 linear feet of swale) at installation and weekly for four weeks thereafter.

5.3 Soil Preparation

No topsoil import is required or specified. Native clay loam soils support establishment of all listed species. A 2–3-inch layer of weed-free compost shall be incorporated into the top 4 inches of soil in Zones A and B only, to improve initial seed-to-soil contact and water retention during establishment. Zones C through E require no soil amendment. No fertilizer shall be applied at any time; fertilizer promotes non-native weed competition and is counterproductive in native grass restoration.

5.4 Erosion Control During Establishment

All seeded areas on slopes steeper than 3:1 (horizontal:vertical) shall receive a biodegradable erosion-control blanket (straw-coconut or 100% straw) anchored with staples at 12-inch intervals. Blankets shall remain in place until vegetation achieves 80% cover, typically by end of Year 1. No plastic netting erosion control products shall be used, as netting entangles wildlife.

5.5 Weed Control

The primary invasive threat during establishment in Cheyenne is cheatgrass (*Bromus tectorum*) and smooth brome (*Bromus inermis*). Both are cool-season annuals or perennials that germinate in early spring and can outcompete native seedlings if not controlled. Management protocol: hand-pull or spot-spray with herbicide any cheatgrass or smooth brome rosettes identified before May 15 in Year 1 and Year 2. Do not mow during the first growing season, as mowing at this stage favors non-native species over establishing natives.

Prohibited species: No seed, plug, or plant material from the following invasive species shall be present in the seed mix, on equipment, or in compost used on this project: cheatgrass (*Bromus tectorum*), smooth brome (*Bromus inermis*), leafy spurge (*Euphorbia esula*), spotted knapweed (*Centaurea stoebe*), or Canada thistle (*Cirsium arvense*). The contractor shall inspect all equipment and materials for invasive propagules before entry onto the site.

6. Installation Schedule

The following schedule governs first-year installation and multi-year establishment. All work is performed by LCMG volunteers or contractors engaged by LCMG. The City of Cheyenne incurs no construction or establishment cost.

Period	Phase	Actions	Notes
March	Site prep	Stake zone boundaries per planting plan; grade swale channels to design cross-sections; add 2–3 in of compost to Zone A and B soils to improve initial water retention and seed-to-soil contact	Grading complete before seed dormancy breaks
April	Sedge plugs	Install Nebraska sedge and Beaked sedge as 4-in plugs at 18-in on-center spacing in Zone A; water in with Gator bags; mulch lightly with straw	Plugs establish faster than seed in saturated conditions
April–May	Grass seeding	Broadcast seed mix across Zones B–E; hand-rake lightly to 1/4-in depth; apply erosion-control mulch blanket on slopes greater than 3:1; no seed dormancy stratification required for species listed	Target soil temp above 50°F for warm-season species
May–June	Establishment	Water weekly if no rainfall event greater than 0.5 in; hand-pull invasive cool-season grasses (cheatgrass, smooth brome) before they set seed; do not mow during first growing season	Cheatgrass is primary establishment threat in Cheyenne
August	Supplemental seeding	Overseed any bare patches identified during June inspection; use same species by zone; press seed into soil surface with foot traffic or roller	Late-summer rains support fall germination for cool-season species
October	First-year cutback	Cut all vegetation to 6–8 in after first hard frost; remove cuttings to prevent thatch buildup; inspect channel grades for erosion or settlement	Leave stubble for winter wildlife cover and snow interception
Year 2–3	Ongoing O&M	Mow or burn every 2–3 years to control shrub encroachment; spot-treat invasives; no fertilizer required; no supplemental irrigation after Year 1; system is fully self-sustaining by Year 3	LCMG volunteer maintenance team; zero City cost

7. Long-Term Maintenance

Following Year 1 establishment, the LCMG bioswale native plant community requires minimal intervention and no supplemental irrigation. The following maintenance activities are documented in the

LCMG Operation and Maintenance Plan and will be performed by LCMG volunteers on an ongoing basis at no cost to the City.

7.1 Annual Tasks

Spring inspection (March–April): Walk all three bioswale channels to inspect for erosion, invasive species, and channel grade changes following winter freeze-thaw cycles. Document any areas requiring repair or spot reseeding.

Growing-season weed monitoring (May–August): Spot-treat invasive species as identified. Pay particular attention to cheatgrass in Years 1–3. After Year 3, the established native plant community provides sufficient competition to suppress most invasive pressure without chemical treatment.

Fall cutback (October–November): Cut vegetation to 6–8 inches after first hard frost. Remove cuttings. Leave stubble and seed heads through winter to provide wildlife forage and erosion protection. Inspect swale channels for sediment accumulation at inlets and outlets.

7.2 Periodic Tasks (Every 2–3 Years)

Prescribed burn or mow: The bioswale planting community benefits from periodic disturbance to prevent shrub encroachment (primarily rabbitbrush and skunkbush sumac) and to recycle nutrients. A low-intensity prescribed burn or mechanical mow to ground level every 2–3 years is recommended. LCMG will coordinate any burn with the Cheyenne Fire Department and comply with all applicable burn permit requirements.

Sedge plug reinforcement: If Zone A sedge cover falls below 70% due to drought or disturbance, install additional plugs in April of the following year using the same species and spacing specified in Section 5.2.

7.3 Prohibited Maintenance Practices

The following practices are expressly prohibited in the bioswale native plant zones: application of fertilizer or herbicide (except spot-treatment of invasives with NRCS-approved aquatic-safe herbicides in Zones A–B); irrigation after Year 1; mowing lower than 4 inches during the growing season; use of plastic weed barrier fabric; and compaction of Zone A soils by vehicle traffic.

8. Alignment with City of Cheyenne Goals and LID Standards

The native seed specifications in this exhibit directly support the Low Impact Development pillars and City policy objectives identified in Exhibit C2:

Source control and infiltration (LID Pillars 1 and 2): Deep-rooted native grasses and sedges — particularly switchgrass (11+ ft root depth) and Nebraska sedge — maximize water infiltration into Cheyenne’s native clay soils, reducing peak stormwater flows and recharging the local aquifer.

Pollutant removal (LID Pillar 2): Dense native grass root mats physically filter suspended sediments, heavy metals, and hydrocarbons from stormwater before it reaches Crow Creek and the South Platte watershed. This is the primary filtration mechanism of the three-element bioswale system.

Evapotranspiration (LID Pillar 3): Native grasses and sedges transpire harvested water back into the atmosphere, reducing soil saturation, moderating microclimate temperatures, and contributing to the urban heat island mitigation function identified in Exhibit C2, Section 8.

PlanCheyenne Resource Stewardship: The native plant community established by this specification converts a previously disturbed urban lot into a functioning native prairie and riparian mosaic, consistent with PlanCheyenne Foundations Pillar goals for resource stewardship, xeriscaping, and water conservation.

BOPU Water Conservation Program: All species specified achieve zero-supplemental-irrigation status by Year 2, consistent with BOPU smart irrigation promotion objectives. The system does not draw on municipal water after initial establishment.

Summary: Ten native Wyoming grasses and sedges, organized across five planting zones, cover the full moisture gradient of the LCMG bioswale system from saturated channel bottom to droughty upland fringe. All species are cold-hardy to Zone 4a, tolerant of Cheyenne's alkaline clay soils and high-wind conditions, and available from regional High Plains seed suppliers. Installation is volunteer-executed. No supplemental irrigation is required after Year 1. No City maintenance cost is incurred at any time.

End of Exhibit E — Native Seed and Plant Specifications: Bioswale and Stormwater Infiltration Zones