

Prairie Point Residential Development Vegetation Establishment Plan

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Submitted to:

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Introduction

The primary goal of vegetation establishment in Mile High Flood District (MHFD) maintenance-eligible channels and facilities is to provide high-functioning, low maintenance native vegetation that stabilizes floodplains, stream banks, and other areas prone to flood flows. The purpose of this plan is to establish clear, site-specific vegetation establishment standards that have been developed for the MHFD's Maintenance Eligibility Program (MEP) Final Acceptance criteria, which follows Construction Acceptance. The site inspection for Final Acceptance includes inspecting vegetation to determine if establishment standards have been met.

The Prairie Point Residential Development project is not a MHFD Development Improvement Project, and therefore is not automatically maintenance eligible. Part of the final determination of maintenance eligibility is the establishment of adequate vegetative cover. This plan serves to document and quantify vegetation establishment to ensure the project will be eligible for maintenance assistance was completed.

This document consists of three parts: 1) discussion of Establishment Standards for Final Acceptance for establishment of native, non-irrigated vegetation; 2) description of the establishment schedule for monitoring and maintenance; and 3) annual performance milestones and a description of triggers for remedial measures if milestones are not being met.

Establishment Standards for Final Acceptance

To accomplish successful vegetation establishment, MHFD requires the project's ecologist or landscape architect to base proposed native non-irrigated or irrigated vegetation communities on existing site conditions including topsoil (amended if needed) and hydrology (xeric, mesic, hydric, frequently flooded, etc.). This combination of factors influences the selection of practical establishment standards for each community.

The Prairie Point Residential Development project proposed the establishment of three vegetation communities including wetlands where adequate hydrology is anticipated, riparian vegetation in the overbank areas, and short grass prairie uplands. The planting plan, seed mixes, and planting schedule from the Final Design plan set are included in Appendix A.

Establishment standards for each vegetation community have been identified based on a field site visit, existing scientific literature on these communities, and best professional judgment. Additionally, up-to-date, high-resolution aerial imagery was analyzed to determine conditions currently present on site to better inform what conditions should be reestablished after construction. Establishment standards are presented in Table 1. These establishment standards are expected to be met 5 years following Construction Acceptance.

Table 1. Establishment Standards for Final Acceptance

Vegetation Community	Percent Vegetation Cover	Percent Native Vegetation Cover	Maximum Percent of Vegetation comprised of Weeds (Eradicate A List Species)	Maximum Size Bare Ground Patch
Upland	≥60%	35%	10%	200 s.f.
Riparian	≥70%	40%	10%	200 s.f.
Wetland	≥80%	50%	10%	200 s.f.

Establishment Period

Native non-irrigated vegetation establishment typically takes about 3 to 5 years to produce a stable, self-reproducing vegetation community with desirable species, after which minimal maintenance is necessary. During this period, monitoring will occur at various frequencies and maintenance will occur according to the prescribed schedule shown in the Maintenance and Monitoring Program section or as needed, if indicated. Throughout the 3 to 5-year establishment period, maintenance crews will be focused on controlling weeds via herbicide treatments and periodic mowing, reseeding bare areas, and overseeding areas lacking desirable species, as necessary. Other activities such as supplemental plug planting, erosion control, and soil decompaction may be necessary if indicated during monitoring. During the vegetation establishment phase, the contractor will also perform trash and debris removal, as needed.

Maintenance and Monitoring Program

The maintenance and monitoring program is designed to support the establishment of native vegetation by performing erosion control measures, weed removal, protection from unauthorized access, trash and debris removal, replanting, reseeding, or other adaptive management practices, if necessary. MHFD plans to document the maintenance and monitoring efforts completed during the vegetation establishment phase to better understand the processes and procedures developed for the maintenance and monitoring program. Quarterly reports will be prepared as part of this effort.

Schedule

Maintenance and monitoring of the project will occur according to the schedule and tasks shown in Table 2.

Table 2. Maintenance and Monitoring Schedule

Task	Year 1	Year 2	Year 3	Year 4
Mowing for Weed Control (non-wetlands)	Mow or string trim areas with dense annual weeds, as needed	Mow or string trim to 6-8" mid to late June and again to 12" in August, as needed	Mow or string trim to 6-8" mid to late June and again to 12" in August, as needed	Pull or string trim taller weeds such as sweet clover during the growing season, as needed

Table 2. Maintenance and Monitoring Schedule

Task	Year 1	Year 2	Year 3	Year 4
Herbicide Weed Control	Monthly during the growing season or as indicated by weed management protocol	Quarterly or as needed	Quarterly	Spring and Fall
Erosion Control	As needed	As needed	As needed	--
Trash and Debris Removal	Quarterly	Quarterly	Quarterly	Quarterly
Reseeding	~November	~November	~November	~November
Qualitative Site Inspection	Monthly, March to October	Monthly, March to October	Quarterly	Late April/Early May and August
Quantitative Establishment Standard Monitoring	June (if applicable) and September	September	September	September

Maintenance Tasks

The following descriptions of maintenance tasks are provided as general guidance. Experienced maintenance supervisors should tailor each task as needed for site-specific conditions.

Mowing

Mowing non-wetland communities can be used to control certain annual and biennial weeds such as Kochia (*Kochia scoparia*) in the first one or two years after seeding and to control invasive winter annual grasses such as cheatgrass (*Bromus tectorum*) in the third year and beyond. During the first growing season and first full year, selectively mow stands of fast-growing annuals to a height of 6-8" as needed. Do not allow weeds to get taller than 16" or set seed before mowing to prevent thatch from burying grass seedlings. Mow or string trim annual and biennials to 6-8" the second year just prior to or when in full bloom. Timing of the second-year mowing will likely be in June but must be timed to occur just before weeds set seed. From year 3 and on, mow as needed to control any remaining weeds and unwanted volunteer shrubs and trees.

Weed Control

Weed control will be accomplished through a combination of hand or mechanical removal (mowing, string trimming) and herbicide treatments and will be performed by qualified maintenance workers. Care will be taken to avoid damaging native plants in the treatment areas through judicious use of herbicides (spot spraying) and avoiding broadcast herbicide application when practicable. Herbicide application will be done by a State-licensed commercial applicator and all product labels and warnings will be followed.

If herbicide-treated weeds have flowered or gone to seed, the week following herbicide treatment, dead weed heads will be cut, bagged, and removed. All weed material removed in this manner will be transported off-site and disposed of at an approved facility.

Weeds targeted for elimination from the site are State of Colorado A list species. Species targeted for control include B list species, some C list species, and other problematic invasive forbs (species lists are available at the Colorado Department of Agriculture <https://www.colorado.gov/pacific/agconservation/noxious-weed-species>).

Erosion Control

For the first two or three years, or until vegetation cover adequately protects the soil, hand fill and compact rills and other erosional features. If needed, install sediment control logs to slow runoff. Reseed and mulch (or erosion control blanket) eroded areas.

Trash Removal

Trash and other debris have the potential to be blown into the site from the surrounding area, dropped by pedestrians accessing the area without authorization, or washed downstream. All such materials will be removed by hand during regular maintenance visits.

Reseeding

In the case that seed in some areas fails to germinate or other damage occurs to the site, supplemental seeding will be done in the fall seeding window (~November). The seed mix will be the original mix or a mix modified as described under adaptive management strategy to include only the most successful species. Seed will likely be hand broadcast and raked in unless large swaths of bare areas are identified.

Site Inspection and Establishment Standard Monitoring

The following section provides the information necessary to evaluate the success of vegetation establishment. Site visits will occur at the frequencies specified in Table 2. Two types of visits are to be performed by the Landscape Architect or Ecologist:

1. Qualitative monthly site inspections,
2. Monitoring of quantitative establishment standards.

These site visits are used to determine the progress towards meeting the performance milestones in Tables 4-6. The full field protocols for each site visit are in Appendix B.

Monthly site monitoring during the growing season is to be performed for general observations, such as phenology of weed species onsite, weed treatment efficacy, vigor/survival of plantings, native plant species recruitment, signs of drought stress, etc. These observations will be noted during the surveys using the Checklist in Appendix C. Additionally, soil erosion, flood damage, vandalism, trampling, and pest problems will be identified. The intent of these site visits is to provide feedback on all maintenance being performed onsite and identify if/when changes to the prescribed maintenance may be needed.

Quantitative establishment standard monitoring is to be conducted in June (if applicable) and September during the first growing season and in September for all remaining years to collect quantitative data to compare against the performance milestones in Tables 4-6.

Quarterly reports documenting regular maintenance tasks and remedial measures will be prepared and submitted to MHFD. Monitoring reports will include photos as well as notes on the timing, and extent of completed work, and what materials and seed mixes were used for reseeding. Data gathered through both types of monitoring events should be used to assess success or the underlying cause of inadequate native cover, including drought, soil compaction, and poorly performing seed mix species, which may require that additional remedial measures be implemented to meet the yearly performance milestones (Tables 4-6) and, eventually, the establishment standards (Table 1). Monitoring reports should also include recommendations for changes to the adaptive management strategy, if necessary.

Performance Milestones

Vegetation establishment will be considered complete when all the applicable establishment standards in Table 1 have been met. If the establishment standards have not been met, the maintenance period may be extended at the discretion of MHFD. To track trends toward meeting establishment standards, yearly performance milestones have been determined for each vegetation community type, see Tables 4 through 6. If performance milestones are not met for any community for any year, remedial measures described in the Adaptive Management Strategy section will be implemented. The following list describes each of the performance milestones.

- **Percent Vegetation Cover:** Average absolute vegetation cover within the vegetation community's square meter plots. This milestone will include tree, shrub, and herbaceous cover of all species (native, non-native, and noxious) within the sampling plots.
- **Percent Native Vegetation Cover:** Average absolute native vegetation cover within the vegetation community's square meter plots. This milestone will include tree, shrub, and herbaceous cover of native species only within the sampling plots.
- **Maximum Percent of Vegetation comprised of Weeds:** This includes average absolute weed cover of all State listed noxious weed species and problematic non-native species of concern including Kochia, sweet clover, etc within the vegetation community's square meter plots. Note, all List A species need to be eradicated.
- **Maximum Size Bare Ground Patch:** Bare ground is defined as any areas (sitewide) with less than 4-6 seedlings per square foot or areas with less than 10 percent vegetation cover of desirable species.
- **Seedlings per Square Foot:** The average number of seeded and native volunteer species observed within the vegetation community's square foot plots. Do not include cover crop species in the tally.

Table 4. Performance Milestones – Upland

Milestone	Percent Vegetation Cover	Percent Native Vegetation Cover	Maximum Percent of Vegetation comprised of Weeds (Eradicate A List Species)	Maximum Size Bare Ground Patch	Seedlings per Square Foot
Year 1	≥30%	15%	10%	500 s.f.	≥4-6
Year 2	≥38%	20%	10%	500 s.f.	N/A
Year 3	≥45%	25%	10%	400 s.f.	N/A

Table 4. Performance Milestones – Upland

Milestone	Percent Vegetation Cover	Percent Native Vegetation Cover	Maximum Percent of Vegetation comprised of Weeds (Eradicate A List Species)	Maximum Size Bare Ground Patch	Seedlings per Square Foot
Year 4	≥53%	30%	10%	300 s.f.	N/A
Year 5	≥60%	35%	10%	200 s.f.	N/A

Table 5. Performance Milestones – Riparian

Milestone	Percent Vegetation Cover	Percent Native Vegetation Cover	Maximum Percent of Vegetation comprised of Weeds (Eradicate A List Species)	Maximum Size Bare Ground Patch	Seedlings per Square Foot
Year 1	≥35%	20%	10%	500 s.f.	≥4-6
Year 2	≥45%	25%	10%	500 s.f.	N/A
Year 3	≥55%	30%	10%	400 s.f.	N/A
Year 4	≥65%	35%	10%	300 s.f.	N/A
Year 5	≥70%	40%	10%	200 s.f.	N/A

Table 6. Performance Milestones – Wetland

Milestone	Percent Vegetation Cover	Percent Native Vegetation Cover	Maximum Percent of Vegetation comprised of Weeds (Eradicate A List Species)	Maximum Size Bare Ground Patch	Seedlings per Square Foot
Year 1	≥35%	20%	10%	500 s.f.	N/A
Year 2	≥45%	28%	10%	500 s.f.	N/A
Year 3	≥65%	35%	10%	400 s.f.	N/A
Year 4	≥75%	43%	10%	300 s.f.	N/A
Year 5	≥80%	50%	10%	200 s.f.	N/A

Adaptive Management Strategy

The goal of this adaptive management strategy is to ensure sitewide vegetation establishment. If during the first five years, any one of the annual performance milestones is not achieved (see Tables 4, 5, and 6), remedial measures (such as replanting and/or overseeding) will be undertaken to reach the following year's required levels. Only areas that fail to meet the performance milestones shall require additional work and/or additional remedial measures. This process will continue until all of the establishment standards are met or until MHFD determines that other measures are appropriate.

Remedial Measures

If the performance milestones are not met, the following remedial measures, or others, would be implemented to adaptively manage the site to meet desired outcomes.

- **Reseeding Bare or Sparsely Vegetated Areas** – In addition to reseeding with the original seed mix, adaptive management actions could include reseeding only species that are exhibiting the greatest growth and survival, varying the seed rate, adjusting the seed mix species or composition based on additional information like soils, or using different seeding equipment. Alternately, if a certain species or group of species (such as warm-season grasses) are not collectively establishing on the site and are desired on the site, reseeding may include just those missing species. In addition, the cumulative effect of noxious weed treatments on the site may effectively reduce the presence of native forbs. As such, overseeding the site with a native forb mix may be desired once noxious weed treatments have reduced in frequency and intensity.
- **De-compact Soil** – A common cause for bare areas and sparse grasses is over-compaction of soils during construction, particularly along access roads. Use a shovel or penetrometer to evaluate if soil compaction is an issue within 12 inches of the soil. De-compact adverse soils using suitable equipment such as chisels, harrows, or cultivators. Conducting decompaction work when the soils are moist, but not wet, may have the most success.
- **Soil test for bare/problematic areas** – Another potential cause for bare areas and sparse grass cover is problematic soil. Following soil tests of bare areas, adaptive management actions could include adjusting the seed mix based to include species adapted to problematic soils or conditioning soils with appropriate amendments.
- **Weed management** – Adaptive management measures may include adjustments to weed control methods, such as changing herbicides and/or timing of treatments, more frequent mowing, hand removal, or adaptive management for novel weed species not initially present at the site.
- **Protect vegetation** – If monitoring results show that revegetation is failing due to trampling (i.e. social trails, maintenance vehicle access etc.), then adaptive management actions would include installing protective fencing and/or signage to protect trampled areas. Soil de-compacting and reseeding trampled areas may also be necessary.

Vegetation Establishment Site Inspection and Establishment Standard Monitoring Protocols

Follow these protocols when filling out the MHFD Vegetation Establishment Plan Checklist (Checklist). For a single project in a typical year, the Establishment Standard Monitoring protocol should be completed once in September, while the Site Inspection protocol (using the Checklist) occurs monthly.

Monthly Site Inspection using the Checklist

Monthly site monitoring is to be performed for general mapping and observations, such as phenology of weed species onsite, weed treatment efficacy, vigor/survival of plantings, native plant species recruitment, signs of drought stress, etc. The intent of these site visits is to routinely review the site, provide feedback on all maintenance being performed onsite, and identify if/when changes to the prescribed maintenance may be needed.

General Site Information – Record this information for all site inspections and monitoring events on the Checklist:

- Project name
- Date of evaluation
- Name(s) of evaluators
- Note site inspection or establishment standard monitoring
- Note the year
- Monthly climatic conditions (ex. average precipitation, average temperatures, drought conditions)

Observations – Walk the entire site and make notes on the following items from the Checklist:

- Note site observations and remarks
- Note evidence of maintenance activities and photo document the activity
- Provide additional maintenance details, if observed (ex. mowing height, seed mix used)
- Document general monitoring observations (ex. disturbance, drought, erosion) and provide any additional monitoring observation notes (ex. safety concerns such as downed fences).

Detailed Data Collection and Mapping – The following data should be recorded and mapped as it's observed and monitored thereafter to determine the need for or efficacy of treatment or other remedial actions that may be necessary to establish vegetation:

- Containerized Plant Survival: Record dead or dying containerized woody plantings by species and location (using GPS).
- Bare Areas: Record, photograph (landscape orientation) and map any bare areas larger than 100 square feet.
- Noxious Weeds: Record, photograph, and map all Colorado List A individuals and B list Noxious Weed populations greater than 25 square feet. Note the species and density using the cover classes provided. If weeds are consistently occurring throughout an area, generally map the entire area and make a note of density and species.

Annual Establishment Standard Monitoring

Filling out the Checklist using the protocol above should be completed during every Establishment Standard Monitoring event. The Establishment Standard Monitoring protocol outlined below is to collect quantitative data on seedling density and vegetation cover. Data collected using this protocol should occur once per year.

Quantitative Establishment Standard Monitoring for seedling density is to be conducted in June or September during the first growing season (depending on seed application timing) with vegetative cover collected in September to compare field data against the annual performance milestones in the Vegetation Establishment Plan.

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Sampling Design – Desktop

- The following steps should be completed once, prior to the first Establishment Standard Monitoring event. Plots are to be revisited in subsequent monitoring events.
- Sampling should be stratified by vegetation community, such as wetland, riparian, and upland.
- Randomly (in GIS) place one plot per a tenth of an acre in each stratified vegetation community, with a minimum of 5 plots per vegetation community and a maximum of 10 plots.

Plot Placement for Seedling Density and Vegetation Cover- Field

- Navigate to each randomly placed plot in the vegetation communities.
- Place the 1 square **meter** quadrat for vegetative cover or the 1 square **foot** quadrat for seedling density at the randomly placed GPS location previously identified. The final plot placement should be in an area that has vegetation representative of the surrounding area. Avoid placing the plot in bare areas unless the entire area is bare.
- If seedling density data is collected in the fall, place the 1 square **foot** quadrat in the southern and western corner of the 1 square **meter** quadrat.
- Photograph the plot from above so that the quadrat is a majority of the photo frame.

Seedling Density Data Collection – First Growing Season Only

- Seedling density data is collected in the 1 square foot quadrats, the quadrat should be placed as noted above in the “Plot Placement” section of the protocol.
- Seedling density data is collected in the first growing season only. The timing of seedling density data collection depends on the timing of seeding. Seedling density data should be collected in June if the site was seeded the previous fall. Seedling density data should be collected in September if the site was seeded in spring or later of the current growing season.
- Observe the 1 square **foot** quadrat from above and COUNT seeded and desirable volunteer seedlings ONLY. Do not include cover crop species, noxious weeds, or invasive/introduced species. Species usually include native perennial cool-season and warm-season grasses and early seral species like Rocky Mountain bee plant (*Cleome serrulata*) and annual sunflower (*Helianthus annuus*).
- Record the data by quadrat number and seedling count.

Vegetation Cover Data Collection – All Years

- Vegetation cover data is collected in 1 square meter quadrats, quadrats should be placed as noted above in the “Plot Placement” section of the protocol.
- Vegetation cover data is collected in September for all years of the of the vegetation establishment phase.
- Observe the 1 square **meter** quadrat from above and estimate the cover class (see cover classes below) for each plant species as a unit.
- Record the data by quadrat number, species, and cover class. For example: Quadrat Number: 1; Species: *Agrostis stolonifera*; Cover Class: 1 (0-5%)

Cover Class	Range of Coverage	Midpoint of Range
1	0 - 5%	2.5%
2	5 - 25%	15.0%
3	25 - 50%	37.5%
4	50 - 75%	62.5%
5	75 - 95%	85.0%
6	95 - 100%	97.5%

- Include only the current year’s growth of herbaceous plants and shrubs, for example, annual plants which grew and senesced earlier in the year should still be included.

- Note that total cover may exceed 100 percent.
- Include plant species canopies extending over the quadrat even if plants are not rooted in the quadrat.
- Summarize data by community type for each Establishment Standard that typically includes:
 - Percent Vegetation Cover
 - Percent Native Vegetation Cover
 - Maximum Percent of Vegetation that Colorado State Listed Weed Species
 - Number of Bare Areas (sitewide)
 - Seedlings per Square Foot (year 1 only)
- Input summarized data into the Establishment Standards Monitoring Results table in the Checklist filled out for that month.
- Create a figure that shows the mapped vegetation communities and plot placement. Include other notable features such as bare areas or noxious weed occurrence as needed for Quarterly Restoration Observation reports.

MHFD Vegetation Establishment Plan Checklist

For Projects being reviewed under the Mile High Flood District (MHFD) Maintenance Eligibility Program (MEP)

Project Name:					Date of Evaluation:		
Evaluator Name(s):					Check One:		
					Site Inspection <input type="checkbox"/>		Establishment Standard Monitoring <input type="checkbox"/>
Year:	Year 1 <input type="checkbox"/>	Year 2 <input type="checkbox"/>	Year 3 <input type="checkbox"/>	Year 4 <input type="checkbox"/>	Year 5 <input type="checkbox"/>		
Average Monthly Temp:		Average Monthly Precip:		Drought Intensity:			
Climatic Notes (ex. flood, above/below averages):							

General Site Remarks and Action Items

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Observed Maintenance

Observed Maintenance Activity	Notes	Photo

To be Performed Maintenance (refer to Vegetation Establishment Plan)

To be Performed Maintenance Activity	Notes	Photo

General Monitoring Observations (ex. disturbance, drought, erosion)

Observation	Notes	Photo

Observation	Notes	Photo

Additional Notes

Establishment Standard Monitoring Results; Year 1 Performance Milestones

Check one:	
Not Completed <input type="checkbox"/> Next Data Collection Event:	Completed <input type="checkbox"/>

Vegetation Community	Upland Performance Milestones	Upland Field Data	Riparian Performance Milestones	Riparian Field Data	Wetland Performance Milestones	Wetland Field Data
Percent Vegetation Cover	≥25%		≥35%		≥35%	
Percent Native Vegetation Cover	12%		17%		17%	
Maximum Percent of Vegetation that is B and C-List Weed Species	10%		10%		10%	
Maximum Size Individual Bare Areas	500 s.f.		500 s.f.		500 s.f.	
Seedlings per Square Foot*	≥4-6		≥4-6		N/A	N/A

**Desirable seedlings including seeded species and desirable volunteers.*

Establishment Standard Notes