City of Calgary Plant Lists

Recommendations based on habitat type and desired outcome to inform revegetation work

2019

Publication Information

CITY OF CALGARY PLANT LISTS: Recommendations based on habitat type and desired outcome to inform revegetation work.

INTENT: This document provides detailed information and recommendations to inform restoration plans as per the *Habitat Restoration Project Framework* (The City of Calgary Parks 2014) and provides necessary information and factors to consider during the plant selection phase of the project.

PREPARED BY: The City of Calgary, Parks, Urban Conservation

VERSION: 2019 Edition

ADDITIONAL COPIES: To download an electronic copy:
http://www.calgary.ca/CSPS/Parks/Pages/Construction/Park-development-guidelines.aspx

INFORMATION: Corporate Call Centre: 3-1-1 (within Calgary)

Copyright

Terms of Use

City of Calgary Plant Lists must be used in conjunction with the document *Habitat Restoration Project Framework* (The City of Calgary Parks 2014), as referenced throughout, and is made available for use in The City of Calgary effective as of the date below.

February 2020

The 2019 *City of Calgary Plant Lists* is presented as accurate and complete as of the date indicated above. Use of this document does not absolve any user from the obligation to exercise their professional judgment and to follow good practice. Nothing in this document is meant to relieve the user from complying with municipal, provincial and federal legislation. Should any user have questions as to the intent of any procedure found in this publication, the user is advised to seek clarification from the lead of Urban Conservation, Parks.

Revision Notice

Subsequent revisions will be released as required.

Cover photograph and Table of Contents photograph taken by The City of Calgary.

Executive Summary

In March 2015, Council approved Calgary's 10-year strategic plan titled *Our BiodiverCity* (The City of Calgary Parks 2014) and the Biodiversity Policy. Within the strategic plan, one of the objectives is to improve the city of Calgary's ecological functions through the restoration of degraded habitats. *City of Calgary Plant Lists* provides vascular plant lists based on habitat type and landscape intent in order to inform restoration plans.

City of Calgary Plant Lists is meant to inform restoration plans as per the *Habitat Restoration Project Framework* (The City of Calgary Parks 2014) and provide necessary information and factors to consider during the species selection phase of the project. It also complements *City of Calgary Seed Mixes* (The City of Calgary Parks 2018) by addressing plant selection as a whole.

City of Calgary Plant Lists is designed to assist with plant selection in low maintenance landscapes which excludes habitat types such as manicured flower beds, highly maintained turf and street trees. Cited plants are native species or hardy horticultural cultivars appropriate for the Calgary area. These species require no to low care and are able to tolerant extreme conditions when used in the appropriate recommended habitat type. Due to the adaptable nature of these plants, they also are important in the mitigation of climate change. Since these species are very robust, they are adaptable to a varying climate and as such, this document assists in satisfying The City of Calgary's *Climate Resilience Strategy Mitigation and Adaptation Action Plans* (The City of Calgary 2018).

Although the species lists and supporting information has been based on observations within the Calgary area, positive results when using these plant species are not guaranteed due to the complex nature of site-specific factors and the unpredictability of managing biological systems. Lastly, the information provided in this document can apply to areas outside of Calgary; however, the focus and associated recommendations are based on the urban environment.

Prairie coneflower (*Ratibida columnifera*) is a native forb (i.e., wildflower) that grows in dry, open grasslands and foothills. This species can withstand both drought and salinity and is an important source of nectar for pollinators, especially native bee specialists.

Table of Contents

Section I: Rationale for City of Calgary plant lists

Introduction

In March 2015, Council approved Calgary's 10-year strategic plan titled *Our BiodiverCity* (The City of Calgary Parks 2014) and the Biodiversity Policy. Within the strategic plan, one of the objectives is to improve the city of Calgary's ecological functions through the restoration of degraded habitats. *City of Calgary Plant Lists* provides plant lists based on habitat type and landscape intent in order to inform restoration plans. In addition, cost saving measures are discussed.

The *Habitat Restoration Project Framework* (The City of Calgary 2014) provides detailed requirements and guidelines for conducting and reporting on habitat restoration projects in existing and future Natural Environment Parks (e.g., a City-owned park, consisting of Municipal Reserve and/or Environmental Reserve, where the primary role is the protection of a relatively undisturbed ecosystem). *City of Calgary Plant Lists* is considered an addendum to that document and is intended to be used for projects outside of and within Natural Environment Parks. *City of Calgary Plant Lists* informs the plant selection portion in activities ranging on the continuum from reclamation (e.g., a type of restoration where one attempts to stabilize disturbed lands to an ecologically productive use) to restoration (e.g., the attempt to fully re-establish the target level of ecosystem function and biodiversity as defined by the reference vegetation community structure). These plant lists are meant for projects that are not aiming to install turf grass and where mowing is not part of the regular maintenance regime.

In addition, this document is meant to complement the information provided in *City of Calgary Seed Mixes* (The City of Calgary Parks 2018) and examine plant suitability for the Calgary area as a whole.

Purpose

In the past, the majority of City restoration projects occurred in existing Natural Environment Parks or Environmental Reserves that were going to be transformed into future urban Natural Environment Parks. Recently, other forms of restoration types have been implemented by The City in order to lessen maintenance costs and improve Calgary's ecological functionality and health. For example, recent projects include the use of salt tolerant native grasses and forbs (e.g., herbaceous flowering plant other than a grass) instead of standard turf grass mixes on boulevards and transforming road corridors into pollinator habitats using both native wildflowers and salt tolerant agronomic species.

Plants, especially native species found in rural areas, may not perform well as restoration species within an urban environment. These plants may be very sensitive and unable to

withstand common urban land management issues such as compacted soils, fragmented landscapes, trampling and/or a lack of a natural disturbance regime (e.g., flood, fire, grazing, etc.). Some species also may be poor competitors. Due to the fragmentation of natural areas (e.g., land comprised predominantly of native species and natural ecosystems [The City of Calgary Parks 2014]) and the high number of invasive plant species present in urban centres, less aggressive plant species tend to get outcompeted and do not persist in the landscape, even when planted or seeded. Since these species were present in the Calgary area prior to development, introducing them back into the landscape is ecologically beneficial; however, it should be done with care to ensure that resources are used wisely and in the end, benefit the ecosystem. These challenges are noted in the Appendix within the plant lists.

Many of the plant species that can colonize challenging habitats within the urban environment tend to be able to thrive in harsh conditions. Due to the hardiness of these plants, they can withstand extreme weather conditions. Utilizing these species in various types of restoration can assist in satisfying the *Climate Resilience Strategy Mitigation and Adaptation Action Plans* (The City of Calgary 2018). The use of these species provides a robust plant community that can withstand climate change pressures while thriving and contributing to the urban ecosystem.

In addition to the challenges of the urban environment, Calgary is also unique in the sense that it is located at a transition zone which encompasses the boundaries of the Foothills Parkland, Foothills Fescue and Central Parkland Natural Subregions (Alberta Sustainable Resource Development 2005). Calgary experiences Chinooks which adds to the complexity of the ecosystems in this area. Additionally, Calgary soil is generally alkaline and has a pH in the range of 7.5 to 8 (Calgary Horticultural Society 2018). Soil salinity is common, both naturally and from road deicing activities. For example, the eastern side of the city contains many seasonal saline wetlands where, during drier times of the year, the salt crust on the soil can be easily observed from afar.

Due to the unique climatic properties of the Calgary area, many plants that are suitable for the same plant hardiness zone (i.e., which plants can grow where) may not grow well in Calgary due to the soil conditions and Chinooks. It takes resilient species that are adapted to withstand the drastic temperature fluctuations and resulting changes in soil moisture that occur during a Chinook. Also, plants that thrive in the more acidic soils within central and northern Alberta may not survive here due the alkalinity content of Calgary's soils. Due to the prairie climate and southern location in Canada, the Calgary area is quite dry and can be very windy at times. This again restricts the vegetation adapted to these conditions as species that are suitable for most of Alberta may not thrive in Calgary's climate.

It should be noted that plants that thrive in one area of the city may not establish in another area of Calgary. This is due to the three natural subregions that are present within the city. For example, on the west side of the city the rolling topography, white spruce and trembling aspen indicate the foothills. Rolling topography with isolated aspen stands and open

meadows illustrate the parkland area of Calgary in the northwest. In the southern and east areas of the city, the prairie ecosystem is evident through the presence of the dry open grassland and prairie pothole seasonal wetlands.

The lists are not inclusive but are provided based on what has been available in the past for purchase and what plants have been used successfully in previous projects within The City of Calgary. Ease of procurement is noted in the context of previous availability and what plant species might be worth looking into procuring, even if they have not been used in the past in restoration work. Information on form (e.g., seed, potted material, plug, etc.) is also provided based on the ease of growth, availability and cost efficiency.

Lastly, in addition to the more obvious ecological improvements that this document intends to support, it serves to provide cost savings to the development industry, contractors, environmental professionals and The City of Calgary itself. This document delivers plant selection advice related to direct project experience within the city limits of Calgary. Sharing this information will reduce costs, both internally and externally, through saving time during consultations, projects that have reduced maintenance and minimizing the time it takes to complete a restoration.

Document outline

The summarized outline of *City of Calgary Plant Lists* is provided below.

1. **Section 1: Rationale for City of Calgary plant lists** contains information regarding how Calgary is environmentally unique and plants that are appropriate for Alberta in general may not thrive in this region. The challenges of urban versus rural restoration along with limiting factors in plant selection and procurement is also discussed in this section.
2. **Section II: Initial considerations** outlines the process of how plants are selected for various types of restoration projects using a number of considerations such as site history, plant biology, and storage practices that may be limiting factors during the project implementation phase.
3. **Section III: Methods** discusses plant compatibility, techniques designed to restore a vegetation community using different forms of plant material to optimize cover, appropriate timing to prevent plant loss, site preparation and planting techniques. Various types of restoration work are also discussed and defined.
4. **Section IV: Habitat types** summarizes how habitat types are defined by Parks and Urban Conservation, the limitations of utilizing these habitat types and how they will be defined in *City of Calgary Plant Lists*.
5. **Section V: References** indicates literature used to compile this document.
6. **Section VI: Appendix: Plant species based on habitat type and intent** outlines appropriate species for various types of restoration work based on what is there now and long term landscape goals. Information on how to increase plant survival and what plant life form is generally used and available is discussed.

Who should use this plan

This framework is meant to guide environmental consultants in their design of restoration plans on City property. It is also meant to inform and assist project managers, land managers and environmental professionals, both internally and externally, in day-to-day restoration work within Calgary.

Disclaimer

City of Calgary Plant Lists does not replace restoration expertise, experience or professional qualifications, nor is the document intended to replace the user's own due diligence and research. Nothing in this document is meant to relieve the user from complying with municipal, provincial and federal legislation. This document provides information on plant species that can be used successfully during the undertaking of restoration work within the urban environment of the Calgary area. It does not replace a site-specific approach to restoration, which is critical to achieving success. These lists also are not guaranteed to be all inclusive. The use of *City of Calgary Plant Lists* does not guarantee results due to the complex nature of restoration and the difficulty associated with managing biological systems.

Using this document does not equal approvals from City of Calgary staff or stakeholder engagement with key personnel.

Should any user have questions as to the intent of any procedure found in this document, the user is advised to seek clarification from the lead of Urban Conservation, Parks.

Restoration in the city of Calgary and associated considerations

The City of Calgary is continuously striving to mitigate the effects of development, disturbance and fragmentation on its sensitive ecosystems. Calgary's climate is distinct as its City limits encompass the boundaries of the Foothills Parkland, Foothills Fescue and Central Parkland Natural Subregions (Alberta Sustainable Resource Development 2005). In addition, Calgary experiences Chinooks which adds to the complexity of the ecosystems in this area.

Urban versus rural restoration

Restoration differs and tends to be more difficult in urban areas than rural areas. Fragmentation of open space and smaller expanses of natural area, surrounding land use, usage pressure and constant sources of invasive species introduction (e.g., adjacent roads, dogs, bikes, etc.) make the re-establishment of native species and revegetation/restoration in general more challenging in urban areas. In addition, the lack of top predators in cities that are more numerous in rural areas cause issues with seed predation and grazing by

smaller herbivores/omnivores such as Richardson ground squirrels, Canada geese, feral rabbits and white-tailed jack-rabbits. Also, deer can problematic for vegetation establishment in some urban areas.

Due to non-native landscapes such as playfields and lawns and the many small disconnected pieces of green space that are common byproducts of development, the goal of restoring an area back to an entirely native landscape may not be possible or desired. Urban development and high usage also leads to a decrease in soil health which is a limiting factor in plant selection. For example, soil may be lacking organics, compacted, lacking natural biota, not draining properly, nutrient deficient, overly saline, and/or have a compromised structure. Soil structures can be altered when they contain additional gravel or cobble from anthropogenic activities, the soil has been admixed and the various horizon layers are not intact (e.g., topsoil is mixed with subsoil), and/or soil has been lost to erosion leading to a lack of topsoil. Best management practices in *Soil Handling Recommendations* (The City of Calgary Parks 2019) can work to mitigate these negative effects but with anthropogenic disturbance, there is almost always a decrease in soil health. Soils that are in poor health will not support certain plant species. It may not be a wise use of resources to amend or replace soil. In those circumstances, aggressive native and non-native plants may be chosen that can assist in soil building, alleviate compaction (i.e., have large taproots which break up soil) and prevent further soil loss. Depending on the proximity to natural areas and ecologically healthy ecosystems, using these aggressive species for revegetation may be the best choice versus using native species to try and restore the area to the reference vegetation that was present before development.

Without the use of fast-establishing plants that thrive in the Calgary area, these sites may only serve as habitat to invasive species. The colonizing weeds may require control under the Alberta *Weed Control Act* (2010) if they are listed in the legislation.

This contradicts the restoration approach used in healthy interconnected rural areas. Natural recovery and restoration using less aggressive later successional native species is successful in rural areas whereas restoration in a highly urban area requires a much more aggressive approach in order to be successful.

Time limitations

Due to the development process, restoration becomes even more complicated, especially in areas designated to stay in a more natural state (e.g., Environmental Reserve). In order to develop communities, various timelines exist which generally do not exceed 5 years from construction start to completion. Many projects have even shorter timelines. Due to this, restoration to a native reference plant community is often impossible without much longer periods of ongoing maintenance than The City has the ability to require or provide after the community is built and/or the development is completed. This is why it is especially important to determine project goals, land use, maintenance regimes and what type of

landscape is deemed acceptable and tolerable based on time limitations, perceived risks, adjacent land use and the condition of adjacent lands.

Availability

Many restoration projects, especially development projects for The City of Calgary, may require a large quantity of plants and/or seed. Depending on the species, it may not be readily available in any life form. There are multiple biological factors that contribute to the difficulty of the procurement of various species.

In most cases, large projects with a significant earth-moving/soils handling component (e.g., restoring disturbed areas of Environmental Reserve during community development) require a combination of both live plants and seed. As soon as it has been decided what plants are required and when, vendors should be contacted so that they can ensure they have the material available at the right time.

Procurement

Large restoration projects generally have to source from multiple vendors. Also, most plant material suppliers are specialized in one or two of the following:

- Seed production
- Woody plant propagation
- Potted graminoid (e.g., grasses, rushes and sedges) production
- Potted forb production

For more information on seed procurement, see *City of Calgary Seed Mixes* (The City of Calgary Parks 2018).

Large full-scale restorations in areas that are highly disturbed or have experienced significant earth-moving activities require vendors that can supply large amounts of plant material. Also, sizable areas that require reclamation (e.g., vegetation cover to transform unusable land into usable land) only will use a great amount of plant material, although the diversity of the species will be low if the goal of the project is to provide vegetation cover only.

Companies that can provide bulk-sized orders and/or many different plant species often have a combination of the following attributes where they:

- Can mass produce seed;
- Can clean seed of organics, debris, awns and/or pappus (e.g., a tuft of scales, bristles or hair-like bristles that crown a seed);
- Have access to open land to grow plant material;
- Have access to open land containing different habitat types to grow plant material;
- Have climate controlled environments and irrigation/access to water (e.g., greenhouse);

- Have large storage areas;
- Have methods to transport large quantities of products;
- Have a regular “drop-off” schedule for transport of goods;
- Have plant material that is farther removed genetically from the wild type due to mass production; and,
- May not know the origin of their plant material.

Since smaller restoration projects require less plant material, vendors do not require the ability to supply large amounts of plant material at once. The differences between these vendors and the companies mentioned above may include the following characteristics listed below.

- They are smaller businesses and do not have as much available land or various habitat types within that land;
- They tend to supply material to a more local market;
- They do not have the ability to clean seed of organics, debris, awns and/or pappus;
- In order to secure seed for purchase, they rely on wild collection, either by hand alone or by a type of hand held seed harvester that utilizes agitation and suction for collection;
- They generally do not have climate controlled environments such as greenhouses with access to water and/or irrigation;
- Storage areas are smaller;
- Cannot transport large quantities of goods;
- Do not have a regular “drop-off” schedule for transport of goods;
- Have plant material that is closer to the wild type; and,
- Know the origin of their plant material.

Most vendors fall between these categories, as these are presented as extremes; however, these factors are important to consider when securing contractors to provide seed or live plants. One of the largest differences generally occurs between companies that supply seed. Smaller companies that do not mass produce seed often rely on hand collection and do not have the ability to clean seed. Smaller projects using seed tend to hand broadcast seed versus seed using machinery. Seed that has not been cleaned is easier to hand broadcast rather than put it through a seeder; however, any seed that is not clean has a higher chance of migrating from the project site. Additionally, seed that is not clean may contain weed seeds that got into the seed lot during the collection process and additional organic material thus reducing the overall seed content per unit weight. Seed that is not cleaned also tends to take longer to germinate as the agitation during the seed cleaning process assists in breaking the hard seed coat and in turn, breaking dormancy.

As mentioned, most companies are usually not at either extreme on this continuum but rather, somewhere in the middle. Seed producers that supply native plant seed are often more familiar with their original seed sources versus a large production company that

supplies agronomic species and/or sells seed wholesale. Regardless, these considerations help guide vendor selection.

Limiting factors for procurement

Procurement is often the last thing that is thought about during the various stages of project management; however, it is very important and should be considered in the initial phases of the project. Firstly, it will save time and unnecessary work if the project manager and/or environmental professional have an understanding of what species are available. The Alberta Native Plant Council website hosts a list of vendors that supply native plant material.

Secondly, becoming familiar with the species selection that is available is beneficial when working on a project that requires restoration to a native plant community. Unfortunately, some plant species may be difficult, if not impossible, to source and as such, recommending these species in landscape plans can hinder project progress. Also, trying to source plant species that are hard to procure may be counterproductive to the project.

When a particular plant species is onerous to procure, it may indicate that the species is not effective for restoration work. If its establishment will not significantly increase the success of the restoration and the health of the ecosystem, then it may not be worth the effort. If a species is unavailable, ask the vendors why it is not available. Their reasons will provide insight into the species biology and influence on the landscape.

In urban restoration especially, many later successional species get outcompeted and as such, soil conservation and reuse along with activities that promote vegetation coverage, may put the landscape on the proper trajectory to the desired vegetation community. Also, depending on connectivity to other healthy landscapes, what is in the seed bank, how fragmented the landscape is, soil conditions (The City of Calgary Parks 2019) and usage pressure, a full restoration to a reference vegetation community may not be feasible or warranted. In addition, using species that are hard to procure and/or costly with a low likelihood of establishment may not be a wise use of resources. Instead, restoration to a native plant community that is more pioneer or seral in nature may be the best option.

If restoration to a native plant community using later successional, less aggressive species is desired, some of the challenges of using these species may be overcome if they are planted in the form of mature potted material. This often makes them more competitive versus seed and young plants as they are further ahead in terms of growth. For example, foothills rough fescue (*Festuca campestris*) has a better chance of competing with non-native Kentucky bluegrass (*Poa pratensis*) when mature foothills rough fescue plants are used in restoration activities (Tannas 2010). In addition, potted material can be artificially stressed or grown without supplemental maintenance such as watering so that it is more tolerant of the climatic extremes in outdoor environments. This can be used to reduce the amount of maintenance in order to establish this material.

In some instances, seed germination is poor and growers can use plant hormones and various other methods to artificially bring the seed out of dormancy. If the project calls for some of these species that are difficult to propagate by seed, purchasing the plant as potted material may be the easiest solution regarding procurement.

As previously mentioned, some species are difficult to procure and in certain instances, the cost and high likelihood that they will not establish outweighs the environmental benefits of their usage. Certain biological characteristics that make these plant species hard to grow and propagate are outlined below.

- Species only grows in forested environments and therefore, collection access and ease is limited.
- Species prefers indirect light and/or shade and as such, grows sporadically in areas with woody vegetation making access difficult. Since the plants are widely spaced apart due to their habitat preferences, this makes collection very labourious.
- Species is a warm season plant and seed matures on the stem into the fall and winter. This makes collection difficult as frigid temperatures and dry vegetation cause significant seed loss during collection. Also, seed is often dropped at unpredictable times and as such, the majority of the seed is on the ground and not available for collection.
- Plants set seed at different times and seed maturity is non-uniform.
- Plant species does not propagate well from seed (e.g., poor germination, propagates more effectively vegetatively/asexually, etc.).
- Seed commonly suffers from disease (e.g., ergot).
- Species occupies a unique habitat type.
- Plant species does not flower yearly.
- Vegetative propagation has made a certain species susceptible to a disease or pest.
- Vegetative propagation tends not to produce viable plants.
- Not a lot of available information on the plant's biology, habitat preference and range.
- Plant species is generally outcompeted and replaced by other more aggressive species in disturbed areas.
- Species is a decreaser (see definition and discussion below).
- The plant's biology make collection difficult (e.g., short stature, seed pods/capsules present, seed flies away easily, etc.).
- Species prefers historically disturbed habitats.

The points cited above that explain why a species is unavailable also support the argument that open communication and constant dialogue between industry and plant propagation specialists is very important, both environmentally and monetarily. Lastly, issues preventing plant procurement also stress that restoration should be seen as a very long-term endeavor. For example, a seral plant community may be restored; however, once this seral community is healthy and land management practices are put into place in order to

preserve its ecological functionality, restoration may put the plant community on a trajectory to a later successional/climax plant community.

Section II: Initial considerations

Biophysical Impact Assessments (BIA) and restoration plans

In the initial stages of project planning prior to breaking ground, an environmental review is required in any areas that may disturb native habitats and/or rare species/species-at-risk, are in potentially sensitive areas (e.g., waterbodies, wetlands, Natural Environment Parks, etc.), are in or adjacent to Environmentally Significant Areas or that are large projects that will cause changes in land use. The *Biophysical Impact Assessment Framework* (The City of Calgary Parks 2010) provides a consistent process of review and approval. This document guides environmental consultants to what level of scrutiny is needed based on environmental triggers that correspond to three reporting levels. Generally, the level of environmental review becomes more in depth as the complexity and size of the project increases.

Range/riparian health assessments (Adams *et al.* 2016, Ambrose *et al.* 2009), Grassland Vegetation Inventory and plant community guides can inform plant selection, as they provide information on preferred vegetation as related to ecosystem health, vegetation community responses to disturbance and plant community composition related to successional stage. Regardless, in an urban environment, reference vegetation communities are difficult to find. Also, restoration to a reference vegetation community may be unrealistic depending on the site conditions. This is where a botanical inventory of the site as part of the Biophysical Impact Assessment can provide information that can be utilized in plant selection. This assessment is especially important when soils are to be reused on site as the conservation of the seed bank will ultimately influence the final vegetation community. The environmental review is also important in identifying what site pressures are present that will influence the establishment of the vegetation. The Biophysical Impact Assessment essentially informs the *Habitat Restoration Project Framework* (The City of Calgary Parks 2014). *City of Calgary Seed Mixes* (The City of Calgary Parks 2019) aids in implementing the seed mix design portion of the project while *City of Calgary Plant Lists* supports the development of the restoration plan as a whole and provides information to inform all plant selection indicated by The City of Calgary Parks (2014).

Vegetation review

As previously mentioned, range health assessments are a beneficial tool that can be used to guide plant selection within a restoration project. Broad terrestrial habitat types are

outlined in *Rangeland Health Assessment for Grassland, Forest & Tame Pasture* (Adams *et al.* 2016). At the most detailed level, these habitats are divided into plant community types based on soil information and dominant plant species by the various Range Plant Community Guides compiled by Alberta Sustainable Resource Development Public Lands. Together, these documents interpret current land conditions and ecosystem health and guide the management of these lands in regards to grazing activities. In an urban environment, grazing activities can be somewhat similar and comparable to anthropogenic disturbance. Although anthropogenic usage is not directly proportionate to grazing, many of the results are the same such as soil compaction, erosion, weed colonization, disturbance species colonization, etc. Due to these comparable outcomes, one can infer plant community changes due to high human usage based on the outcomes of overgrazing.

Similarly to range health assessments, riparian (e.g., areas influenced by the presence of water but not aquatic/open water) health assessments provide information related to ecosystem health and how these areas change under the influence of grazing (Fitch *et al.* 2009) (Ambrose *et al*. 2009). As mentioned above, human usage is not directly proportionate to cattle grazing; however, changes in the landscape with increasing usage or grazing are somewhat alike. Due to these similarities, previous pressures on the landscape and future changes in the vegetation communities can be anticipated which can provide guidance to the plant selection phase of the revegetation project. This information also provides insight to the feasible level of revegetation/restoration (e.g., increasing complexity and ecosystem function from reclamation to restoration).

Height

During the plant selection phase of a project, plant heights must be compatible at all growth stages in order to ensure each plant species that is intentionally put into the landscape is not outcompeted by another adjacent taller and more aggressive species. See *City of Calgary Seed Mixes* (The City of Calgary Parks 2019) for additional guidance on considering plant heights in seed mix design.

Although considering maximum height during plant selection is important, it is also crucial to look at growth rates and potential plant stressors. For example, a certain plant species may eventually surpass an adjacent plant in height but not for a long time as it is slow growing. Also, depending on the project, a selection of desired plant species used in restoration may be rather stressed whereas other plants on site may be growing vigorously. This consideration is especially important in urban areas that tend to stunt plant growth due to usage pressure and lack of soil volume.

Regarding plant heights within the vegetation community, it is also useful to determine what existing species may be present in the project area with respect to the seed bank, roots and rhizomes. These species, which may not be visible at the time of planting, could possibly outcompete the other selected plant material.

Cool season versus warm season grasses

Due to our climate, grasses are often quite dominant in the landscape and as such, they tend to make up a lot of the vegetation used in restoration activities. Together they make a plant community with other vegetation forms such as forbs, shrubs and trees.

It is important to know whether a grass species is a cool season or warm season grass. This is defined as when the species begins to grow. Many cool season grasses tend to be aggressive and early successional as they begin to grow early in spring during cool temperatures. Warm season grasses do not start growing until temperatures increase in the summer. Taking these differences, along with height, into consideration is important when designing a restoration plan, as this will strongly affect the outcome of the plant community. This can also save money in project costs as many warm season species are often seeded but never actually come up as they are outcompeted before they even get a chance to germinate. Similarly, if slow growing plant species are planted into an area with aggressive cool season grasses, they will be outcompeted unless there were mitigation measures put in place to prevent the cool season grasses from taking over the site (e.g., cool season grasses seeded at a low percentage by weight, plant material form, phased seeding approaches, etc.).

Increasers versus decreasers

These terms are most commonly used in grazing management although they can apply to plants in an urban context. Plants termed “increasers” tend to be less palatable to wildlife and do not experience grazing or browsing pressure unless there is a limited supply of more palatable species present for wildlife in the area. Increasers tend to exhibit characteristics that prevent grazing and browsing such as awns (e.g., long spike-like appendages) or thorns. In an urban context, these species also tend to increase under a lack of natural disturbance regimes such as flooding and fire and also increase with anthropogenic disturbance. Increasers tend to be more early successional and not as deep rooted as decreasers. Graminoids that are increasers also tend to be cool season grasses.

Species termed “decreasers” are quite palatable to wildlife and are their preferred food so they tend to get grazed and browsed extensively. These species also tend to fill a niche in the ecosystem’s food web by providing food at times when other food is unavailable. For example, many agronomic forage species were introduced into the region as they provide early spring forage; however, their forage value decreases dramatically after early spring (e.g., crested wheatgrass [*Agropyron cristatum*]). Decreasers usually provide food to wildlife during critical times such as in winter. For example, foothills rough fescue (*Festuca campestris*) holds its protein content in winter whereas other forages provide very little nutrients in winter (Pavlick & Looman 1984). Unfortunately, as in the case of foothills rough fescue, decreaser populations often decline when the environment lacks its natural disturbance regimes and is under increased anthropogenic disturbance; therefore, if the

site will likely support these decreaser species, it is important to include them in the landscape plan.

The concept of increasers and decreasers is also an important characteristic to consider when planning any type of restoration work. It can save costs and ensure that plant material is appropriate and compatible as well as assist in project phasing and timing.

Storage

Storage considerations for plant material is an important component of the restoration process. Generally, in order to save costs, one should store material at the vendor's location up until the material is required. Regardless, short term storage is often required during the installation/planting phase. If storage plans are not made in advance, plant material can die and as such, storage considerations prior to project initiation can alleviate a lot of last minute problems and issues.

Live stakes for bioengineering

It should be noted that storage recommendations of the live woody stakes required in bioengineering projects will not be discussed in depth within this document. Harvest and storage of this material is out of scope for *City of Calgary Plant Lists.* Different species of shrubs and trees have varying sensitivities during harvest and as such, storage of these species differs in the sense that some species need to be kept entirely dormant before staking while others can tolerate a slight break in dormancy. Since bioengineering is an excellent tool for bank repair and flood resistance, it is recommended in multiple areas of the city through *The Riparian Action Program: A blueprint for resilience* (The City of Calgary 2017). A forthcoming document through Water Resources is going to outline species specific methods for bioengineering along Calgary's riparian areas.

Plant material that may be used in bioengineering will be noted in Appendix; however, since there is still uncertainty regarding species specific methodologies, this document will discuss these species at a high level. Once specific storage methods, timing limitations and site variations are determined for candidate species, this document may be amended at a future date to ensure that these details are captured.

In general, stakes that are harvested for bioengineering projects need to be harvested and planted before the tree or shrub breaks dormancy. Depending on the species, they need to be a certain diameter and there may be recommendations for the angle of the end cuts and treatment of the exposed top. For projects that require stakes to be stored over the winter or summer months, they need to be stored in conditions that mimic the environment such as outside and with adequate moisture (e.g., buried in a snow drift). There are more complex methods for storage that may involve inducing/maintaining dormancy but these again will not be discussed in this document as standard methodologies are still under investigation and development.

Tall Rooted Stock (TRS) for bioengineering

TRS is another form of plant material that was developed recently for use in bioengineering as a substitute for live stakes. Bioengineering is an excellent way to stabilize banks and increase riparian health and flood resilience. Unfortunately, the use of live stakes in these bioengineering projects has had mixed success, mostly because the stakes have to be cut, stored and installed when they are dormant. Besides the challenges associated with construction logistics, environmental factors can further complicate things such as when the stakes need to be installed, the ground may still be frozen. Additionally, different woody species also have different tolerances regarding breaking dormancy and successful growth.

TRS utilizes the same species used in live cuttings for bioengineering. The difference is that the TRS is rooted using rooting hormone and then grown out for maximum root formation. After the roots are well-developed, TRS is hardened off using less and less water in the growing media to prevent shock during installation. Stakes are then installed in the same way as bioengineering with the exception that some backfilling of the stakes within the larger planting holes is required to ensure roots are not damaged during installation and that roots are in close contact with soil.

Due to this, vendors offering TRS generally store it until it is time to plant it so City storage is not required. Also, since this method is quite new, the proprietary details are not available. This is good in the sense that the product is coming from elsewhere so contractors are not continuing to source live stakes along Calgary's river valleys which have been heavily impacted by the 2013 flood and the associated live stake harvesting that was done to repair flood damage and increase resiliency. Similar to all other plant material used in restoration, the source location should be as geographically close to Calgary as possible and be from similar habitat types.

Seed

Generally, only short-term seed storage is required from anyone other than seed producers and wholesalers so long term storage methods are not discussed. In addition, most companies and organizations that do not produce or store seed as part of their business do not have the capacity and financial ability to purchase the equipment required for long-term seed storage (e.g., landscape contractors). Although freezing seed for long-term storage is encouraged, this will not be outlined in depth.

Ideally, the vendor should hold the seed until it is required to ensure it is stored properly, as any company in the seed selling industry should be outfitted with optimal seed storage infrastructure. This can also save costs during project implementation by ensuring germination is maximized and transport is minimized.

Although the storage of potted material is usually considered, short term seed storage is often overlooked. It is very important to consider what the seed is stored in as well as how it is stored. Generally, seed that is intended for and grown in terrestrial environments will

remain viable when it is harvested under dry conditions and kept dry. Seed should be dry when it is purchased; however, if it is stored in an area with high humidity such as a basement, viability will tend to decrease due to the ability of seeds to pick up moisture from the air. Increasing seed moisture contributes to seed death by increasing metabolic activities and respiration, heating and weakening the seed and therefore making the seed susceptible to fungal infection (Elias *et al.* 2017). Fortunately, Calgary has a fairly dry climate with low humidity. In areas where the outside conditions are cool and dry, viability of seed is maintained through storing in packaging that allows for air exchange. This prevents the seed from molding and maintains dormancy. In areas with high humidity, sealed containers that prevent the influence of outside air on the seed are encouraged; however, in the Calgary area, storing seed in a cool, dry environment within a breathable packaging such as a woven bag or paper bag is ideal. A storage container that does not have high air humidity and is temperature-regulated is preferred. High humidity in the Calgary area will generally only occur in basements or in areas next to waterbodies and watercourses. The ideal conditions for seed storage consider both moisture and temperature as the temperature in degrees Fahrenheit plus the humidity should be less than 100.

As with every living species, characteristics vary between species and among species. Seed viability (e.g., alive and capable of germination) versus storage time is no exception as plant species will exhibit different limitations in the length of how long they can be stored before seed essentially becomes dead. For recommended longevity guidelines, consult with *City of Calgary Seed Mixes* (The City of Calgary Parks 2018).

Another storage issue is consumption of seed by wildlife. This can be a problem, especially in the winter months, when other food is unavailable and a large cache of seed is irresistible. Mice are very good at squeezing into the tightest areas so it is important for the storage location to be very secure without any openings such as small cracks under the doors, etc. Mice easily chew through seed bags but mice predation can be minimized by secondary containment such as storing seed bags in sealable containers. Once mice get into stored seed, they can eat a substantial amount and the seed becomes contaminated with mouse droppings which can pose a safety risk when seed is handled.

Potted plants

Potted/container material refers to plants grown in equal to or greater than 1 gallon pots. Similar to seed storage, potted plant material should be stored with the grower for as long as possible. Ideally, plants should be delivered to the project site to minimize transport time. During relocation, plants often will be stressed through improper temperature, lack of water, lack of light and ethylene buildup. Ethylene is the gas responsible for ripening soft fruits such as peaches, bananas and plums. This gas can build up in closed environments and prematurely age plants.

Although transport to the project site is ideal, it is often not feasible. Due to this reason, many contractors and environmental professionals who perform landscaping work require a space for temporary potted plant storage.

Plant storage should typically mimic the conditions that they will be planted into in order to reduce shock and mortality. For this reason, outside storage areas for restoration species are ideal; however, they can provide some challenges as they may not be in ideal locations (e.g., Parks Depot parking lot, etc.). There are things that can be done to ensure that the temporary storage areas are more hospitable for plants. In order to lessen stress on stored plant material and properly care for them, these areas must ensure that the plants:

- Can be watered appropriately. For example, hose length and nozzle attachment should ensure that all plants in the area can receive moisture and that they are not damaged by water pressure (e.g., misting or shower nozzle);
- Are maintained at an appropriate temperature. In very sunny hot areas, a shade tarp may keep the plants from drying out and, depending on the plant material, prevent sun damage;
- Can be regularly inspected. This can help detect pest issues and may help put a watering schedule in place;
- Are protected from vandalism and theft; and,
- Are protected from predation from wildlife, if possible.

Plugs

Most plants in “plug” form (e.g., small potted plants 2” by 2” or less that are rooted in soil) are stored the same way as potted because the plants are grown similarly, except just in smaller pots. The disadvantage of plugs is that they tend to dry out quicker as there is less soil volume and due to that, they need to be regularly inspected as they become dry quickly. Plugs may have some advantages in the sense that many of them are grown in containers that resemble test tubes, sometimes termed as root trainers. This method optimizes the root depth and as such, contributes to the survival rate of plantings as roots can access more moisture deeper in the soil profile.

It should be noted that plugs do take time to mature and that they may require a few years in order to reach an average adult plant height and produce flowers. The benefit with smaller potted stock is that they do not go into shock as readily as larger potted material. This increased survival of smaller potted material has been the case during restoration projects in Calgary, especially involving woody material.

Due to the small size of plugs, they can be easily overlooked and may be accidentally mowed or trampled if the storage area is not well delineated. They also may get overwhelmed by weeds due to their small size.

Plugs are also very susceptible to mortality by grazing. As they are very small plants with an underdeveloped root system, they may not survive being grazed before they have had the chance to mature.

Depending on the packaging of the plugs, short term storage may not require much labour; however, storing material to reduce normal plant care has to be very temporary in nature.

Many of the tree plugs meant for reforestation and rapid replanting are similar in shape to the plugs grown in root trainers; however, they are packaged in material that allows them to be shipped and stored in boxes for 1-2 weeks. Soil is contained in packaging that retains moisture and boxes are wax lined to maintain humidity. Plant material can be stored horizontally in boxes and often does not require added moisture; however, since the plants cannot photosynthesize due to the lack of light, storage time should be minimized.

Bare root material

During planting activities, up to this point, bare root material has not been used by Parks, Urban Conservation. This statement does not include activities performed by Urban Forestry, which often work with larger more mature trees in the built environment, developers and other environmental professionals involved in tree planting within Calgary.

Due to the high mortality rate of larger trees in restoration projects within Natural Environment Parks, smaller woody material stock is primarily used such as plugs or 1-2 gallon pots. This is the reason why bare root stock has not been utilized in these situations.

Bare root stock applies to woody plant material that is not stored in soil such as potted plants but that contains the roots, unlike the live stakes used in bioengineering. This plant material is harvested in late fall by digging out the plant, shaking off the soil and stored lightly frozen for the following year (Sherwood's Forests 2018). The advantage of bare root stock is that it is lighter and easier to ship. In addition, trees are larger and are usually 2 years old although they may be as old as 4 years. Although the trees and shrubs are larger, the roots lack root hairs and these will need to be regrown so that the plant can establish at the destination site. Unfortunately, plant mortality is quite high using bare root stock and the plants need to be in soil within a couple days of arrival (Sherwood's Forests 2018). If the timing is not conducive to planting right after shipment, plants may be stored in a cold room just above freezing. Alternatively, roots can be kept moist and covered in compost or sawdust.

Bare root stock can be advantageous in the sense they need to be planted right away while they are still dormant, similarly to live woody stakes used in bioengineering. This can allow for projects to proceed earlier than the last frost free night in Calgary which usually falls around the long weekend in May. Unfortunately, ground thaw may become the other challenge during the planting phase as bare root material should not be planted in frozen or water-saturated spring soils (Fowler Nurseries 2010). These reasons indicate why potted material is used over bare root stock in restoration activities.

Other methods of propagation

Bulbs, rhizomes, tubers and corms are all methods of nutrient storage utilized by plants so that when the right conditions occur, plant growth can begin. Examples of plants that use this as a survival and growth mechanism are grasses, lilies, onions and tulips. For planting grasses, the most common method used is seeding but in some circumstances where

germination is difficult and/or the grass tends to outcompeted at an early growth stage, plugs are used. If rhizomes are a characteristic of the plant species, they may be developed within the soil already and spread further after planting. Native white prairie onion (*Allium textile*) and nodding onion (*Allium cernuum*) are planted as plugs although the bulb is present inside the soil. Our native prairie crocus is in a different family than the European crocus and spreads by seed, not bulbs, so adding this wildflower into the landscape does not involve the use of bulbs.

Floral displays within Calgary often include species that are planted using these storage methods; however, floral displays and land management are very different. As this document focuses on revegetation in areas that are not heavily maintained, floral displays are not within the scope of this document. This is why storage considerations for bulbs, rhizomes, tubers and corms are not discussed in depth within *City of Calgary Plant Lists*.

Very generically, these structures are stored when dormant in a dark dry place within an organic medium that prevents rot and water uptake prior to being planted. They cannot be dried out to the point of complete desiccation or else they will die; however, they cannot be wet prior to planting as that will cause rot. It should be noted that some of these structures require a cold period in order to trigger flowering (e.g., tulip bulbs).

Since plant material for restoration activities is not procured in this manner, storage in this instance is not discussed further.

Section III: Methods

Plant compatibility

It is very important that the contractors be familiar with the restoration plan and accurately follow it as sometimes slight adjustments or incorrect assumptions can cause project failure. In the Appendix, plant lists per habitat type and desired outcome are provided which will assist personnel that are involved in any type of revegetation work for The City of Calgary. In addition, the Initial considerations section provides information that will aid in the preparation of restoration plans to ensure that plants are compatible with one another. It should be noted that plants cannot be randomly selected from the lists in the Appendix in order to inform a project plan. The lists are meant to provide a resource, especially regarding restoration in the urban environment; however, site specific planning and experience in restoration is always required to be effective in land management and projects dealing with the living environment.

Vegetation community

Considering all Strata Layers

Using seed is not just for restoring grasslands while using woody material is not just for restoring shrubland and forested areas. In natural reference vegetation communities, shrubs are found in healthy grasslands and graminoids are found in healthy forests while many combinations occur in transitional areas and shrubland. Using this logic, a combination of seeded and planted material is most effective in restoration projects, especially when they include many plant species. Conversely, planting appropriate potted material in grasslands can add biodiversity and provide the grassland with the low shrub strata layer that it would naturally have. Planting potted graminoid material may also provide the desired species for a vegetation community that is dominated by grasses that are poor competitors. For example, certain grasses may be outcompeted when planted as seed such as Parry's oat grass (*Danthonia parryi*) or foothills rough fescue. When planted as potted specimens, usually in plug form, they tend to lend cover to the site (Tannas 2010).

If the goal of the project is to replicate a complex vegetation community with different strata layers such as groundcovers, forbs, low shrubs, tall shrubs, tree understory and tree canopy, a combination of seed and planted material is generally the best approach as it allows for the planted material to grow taller while the seed mix establishes. Once the seed germinates and begins to grow, then the planted material has already gotten a head start on growth. Using a combination of seed and planted material also saves resources as some species readily germinate and persist when seeded while other species are a lot easier to procure and grow in the form of potted material. For example, many shrubs are propagated from cuttings which is the most cost effective method. If one is not familiar with the most cost efficient form of plant material that has the best competitive advantage, projects can become unfeasible quickly due to monetary constraints.

If planted material only is used in revegetation projects, the plantings have to be extremely close together to reduce weed invasion and as such, the site is extremely overplanted. In the end, many of the planted species will get shaded out by a stronger adjacent competitor. The robust competitor may be of a different species or even of the same species. Due to overplanting, the project may be unnecessarily costly.

Seeding a groundcover along with planting desired ground covers can be very effective and seeded ground covers can be specified so they are shorter in stature. In addition, using seed along with planted material allows for project phasing and can accommodate appropriate timing constraints.

In addition to the Initial considerations section, in order to properly plan restoration projects and decide whether seed or planted material is appropriate, one should be familiar with these characteristics of each plant species in the plan:

1. Time to germination regarding seed;

2. Whether the species is early or late successional regarding establishment timeframes in comparison to other species in the restoration plan;
3. Growth rate;
4. Water requirements;
5. Preferred light penetration;
6. Soil preferences;
7. Maximum height at maturity;
8. Maximum spread at maturity;
9. Primary reproductive mechanism (e.g., seed, rhizomes, etc.);
10. Average height after one year; and,
11. Average spread after one year.

The information outlined above does not have to be exact; however, an idea of how tall plants will be at the end of the growing season, if the seed will germinate after one year and how tall and wide the species will get with time are important considerations. Even if this information is roughly known in comparison to other species in the restoration plan, it will be helpful.

It should be noted that most urban centres do not have quality soil and as such, plants are often stressed as soon as they are in the project area or begin to germinate. Most often, plants will be on the shorter and narrow end of the growth spectrum. Maintenance efforts may mitigate this and provide additional resources to increase growth.

Mulch

It also should be noted that in a natural setting, there is not a reliance on mulch as a ground cover to mitigate weed colonization and retain moisture. It is important when designing a restoration plan, especially a rehabilitation/restoration designed to replicate a reference vegetation, that the ground cover within the restoration is considered in depth. In an urban environment especially, perennial weeds (e.g., creeping [Canada] thistle [*Cirsium arvense*] and smooth perennial sow-thistle [*Sonchus arvensis ssp. uliginosus*]) and rhizomatous agronomic grasses colonize the mulch within a short period of time. This can be prevented by weeding and consistent mulch additions; however, this is not desirable in a natural landscape and is costly to maintain. Due to this, weeds colonize the site and choke out the desired vegetation.

Although mulch has its place in certain situations such as shrub beds in highly maintained parks that are more ornamental in nature and frequently mowed, it does not provide a proper ground cover for the vegetation to establish and spread as it prevents plants from spreading by underground structures such as rhizomes and prevents plants from self-seeding due to the lack of soil available for the seeds to come in contact with. Mulch also depletes the area of nitrogen as it decomposes so again, that is why it is more appropriate for areas that are highly maintained which often corresponds to fertilizer application.

Field fitting

Many of the initial considerations that are required to design the restoration plan are mentioned in the Initial Considerations section. Regardless, planning a restoration plan on paper is much different than implementing it in the field. Similar to construction projects, the "as-built" design is often different than the proposed design due to challenges that are encountered in the field. For example, soil settling may have changed the grade of the landscape. This is why it is important to have environmental professionals on the job and present in the field so that appropriate adjustments can be made. These professionals should be familiar with the various plant species in the restoration plan and have an understanding of their biology. For example, if a change in the landscape causes a shadow to be cast, then putting sun-loving plants into that location would not be appropriate.

Timing

This section discusses preferred timing of revegetation related to form such as seed, potted material, bare root stock, live stakes and underground storage structures. As mentioned previously, revegetation in unmaintained areas is accomplished primarily with potted material and seed; whereas, Water Resources takes the lead on bioengineering projects involving live woody stakes. Due to this, the timing for seeding and planting are discussed in the most depth while timing for other forms of plant material is discussed at a high level.

Live stakes for bioengineering

As previously mentioned, bioengineering methods are very species-specific and are generally led by Water Resources. Also, a document is being prepared by Water Resources to address timing and methods for species that can be cut and used as live poles/stakes. Regardless, the overarching principle in bioengineering is that stakes should be cut from appropriate woody material during dormancy and put into the ground while still dormant. Some species are more sensitive to being cut and/or planted while breaking dormancy so this should be considered during project planning.

Complications occur in situations where a species is very sensitive to a break in dormancy during the harvesting process. This can create issues as in order to install these live stakes, they need to go in right away before they break dormancy. This often occurs when the ground is frozen so appropriate storage mechanisms are required. These small time windows and unpredictable weather from season to season can create issues as manpower has to be available for these activities with very short notice.

Unless the live stakes are installed in moist soil near the permanent open water mark, supplemental watering may be required. Often, in urban areas, watercourse channelization and usage pressures tend to steepen and further erode banks. The result of this is that the restoration activities are further from the permanent open water mark and in turn, harder to revegetate and stabilize without additional watering activities. This can be mitigated somewhat by installation in the spring so that the live stakes gain more access to water for

development; however, there is a risk that high water flows during spring run-off will wash away the stakes.

Tall Rooted Stock (TRS) for bioengineering

As TRS has well-developed roots at the time of installation, timing is not as restrictive as with using live stakes for bioengineering. Since the material does not need to develop roots, it can be installed at any time in the growing season with limited restrictions.

Regardless, similar to plantings, TRS should be installed when temperatures are not hot and dry, such as in mid-summer. Additionally, TRS should be installed so that it can establish before colder temperatures cause ground freeze. Every effort should be made to minimize shock during installation. Finally, if TRS is to be installed in areas where moisture is limited such as above the high water mark or even above the permanent open water mark, watering should be performed for establishment.

Seed

Since seed pre-treatment to induce germination requires expertise in plant physiology, species specific knowledge, a lot of time and storage space, pre-treatment of seed by contractors is generally not feasible with the exception of seed cleaning. Due to this, timing is crucial when seeding species that are native to Alberta and the Calgary area. The seed of most indigenous species has a hard seed coat and as such, will not germinate until that seed coat is broken. Native seed requires drastic fluctuations in temperature and moisture to induce germination. In addition, some type of scarification (e.g., roughening/scratching the seed coat) is usually required. This may occur during the cleaning process or due to weathering in the field. The cleaning process agitates the seed and scarifies the seed coat while organics are removed as well as structures on the seed such as the awn(s) and/or pappus (e.g., appendage on seed) which makes seed handling easier.

Ideal seeding times for native species maximizes these climatic fluctuations to ensure that the seed breaks dormancy and germinates. This contrasts with many agricultural species and horticultural cultivars which can be seeded any time conditions are favourable for growth. Unlike native plants, agricultural species and horticultural species are mostly quick germinating and do not require these extreme climatic fluctuations. It should be noted that watering native seed is generally not performed, unless conditions are unseasonably dry.

When seeding of native species is done during the mid-summer months, there is a chance that germination will occur but the root will not be developed enough to withstand dry, warm conditions. This leads to die-off and as such, often causes project failure.

Table 1 outlines preferred seeding times under average Calgary conditions and assumes seed is not watered. It should be noted that this table does not apply to cereal crops that are seeded in the fall in order to yield an early spring harvest such as winter wheat, fall wild rye and winter triticale.

Table 1 Seeding time frame information assuming no maintenance activities*

Seed Type	Time Frame	Preferred Seeding Time	Notes
Native	After ground thaw (April))	Yes	Ideal for late spring germination and establishment prior to fall.
	May	Yes	The earlier in May, the better the chance of establishment during the same growing season.
	June	Not ideal but may provide coverage	Germination may occur but there is a likely chance of die off during the summer months; Early June is preferred over late June.
	July to mid-August	Risky	If any precipitation occurs during these months, germination is likely. Hot weather post precipitation is anticipated and die off of seedlings will be large. Vegetation cover will likely not establish.
	mid-August through September	Not recommended	High likelihood that warm dry fall days will cause die off prior to enough root establishment; Fall precipitation and hot days are very poor conditions to ensure seedling survival; Very weather dependent.
	October to ground freeze	Yes	Very high chance that seed will stay dormant and germinate the following spring; Seeding can occur into winter if ground is still thawed; A very light snow cover may be beneficial in holding seed in place.
Non-native forage/horticultural species	April to August	Yes	It is being assumed that plant growth and overwintering is desired during the same growing season so that root establishment occurs in September until October or until first frost, whichever is sooner. It should be noted that there is a lot of variety regarding preferred seeding times so this generic guideline is more meant as a contrast to the ideal seeding conditions for native species.

*All seeding methods assume watering is not implemented; during years of severe drought watering the site before seeding and misting after can be done to mimic natural precipitation and aid in vegetation establishment.

It should be noted that many of the non-native grasses are quite aggressive and do not require drastic fluctuations in moisture and temperature and/or scarification in order to trigger germination. Due to these characteristics, most non-native lawn grass blends can be planted when the temperatures are warm; however, ensuring that the seed has enough water to grow can be challenging when temperatures are at their hottest in mid-summer. Essentially, water may need to be substantially supplemented during this time of year.

Although seeding in the hottest and driest time of summer is not recommended, seed also needs to be put in the ground to ensure adequate root growth in order for it to overwinter, if desired. Generally, seed mixes for lawns and other applications are readily commercially available and instructions are provided based on the composition of the mix and the climate that it is being used in.

As mentioned, optimizing seeding time is based on nativity and in cases of commercial availability, the manufacturer's instructions. In the case of non-native plants and cover crops, seeding timing may be manipulated so that project goals are met. Cover crops may be seeded at a time so as to not develop sufficient root mass to overwinter and self-seed. Other non-native plants may provide annual or perennial cover, based on manipulations to the seeding time.

Potted material

To avoid night time frost, potted plant material can be put in the ground generally any time after the May long weekend. Depending on species hardiness, it may be best to wait after the May long weekend as that tends to be the last potential weekend where precipitation is in the form of snow within the Calgary area.

If possible, planting potted material in the hot mid-summer months should be avoided. This prevents plant mortality due to shock and saves watering costs. Depending on project phasing, sometimes this cannot be avoided but if possible, this should be considered in project planning as a cost saving measure as watering is very expensive. During the summer months, watering daily would not be out of line although every second day is more realistic based on costs if hauling water to site versus installing temporary irrigation.

If planting can occur once temperatures cool down slightly and provide time for the plants to get adjusted to their new environment, this can reduce maintenance. Ideally, potted material that is planted before frost can be watered in so that the roots establish and the plant has enough moisture to survive a dry, warm autumn and/or winter. Caution should be taken when planting in the fall as unexpected frosts may occur. Due to this, it is advantageous to put some leaf litter or thatch around the base of the planting to insulate the roots during cold winter months and to mitigate the event of unexpected cold fall temperatures. Mulch is often the preferred substrate versus leaf litter and thatch; however, mulch is generally not used in restoration within natural areas and Natural Environment Parks.

Ideally, potted plants should be watered the first growing season of establishment and the next subsequent growing season to ensure maximum survival. Plant mortality increases when watering only occurs the first year of establishment and is absent during the second year. Plant mortality also increases when watering is cut off prematurely.

Bare root material

Similar to live stakes used in bioengineering, bare root material should be harvested and planted when dormant. This allows the plant to not go into shock and grow the root hairs that it requires for water uptake. Regardless, in revegetation projects bare root material is seldom used as it cannot be stored for very long. As previously mentioned, its main advantage is having a larger shrub or tree that is lighter in transport.

Other methods of propagation

As mentioned during the discussion of storage, bulbs, rhizomes, tubers and corms are plant propagules that store energy when dormant so that when environmental conditions are favourable, growth can begin. Generally, during revegetation projects, this type of plant propagule is not utilized whereas it is commonly used in floral displays and gardens which is out of the scope of this document.

Regardless, very generically, these structures need to be kept dormant until ready to plant or planted during times that retain dormancy such as late fall. They cannot be dried out but a moist environment will cause rot. Also, keeping these structures in breathable packaging along with something to retain and absorb moisture in a cool, dark and dry environment is best to retain longevity and maintain dormancy until ready to plant. Since Calgary's humidity is quite low, any storage areas that have the above characteristics that are not overly humid (e.g., damp basement) are appropriate.

In the case of plants that are used in restoration that are propagated by these storage structures (e.g., native onions), the plant material will be in potted form of some type. This prevents the necessity of storing these dormant plant storage structures.

Preparing and planting

As referenced in the *Habitat Restoration Project Framework* (The City of Calgary 2014) (Figure 1), there are various levels of revegetation which are synonymous with what is termed restoration as a whole. This can be misleading as although all types of revegetation are termed restoration, restoration is actually split up into different levels of revegetation complexity. These levels correspond to the level of desired ecosystem function and similarity to the reference vegetation community that the project is trying to achieve. Various policies, environmental and project goals, along with realistic objectives, will guide the decision making process of what type of restoration work is required.

Site preparation will differ depending on the desired level of restoration. For example, soil amendments and additional topsoil may be required to provide the appropriate level of soil

health to support a reference vegetation community. See *Soil Handling Recommendations* (The City of Calgary Parks 2019) for additional details on soil health. Regardless, it should be noted that soil health is often the limiting factor in restoration projects as the healthier the soil food web is, the more likely it can support the reference vegetation community or put the project area on the proper trajectory to the reference vegetation community. The soil food web includes everything in the soil such as the beneficial bacteria, fungi, protozoa and nematodes that live in the soil and also the compost present in the soil that function together to improve and maintain soil health (Soil Foodweb Canada Ltd. 2017). This does not mean that all soils must be very high in certain nutrients and organics. The soil food web is a complex system and needs to be looked at holistically as healthy soils vary in properties and as such, if the soil food web is similar to a reference site, then the soil is healthy. For example, some soils are very sandy and lack organics but in some cases, that is the appropriate soil type to support a vegetation community that grows in sandy prairie.

Similarly, if a site needs to be revegetated to prevent soil loss but the goal is not to provide biodiversity or a complex palate of vegetation, reclamation would be an appropriate solution. The definition of reclamation involves the process of stabilizing disturbed lands to an ecologically productive use (The City of Calgary Parks 2014). This could involve using a fast-growing non-native grass to provide cover. Even as a monoculture, the landscape has increased in functionality as the vegetation provides potential forage and habitat to wildlife while also preventing soil loss.

Naturalization generally uses native and non-native plant species to create a low maintenance landscape and increase plant biodiversity on site. In turn, increased flora biodiversity leads to increased fauna biodiversity. This landscape is not as complex as a reference vegetation community or even a healthy early to mid-seral vegetation community. Regardless, this activity can be especially useful in an urban context, where surrounding disturbances, usage pressure and past development prevent an area of achieving a reference vegetation community. This activity provides native plant elements along with aesthetically pleasing hardy non-native plant cultivars that function to provide habitat value and forage for pollinators.

Rehabilitation is the term used when landscapes are transformed to a similar level of ecosystem function as the native reference vegetation community. Obtaining the desired reference vegetation community may take time, adaptive management and various inputs, such as additional plant species. Once ecosystems are functioning at a level close to the reference vegetation community, it may be on the proper trajectory to obtain the desired plant community. Time may be the only limiting factor at that point, especially as plant species fill in and spread.

Restoration returns the degraded habitat to the full ecosystem function and biodiversity levels of the reference habitat. As previously mentioned, rehabilitation along with time may achieve this. As the area develops the appropriate plant strata layers in a healthy reference vegetation community, various other organisms begin to utilize these habitat niches. This

achieves maximum biodiversity and mimics what would be present in the reference vegetation community, including both flora and fauna.

Ensuring that the site is not compromised again during the necessary time frame to restore biodiversity and ecosystem function is crucial.

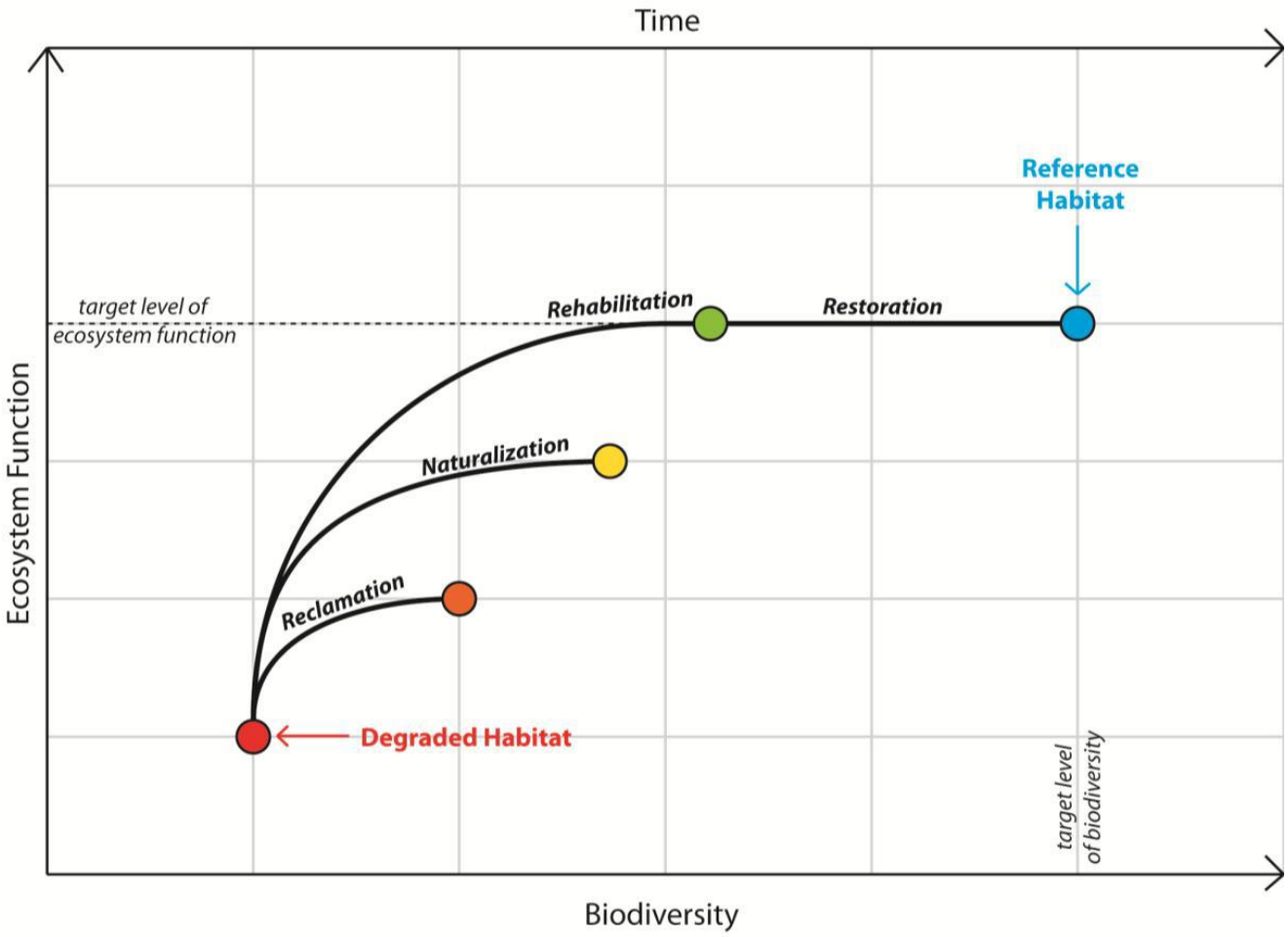

Figure 1. The range of habitat restoration types includes reclamation, naturalization, rehabilitation, and restoration. The starting point of habitat restoration is a degraded habitat that has less biodiversity and lower ecosystem function than a reference habitat. Through the processes of reclamation (orange) and naturalization (yellow), ecosystem function and biodiversity will increase over time, but result in an ecosystem that would not normally occur along a natural successional trajectory. Rehabilitation (green) restores ecosystem function and biodiversity to a level similar to, but lower than, a reference habitat and would allow the ecosystem to recover naturally to reference habitat conditions. Restoration (blue) returns the degraded habitat to the full ecosystem function and biodiversity levels of the reference habitat. Figure modified from Bradshaw (2002) and Naeem (2006) and taken from The City of Calgary Parks (2014).

Site preparation

As noted in Figure 1, various levels of habitat restoration exist concomitant with increased biodiversity and ecosystem function over time. Reclamation is generally synonymous with revegetation in its most simplistic form, while restoration is the most complex form. Reclamation often uses non-native plants while naturalization uses non-native and native plants. During rehabilitation and restoration, only native species are used in order to recreate the reference vegetation community.

Due to these various objectives and the increasing complexity of revegetation work as projects proceed towards restoration, site preparation and planting methods for various methods of habitat restoration types can be challenging. The content outlined below is not all inclusive but it is intended to provide some guidance regarding the most effective methods for habitat restoration types in the Calgary area using seed and potted material.

It also should be noted that all plants in the legume family fix atmospheric nitrogen into bioavailable nitrogen. Due to this, using legumes in restoration plans, both in seed and potted form, is advantageous as they condition the soil without the addition of fertilizer. If an area has very poor soils, using a cover crop of legumes which is then ploughed into the soil before the next planting can increase the soil health. A cover crop may also increase the porosity of the soil as well as the organic content. See *Soil Handling Recommendations* (The City of Calgary Parks 2019) for additional details increasing soil health.

Preparing the site for seeding

In most instances, seeding needs to ensure that soil to seed contact is maximized. Very few species can germinate in thatch, leaf litter or mulch. For additional information, see *City of Calgary Seed Mixes* (The City of Calgary Parks 2018). When there are undesirable species within the project area, the canopy can be opened up for seeding through a combination of mechanical and chemical weed control with the detailed methods being dependent on the dominant target plant species in the area.

For example, many rhizomatous species respond well to a mow, followed by a thatch removal and finally, a chemical treatment once significant leaf area has established effectively in order for the herbicide to penetrate into the plant. This allows for the chemical to translocate to the roots so that the species can be controlled on site. This may take a few cycles in order to be effective. Seeding should not occur less than one week after herbicide application as growers and farmers have indicated seeing residual effects. This information is anecdotal and was mentioned to The City while researching information for restoration work.

Other methods of naturalization and/or rehabilitation may involve simply the introduction of species to a landscape dominated by undesirable vegetation species. In this instance, a mow and/or abandoning turf grass maintenance followed by a hard rake in order to remove thatch and open up the canopy can allow for the introduction of native species through seed and plantings.

Alternatively, if the site is colonized with invasive rhizomatous agronomic grasses and the goal is to restore it to an entirely different plant community, a sod cutter may be used instead to remove the first 10 cm of the thick sod layer. This method can be an alternative to herbicide and mowing. Depending on the soil conditions, topsoil may be added. If the soil is very poor, the sod may be flipped over and buried with as much topsoil is feasible to increase soil organic matter, increase topsoil depth and provide weed control. It should be noted that any soil openings that allow light penetration to the rhizomatous invasive grass layer will promote the agronomic grasses to re-establish.

When reintroducing any type of vegetation to a site, understanding current soil conditions is very important to the success of the plants. This is crucial for sites that do not have any existing vegetation as the plant species on site cannot provide information regarding the suitability of the soils for various vegetation communities. *Soil Handling Recommendations* (The City of Calgary Parks 2019) can provide guidance whether soils require decompaction and/or amendments prior to seeding and planting.

Generally, in order to ensure maximum seed to soil contact, soils should be loose enough that one can make a foot print in them but not loose enough so that heavy objects sink in the soils. This allows for seed to “catch” in the unevenness of the surface but prevents soil and subsequent seed loss. Seeding is most effective when the surface of the soil slightly uneven and scarified.

Another factor prior to seeding that must be considered is the possibility of losing seed to erosional forces. Many solutions exist to combat this problem such as the use of geotextiles in various forms as well as the seeding method. Due to the large selection of geotextiles, it is important to find the right product for the project. Many geotextiles are too heavy to allow native species to germinate and break through the fabric. Others may be too light to keep the soil in place. Regardless, if there are opportunities prior to the revegetation phase that can mitigate for erosion, they should be explored. Some of these include recontouring the area so that the angle of the slope is lessened or so that there are a series of flat plateaus to seed on and therefore, a stepped landscape is created.

As previously mentioned, most species do not germinate in anything but soil; however, there are some species that can germinate in mulch and/or gravel. See *City of Calgary Seed Mixes* for additional information regarding seed mixes for shrub beds. Although these species are able to colonize areas lacking in topsoil, there are things that can be done to improve germination in the site preparation phase.

For example, if the goal is to naturalize a shrub bed through seeding directly into the mulch, removal of the upper coarse mulch, as much as feasible, will increase germination. After removing the course woody material, application of a high nitrogen fertilizer can increase the decomposition of the mulch and provide new plants a source of nitrogen. Nitrogen is depleted during the mulch decomposition process.

Preparing the site for planting

The most important site preparation that can be performed prior to planting any vegetation propagule is to ensure that the soil and the associated soil food web is healthy (The City of Calgary Parks 2019). During large development projects, stripping and grading removes the vegetation and as such, transformation to a desired plant community will be less problematic, especially if soil handling methods have mitigated for weed seeds within the seed bank. Regardless, many restoration projects are dealing with lands that have already been colonized by some type of vegetation community. Due to this, site preparation is extremely important to ensure revegetation activities are compatible with site conditions.

A situation that relates to the Initial Considerations – Height Section is the presence of tall and/or fast growing species on a site where slower growing native material is to be planted. This is sometimes overlooked when planting potted material into a site that has been colonized by non-native agronomic grasses. These aggressive grasses that start growing at a rapid rate during the early spring (e.g., cool season) may shade out and kill off newly planted material.

Sometimes mowing the site and removing the thatch prior to a fall planting of taller plant material may provide enough of an advantage for the slower growing material to grow above the aggressive agronomic grasses. When spring arrives, these agronomic grasses that prefer full sun will be shaded, giving the taller native plants an advantage and promoting establishment.

Lastly, as recommended for site preparation in the case of seeding, there are overlapping methods that are appropriate for plantings. These same steps ensure that the competition is reduced so that the newly planted material can thrive. These techniques may include:

- Cycles of mowing, thatch removal and herbicide treatment;
- Removing invasive agronomic grasses with a sod cutter;
- Removing invasive agronomic grasses with a sod cutter, flipping and adding topsoil; and,
- Recontouring into a stepped landscape.

Getting plant propagules in the ground

Seed

A concern during seeding activities is seed loss and erosion. This is exacerbated when seeding occurs on sloping ground. A common seeding method that prevents erosion is hydroseeding but seed germination, especially of native species, can be reduced by this method. In addition, hydroseeding can prevent the mix from going onto the site as desired due to seed settling out in the slurry/tackfier based on weight differences. Also, native seed that is not fully cleaned will prevent hydroseeding from occurring to specifications as again, the seed will not be evenly distributed in the slurry.

Other methods besides hydroseeding are available to prevent erosion. Seed loss can be lessened by applying a very light tackifier, ideally paper based. Other tackifiers that are appropriate for other applications, such as trail building, are not compatible with seeding. This tackifier would be applied at a very light rate as it would not replicate the rate of tackifier application when hydroseeding. The seed should not be entirely coated but just slightly anchored in place.

In addition to keeping seed and soil in place, a very light application of tackifier can also prevent unwanted seeds from migrating into the project area. This can reduce future weed problems. An approach that uses tackifier alone is not common but could be used in areas where seeding is delayed post stripping activities.

Various geotextiles are available to prevent erosion and seed loss. It should be noted that when using geotextiles, similar to heavily applied tackifier, these methods may hinder seed germination. Tackifier tends to coat the already hard seed coat so it takes more extreme temperature and moisture fluctuations or additional mechanical agitation to break dormancy and in turn, cause germination.

If geotextile material is secured over seed, careful consideration must occur regarding the type of seed mix and the geotextile specifications. Often, the geotextile is too thick for tender native seedings to break through. Additionally, geotextiles may prevent light penetration and in turn, not allow for plant growth. It is important to consider these issues before covering seed mixes with geotextile fabric. It is common to see grass sprouting from geotextile fabric but sadly, these are often not the desired species in the seed mix and instead, invasive turf and agronomic grasses.

A very light layer of coconut matting has been successful in keeping seed in place on slopes and in areas with high winds. This allows for light penetration and does not prevent the seedlings from pushing through the fabric due to the looseness of the weave. When using fabric, wildlife safety (e.g., snakes, birds, amphibians, small mammals, etc.) must be considered in order to prevent accidental mortality.

Another option to geotextile fabrics is crimping in clean straw or straw containing desired vegetation. This can be done using the organics (e.g., leaves and stems) from the species that the seed was harvested from or crimp in the desired vegetation, with all parts in tact as an alternative to seeding. Alternatively, other clean straw sources can be sought out. Slightly pushing in straw in divots over a seed mix will preserve soil and seed. Ensuring that the straw is free of weed seeds is paramount. This method has worked well for seeding along highways in central Alberta. A seeder such as a Land Pride seeder is used then clean straw is crimped in over top of the seed mix. Benefits of this method include increased soil organics and soil moisture which aids in seed germination.

Depending on the variability of the size of seed in the seed mix, the seeding method should be considered during project planning. Certain seeding methods are more appropriate for seed mixes that have a large discrepancy between seed sizes and weights. Refer to The

City of Calgary Parks 2018 for more detailed information on seeding methods and rates. A summary table from *City of Calgary Seed Mixes* is provided below.

Table 1 Seeding methods summary

Seeding Method	Advantages	Limitations	Recommendations on Usage
Hand broadcast	• Can access remote areas and other locations where equipment cannot access • Cost efficient for small areas as labour is the only requirement • Can ensure seed is constantly mixed (e.g., by hand) to allow for even coverage • Can use seed that has not been cleaned/debearded • Can mix seed with amendments such as worm castings, perlite, etc. to increase seed flow and aid in keeping the seed in place • Can seed in places that would be unsuitable for other machinery (e.g., forested areas) • Can adjust seeding rate based on microclimate • Belly grinder (e.g., hand held seed spreader) can assist in ensuring more even coverage • Can ensure small seed is not covered too deeply	• Manually raking in seed does not allow for even seed to soil contact • As seed is not evenly covered and/or buried in the soil, there is a risk of erosion and seed loss • Large areas require a lot of labour • Require soil that is loose enough to rake seed in • It is easy to accidentally seed at a higher rate when hand broadcasting • Cannot separate seed into size groups while seeding	This method is ideal for smaller areas in hard to access locations and areas that limit the use of any equipment such as forested habitats. Hand broadcast seeding should be used in level areas where there is a low risk of erosion and seed loss. Seed that has not been cleaned can be used although there will be more risk that it will not stay in place.
Brillion seeder	• Buries seed into soil and allows for more uniform seed to soil contact • As seed is consistently buried	• Cannot traverse steep slopes • Cannot easily travel between trees	This method is commonly used in areas that are level and have fairly homogeneous habitat (e.g., no large rocks, no deadfall, etc.). Less seed is required as erosion and seed loss is minimized

Seeding Method	Advantages	Limitations	Recommendations on Usage
	in soil, less erosion potential is present • Can seed large areas quickly • This methodology encourages evenness as seeding rate is not influenced by human error • Equipment is easily available • Can use less seed versus hand broadcasting as lower erosion potential • Typically, the seeders have 2 seed boxes so uncleaned seed can be separated (e.g., box with metered seed feed rolls is appropriate for small seed other box with a sliding gate with a powered rolling cage is appropriate for large or fluffy seed that has not been cleaned) • The box with the sliding gate and powered rolling cage prevents seeds from sticking together and forming solid seed masses (e.g., bridging) • Two seed boxes allow for the separation of seed which leads to better seed flow and more even coverage • The seeder is less heavy than other models and	• Requires soil free of rocks and debris • This seeder is not as robust as some other models • The two sets of packing cast notched wheels often require frequent adjustments • User must be proficient at adjusting and calibrating hoppers to obtain the desired seeding rate • Seeder is made of lighter material which is not as durable as some of the other materials comprising other seeders • This seeder generally does not accommodate a third optional seed hopper which may not be sufficient for some types of seed mixes	versus the hand broadcast method. The flow of the seed mix will be better with clean seed and clean seed will allow for more even coverage of the seed mix. Seed can be separated into two hoppers to accommodate different sized seeds. This machine may not be able to accommodate seed blends that require three hoppers for proper flow (e.g., small seed, large seed and uncleaned seed).

Seeding Method	Advantages	Limitations	Recommendations on Usage
	requires less horsepower to pull it • Can be loaded more easily than heavier models		
Land Pride Seeder	• Same advantages as Brillion seeder but heavier • Standard design has one seed hopper but additional models now can accommodate up to three seed hoppers • Various seed boxes allow for the separation of seed sizes and/or seed that has not been cleaned (e.g., small, regular and native/unclean) which leads to better seed flow and more even coverage • This allows for better flow and more even coverage • The native seed that has not been cleaned is seeded in a way to reduce seed loss • Constructed out of heavier metal and as such, more durable	• Cannot traverse steep slopes • Cannot easily travel between trees • Requires soil free of rocks and debris • Clean seed always flows better through seeders • Extensive knowledge of how to separate seed into size groupings and calibrate the hoppers to the correct seeding rate is required	This method is commonly used in areas that are level and have fairly homogeneous habitat (e.g., no large rocks, no deadfall, etc.). This method is most efficient for seeding mixes with a wide variety of seed sizes and/or a portion of unclean The least amount of seed is required for this method as erosion and seed loss is minimized. Seed is evenly distributed and seeds are buried at the appropriate depths. Constructed out of heavier materials so withstands more usage and adverse conditions without requiring repairs.
Hydroseed	• Can revegetate slopes • Can revegetate areas that contain rocks and woody debris as this type of seeding does not work the soil, although seed loss will occur due to	• Slurry interferes in seed germination, especially with native seed, as the seed coat is protected by the slurry • Germination of native seed is reduced	This method should be used on steep slopes that cannot be seeded using any other method. Hydroseeding may also be appropriate for uneven terrain or areas that a conventional seeder could not traverse such as areas containing rocks and other debris. Hydroseeding may be warranted in a level site within a

Seeding Method	Advantages	Limitations	Recommendations on Usage
	lack of seed to soil contact • Most large projects require hydroseeding for escarpments and as such, equipment will likely be on site • Innovations in slurry amendments are increasing the effectiveness of this method • Erosion potential is less than using the hand broadcast method	• Settling issues occur with mixes that have a wide variety of seed sizes • Seed that has not been cleaned causes coverage of species to not occur as intended in the seed mix design as unclean seed interferes with seed flow • Slurry decreases seed to soil contact • A lot of seed is needed to ensure germination and coverage • The drying out of the slurry can cause decreased vegetation coverage due to die off or interference with germination • Erosion potential exists because seed is not buried • Hydroseeding equipment may often be contaminated with other seed mixes or tackifiers due to inadequate cleaning	project where bringing in another piece of seeding equipment would not offset the expense of the additional seed cost. This method should not be used to seed rare species and/or species that are hard to procure due to the high seed requirement.
Great Plains	• Same benefits as Brillion and Land Pride Seeders • Seeders have models with 3 hoppers available • Seed can be seeded at 3 different rates at 3 different depths, simultaneously • Picker-Wheel Meters allow for	• Very heavy and require counter balance when loading • Requires a lot of horsepower to pull seeder	Suitable for large seeding jobs by an experienced user who can properly calibrate all three hoppers to achieve the proper seeding rate. Due to its durability and design, this seeder can traverse uneven terrain. The machine's weight limits its usage as transporting it and having enough horsepower to pull the seeder present challenges.

Seeding Method	Advantages	Limitations	Recommendations on Usage
	calibration of seeding rate for small and larger seeds • Native grass agitators prevent clumping and help ensure flow and even coverage • Good for large seeding projects due to size and capacity • Very durable and can traverse uneven terrain		

If seeding will be performed in the fall, the seeding rate should possibly be increased due to the risk of wildlife predation over fall and winter when forage is scarce.

Potted Material

Firstly, it should be noted that the setback distances to various types of infrastructure outlined in the *Development Guidelines and Standard Specifications: Landscape Construction* (Calgary Parks current edition) apply to revegetation projects using trees that may affect hard infrastructure, private land and utility lines. Due to this requirement, adjacent structures and land ownership should be reviewed prior to implementing a project where tree planting will occur. Regardless, this document is meant to address restoration projects that are not in the built environment (e.g., street trees, boulevard trees, etc.) and as such, the majority of the information in the *Development Guidelines and Standard Specifications: Landscape Construction* addressing tree planting is not applicable as it is addressing tree planting in a context other than restoration.

Most tree planting performed by other Business Units is in an urban context that is outside of the restoration projects performed by Urban Conservation, Parks. These plantings use much larger tree specimens, many ornamental tree species that are not native to the Calgary area and often add mulch to the base of the tree. As this document focusses on revegetation in the non-built environment and low-maintenance landscaping, a small number of tree species are used that are generally smaller in size. Smaller tree material will not have a large root ball nor a trunk flare and as such, these features are not accurate ways to determine planting depth.

The majority of the time, small potted material, ideally 1 gallon pot size or less, will be used in revegetation projects. Forbs usually come in as plugs or in small pots within trays while trees and shrubs are in plugs, 1 gallon pots or, less commonly, larger pots such as 2 gallon size. Pot size is minimized during restoration work as experience indicates that plants do

not go into shock as easily when in smaller pots, especially as maintenance such as watering is reduced.

Forbs, trees and shrubs are planted in a similar fashion to bedding plants. As mentioned previously, all plants need to be accustomed to the climate that they will be planted into, termed hardening off, to prevent shock. After site preparation is complete and the plants are hardened off, planting will follow the steps outlined below.

1. Ensure soil is level, as much as feasible, and remove rocks or large stones.
2. Loosen plants from their containers by gently pushing them up from the base, tapping the bottom or using a trowel. Be careful to not drop the plant.
3. Handle the plant gently from the sturdiest part of the plant which is usually the roots and the soil around the roots.
4. To ensure that the revegetation plan is followed accurately, placing the plants in their proposed locations before planting may mitigate mistakes in spacing.
5. Avoid compacting the soil as much as possible.
6. Dig a hole approximately the same size as the root ball.
7. Plant so that the root mass is just under the soil surface.
8. Lightly press around the plant to ensure that the soil is firm enough to hold the plant and stay in place.
9. Water plants near the base using a hose attachment or watering can that does not damage the plants or displace the soil (e.g., light spray).
10. The majority of the time, newly planted vegetation needs to be watered in to establish. Also, newly potted material has shallower roots than established plants so its drought tolerance is much lower. Due to this, new plantings require maintenance and monitoring to ensure survival.

Planting methods have been adapted from The Royal Horticultural Society (2018). It should be noted that these planting methods do not include any instructions on additions that may be made to increase survival such as tree protection for wildlife or structures/ammendments designed to hold and retain water.

If soils do not adequately retain water, rather than amending soils on the project site, a slightly larger planting hole can be dug and material that retains water can be added to the hole prior to planting. There are many commercially available amendments that may be in the form of organics such as sphagnum moss or non-toxic crystals that expand into a water-holding gel. Similarly, these soil additions may be fortified with nutrients or they may already naturally provide additional nutrients. There are also commercially available solutions which can reintroduce beneficial fungi into the soil which will help plant growth. Balanced organic fertilizers may be used; however, inorganic fertilizers are not recommended and caution must be taken to ensure that the addition of soil nutrients does not promote weed growth. Lastly, materials may be added to the soil around the plant to mitigate soil compaction such as perlite.

Although the spacing and densities of plants during restoration activities should replicate the reference vegetation community, many revegetation projects, especially rehabilitation and restoration efforts, occur in areas that are hard to access. This can cause issues as watering the plants when they are initially planted can be impossible in certain locations. In this case, overplanting small less expensive plant stock with the anticipation of high mortality is often performed. Water retention amendments, as mentioned above, can also increase survival in areas where watering is not feasible. Lastly, when projects are too remote to access, revegetation projects will highly rely on seed and appropriate timing to ensure watering is not a necessary or large part of the maintenance plan.

Section IV: Habitat types

Introduction

City of Calgary Plant Lists provides lists of suitable plant species based on habitat types and desired outcomes, as detailed in the Appendix. It is the onus of the project manager and/or environmental professional to ensure that the restoration plan uses *City of Calgary Seed Mixes*, *City of Calgary Plant Lists* and the *Habitat Restoration Project Framework* to inform the revegetation phases of the restoration plan. Additionally, these documents will provide information to assist in choosing the most appropriate form of plant material. *City of Calgary Plant Lists* indicates the most effective form of plant material based on restoration experiences within Calgary, availability and current research.

It should be noted that these lists are not inclusive and should be used as a guide only. Additionally, all restoration plans should address site specific anomalies and how that affects the chosen plant palate. For managing a restoration project see the *Habitat Restoration Project Framework*. All restoration plans need to be based on the project areas themselves; however, the plant lists provide a good base of appropriate plant species to inform restoration plans.

Habitat types and project outcomes

Parks asset reporting and information system (PARIS)

In Natural Environment Parks, especially in the larger parks, there are usually many different habitat types and vegetation communities. Unfortunately, the native plant communities that are present are often fragmented due to high usage pressure, anthropogenic disturbances and sometimes, a lack of natural disturbance regimes. The result is that the reference vegetation communities are replaced with weedy non-desirable plant communities and over time, without intervention, the native plant communities slowly turn into ecologically poor areas. As the unhealthy ecosystems grow, the healthy vegetation communities shrink in size.

Generally, larger areas of native vegetation remain healthier than smaller areas due to less disturbance and weed invasion pressures that come in from the edges. Due to this, restoration work generally tries to ensure that areas are large enough to be self-sustaining, once restored. This activity generally involves using native vegetation only, with the very odd exception when it involves soil and organic building.

Habitat types in Natural Environment Parks and other non-turf assets maintained by Parks are broadly categorized within PARIS. Although some natural areas may contain areas of turf, the dominant habitat types in Natural Environment Parks include:

- Aspen forest;
- Balsam poplar forest;
- Disturbed (usually dominated by non-native weedy vegetation or mostly devoid of vegetation);
- Douglas fir;
- Grassland;
- Riparian gravel/sand shoulders;
- Riparian tall shrub;
- Streams open water;
- Upland low shrub;
- Upland tall shrub;
- Wetland emergent vegetation;
- Wetland open water; and,
- White spruce forest.

Habitat types outlined in this document do not use PARIS classifications as they do not indicate the habitat structure as a whole. When it makes sense to do so based on restoration goals, habitat types are grouped together and appropriate plant species are noted based on the geographic area in which they dominate. This is because of the significant overlap of species within these various habitat types and the changes in species composition from prairie, to foothills to parkland.

PARIS habitat types are also subdivided, based on whether the restoration work would take a different approach in a certain kind of habitat type. For example, grasslands are divided into different types, based on the area of the city that they dominate and moisture regime. These grasslands also exemplify various states of range health as they can be almost fully vegetated with non-native invasive species. On the other ecologically healthy end of the spectrum, they may be very close to a pristine reference vegetation community.

Additionally, the goal of the restoration work is indicated as native and non-native species may be used. This is dependent on the level of restoration. For example, roadsides may be naturalized with native and non-native species; however, a disturbed area surrounded by relatively pristine forest would be rehabilitated and then, ideally put on the proper trajectory to restoration.

In addition to the habitat types used to define Natural Environment Parks, other classifications exist; however, they are not descriptive. These are based on turf classes and are listed and defined below:

- Turf Class A – frequent mowing; highly groomed.
- Turf Class B – medium frequency of mowing.
- Turf Class T – limited mowing.
- Turf Class S – no mowing; slope hazard.

Areas with turf grass that are not highly maintained are sometimes restored to a naturalized condition to decrease maintenance activities and increase biodiversity. Areas that have been restored into habitat types other than turf grass are seldom converted back to turf and as such, conversion to turf grass will not be discussed. This document focuses on the revegetation of areas into more self-sustaining lands and so the construction of turf areas is outside of the document scope.

Further classifications exist which will not be discussed as they are not based on habitat or any type of turf management regime. Often these are managed by other business units besides Parks (e.g., Calgary Roads) or are still under Developer maintenance.

As previously mentioned, the PARIS habitat classifications are helpful but do not provide enough information to guide restoration plans.

It is critical to examine any proposed project area field prior to preparing restoration plans. This will mitigate allow for a more accurate understanding of the area and its challenges. It will also confirm whether or not the habitat type in PARIS is correct and mitigate for human error. If it is not accurate, it should be updated in the PARIS system. Lastly, a site visit is paramount for restoration plan design so that transition areas, microclimates, unique habitat features, rare species, anomalies and site challenges are captured and incorporated into the restoration plan.

Habitat Condition Rating (HCR)

The HCR was developed as a park and land management tool. It differs from range health assessments because the model is adapted for the urban environment. The model is also able to utilize Geographic Information System (GIS) data to provide a score indicative of park health. This score is then confirmed in the field by using various observations that are fed into the model in addition to the GIS information that originally informed the computer program. Examples of information that are collected in the field to confirm the HCR include canopy cover of native grass versus non-native invasive grass, indicator species, forest understory presence/absence, etc.

Three (3) broad Terrestrial Habitat Categories are present within the HCR methodology and model. The Terrestrial Habitat Categories are made up of HCR Habitat Classes which further define the habitat types and correspond somewhat to PARIS habitat types. The HCR

Habitat Classes and broader Terrestrial Habitat Categories have very stringent definitions, to ensure habitats are defined consistently, both from and among users. Although PARIS habitat types generally correspond to some Habitat Classes, the categorization of them from HCR to PARIS differs.

The HCR habitat types are listed below in Figure 2. HCR Habitat Classes are helpful as they provide an indication of what species dominate the HCR Terrestrial Habitat Category (Figure 2).

Lastly, the HCR model has not included riparian habitat types and as such, desktop review, restoration prioritization and work planning for areas adjacent to waterbodies and watercourses is limited under our current GIS data and models.

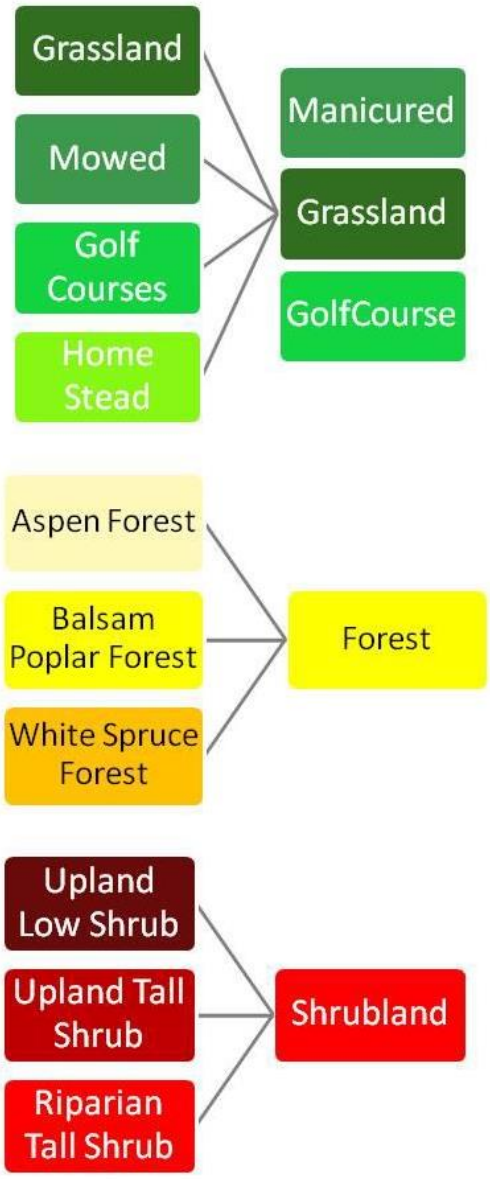

Figure 2. Habitat condition in City parks is assessed for each HCR Terrestrial Habitat Category present. The HCR Terrestrial Habitat Categories on the right are composed of HCR Habitat Classes on the left, some of which are defined in existing City of Calgary spatial datasets such as PARIS.

Plant list habitat types

As outlined previously, there are some gaps in both the HCR and PARIS habitat classifications. HCR works with terrestrial habitat types only while PARIS habitat types often do not provide enough information for restoration planning based on a desktop review alone. Due to this, habitat types in *City of Calgary Plant Lists* broadly follow existing classification systems but focus on descriptions that indicate parameters that limit and influence restoration potential and, in turn, plant selection. These habitat type descriptions are broader in comparison to *City of Calgary Seed Mixes*; however, nativity and information outlined in the notes section provide the details that are needed for plant selection. Similarly, habitat descriptions also provide information based state of the habitat, its limitations and desired intent of restoration.

Plant list selection rationale

The intent of the landscape and desired outcome are explained in the Appendix. They highlight the appropriate usage of species and life-form to minimize costs and maximize success. Plant life-form is a commonly used system, both by scientists and the general public, to classify species based on the way they grow versus phylogenetic relationships that account for lineage and evolution. Life-form includes classifications that group the physical characteristics of plants such as shrubs, trees, forbs (e.g., herbaceous flowering plants), graminoids (e.g., rushes, sedges and grasses) and dwarf shrubs. These species lists attempt to identify risks when using non-native species as nativity is noted along with notes on the plant species' biology, and recognize limiting factors for plant species growth. Examples of limiting factors for growth in certain habitat types may be saline soils on medians and areas adjacent to roadways, soils that are lacking organics, drought and shade.

Plant life-forms - maximizing success, minimizing costs

Woody material

The majority of woody species are propagated from cuttings and are identical clones of the parent plant. Due to this, the most inexpensive method of procuring shrubs and trees is in the form of potted material. In the case of woody material, its growth from potted material is also the most reliable in comparison to live stakes and seed. Unfortunately, the watering costs to establish potted material are much higher than the plant costs themselves.

Live stakes and Tall Rooted Stock (TRS) are used in bioengineering; however, potted material is, again, more reliable for survivability. Regardless, information pertaining to TRS's performance in bioengineering work is limited as it is a new product. Both live stakes and TRS are commonly used in riparian restoration; however, supplemental watering is normally required. As previously noted, bioengineering is not covered in detail in this document; however, common species used in bioengineering are noted in the plant lists that apply to riparian areas (e.g., influenced by the presence of water).

Species selection when using seed

Many of the benefits and disadvantages when using seed were discussed in Section II and Section III; however, some limitations when using seed should be clarified and summarized in order to better explain the recommended life-forms of various hydrophytic (e.g., plants adapted for saturation and anaerobic conditions) species.

It should be noted that hydrophytic species are considered more in this document and in more depth than in *City of Calgary Seed Mixes* (The City of Calgary Parks 2018). Also, for practicality, hydrophytic species are not grouped with riparian species as this distinction is required in order to be successful in restoration work. For all intents and purposes, plant species can be riparian but riparian species may or may not be hydrophytic species. Hydrophytic species can withstand water inundation and as such, survive in an absence of oxygen available to the root system (e.g., anaerobic conditions). Hydrophytic species tend to exist in areas that are closer to the permanent open water mark and may survive as aquatic species either rooted into the sediment or floating in the water itself. Riparian plant species are adapted to soils that are influenced by the presence of water but not necessarily to completely saturated soils and/or the aquatic environment.

Issues that arise from using seed of hydrophytic species in restoration activities are summarized below. Due to these challenges, they are recommended as potted material. These types of species are available through specialty growers that are experts in the field of the propagation of these types of water-loving plants.

Soil salvage combined with adhering to best practices in soil handling may eliminate the need entirely to purchase hydrophytic plants. Often, these species establish on their own; however, it takes approximately 4-5 years until emergent vegetation is well established, in the absence of human intervention. Since some situations warrant restoration of hydrophytic plants, they are outlined in the Appendix. Regardless, resources are often better used on establishing the more terrestrial vegetation and allowing natural recovery, along with soil salvage, to take care of the establishment of the hydrophytic plants.

Limitations of using seed of hydrophytic plant species in restoration are:

- Collection of those species is difficult due to the wet soils and in some cases, the open water, that they grow in;
- Collection of seed may damage sensitive wetland/riparian soils;
- Seeding equipment within the areas where these plants grow may damage (e.g., compact and admix) soils and the wet conditions may damage the equipment itself;
- Seeding equipment or even hand broadcast seeding is risky in these areas as the equipment may sink and get stuck or the person hand broadcast seeding may have issues getting out of the saturated soils;
- Very little seed actually will stay where it is put due to the influence of water, especially when precipitation and runoff causes the water level to become higher.

Due to this, much of the seed tends to not influence the project area and become wasted;

- Losing seed due to water erosion is common and as such, a better use of resources is to plant potted specimens;
- Seed is difficult to procure due to the issues with growing plants in consistently wet soils and the issues with wild seed collection;
- Legislation makes the permitting process of collection and growing difficult (e.g., *Water Act*, *Public Lands Act*, etc.);
- Proper seed storage is difficult as the seed either needs to be stored in water or in ice during the winter;
- Soil reuse and proper soil handling procedures can ensure that seed bank of the wetland soils is conserved so that restoration of these areas is not necessary; and,
- The aquatic vegetation tends to come in on its own with time. Without human influence, it takes longer (e.g., approximately 4-5 years for emergent zone establishment) but it still recovers naturally.

Fortunately, as mentioned in the above list, hydrophytic species generally establish independently from active revegetation activities. Establishment is aided further when proper soil handling procedures are followed and wetland soils are reused or imported from similar healthy wetlands (The City of Calgary Parks 2019). Additionally, connected sites that contain hydrophytic vegetation will also substantially aid in hydrophytic species establishment due to seed spread and if in close enough proximity, vegetative reproduction.

Vegetation that is not consistently in the high water mark needs to be actively restored in an urban environment in order to mitigate for weed establishment and maintain the site's structural integrity (e.g., prevent erosion) as weedy undesirable species do not bind soil and prevent flood damage. These emergent and peripheral low prairie species tend to be only submerged after high precipitation events or at a certain time during the growing season such as after spring rains when runoff is also at a maximum due to spring thaw.

In special exceptional circumstances, hydrophytic vegetation may need to be actively restored. These situations would occur when the desired outcome is to replicate a natural wetland as closely as possible that lacks connectivity to a similar habitat and/or does not have an aquatic vegetation seed bank (e.g., no soil reuse). These situations are challenging and may result from constructing isolated wetlands and/or the desire to restore populations of a certain hydrophytic plant species. Another situation may occur when the desire is to maintain the health of a large wetland complex. There may be small areas of pristine wetland habitats within a larger complex that has been degraded by disturbance. If the desire is to maintain the integrity and health of the pristine wetland areas, then restoration of the surrounding areas in poorer health would be warranted.

Plant Lists

Plant lists for various habitat types and restoration intents are provided in the Appendix. These recommendations are informed by restoration work experience within the Calgary area. Suggestions are also based on limiting factors and environmental challenges as restoration to a full reference vegetation community in an urban area is generally not possible. Recommended plant life-forms of are provided for maximizing success and minimizing costs. It should be noted that naturalization is the most common type of restoration that occurs in an urban environment as the likelihood of achieving a reference vegetation community with a fully functioning ecosystem is low in areas containing anthropogenic disturbance and ongoing usage pressure.

Connectivity and adjacent land uses provide opportunities for restoration work and things to consider during the planning process. These factors influence long term maintenance in restored landscapes and dictate what type of restoration work is feasible. Connectivity, adjacent land use and the ecological health of adjacent lands indicate the most appropriate and risk adverse restoration type. For example, aggressive non-native plant species may be suitable as roadside plantings but would not be appropriate for areas connected to healthy Natural Environment Parks. Although the appendix provides information in order to make the best informed decisions, site specific limitations and opportunities must be considered as these lists are generalizations and not all inclusive.

Section V: References

Adams, B. W., G. Ehlert, C. Stone, M. Alexander, D. Lawrence, M. Willoughby, D. Moisey, C. Hincz, A. Burkinshaw, J. Richman, K. France, C. DeMaere, T. Kupsch, T. France, T. Broadbent, L. Blonski, A. J. Miller. 2016. Rangeland Health Assessment for Grassland, Forest and Tame Pasture. AEP, Rangeland Resource Stewardship Section.

Alberta Conservation Information Management System. 2017. Online data accessed (February 6, 2019). Alberta Environment and Parks, Edmonton, Alberta.

Alberta Government. 2010. Environmental Code of Practice for Pesticides. Alberta Queens Printer. Edmonton, Alberta.

Alberta Sustainable Resource Development. 2005. Alberta Environment, Alberta Community Development and Agriculture and Agri-Food Canada. Edmonton, Alberta.

Ambrose, N., G. Ehlert, K. Spicer-Rawe. 2009. Riparian Health Assessment for Lakes, Sloughs, and Wetlands - Field Workbook Second Edition. Modified from Fitch, L., B. W. Adams, and G. Hale, 2001. Riparian Health Assessment for Streams and Small Rivers - Field Workbook. Lethbridge, Alberta. Cows and Fish program. 96 pgs.

Backyard Gardener. 2019. Shade Gardening Plants – Zone 3. Tacoma, Washington. https://www.backyardgardener.com/garden-themes/shade-garden/shade-gardening-plants-zone-3/

Badgett, B. 2015. Brunnera Plants: How to Plant Brunnera Siberian Bugloss. https://www.gardeningknowhow.com/ornamental/flowers/brunnera/growing-brunnera-plants.htm

Barker, B. 2014. Reducing establishment costs of AC Saltlander: Lower seeding rates and using seeding mixtures show potential. Top Crop Manager. Simcoe, Ontario. https://www.topcropmanager.com/seeding-planting/reducing-establishment-costs-of-ac-saltlander-15907

Beaulieu, D. 2019. 34 Salt-Tolerant Plants for Landscaping. New York, New York. https://www.thespruce.com/salt-tolerant-plants-for-beach-landscaping-2132423

Calgary Horticultural Society. 2018. Design Considerations, Soil. Calgary Alberta. https://www.calhort.org/community-gardens/start-a-garden/design-your-garden/design-considerations/soil.aspx

Calgary Parks. Current edition. Development Guidelines and Standard Specifications: Landscape Construction. Calgary, Alberta.

Elias, S. Garay, A. Young, B & Tom Chastain. 2017. A brief review of management principles with emphasis on grass seeds stored in Oregon. The Oregon State University Seed Laboratory, Oregon, U.S.A.

Fitch, L., B.W. Adams and G. Hale, 2009. Riparian Health Assessment for Streams and Small Rivers - Field Workbook. Second Edition. Lethbridge, Alberta: Cows and Fish Program. 94 pages.

Fowler Nurseries. 2010. Planting Guide. Newcastle, California. http://www.fowlernurseries.com/Tour.htm

Government of Canada. 2015. Sea Buckthorn. Agriculture and Agri-Food Canada. Ottawa, Ontario. http://www.agr.gc.ca/eng/science-and-innovation/agricultural-practices/agroforestry/shelterbelt-planning-and-establishment/selecting-trees-and-shrubs-species/sea-buckthorn/?id=1345846726859

Kershaw, L., MacKinnon, A. & J. Pojar. Plants of the Rocky Mountains. Lone Pine Publishing. Edmonton, Alberta.

Lahring, H. 2003. Water and Wetland Plants of the Prairie Provinces. Canadian Plains Research Centre, University of Regina. Regina, Saskatchewan.

J. R. Simplot Company. 2019. 'Fults' *Puccinellia distans* (Alkaligrass). Boise, Idaho. http://techsheets.simplot.com/Partners/Fults_Alkaligrass.pdf

Landoll. 2019. Agricultural Seeder. Marysville, Kansas. http://landoll.com/content/index.php/products/farm_equipment/brillion-farm-equipment/agricultural-seeders/

Marinelli, J. 2016. Native, or Not so Much? Native plants transformed into flashy "nativars" may look pretty, but are they good for wildlife? The National Wildlife Federation. Merrifield, VA. https://www.nwf.org/Magazines/National-Wildlife/2016/JuneJuly/Gardening/Cultivars

Mckay Nursery Company. 2016. Magic Carpet Spirea. Waterloo, Wisconsin. https://www.mckaynursery.com/contact-us.html

Miller Seeds. 2017. AC Saltlander. http://millerseeds.com/acsaltlander.php

Missouri Botanical Garden. 2019. *Humulus lupulus*. St. Louis, Missouri. http://www.missouribotanicalgarden.org/PlantFinder/PlantFinderDetails.aspx?kempercode=f191

Missouri Botanical Garden. 2019. *Prunus glandulosa* 'Sinensis.' St. Louis, Missouri. http://www.missouribotanicalgarden.org/PlantFinder/PlantFinderDetails.aspx?kempercode=d136

Missouri Botanical Garden. 2019. *Sempervivum tectorum*. St. Louis, Missouri. http://www.missouribotanicalgarden.org/PlantFinder/PlantFinderDetails.aspx?kempercode=b711

Moss, E. H. 1983. Flora of Alberta. 2nd edition, revised by J. G. Packer, University of Toronto Press, Toronto.

National Sunflower Association. 2011. Soil Salinity: An Expanding Issue. Mandan, North Dakota. https://www.sunflowernsa.com/magazine/articles/default.aspx?ArticleID=3398

Naeem, S. 2006. Chapter 10: Biodiversity and ecosystem functioning in restored ecosystems: extracting principles for a synthetic perspective. Pp. 210-237. In: Falk, D.A., Palmer, M.A. and J.B. Zedler (Eds.). 2006. *Foundations for Restoration Ecology*. Society for Ecological Restoration International. Island Press, Washington, D.C. 364 pp. [Online]: http://www1.inecol.edu.mx/repara/download/III_1_FoundationsofRestorationEcologyThe%20ScienceandPracticeof%20EcologicalRestoration.pdf Accessed: Dec 3, 2013.

NAPPC and Pollinator Partnership Canada Publication. Selecting Plants for Pollinators. A Guide for Gardeners, Farmers, and Land Managers in the Mixed Grassland Ecoregion. file://coc/parks/Shared/URBAN_CONSERVATION/ConservationPolicy/ArticlesPoliciesGuidelines/Plant%20Lists/MixedGrasslnd_planting%20for%20pollinators.pdf

Oldman Watershed Council. N/A. 50 Best Plants for Prairie Urban Gardens in Southern Alberta. Lethbridge, Alberta.

Pavlick L.E. and J. Looman. 1984. Taxonomy and nomenclature of rough fescues, *Festuca altaica, F. campestris (F. scabrella* var. *major)* and *F. hallii*, in Canada and the adjacent part of United States. Can. J. Bot. 62: 1739-1749.

Peace Forage Seeding Tool. 2019. Hairy Vetch. Peace River Forage Association. http://www.peaceforagetool.ca/species/hairy-vetch

Perry, L. 2019. Salt Tolerant Perennials. Department of Plant and Soil Science, University of Vermont. Berlington, Vermont. https://pss.uvm.edu/ppp/articles/saltherb.html

Reeves, Sonja L. 2006. Mertensia paniculata. In: Fire Effects Information System, [Online]. U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory (Producer). Available: https://www.fs.fed.us/database/feis/plants/forb/merpan/all.html [2019, April 1]

Province of Alberta. 2010. Weed Control Act. Alberta Queen's Printer. Edmonton, Alberta.

Rao, N.K. & M. Shahid. 2011. Response of *Gaillardia aristata* Pursh to salinity. Journal of Applied Horticulture, 13(1): 65-67.

Richer, C. & Marie-Helene Croisetiere. Shrubby cinquefoil. Agriculture and Agri-Food Canada. Horticulture Research and Development Centre. Quebec, Canada. http://publications.gc.ca/collections/collection_2015/aac-aafc/A52-72-2006-eng.pdf

Royer, F. & R. Dickinson. 2007. Plants of Alberta. Lone Pine Publishing. Edmonton, Alberta.

Sherwood's Forest. 2018. Seedlings – Bare Root and Plug Seedlings. Edmonton, AB. http://sherwoods-forests.com/Inventory/Seedlings.html

Soil Foodweb Canada Ltd – Soil Laboratory & Research Centre https://www.soilfoodweb.ca/ (accessed September 14, 2017)

Stewart, R.E. and H.A. Kantrud. 1971. Classification of Natural Ponds and Lakes in the Glaciated Prairie Region. Bureau of Sport Fisheries and Wildlife, U.S. Fish and Wildlife Service, Washington, D.C., USA. Resource Publication 92. 57 pp.

Tannas, K.E. 2001. Common Plants of the Western Rangelands – Volume 1: Grasses and Grass-Like Species. Olds College. Alberta Agriculture, Food and Rural Development. Edmonton Alberta. ISBN 0-7732-6154-0.

Tannas, S. C. 2010. Mechanisms Regulating *Poa pratensis* and *Festuca campestris* within the foothills fescue grasslands of Southern Alberta. Department of Agriculture, Food and Nutritional Science, University of Alberta. Edmonton, Alberta.

The City of Calgary. 2003. Utilities and Environmental Protection. Calgary, Alberta.

The City of Calgary. 2016. Low Impact Development Guidelines: Module 2 – Bioretention and Bioswales Final Report. Calgary, Alberta.

The City of Calgary. 2016. Low Impact Development Guidelines, Module 2 – Bioretention and Bioswales. Calgary, Alberta.

The City of Calgary. 2017. The Riparian Action Program: A Blueprint for Resilience. Calgary, Alberta.

The City of Calgary Parks. 2014. Habitat Restoration Project Framework. Calgary, Alberta.

The City of Calgary Parks. 2014. Our BiodiverCity: Calgary's 10 – year biodiversity strategic plan. Calgary, Alberta.

The City of Calgary Parks. 2019. Soil Handling Recommendations – best practices to improve restoration work. Calgary, Alberta.

The City of Calgary Parks & Urban Development Institute - Calgary. 2010. Biophysical Impact Assessment Framework. Calgary, Alberta.

The Royal Horticultural Society. 2018. Bedding Plants and Displays. London, England.

The Old Farmer's Almanac. 2019. Growing Peonies. How to Plant, Grow, and Care for Peony Flowers. https://www.almanac.com/plant/peonies

Tilley, D., and L. St. John. 2012. Plant Guide for yellow rabbitbrush (Chrysothamnus viscidiflorus). USDANatural Resources Conservation Service, Aberdeen Plant Materials Center. Aberdeen, Idaho 83210.

Thorpe, J. 2014. Saskatchewan Rangeland Ecosystems, Publication 14: Communities on Saline Ecosites. Saskatchewan Research Council Pub. No. 11881-14E14.

United States Department of Agriculture-Natural Resources Conservation Service Plant Materials <http://plant-materials.nrcs.usda.gov/> Plant Fact Sheet/Guide Coordination Page <http://plant-materials.nrcs.usda.gov/intranet/pfs.html> National Plant Data Center http://npdc.usda.gov

University of Alberta. 2019. Galium boreale. Faculty of Agricultural, Life and Environmental Sciences. Edmonton, Alberta. https://acrre.ualberta.ca/acrre/wp-content/uploads/sites/45/2018/04//Galium_boreale.pdf

Vance, F. R., McLean, J. S. & James R. Jowsey. Wildflowers Across the Prairies. Western Producer Prairie Books. Saskatoon, Saskatchewan.

Virginia Cooperative Extension. 2015. Trees and Shrubs that Tolerate Saline Soils and Salt Spray Drift. College of Agriculture and Life Sciences, Virginia Polytechnic Institute and State University. Blacksburg, Virginia. https://www.pubs.ext.vt.edu/content/dam/pubs_ext_vt_edu/430/430-031/430-031_pdf.pdf

Weed Control Act. 2010. Government of Alberta. Alberta Queen's Printer. Edmonton, Alberta.

Wilkinson, K. 1999. Wildflowers of Alberta. The University of Alberta Press. Edmonton, Alberta.

Section VII Appendix – plant lists based on habitat type and landscape intent

Introduction

The current botanical and common names correspond to the names indicated by the Alberta Conservation and Information Management System (ACIMS) (ACIMS 2016). Other prevalently used botanical and common name variations are listed in brackets.

Although species of varying heights, widths and growth rates are recommended, plant selection must account for height restrictions and setback distances based on City policies (e.g., line-of-sight). Nothing in this document is meant to relieve the user from complying with municipal, provincial and federal legislation. This document provides information on plant species that can be used successfully during the undertaking of restoration work within the urban environment of the Calgary area. It does not replace a site-specific approach to restoration, which is critical to achieving success. The use of *City of Calgary Plant Lists* does not guarantee results due to the complex nature of restoration and the difficulty associated with managing biological systems. Using this document does not equal approvals from City of Calgary staff or stakeholder engagement with key personnel.

Although the plant lists contain species selected to be appropriate for each habitat type and restoration intent, they are by no means all inclusive. Also, there is no clear divide between habitat types and as such, transition zones exist, which may naturally include species from more than one habitat type. In all cases, in order to plan a restoration, a site visit needs to be performed to address site-specific concerns.

Notes on each plant species are provided to assist the user in plant selection. This information differs for each habitat type and application although recommended plant species overlap throughout various habitat types.

When appropriate, common cultivars (e.g., non-native species produced through selective breeding that is available through the horticultural industry) or nativars (e.g., a native plant cultivated for a particular characteristic that differs from the wild type and is available through the horticultural industry) are listed due to a desired characteristic. Nativars are often used in restoration to enhance the aesthetic appeal of the landscape versus providing resources to wildlife.

Nativars are cultivars of native plants and may be developed from a natural variant or from extensive breeding within the nursery trade (Marinelli 2016). Sometimes nativars are cultivated due to certain characteristics that allow more consistent propagation, an ongoing challenge with native plants. Regardless, plants that are closest to the wild type tend to be most beneficial to dependent wildlife, although research has been limited. To include all appropriate cultivars and nativars within this document would be difficult and as such, the focus is on plants at the

species level. Regardless, due to the fact that the urban environment places high value on aesthetic appeal, some nativars and cultivars are mentioned. Besides the appearance of various nativars, availability will also influence whether or not the nativar is mentioned.

Availability for procurement of plant species within the lists below has been considered during species selection and additional information is provided in the notes. The majority of the listed plants have been shown to be effective in restoration projects within the Calgary area and/or have characteristics and tolerances that indicate they are likely to perform in the cited landscape applications. Unfortunately, restoration research is a new field and research is limited so the plant lists may change over time and will be updated in subsequent versions of this document.

It should be noted that some plants, especially native forbs, may not be available in as large of quantities as desired, both in seed and in potted form. Due to this, increasing forb biodiversity will mitigate supply issues and benefit the landscape overall. Additionally, many native plant growers are able to fulfil large orders if they are consulted the growing season prior to when the plants are needed.

Also, the life-form of the various plant species along with the recommended planting form are indicated in the plant list tables. This can aid in ensuring the restoration accounts for all vegetation strata layers and aid in putting the restoration on the proper trajectory so that adjacent plants do not outcompete each other and grow at compatible rates to ensure coexistence.

All members of the legume family (e.g., Fabaceae/Leguminosae) fix nitrogen in root nodules containing a special kind of bacteria. This can aid in restoration work as including a legume in the plant palette can assist in soil conditioning. This should be considered although it is not noted for every legume species.

Plant species that are appropriate for restoration activities are focused on within these lists meaning that provincially rare species are generally not included, although there are some exceptions when a species has been propagated successfully and used in restoration in the Calgary area. Information about these exceptions is provided. Since urban restoration is the focus, provincially rare species are often not good candidates in restoration as they have very specific requirements, many of which are unknown. Also, propagating rare species can be difficult due to the risk that the collection of seeds may adversely affect existing populations. If provincially Tracked or Watched species are listed and are desired for procurement, it is critical to ensure that a reputable grower is contacted so that restoration activities do not further reduce populations of these species. This urban restoration approach differs from circumstances where restoring rare plant populations and/or rare vegetation communities is desired.

Mesic native grassland

This list of species is intended to be used in restoration projects with the goal of restoring a native grassland that has medium moisture (e.g., mesic) and where the majority of the habitat receives full sun. Thicker topsoil profiles are present in this habitat type versus more xeric (e.g., very dry) grasslands which tend to have shallower topsoil. Grasses and forbs are the dominant life-forms within grasslands, although areas of patchy or discontinuous shrubs are usually present.

This list includes species that are present and should be present in mountain (foothills) rough fescue (*Festuca campestris*) grasslands; however, it should be noted that there is little evidence of successful restoration back to a mountain rough fescue grassland. Also, since little is known about the mechanisms of mountain rough fescue germination and persistence, this type of restoration requires a more specific approach and many of the other species on this list would outcompete the fescue if used together.

Mostly, in an urban environment such as Calgary, naturalization is the form of restoration that is more feasible and realistic. Efforts to restore highly disturbed areas or areas surrounded by disturbance to mountain rough fescue grassland often wastes resources, effort and wild-collected mountain rough fescue seed. In areas that contain remnant mountain rough fescue, are large in size and have healthy soils, attempts to restore areas to the reference vegetation community can be warranted as there is a chance of success. Otherwise, attempts to restore/improve mesic grasslands or restore areas back to mesic grasslands should focus on increasing the nativity of the vegetation and rebuilding vegetation strata layers.

Additionally, mesic grassland in the Calgary area occurs city-wide but species in the most western and eastern portions of the city differ. If a species is more suited to a particular area of the city, it is mentioned in the Notes column.

Although mesic grassland occurs city-wide, xeric grassland is much more common in the eastern portion of Calgary; however, xeric prairie still can be found along escarpments in the west portion of the city. Although xeric and mesic prairie are separated in the species lists, there may be overlap of appropriate species in transitional areas.

All species in this list are native. This is due to the intent of restoring an area of mesic grassland or restoring an area that has transitioned into another habitat type that should be mesic grassland back to mesic grassland.

Life form	Botanical name (common synonym)	Common name (frequently used synonym)	Preferred planting form	Notes
forb	*Achillea millefolium*	common yarrow	plug, seed	Can withstand highly disturbed areas; drought tolerant; spreads readily vegetatively
forb	*Agastache foeniculum*	giant hyssop	plug	Can withstand light partial shade; prefers mesic richer soils
forb	*Agoseris glauca*	yellow false dandelion	plug	Attractive; do not mistake for introduced common dandelion
forb	*Allium cernuum*	nodding onion	plug	Found in foothills, montane and parkland habitat types; appropriate for west side of Calgary
forb	*Allium schoenoprasum*	wild chives	plug	Can spread unwantedly; prefers moister areas
forb	*Allium textile*	prairie onion	plug	Found in drier prairie; more appropriate for east side of Calgary
forb	*Anemone canadensis*	Canada anemone	plug, seed	Common in moister grasslands; tolerates partial shade; HCR forest health indicator species
forb	*Anemone cylindrica*	long-fruited anemone	plug, seed	Similar to cut-leaved anemone preferences; HCR forest health indicator species
forb	*Anemone multifida*	cut-leaved anemone	plug, seed	More drought tolerant than Canada anemone; prefers more sun than Canada anemone
forb	*Anemone patens*	prairie crocus	plug	Ensure taller vegetation will not outcompete and smother prairie crocus; excellent early season pollinator forage; do not confuse with commercially available crocus bulbs
forb	*Antennaria pulcherrima*	showy everlasting	plug	Can compete with taller species in mesic grassland; suitable for western side of city as prefers more foothills and montane areas
forb	*Arnica chamissonis*	leafy arnica	plug	Somewhat salt tolerant; can withstand drought, partial shade and full sun
forb	*Arnica fulgens*	shining arnica	plug	Prefers full sun
forb	*Artemisia ludoviciana*	prairie sagewort (sage)	plug	Seed difficult to harvest; readily spreads vegetatively
forb	*Asclepias speciosa*	showy milkweed	plug	Only plant that monarch caterpillars feed on; drought tolerant; can form large patches

Life form	Botanical name (common synonym)	Common name (frequently used synonym)	Preferred planting form	Notes
forb	*Astragalus agrestis*	purple milkvetch	plug, seed	Can withstand mowing; seems to persist in seed bank; appears to spread by seed in disturbed areas; ensure it is not outcompeted by adjacent taller vegetation as short in stature
forb	*Astragalus bisulcatus*	two-grooved milkvetch	plug	All milkvetches benefit pollinators; drought tolerant; quite showy
forb	*Astragalus canadensis*	Canada milkvetch	seed	Germinates easily from seed; nitrogen fixing as legume; prefers soils characteristic of mesic grasslands, open forests and riparian areas; inexpensive
forb	*Astragalus crassicarpus*	ground-plum	plug	As with other milkvetches, it is good pollinator forage
forb	*Campanula rotundifolia*	harebell	plug	Only plant that one native bee feeds on in Alberta; spreads readily; blooms throughout the growing season
forb	*Chamerion angustifolium*	common fireweed	plug, seed	Seed can be difficult to procure due to its small size and cottony pappus; prefers richer soil; more common in western part of Calgary
forb	*Dalea purpurea*	purple prairie clover	plug, seed	Drought resistant; nitrogen fixing as it is a legume; requires about 4 years to establish and grow from seed
forb	*Drymocallis arguta*	white cinquefoil	seed, plug	Comes up well from seed
forb	*Erigeron philadelphicus*	Philadelphia fleabane	seed, plug	Germinates well from seed
forb	*Fragaria virginiana*	wild strawberry	plug	Excellent ground cover; spreads by stolons
forb	*Gaillardia aristata*	gaillardia (blanket-flower)	plug, 1 gal	Ensure using native plant vs. nativar in native restoration situations; HCR grassland health indicator species
forb	*Galium boreale*	northern bedstraw	plug	Withstands shade and full sun; drought tolerant; one of last native plants to die out with disturbance
forb	*Geranium viscosissimum*	sticky purple geranium	plug	Readily spreads once planted

Life form	Botanical name (common synonym)	Common name (frequently used synonym)	Preferred planting form	Notes
forb	*Geum triflorum*	three-flowered avens	plug	Ensure it does not get shaded out during restoration planning; indicator of healthy grassland in the Calgary area through the HCR model
forb	*Glycyrrhiza lepidota*	wild licorice	plug	Prefers well drained areas with periodic moisture such as edges of escarpments
forb	*Hedysarum alpinum*	alpine hedysarum	plug, seed	Not as drought tolerant as northern hedysarum; range is more western in Calgary; growth pattern less bunched and more elongate; lighter flower colour than northern hedysarum
forb	*Hedysarum boreale*	northern hedysarum	plug, seed	More drought tolerant than alpine hedysarum; takes ~4 years to grow and flower from collected seed due to hard seed coat; dark pink flowers; population extends more east in Calgary than alpine hedysarum
forb	*Helianthus annuus*	common annual sunflower	seed	Annual so needs to be able to self-seed; can be used as somewhat of an early succession cover crop; ensure genetic origin is known as most annual sunflowers are cultivars that have been bred extensively for the horticultural industry; can grow in very poor soils or substrates with little to no topsoil (e.g., road crush); very drought tolerant
forb	*Helianthus nuttallii*	common tall sunflower	plug, seed	Very good late summer pollinator forage, like most plants in the aster family; requires a little more moisture than common annual sunflower
forb	*Helianthus pauciflorus ssp. subrhomboideus*	rhombic-leaved sunflower	plug	Drought and disturbance tolerant; very good late season pollinator forage
forb	*Helianthus petiolaris*	prairie sunflower	seed	Similar to common annual sunflower
forb	*Heuchera richardsonii*	Richardson's alumroot	plug	Specialized flowers cater to certain species of native pollinators such as hummingbirds and butterflies
forb	*Linum lewisii*	blue flax	seed	Very hardy; provides excellent early coverage; aesthetically pleasing;

Life form	Botanical name (common synonym)	Common name (frequently used synonym)	Preferred planting form	Notes
				good forage for native pollinators; germinates quickly; inexpensive
forb	*Lithospermum ruderale*	woolly gromwell	plug	Common native wildflower in Calgary grasslands; HCR grassland indicator species
forb	*Lupinus argenteus*	silvery perennial lupine	plug, 1 gal	Indicator of good health in grasslands in Calgary through the HCR model; provides food for pollinators
forb	*Lupinus sericeus*	silky perennial lupine	plug, 1 gal	Indicator of good health in grasslands in Calgary; provides forage for pollinators
forb	*Maianthemum stellatum* (*Smilacina stellata*)	star-flowered Solomon's-seal (star-flowered false Solomon's-seal)	plug	Very common forb; found in many different habitat types
forb	*Monarda fistulosa*	wild bergamot	seed, plug	Comes up well from seed; plants spread readily; long blooming time
forb	*Oenothera biennis*	yellow evening-primrose	seed, plug	Prefers open areas that regularly experience disturbance such as trail edges; establishes from seed but requires a few years to establish
forb	*Oxytropis monticola*	late yellow locoweed	plug	Seems to be more prominent in western parts of Calgary
forb	*Oxytropis sericea*	early yellow locoweed	plug	Drought tolerant; will handle being mowed; frequently comes up in areas that are mowed only periodically later in the season; seeds in seed bank persist
forb	*Oxytropis splendens*	showy locoweed	plug	Very drought tolerant; prefers more xeric microclimates with short vegetation but colonizes more open microclimates in mesic grassland (e.g., informal trail edges); common along dry areas with little soil organics (e.g., sandy, gravelly and silty shores); HCR grassland health indicator species
forb	*Potentilla gracilis*	graceful cinquefoil	plug	Commonly colonizes trail edges and open areas
forb	*Psoralea esculenta*	Indian breadroot	plug	In Calgary, this species is an indicator of healthy grassland;

Life form	Botanical name (common synonym)	Common name (frequently used synonym)	Preferred planting form	Notes
				usually not available but included as it is an indicator species in the HCR model and appropriate for this habitat type
forb	*Solidago canadensis*	Canada goldenrod	seed, plug	New taxonomy findings are breaking this species into 2 separate species; very hardy; excellent late season forage for pollinators; plugs more expensive than seed; spreads readily once established
forb	*Solidago missouriensis*	low (Missouri) goldenrod	seed, plug	Ensure restoration plans take into account smaller stature of this goldenrod; very drought tolerant; readily spreads once established
forb	*Symphyotrichum ericoides*	tufted white prairie aster	seed, plug	Withstands mowing and other disturbances; very hardy
forb	*Symphyotrichum laeve*	smooth aster	plug, seed	Very hardy and drought tolerant
forb	*Thermopsis rhombifolia*	golden bean	plug	Early season pollinator forage; can function somewhat as a ground cover
forb	*Vicia americana*	American vetch	seed, plug	Common in grasslands and open woods; nitrogen fixing; seed is moderately expensive but readily available and not as expensive as other hand-collected species
forb	*Zigadenus elegans*	white (mountain) camas	plug	Somewhat poisonous to livestock
forb	*Zizia aptera*	heart-leaved Alexanders	plug	In Calgary, this species is an indicator of healthy grassland in the HCR model
grass	*Agrostis scabra*	rough hair grass (hair bentgrass)	seed	Drought tolerant; common on wetland edges; drought tolerant; not common in abundance in areas other than wetland edges, provides good native early to mid-successional coverage in restoration
grass	*Bromus ciliatus*	fringed brome	seed	More of a parkland/montane species but good for restoration due to aggressive nature
grass	*Bromus marginatus*	mountain brome	seed	Although it is a more of a southwest montane species, it works well in urban restoration as it is

Life form	Botanical name (common synonym)	Common name (frequently used synonym)	Preferred planting form	Notes
				competitive; prefers full sun to very light partial shade
grass	*Calamovilfa longifolia*	sand grass	seed	Excellent for sites with silty/sandy soils; very drought tolerant
grass	*Danthonia parryi*	Parry oat grass	plug	Seed requires tedious hand cleaning to trigger germination; easily out-competed; plugs provide a competitive advantage
grass	*Deschampsia cespitosa*	tufted hair grass	seed	Drought tolerant; highly tufted; can create drought tolerant "turf" if seeded at a very high rate so tufting is obscured; can withstand mowing after establishment
grass	*Elymus canadensis*	Canada wild rye	seed	Aggressive but works well in seed mixes; will form monoculture if seeded first as a cover crop
grass	*Elymus glaucus*	smooth wild rye	seed	Drought and salt tolerant; ensure native species as required vs. nativar
grass	*Elymus lanceolatus*	northern wheatgrass	seed	Will colonize drier microclimates in mesic prairie grassland
grass	*Elymus trachycaulus spp. subsecundum*	awned wheatgrass	seed	Similar characteristics to slender wheatgrass but not as aggressive; may be due to genetics or awns
grass	*Elymus trachycaulus ssp. trachycaulus*	slender wheatgrass	seed	Use plant material propagated or collected from plants in the wild and as close to the wild type as possible; many cultivars of slender wheatgrass exist; commercially available slender wheatgrass tends to be more aggressive than the wild type
grass	*Festuca campestris*	mountain (foothills) rough fescue	plug	Easily outcompeted; seed is usually wild collected as it is hard to propagate consistently; use with caution in areas that have the potential to be restored to rough fescue grassland (e.g., remnant fescue patches present, supported rough fescue grassland in the past, surrounded by rough fescue grassland, etc.); rare in urban and disturbed environments; plugs can

Life form	Botanical name (common synonym)	Common name (frequently used synonym)	Preferred planting form	Notes
				be used to provide a competitive advantage
grass	*Festuca hallii*	plains rough fescue	plug, seed	Germination of seed may be more promising than mountain rough fescue; does not create large stands in the Calgary area but does occur in the city
grass	*Festuca idahoensis*	bluebunch (Idaho) fescue	seed	Ensure cultivars are not used in restoration work; wild species has bluish-coloured leaves; looks similar to the non-native *Festuca ovina* 'Elijah blue'
grass	*Festuca saximontana*	Rocky Mountain fescue	seed	Provides early successional cover when used in a seed mix; retains green colour until late in season, sometimes even under snow; ungulates preferentially graze on this species and other native fescues during winter
grass	*Koeleria macrantha*	June grass	seed	Ensure that short stature of plant is considered during restoration work so that it is not shaded out by other taller species
grass	*Nasella viridula*	green needle grass	seed	Very drought tolerant; colonizes open areas next to disturbances; tolerant of disturbance; awns can cause seeds to stick to clothing
grass	*Pascopyrum smithii*	western wheatgrass	seed	Prefers more moisture than northern wheatgrass; common in mesic grasslands
grass	*Poa palustris*	fowl bluegrass	seed	Common on wetland edges; prefers moisture but is very drought tolerant; provides good coverage and weed suppression in restoration applications
grass	*Schizachyrium scoparium*	little bluestem	plug, seed	This species is provincially tracked on the Watch List. disjunct populations occur along the Elbow River valley on well drained slopes and grasslands
shrub	*Amelanchier alnifolia*	Saskatoon	1 gal	Excellent for wildlife (e.g., birds, pollinators and grazing animals); sporadic in grasslands

Life form	Botanical name (common synonym)	Common name (frequently used synonym)	Preferred planting form	Notes
shrub	*Dasiphora fruticosa*	shrubby cinquefoil	1 gal	Common shrub in mesic grassland
shrub	*Elaeagnus commutata*	wolfwillow	1 gal	Do not plant near hard infrastructure as suckers will break pathways and sidewalks
shrub	*Ribes aureum*	golden currant	plug, 1 gal	Important source of early season forage for native bees and other pollinators; fruit attracts wildlife; fruit is edible; prefers moist soil but generally can withstand some drought; full sun to light shade tolerant; flowers have strong fragrance; thorns absent
shrub	*Ribes oxyacanthoides*	northern gooseberry	plug, 1 gal	Important source of early season forage for native bees and other pollinators; fruit attracts wildlife; fruit is edible; prefers moist soil but generally can withstand some drought; full sun to part shade tolerant
shrub	*Rosa acicularis*	prickly rose	1 gal	This species is more suitable for the foothills and parkland areas of Calgary
shrub	*Rosa woodsii*	common wild rose	1 gal	This species is more suitable for the prairie areas of Calgary
shrub	*Shepherdia argentea*	thorny buffaloberry	1 gal	Infrequent in grassland but small populations may occur; salt and drought tolerant; in mesic grassland often found along roadsides as remnant shelter belts
shrub	*Symphoricarpos occidentalis*	buckbrush	1 gal	Tend to not use in restoration work unless nothing else will grow; increases and becomes weedy while out-competing other more desirable forage species; do not confuse with *S. albus*
shrub (dwarf)	*Arctostaphylos uva-ursi*	common bearberry	1 gal, plug	Prefers open dry areas with sandy soils; drought and salt tolerant; effective as a ground cover; grows in grasslands adjacent to forests; HCR grassland health indicator species

Xeric native grassland

The plant species listed below are for restoration work in xeric (e.g., very dry) grassland where the goal of the restoration is to maintain and/or increase the nativity and ecological health of the grassland.

Xeric grasslands occur more commonly in the eastern parts of the city; however, they are present in the western foothills and parkland areas on south-facing slopes and as the upper portion of dry escarpments. Although species in mesic and xeric grasslands overlap, these dry prairie environments host many unique species that are adapted to drought. Xeric grasslands tend to have shorter vegetation than other grassland types which allows for species shorter in stature to thrive. Additionally, species that provide ground cover play an important role in maintaining the integrity of xeric prairie. In ecologically healthy xeric grasslands, and in all plant communities, lichens and mosses play a large role in sustaining the health of the vegetation community. In xeric grasslands, lichen and moss cover contributes significantly to the ground cover strata layer. In these habitat types, the lichen and moss ground cover is much more visible and obvious than in other vegetation communities.

In urban environments, lichens and mosses are some of the first species to be affected by pollution and disturbance and as such, this strata layer is usually very compromised. The below list contains vascular plants only as restoration using mosses and lichens is not well-documented; therefore, this document only focuses on vascular plant species. Due to the lack of mosses and lichens as ground cover in the urban environment, restoration relies heavily on vascular plants. Ensuring that plant height, temperature when grass species begin to grow (e.g., warm season vs. cool season), successional place in the vegetation community and the importance of vascular ground covers are considered is crucial to restoration success in urban xeric grassland.

Restoration work in xeric grasslands is generally less challenging than in mesic grasslands as most common invasive species prefer slightly more moisture and richer soils than what are present in xeric grasslands. Regardless, due to the urban environment and the fragmentation of natural areas that create remnant patches of habitat, more invasive species pressure is present in these urban xeric grasslands. Due to this, natural recovery, which is often preferred in these types of habitats, is not an option. Lastly, in urban areas, invasive drought tolerant species are more prevalent (e.g., crested wheatgrass [*Agropyron cristatum*]), so restoration work must account for these risks.

Life form	Botanical name (common synonym)	Common name (frequently used synonym)	Preferred planting form	Notes
forb	*Achillea millefolium*	common yarrow	plug, seed	Can withstand highly disturbed areas; drought tolerant; spreads readily vegetatively; often first to establish in harsh environments with poor soils
forb	*Allium textile*	prairie onion	plug	Found in dry open prairie; appropriate for east side of Calgary
forb	*Anemone cylindrica*	long-fruited anemone	plug	Similar to cut-leaved anemone preferences
forb	*Anemone multifida*	cut-leaved anemone	plug	More drought tolerant than Canada anemone; prefers more sun than Canada anemone
forb	*Anemone patens*	prairie crocus	plug	Ensure taller vegetation will not outcompete prairie crocus; excellent early season pollinator forage; do not confuse with commercially available crocus bulbs
forb	*Antennaria parvifolia*	small-leaved everlasting	plug, seed	Colonizes open areas such as upper escarpments, trail edges and blowouts; great groundcover as forms matts; requires full sun; will come up from seed but requires a few years to germinate, mature and flower
forb	*Antennaria rosea*	rosy everlasting	plug, seed	Colonizes open areas such as upper escarpments, trail edges and blowouts; not as matt forming as small-leaved everlasting; requires full sun; more appropriate for the west portion of the city
forb	*Arnica fulgens*	shining arnica	plug	Prefers full sun
forb	*Artemisia frigida*	pasture sagewort (sage)	plug	Tends to increase with grazing in xeric grasslands; use with caution as it is an increaser species
forb	*Artemisia ludoviciana*	prairie sagewort (sage)	plug	Seed difficult to harvest; readily spreads vegetatively
forb	*Asclepias speciosa*	showy milkweed	plug	Only genus that monarch caterpillars feed on; drought tolerant; can form large patches
forb	*Astragalus agrestis*	purple milkvetch	plug, seed	Can withstand mowing; seems to persist in seed bank; appears to spread by seed in disturbed areas

Life form	Botanical name (common synonym)	Common name (frequently used synonym)	Preferred planting form	Notes
forb	*Astragalus bisulcatus*	two-grooved milkvetch	plug	All milkvetches benefit pollinators; drought tolerant; quite showy
forb	*Astragalus crassicarpus*	ground-plum	plug	As with other milkvetches, it is good pollinator forage
forb	*Astragalus pectinatus*	narrow-leaved milkvetch	plug	Very drought tolerant; may have some salinity tolerance; more appropriate for east side of city
forb	*Campanula rotundifolia*	harebell	plug	Only plant that one native bee feeds on in Alberta; spreads readily; blooms throughout the growing season
forb	*Cirsium undulatum*	wavy-leaved thistle	seed, plug	Generally not used in restoration due to the abundance of weedy non-native thistles; provides forage for pollinators and seeds for birds; not invasive; population is likely decreasing due to control efforts targeting other thistles and mistakenly targeting wavy-leaved thistle; requires full sun
forb	*Cymopterus glomeratus*	plains spring parsley	plug	Early season pollinator forage; very short and requires sunny location so cannot be paired with dense tall plantings; can function as a groundcover
forb	*Dalea purpurea*	purple prairie clover	plug, seed	Drought resistant; nitrogen fixing as it is a legume; requires a few years to establish and grow from seed
forb	*Erigeron caespitosus*	tufted fleabane	plug	Common in dry open grassland
forb	*Eriogonum flavum*	yellow umbrella-plant	plug	Prevalent on open dry slopes in prairie grassland
forb	*Gaillardia aristata*	gaillardia (blanket-flower)	plug, 1 gal	Ensure using native plant vs. nativar in native restoration situations; HCR grassland health indicator
forb	*Galium boreale*	northern bedstraw	plug	Withstands shade and full sun; drought tolerant; one of last native plants to die out with disturbance
forb	*Geum triflorum*	three-flowered avens	plug	Ensure it does not get shaded out during restoration planning; indicator of healthy grassland in the Calgary area through the HCR model; leaves somewhat form a ground cover

Life form	Botanical name (common synonym)	Common name (frequently used synonym)	Preferred planting form	Notes
forb	*Grindelia squarrosa*	curly-cup gumweed	plug	Very important resource for native pollinators; salt and drought tolerant; not usually thought of as an attractive plant, the flowers are yellow, daisy-like and showy
forb	*Hedysarum boreale*	northern hedysarum	plug, seed	More drought tolerant than alpine hedysarum; takes ~4 years to grow and flower from collected seed due to hard seed coat; dark pink flowers; population extends more east in Calgary than alpine hedysarum
forb	*Helianthus annuus*	common annual sunflower	seed	Annual so needs to be able to self-seed; can be used as somewhat of an early succession cover crop; ensure genetic origin is known as most annual sunflowers are cultivars that have been bred extensively for the horticultural industry; can grow in very poor soils or substrates with little to no topsoil (e.g., road crush); very drought tolerant
forb	*Helianthus pauciflorus ssp. subrhomboideus*	rhombic-leaved sunflower	plug	Drought and disturbance tolerant; very good late season pollinator forage
forb	*Helianthus petiolaris*	prairie sunflower	seed	Similar to common annual sunflower
forb	*Heterotheca villosa*	golden aster (hairy golden aster)	plug, seed	Usually found in small patches; low in stature and aids as a groundcover; drought tolerant; some salt tolerance; tolerant of poor soils
forb	*Liatris punctata*	dotted blazingstar	plug, seed	Establishes from seed but takes multiple years to flower; can withstand taller adjacent vegetation once established; HCR grassland health indicator species
forb	*Linum lewisii*	blue flax	seed	Very hardy; provides excellent early coverage; aesthetically pleasing; good forage for native pollinators; germinates quickly; inexpensive
forb	*Linum rigidum*	yellow flax	seed, plug	Lower growing than blue flax; much less common in Calgary than blue flax

Life form	Botanical name (common synonym)	Common name (frequently used synonym)	Preferred planting form	Notes
forb	*Lithospermum incisum*	narrow-leaved puccoon	plug	Less common in Calgary than woolly gromwell; prefers drier more open sites
forb	*Maianthemum stellatum* (*Smilacina stellata*)	star-flowered Solomon's-seal (star-flowered false Solomon's-seal)	plug	Very common forb; found in many different habitat types
forb	*Musineon divaricatum*	leafy musineon	plug	Early season pollinator forage; very short and requires sunny location so cannot be paired with dense tall plantings; can function as a groundcover
forb	*Oenothera suffrutescens* (*Gaura coccinea*)	scarlet butterflyweed (scarlet gaura)	plug	Very drought tolerant; readily comes up after spring rains on the edges of unpaved roads; salt and drought tolerant; likely pollinated primarily by moths at night
forb	*Oxytropis sericea*	early yellow locoweed	plug	Drought tolerant; tolerates mowing; persists in seed bank
forb	*Oxytropis splendens*	showy locoweed	plug	Very drought tolerant; prefers more xeric microclimates with short vegetation; common along dry areas with little soil organics (e.g., sandy, gravelly and silty shores); HCR grassland health indicator species
forb	*Packera cana* (*Senecio canus*)	prairie groundsel	plug	Prefers open dry prairie; attractive silver foliage and yellow flowers
forb	*Penstemon nitidus*	smooth blue beardtongue	plug	Found on sparsely vegetated xeric escarpments
forb	*Phlox hoodii*	moss phlox	plug	Great groundcover; needs full sun so cannot be paired with tall dense plantings; provides early season pollinator forage; ensure that it is the native species as many cultivars are available
forb	*Potentilla concinna*	early cinquefoil	plug	One of the first plants to bloom in spring
forb	*Potentilla pensylvanica*	prairie cinquefoil	plug	Native pollinator forage; aesthetically pleasing
forb	*Psoralea esculenta*	Indian breadroot	plug	In Calgary, this species is an indicator of healthy grassland; usually not available but included as

Life form	Botanical name (common synonym)	Common name (frequently used synonym)	Preferred planting form	Notes
				it is an indicator species in the HCR model
forb	*Ratibida columnifera*	prairie coneflower	plug, seed	Very drought tolerant; forage for native pollinators
forb	*Solidago missouriensis*	low (Missouri) goldenrod	seed, plug	Ensure restoration plans take into account smaller stature of this goldenrod; very drought tolerant
forb	*Solidago rigida*	stiff goldenrod	plug	Grows in dry open areas; good late season pollinator forage
forb	*Sphaeralcea coccinea*	scarlet mallow	plug	Showy orange flowers; colonizes open dry prairie and roadsides; due to vegetative spread, it can act as a ground cover; drought tolerant with some salt tolerance
forb	*Symphyotrichum ericoides*	tufted white prairie aster	seed, plug	Withstands mowing and other disturbances; very hardy
forb	*Symphyotrichum falcatum*	creeping white prairie aster	seed, plug	Establishes from seed; plugs speed up establishment; prefers open dry areas
forb	*Symphyotrichum laeve*	smooth aster	plug, seed	Very hardy and drought tolerant; tolerates some disturbance but does not tolerate as much disturbance as tufted white prairie aster
forb	*Thermopsis rhombifolia*	golden bean	plug	Early season pollinator forage; can function somewhat as a ground cover
forb	*Vicia americana*	American vetch	seed, plug	Common in grasslands and open woods; nitrogen fixing; seed is moderately expensive
forb	*Zigadenus venenosus*	death camas	plug	Very poisonous to livestock
grass	*Agrostis scabra*	rough hair grass (hair bentgrass)	seed	Drought tolerant; common on wetland edges; drought tolerant; not common in abundance in areas other than wetland edges, provides good native early to mid-successional coverage in restoration
grass	*Bouteloua gracilis*	blue grama	seed	Warm season grass and therefore, must ensure that cool season grasses do not outcompete it in restoration activities; mid-successional but slightly earlier successional than needle-and-thread and western porcupine grass;

Life form	Botanical name (common synonym)	Common name (frequently used synonym)	Preferred planting form	Notes
				does well from seed under the right conditions
grass	*Calamovilfa longifolia*	sand grass	seed	Excellent for sites with silty/sandy soils; very drought tolerant
grass	*Deschampsia cespitosa*	tufted hair grass	seed	Drought tolerant; highly tufted; can create drought tolerant "turf" if seeded at a very high rate so tufting is obscured; can withstand mowing after establishment
grass	*Elymus lanceolatus*	northern wheatgrass	seed	Will colonize drier microclimates in mesic prairie grassland; prevalent in xeric grassland
grass	*Elymus trachycaulus spp. subsecundum*	awned wheatgrass	seed	Similar characteristics to slender wheatgrass but not as aggressive; may be due to genetics or awns
grass	*Elymus trachycaulus spp. trachycaulus*	slender wheatgrass	seed	Use plant material propagated or collected from plants in the wild and as close to the wild type as possible; many cultivars of slender wheatgrass exist; commercially available slender wheatgrass tends to be more aggressive than the wild type
grass	*Festuca campestris*	mountain (foothills) rough fescue	plug	Easily outcompeted; seed is usually wild collected as it is hard to propagate consistently; use with caution in areas that have the potential to be restored to rough fescue grassland (e.g., remnant fescue patches present, supported rough fescue grassland in the past, surrounded by rough fescue grassland, etc.); rare in urban and disturbed environments; plugs can be used to provide a competitive advantage
grass	*Festuca idahoensis*	bluebunch (Idaho) fescue	seed	Ensure cultivars are not used in restoration work; wild species has bluish coloured leaves; looks similar to the non-native *Festuca ovina* 'Elijah blue'
grass	*Festuca saximontana*	Rocky Mountain fescue	seed	Provides early successional cover when used in a seed mix; retains green colour until late in season,

Life form	Botanical name (common synonym)	Common name (frequently used synonym)	Preferred planting form	Notes
				sometimes even under snow; ungulates seem to preferentially graze on this species and other native fescues during winter
grass	*Hesperostipa comata* (*Stipa comata*)	needle-and-thread	seed	Long awns make cleaning difficult; mid-succession species so if in a seed mix, requires early successional coverage to control weeds but not enough coverage to prevent establishment; could be planted as plugs to aid in establishment; less common in Calgary than western porcupine grass; other grasses it commonly grows alongside with include blue grama, green needle grass, northern wheatgrass, June grass and Rocky Mountain fescue
grass	*Hesperostipa curtiseta* (*Stipa curtiseta*)	western porcupine grass	seed	Long awns make cleaning difficult; mid-succession species so if in a seed mix, requires early successional coverage to control weeds but not enough coverage to prevent establishment; could be planted as plugs to aid in establishment; more common in Calgary than needle-and-thread; other grasses it commonly grows alongside with include blue grama, green needle grass, northern wheatgrass, June grass and Rocky Mountain fescue
grass	*Koeleria macrantha*	June grass	seed	Ensure that short stature of plant is considered during restoration work so that it is not shaded out by other species
grass	*Nasella viridula*	green needle grass	seed	Very drought tolerant; colonizes open areas next to disturbances; tolerant of disturbance; awns can cause seeds to stick to clothing
grass	*Pascopyrum smithii*	western wheatgrass	seed	Prefers more moisture than northern wheatgrass; common in mesic grasslands; found in lower quantities

Life form	Botanical name (common synonym)	Common name (frequently used synonym)	Preferred planting form	Notes
				than northern wheatgrass in this habitat type
grass	*Poa palustris*	fowl bluegrass	seed	Common on wetland edges; prefers moisture but is very drought tolerant; provides good coverage and weed suppression in restoration applications
grass	*Pseudoroegneria spicata*	bluebunch wheatgrass	seed	Good for open xeric areas that require soil binding to prevent erosion; awnless variety better for restoration or alternatively, awned variety that has been cleaned to remove the awns
grass	*Schizachyrium scoparium*	little bluestem	plug, seed	Restoration of this species which is provincially tracked on the Watch List may be desired if development is going to disturb a population; in xeric areas, this species forms rare vegetation communities with sand grass and blue grama which are provincially tracked
sedge	*Carex filifolia*	thread-leaved sedge	plug	May be the only plant in the area growing on steep, dry eroded slopes; may be beneficial to in restoration activities; not commonly used in restoration
shrub	*Dasiphora fruticosa*	shrubby cinquefoil	1 gal	Common shrub in many different habitat types
shrub	*Ribes oxyacanthoides*	northern gooseberry	plug, 1 gal	Important source of early season forage for native bees and other pollinators; fruit attracts wildlife; fruit is edible; prefers moist soil but can withstand drought; full sun to part shade tolerant
shrub	*Rosa arkansana*	prairie rose	plug, 1 gal	Common in grasslands and areas with little vegetation cover such as blowouts; dies back to the ground each year; short in stature
shrub	*Shepherdia argentea*	thorny buffaloberry	1 gal	Infrequent in grassland but small populations occur; very drought tolerant; often found at the top of escarpments
shrub	*Symphoricarpos occidentalis*	buckbrush	1 gal	Tend to not use in restoration work unless nothing else will grow;

Life form	Botanical name (common synonym)	Common name (frequently used synonym)	Preferred planting form	Notes
				increases and becomes weedy while out-competing other more desirable forage species; do not confuse with *S. albus*
shrub (dwarf)	*Gutierrezia sarothrae*	broomweed	plug	Provides groundcover and forage to native pollinators
shrub (dwarf)	*Juniperus horizontalis*	creeping juniper	plug, 1 gal	Suitable for dry sandy slopes within xeric grassland; stabilizes soil

Open native forest/forest edge

The intent of this plant list is to restore open forest and increase the nativity of the plant species present within the forest. In order to increase the biodiversity and health of that ecosystem using native species, the forest must have potential to be improved. For example, these situations include when the forest itself does not require a lot of intervention to become healthier or the area has undergone an extensive weed management program in order to prepare the site for revegetation.

This habitat type tends to be poplar-dominated and tends to be drier than the forests within the west side of the city, although some exceptions occur. These forests may contain incidental spruce, if any at all. The habitat type of the forest is called open as this type of forest tends to have a lot of standing old decadent poplar which are in their final life phase. The lack of balsam poplar regeneration in our urban forests, and forest regeneration overall, causes the canopy to be fairly open which contributes to fuller light penetration to the forest floor and less moisture.

Additionally, these forests may or may not be riparian in nature. If the forests were not within the confines of the city, riparian forests would generally be moister than non-riparian forests and experience more regeneration. Due to the channelization of watercourses in urban areas and associated flood protection; the high water does not spread across the riparian flood plain as it would naturally. This can also be contributed to a deeper scoured channel that causes the riverbed and banks to be unnaturally deep and steep, respectively.

It is important to note that all recommended species in this list are native. This open forest type is typically found more along the beltline and southern areas of Calgary. Due to the connectivity and larger areas of Natural Environment Parks present in the western portion of the city and the influence of the foothills, the forests tend to be moister than the more centrally located forests.

In the western portion of Calgary, this habitat type may be analogous to drier forest edges.

Lastly, this list does not include river banks which are typically inundated with water during snow melt and high precipitation events.

Life form	Botanical name (common synonym)	Common name (frequently used synonym)	Preferred planting form	Notes
forb	*Achillea millefolium*	common yarrow	plug, seed	Prefers full sun but very hardy; good for drier open areas and disturbed forest edges
forb	*Agastache foeniculum*	giant hyssop	plug	Can withstand light partial shade; prefers richer soils; more of a parkland and foothills species
forb	*Allium cernuum*	nodding onion	plug	Found in foothills, montane and parkland habitat types; more appropriate for west side of Calgary
forb	*Allium schoenoprasum*	wild chives	plug	Can spread unwantedly; prefers moister areas
forb	*Anemone canadensis*	Canada anemone	plug	Can be in forests or moister grasslands; HCR grassland health indicator species
forb	*Antennaria pulcherrima*	showy everlasting	plug	Prefers open woods
forb	*Artemisia ludoviciana*	prairie sagewort (sage)	plug	Seed difficult to harvest; readily spreads vegetatively
forb	*Asclepias ovalifolia*	low milkweed	plug	Native milkweed that is appropriate for open parkland forests
forb	*Astragalus canadensis*	Canada milkvetch	seed	Germinates easily from seed; nitrogen fixing as legume; prefers moist grasslands, open forests and riparian areas; inexpensive
forb	*Campanula rotundifolia*	harebell	plug	Appropriate for all habitat types, except for very shady areas
forb	*Chamerion angustifolium*	common fireweed	plug, seed	Seed can be difficult to procure due to its small size and cottony pappus; prefers richer soil; more appropriate for western part of Calgary
forb	*Erigeron philadelphicus*	Philadelphia fleabane	seed, plug	Germinates well from seed
forb	*Eurybia conspicua*	showy aster	plug	May be dominant forb on forest floor; occurrences are higher in northwestern areas of Calgary
forb	*Fragaria virginiana*	wild strawberry	plug	Excellent ground cover; will not grow in areas with tall dense vegetation as requires full sun to partial shade; spreads by stolons
forb	*Galium boreale*	northern bedstraw	plug	Often a fairly dominant plant due to its wide range of tolerances

Life form	Botanical name (common synonym)	Common name (frequently used synonym)	Preferred planting form	Notes
forb	*Geranium viscosissimum*	sticky purple geranium	plug	Readily spreads once planted
forb	*Geum aleppicum*	yellow avens	plug	Plug recommended due to seed handling issues; fruit is hooked achene; grows in moist forest edges (e.g., open moist areas in Prince's Island Park)
forb	*Glycyrrhiza lepidota*	wild licorice	plug	Appropriate for forest edges; requires well-draining soil
forb	*Hedysarum alpinum*	alpine hedysarum	plug, seed	More of a forest edge species versus northern hedysarum
forb	*Heracleum maximum*	cow parsnip	plug, 1 gallon	Tolerates open dry forest and forest edges to shadier moist forest
forb	*Lathyrus ochroleucus*	cream-colored vetchling	plug, seed	Suggesting plug so that seed is not outcompeted by other restoration species; restoration through seed showed promising preliminary results in Calgary; HCR forest health indicator species
forb	*Linum lewisii*	blue flax	seed	Can function as a groundcover in restoration; ensure it is placed to maximize sunlight hours; good for sunnier edges with usage pressure
forb	*Maianthemum stellatum* (*Smilacina stellata*)	star-flowered Solomon's-seal (star-flowered false Solomon's-seal)	plug	Very common forb; found in many different habitat types; tolerates full sun to partial shade
forb	*Oenothera biennis*	yellow evening-primrose	seed, plug	Prefers open areas that regularly experience disturbance such as trail edges; makes for a good forest edge species
forb	*Oxytropis monticola*	late yellow locoweed	plug	Seems to be more prominent in western parts of Calgary
forb	*Pyrola asarifolia*	common pink wintergreen	plug	HCR forest health indicator species; most common wintergreen in Calgary; appears to withstand somewhat drier forest conditions than other wintergreens
forb	*Solidago canadensis*	Canada goldenrod	seed, plug	Very common in all forest types and more mesic grassland
forb	*Solidago gigantea*	late (tall) goldenrod	seed, plug	Prefers areas with additional moisture; would be suitable for a

Life form	Botanical name (common synonym)	Common name (frequently used synonym)	Preferred planting form	Notes
				moister open forest; observed on upper shores along the Elbow river in the beltline
forb	*Solidago missouriensis*	low (Missouri) goldenrod	seed, plug	Ensure restoration plans take into account smaller stature of this goldenrod; use in more open dry areas and forest edges
forb	*Symphyotrichum ciliolatum*	Lindley's aster	plug	Begins to replace smooth aster in grasslands as proximity to trees increases and in more foothills and parkland habitats
forb	*Symphyotrichum ericoides*	tufted white prairie aster	seed, plug	Very hardy; good for dry disturbed forests and edges
forb	*Symphyotrichum laeve*	smooth aster	plug, seed	Very hardy and drought tolerant; use on more eastern side of city
forb	*Vicia americana*	American vetch	seed, plug	Common in grasslands and open woods; nitrogen fixing; seed is available but moderately expensive
forb	*Viola adunca*	early blue violet	plug	Grows in open forests and forest edges/grasslands near forests; appears to withstand more disturbance with increased site moisture
forb	*Viola canadensis*	western Canada violet (Canada violet)	plug	Generally absent from far east end of Calgary; prefers slightly more moisture and shade than early blue violet; common in foothills and parkland open forest/forest edges
forb	*Zigadenus elegans*	white (mountain) camas	plug	Somewhat poisonous to livestock; less common in disturbed areas in the beltline and more common in western parts of the city
forb	*Zizia aptera*	heart-leaved Alexanders	plug	In Calgary, this species is an indicator of healthy grassland in the HCR model; can also be found in open drier forests and forest edges as well as grasslands
grass	*Bromus ciliatus*	fringed brome	seed	More of a parkland/montane species but good for restoration due to aggressive nature
grass	*Bromus marginatus*	mountain brome	seed	Although it is a more of a southwest montane species, it works well in urban restoration as it is

Life form	Botanical name (common synonym)	Common name (frequently used synonym)	Preferred planting form	Notes
				competitive; prefers full sun to very light partial shade
grass	*Calamovilfa longifolia*	sand grass	seed	Very drought tolerant; naturally, sporadic in open forests and edges; prefers forests with silty and sandy depositions
grass	*Deschampsia cespitosa*	tufted hair grass	seed	Drought tolerant; highly tufted; more of a species for low lying areas but works well in most habitat types; full sun to partial shade tolerant
grass	*Elymus canadensis*	Canada wild rye	seed	Prefers sunny areas; would be appropriate for sunnier areas in forest or edge
grass	*Elymus glaucus*	smooth (blue) wild rye	seed	Ensure native species as required vs. nativar; very good for restoration in both grasslands and disturbed forested areas
grass	*Elymus trachycaulus spp. subsecundum*	awned wheatgrass	seed	Similar characteristics to slender wheatgrass but not as aggressive; may be due to genetics or awns
grass	*Elymus trachycaulus spp. trachycaulus*	slender wheatgrass	seed	Use plant material propagated or collected from plants in the wild and as close to the wild type as possible; many cultivars of slender wheatgrass exist; commercially available slender wheatgrass tends to be more aggressive than the wild type
grass	*Festuca saximontana*	Rocky Mountain fescue	seed	Grassland species but provides early successional cover when used in an open forest seed mix; retains green colour until late in season, sometimes even under snow; ungulates preferentially graze on this species and other native fescues during winter
grass	*Koeleria macrantha*	June grass	seed	Grassland species but good for dry forest openings or edges
grass	*Leymus innovatus*	hairy wild rye	plug	Seed is not readily available as germination is poor and ergot can be problematic; generally not used in restoration due to supply issues but a possible species to add biodiversity; naturally grows

Life form	Botanical name (common synonym)	Common name (frequently used synonym)	Preferred planting form	Notes
				sporadically in forested areas; tends to not persist with disturbance
grass	*Nasella viridula*	green needle grass	seed	Appropriate for sunnier forest openings; prefers full sun but tolerates partial shade
grass	*Pascopyrum smithii*	western wheatgrass	seed	Prefers more moisture than northern wheatgrass; common in mesic grasslands and forest openings
grass	*Poa palustris*	fowl bluegrass	seed	Common on wetland edges; prefers moisture but is very drought tolerant; provides good coverage and weed suppression in restoration applications
shrub	*Amelanchier alnifolia*	Saskatoon	1 gal	Excellent for wildlife (e.g., birds, pollinators and grazing animals)
shrub	*Cornus stolonifera*	red-osier dogwood	1 gal	Ensure site is moist; tolerates full sun to partial shade
shrub	*Crataegus chrysocarpa*	*Crataegus chrysocarpa*	1 gal+	Appears more like a smaller tree as tends to be more single-stemmed; provides forage to pollinators and birds; fruit is edible for humans; large thorns present
shrub	*Dasiphora fruticosa*	shrubby cinquefoil	1 gal	Common in most habitat types
shrub	*Elaeagnus commutata*	wolfwillow	1 gal	Do not plant near hard infrastructure as suckers will break pathways and sidewalks
shrub	*Juniperus communis*	ground (common) juniper	1 gal, plug	Grows in open to dense forests and open slopes associated with foothills or parkland; quite drought tolerant; spreads but not invasive; take caution to not buy a cultivar/nativar if the native species is desired
shrub	*Lonicera dioica*	twining honeysuckle	1 gal	Common in dry to moist forest city-wide; attractive plant and can be used in applications to increase the aesthetic appeal of the site; has a vine-like growth habit and will grow up fences and other vegetation; not invasive as does not smother other vegetation

Life form	Botanical name (common synonym)	Common name (frequently used synonym)	Preferred planting form	Notes
shrub	*Prunus pensylvanica*	pin cherry	1 gal	Prefers sandy soils and as such, more common in areas with sand deposition (e.g., open forest area on shore)
shrub	*Prunus virginiana*	choke cherry	1 gal	Common in grasslands and forests within Calgary; very tolerant of various conditions
shrub	*Ribes aureum*	golden currant	plug, 1 gal	Important source of early season forage for native bees and other pollinators; fruit attracts wildlife; fruit is edible; prefers moist soil but generally can withstand some drought; full sun to light shade tolerant; flowers have strong fragrance; thorns absent
shrub	*Ribes oxyacanthoides*	northern gooseberry	plug, 1 gal	Important source of early season forage for native bees and other pollinators; fruit attracts wildlife; fruit is edible; prefers moist soil but generally can withstand some drought; full sun to part shade tolerant
shrub	*Rosa acicularis*	prickly rose	1 gal	This species is more suitable for the foothills and parkland areas of Calgary
shrub	*Rosa woodsii*	common wild rose	1 gal	This species is more suitable for the prairie areas of Calgary
shrub	*Rubus idaeus*	wild red raspberry	1 gal	More common in the western parts of Calgary; volunteer plants are often cultivars and are more aggressive; spreads easily; grows in both dry open forest and dense moist forest
shrub	*Shepherdia argentea*	thorny buffaloberry	1 gal	Occurs in thickets within open dry forest
shrub	*Shepherdia canadensis*	Canada buffaloberry	1 gal	Grows in open dry forests, dry slopes on forest edges and shady moist forests; flowers are some of first to open in the spring and open prior to leaves
shrub	*Symphoricarpos occidentalis*	buckbrush	1 gal	Tend to not use in restoration work unless nothing else will grow; increases and becomes weedy while out-competing other more

Life form	Botanical name (common synonym)	Common name (frequently used synonym)	Preferred planting form	Notes
				desirable forage species; do not confuse with *S. albus*
shrub (dwarf)	*Arctostaphylos uva-ursi*	common bearberry	1 gal, plug	Prefers open dry areas with sandy soils; drought and salt tolerant; effective as a ground cover; HCR grassland health indicator species
shrub (dwarf)	*Spiraea betulifolia*	white meadowsweet	plug, 1 gal	Cultivated spiraeas are very common and need to ensure origin if require native species; occurs from beltline westward
tree	*Betula occidentalis*	water birch	1 gal	Common name is deceiving as tolerates drier forests and edges
tree	*Populus balsamifera*	balsam poplar	plug, 1 gal	Ensure native species versus cultivar/nativar as desired; smaller trees have a higher survival rate as they do not get as shocked when planted; larger sized trees can be planted but shock needs to be mitigated for with consistent watering; very common
tree	*Populus tremuloides*	(trembling) aspen	plug, 1 gal	Present in open forest but tends to prefer denser forests in parkland and foothills habitat types

Moist dense native forest

The intent of this plant list is to indicate species that are suitable for restoring dense moist forests back to a more native species assemblage/reference vegetation community. These habitat types area more common in the western portion of the city.

Similar to other areas where all native species are going to be used, the forest must have potential to be improved. For example, these situations include when the forest itself does not require a lot of intervention to become healthier or the area has undergone an extensive weed management program in order to prepare the site for revegetation.

These forests are generally associated with parkland and the foothills. They tend to be moister and denser with less light penetrating the forest floor, although some exceptions occur.

Although this habitat type generally consists of some balsam poplar, white spruce (*Picea glauca*) is generally present and may be dominant on north-facing slopes. Additionally, these moister forests are more likely to contain aspen and a mossy forest floor. Scattered lodgepole pine (*Pinus contorta*) may be present and some areas in the city's northwest contain the eastern most extent of Douglas-fir (*Pseudotsuga menziesii*).

It is important to note that all recommended species in this list are native and that there is significant overlap between forest species found in all areas of Calgary; however, some are more appropriate for the extreme end of the habitat spectrum (i.e., dry open forest versus dense moist forest). These considerations are outlined in the Notes section.

Similar to the dry open forest habitat type, these moister denser forests may get inundated during flood events if they are within the flood plain but often receive less moisture overall due to urban river channelization and surrounding hard infrastructure. Besides naturally being influenced by the foothills in the west portion of the city, additional connectivity, larger natural areas and less disturbance/usage pressure helps maintain the forest structure.

It should be noted that this list does not include species that occur only on river banks which are more reliant on periodic saturation to thrive.

Additionally, it is very important to consider the challenges of restoring a dense forest habitat type. Many of the dominant species in this plant community (e.g., red and white baneberry [*Actaea rubra*]) prefer moist shady conditions. If species such as these are planted initially prior to the establishment of a forest canopy, it is likely that they will not thrive and get outcompeted by invasive species. Phasing restoration work to ensure that the appropriate vegetation strata layers are restored properly and in the correct order to maximize survival can assist in maximizing success. Using vegetation that is more appropriate for grasslands may be initially required in order to essentially "build" the forest. Unfortunately, many restoration projects have a limited time frame for completion but in complex restoration work, a longer time frame is required to rebuild the vegetation strata layers.

Life form	Botanical name (common synonym)	Common name (frequently used synonym)	Preferred planting form	Notes
forb	*Actaea rubra*	red and white baneberry	plug	Localized to more moist dense forest types in Calgary's foothills and parkland Natural Subregions; HCR forest health indicator species
forb	*Agastache foeniculum*	giant hyssop	plug	Can withstand light partial shade; prefers richer soils; more of a parkland and foothills species
forb	*Allium schoenoprasum*	wild chives	plug	Can spread unwantedly; prefers moister areas
forb	*Anemone canadensis*	Canada anemone	plug	Can be in forests or moister grasslands; HCR forest health indicator species
forb	*Campanula rotundifolia*	harebell	plug	Appropriate for all habitat types, except for very shady areas
forb	*Cornus canadensis*	bunchberry	plug	Suitable for the shadier microclimates of the forest
forb	*Disporum trachycarpum*	fairy-bells	plug	Indicator for forest health in HCR model
forb	*Eurybia conspicua*	showy aster	plug	May be dominant forb on forest floor; occurrences are higher in northwestern areas of Calgary
forb	*Fragaria virginiana*	wild strawberry	plug	Generally not present in very shaded areas; makes a good early successional ground cover in restoration; will decrease in population after forest becomes more dense
forb	*Galium triflorum*	sweet-scented bedstraw	plug	In Calgary, this species is found in moist shady forests in the northwest section of the city
forb	*Gentianella amarella*	felwort (northern gentian)	plug	Tends to grow in slightly more open microclimates of moist dense forests
forb	*Geranium richarsonii*	wild white geranium	plug, seed	Prefers moist areas
forb	*Geum aleppicum*	yellow avens	plug	Plug recommended due to seed handling issues; appropriate for more open areas of moist forest
forb	*Heracleum maximum*	cow parsnip	plug, 1 gallon	Can be the dominant forb within forests
forb	*Lathyrus ochroleucus*	cream-colored vetchling	plug, seed	Suggesting plug so that seed is not outcompeted by other restoration species; restoration through seed

Life form	Botanical name (common synonym)	Common name (frequently used synonym)	Preferred planting form	Notes
				showed promising preliminary results in Calgary; HCR forest health indicator species
forb	*Lathyrus venosus*	purple peavine	plug	Indicator for forest health in HCR; less common in Calgary than cream-coloured vetchling as prefers more moist shadier wooded areas
forb	*Lilium philadelphicum*	western wood lily	plug, 1 gal	Occurs in open microclimates of moist dense forests within Calgary; localized to the western edge of the city; somewhat more challenging to propagate so source from a reputable vendor as potted material
forb	*Maianthemum stellatum* (*Smilacina stellata*)	star-flowered Solomon's-seal (star-flowered false Solomon's-seal)	plug	Very common forb; found in many different habitat types
forb	*Moneses uniflora*	one-flowered wintergreen	plug	Indicator for forest health in HCR model; toothing on leaves is helpful for identification if not in flower
forb	*Orthilia secunda*	one-sided wintergreen	plug	Indicator for forest health in HCR model; dark green glossy leaves aid in identification if not in flower
forb	*Pedicularis bracteosa*	western lousewort	plug	Appropriate for moist shady forests on the far western edge of Calgary; difficult to establish due to the host requirement but a reputable vendor may have it available
forb	*Petasites frigidus*	coltsfoot	plug	In Calgary, this species tends to grow in moist forests but will also grow in open moist areas elsewhere; 4 varieties which differ based on leaf shape
forb	*Pyrola asarifolia*	common pink wintergreen	plug	Indicator for forest health in HCR model; most commonly observed wintergreen in Calgary
forb	*Pyrola chlorantha*	greenish-flowered wintergreen	plug	Indicator for forest health in HCR model
forb	*Solidago canadensis*	Canada goldenrod	seed, plug	Suitable for areas with more light penetration; provides late season forage for pollinators

Life form	Botanical name (common synonym)	Common name (frequently used synonym)	Preferred planting form	Notes
forb	*Solidago gigantea*	late (tall) goldenrod	seed, plug	Suitable for areas with more light penetration
forb	*Symphyotrichum ciliolatum*	Lindley's aster	plug	Replaces smooth aster as areas become more forested
forb	*Symphyotrichum lanceolatum*	western willow aster	plug, seed	Grows in open moist areas as well as more shaded areas
forb	*Vicia americana*	American vetch	seed, plug	Common in grasslands and forests; seed is available but moderately expensive
forb	*Viola canadensis*	western Canada violet (Canada violet)	plug	Generally absent from far east end of Calgary; prefers slightly more moisture and shade than early blue violet; common in foothills and parkland
forb	*Zigadenus elegans*	white (mountain) camas	plug	Somewhat poisonous to livestock; although seems to prefer open woods, it is present in denser woodlands in the west side of the city
forb shrub (dwarf)	*Mertensia paniculata*	tall lungwort	plug	Grows in very damp shady forests on the western side of Calgary (e.g., Weaselhead Flats); spreads vegetatively as well as by seed; pollinated by bumble bees
forb/ shrub (dwarf)	*Rubus pubescens*	dewberry (dwarf red raspberry) (trailing raspberry)	1 gal, plug	Makes an excellent groundcover; provides forage for wildlife
grass	*Bromus ciliatus*	fringed brome	seed	Forest species; good native competitor so it is often used in restoration of other habitat types like mesic grasslands
grass	*Elymus glaucus*	smooth (blue) wild rye	seed	Very good for restoration as it is an excellent competitor and can tolerate a wide range of conditions; ensure cultivar is not procured for native plant restoration
grass	*Elymus trachycaulus spp. subsecundum*	awned wheatgrass	seed	Similar characteristics to slender wheatgrass
grass	*Elymus trachycaulus ssp. trachycaulus*	slender wheatgrass	seed	Ensure that source is known to ensure suitability and degree of nativity; most often observed in

Life form	Botanical name (common synonym)	Common name (frequently used synonym)	Preferred planting form	Notes
				open areas but shade tolerant; short-lived and provides early successional cover which allows other later successional species to establish
grass	*Leymus innovatus*	hairy wild rye	plug	Seed is not readily available as germination is poor and ergot can be problematic; generally not used in restoration due to supply issues but a possible species to add biodiversity; naturally grows sporadically in forested areas; tends to not persist with disturbance
grass	*Nasella viridula*	green needle grass	seed	Appropriate for sunnier forest openings but appears to tolerate shade and found naturally in dense forest within Calgary's northwest quadrant
grass	*Pascopyrum smithii*	western wheatgrass	seed	Tolerates moderate shade and found sporadically in Calgary's northwest forests
grass	*Poa interior*	inland bluegrass	seed, plug	A good addition to seed mixes and restoration plans for forested areas; not readily available but may want to use to maintain forest integrity and biodiversity versus to achieve cover; fowl bluegrass is more commonly used in restoration; in Calgary, tends to only be in the moister shadier forested areas within the northwest
grass	*Poa palustris*	fowl bluegrass	seed	Common on wetland edges; prefers moisture but is very drought tolerant; provides good coverage and weed suppression in restoration applications; withstands open sun to partial shade
shrub	*Amelanchier alnifolia*	Saskatoon	1 gal	Excellent for wildlife (e.g., birds, pollinators and grazing animals); provides excellent understory coverage
shrub	*Cornus stolonifera*	red-osier dogwood	1 gal	Tolerates full sun to partial shade; requires moist conditions; often a dominant understory shrub

Life form	Botanical name (common synonym)	Common name (frequently used synonym)	Preferred planting form	Notes
shrub	*Elaeagnus commutata*	wolfwillow	1 gal	Do not plant near hard infrastructure as suckers will break pathways and sidewalks
shrub	*Juniperus communis*	ground (common) juniper	1 gal, plug	Grows in open to dense forests and open slopes associated with foothills or parkland; quite drought tolerant; spreads but not invasive; take caution to not buy a cultivar/nativar if the native species is desired
shrub	*Lonicera dioica*	twining honeysuckle	1 gal	Common in dry to moist forest city-wide; attractive plant and can be used in applications to increase the aesthetic appeal of the site; has a vine-like growth habit and will grow up fences and other vegetation; not invasive as does not smother other vegetation; HCR forest health indicator species
shrub	*Lonicera involucrata*	bracted honeysuckle	1 gal	Prefers moist shady woods; to be used in the western-most parts of the city
shrub	*Prunus pensylvanica*	pin cherry	1 gal	Prefers sandy soils and as such, more common in areas with sand deposition such as within flood plains
shrub	*Prunus virginiana*	choke cherry	1 gal	Common in mesic grasslands to dense forests within the Calgary area; provides important pollinator and bird forage; one of the first species to flower in the spring
shrub	*Ribes aureum*	golden currant	plug, 1 gal	Important source of early season forage for native bees and other pollinators; fruit attracts wildlife; fruit is edible; prefers moist soil but generally can withstand drought; flowers have strong fragrance; thorns absent; common along the Elbow River approximately 30 years ago; prefers sunnier locations but was observed in the past growing in shady thickets along the river
shrub	*Ribes oxyacanthoides*	northern gooseberry	plug, 1 gal	Important source of early season forage for native bees and other

Life form	Botanical name (common synonym)	Common name (frequently used synonym)	Preferred planting form	Notes
				pollinators; fruit attracts wildlife; fruit is edible; prefers moist soil but generally can withstand drought; prefers full sun to partial shade but can be found sporadically in shady forests
shrub	*Rosa acicularis*	prickly rose	1 gal	This species is more suitable for the foothills and parkland areas of Calgary
shrub	*Rosa woodsii*	common wild rose	1 gal	This species is more suitable for the prairie areas of Calgary but can be found city-wide
shrub	*Rubus idaeus*	wild red raspberry	1 gal	More common in the western parts of Calgary; volunteer plants are often cultivars and are more aggressive; spreads easily; grows in both dry open forest and dense moist forest
shrub	*Sambucus racemosa*	red elderberry	1 gal	Localized to moist forest in the north/west areas of the city; Ensure the native species is planted in forest restoration; many cultivated escapes in urban forests with showier characteristics such as purple leaves and highly toothed/scalloped leaf edges
shrub	*Shepherdia canadensis*	Canada buffaloberry	1 gal	Grows in open dry forests, dry slopes on forest edges and shady moist forests; flowers are some of first to open in the spring and open prior to leaves
shrub	*Sorbus scopulina*	western mountain ash	1 gal	Do not confuse it with European mountain-ash which spreads readily and can be considered invasive; fruit attracts waxwings; appropriate for most western areas of Calgary
shrub	*Symphoricarpos albus*	snowberry	1 gal	Not as weedy as buckbrush; grows in healthier shady forests and thickets
shrub	*Viburnum opulus spp. trilobum*	high-bush cranberry	1 gal	Occurs in boggy forest types in Calgary; fairly uncommon, likely due to watercourse channelization and wetland disturbance; provides good wildlife habitat and forage as fruit

Life form	Botanical name (common synonym)	Common name (frequently used synonym)	Preferred planting form	Notes
				often remains throughout winter; large population present in Elbow Island Park; ensure that native species is procured
shrub (dwarf)	*Arctostaphylos uva-ursi*	common bearberry	1 gal, plug	Effective as a ground cover; prefers more open areas but observed in shady moist forest within the city; HCR grassland health indicator species
shrub (dwarf)	*Linnaea borealis*	twinflower	plug, 1 gal	Excellent fragrant groundcover; prefers foothills and parkland areas of the city
shrub (dwarf)	*Spiraea betulifolia*	white meadowsweet	plug, 1 gal	Cultivated spiraeas are very common; need to ensure origin if require native species; plant species is appropriate for the beltline westward ; observed in open and shady forests
tree	*Betula occidentalis*	water birch	1 gal	Very common in all forest types and along shores in Calgary
tree	*Pinus contorta*	lodgepole pine	plug, 1 gal	Not common in the Calgary area but scattered trees occur in the most western portion of the city within dense forested areas and on north-facing slopes; tree-planting style plugs for reforestation are available for mass plantings
tree	*Populus balsamifera*	balsam poplar	plug, 1 gal	Ensure native species versus cultivar/nativar as desired; smaller trees have a higher survival rate as they do not get as shocked when planted; larger sized trees can be planted but shock needs to be mitigated for with consistent watering; very common
tree	*Populus tremuloides*	(trembling) aspen	plug, 1 gal	Present in open forest but tends to prefer denser forests in parkland and foothills habitat types
tree	*Pseudotsuga menziesii*	Douglas-fir	plug, 1 gal	Calgary's northwest contains the eastern-most population of this species; population appears to be decreasing with white spruce replacing the evergreen component in the forest type; restoration

Life form	Botanical name (common synonym)	Common name (frequently used synonym)	Preferred planting form	Notes
				activities for this species need to consider local genetics and if the population will persist
vine	*Clematis occidentalis*	purple clematis	1 gal	Can add diversity to forest structure due to its vining growth form

Naturalized grassland and forest edges

The plants described below are a mix of native species and species that are not native to the Calgary area, although there are some species mentioned that are native to areas outside of Calgary (e.g., alpine areas). Species that are native to Alberta are indicated as native.

The recommended plants generally do not require a lot of supplemental watering, although watering for establishment and during times of drought can be helpful. Generally, potted material should be watered in for establishment but this can be minimized through timing.

The species outlined below require little maintenance as the intent of naturalization is to create a viable biodiverse landscape that requires little intervention. Regardless, in urban areas, maintenance may be periodically required due to the existing pressures present in a developed landscape versus a rural area. For example, park size alone may be the biggest challenge that prevents ecosystems from being self-sustaining and not requiring periodic inputs, such as weed control.

It should be noted the usage of non-native species needs to be evaluated when project areas are in close proximity to Natural Environment Parks. Since there is a risk of non-native species spreading into Natural Environment Parks and decreasing their ecological health, care must be exercised.

These species cited below are appropriate for this habitat type. They are drought tolerant, tolerate full sun to light shade, naturally spread and persist in areas of adjacent and/or ongoing disturbance. Due to the low amount of input required to grow these plants, they help in mitigating climate change and also provide resources to pollinators. These plants can be used as a better alternative to turf, maintained landscapes and impermeable surfaces.

The use of all vegetation strata layers is important in restoration as weeds may present a problem when certain plants are not included in restoration plans such as ground covers. Also, if a certain type of plant is not introduced through restoration, it may not come in with time if the area is somewhat isolated from other similar habitat types (e.g., forbs). For example, although some people may feel that grasses are not aesthetically pleasing, using them along with forbs and shrubs

allow for a more self-sustaining vegetation community as weeds are less able to colonize a certain strata layer in the community.

Depending on resources, other native species appropriate to grasslands may be added to the plant palette, as appropriate. These decisions depend on available resources and time as the species selected below spread naturally and are quite aggressive. Lastly, the majority of the recommended species for naturalization are in seed form as seed, when seeded at the correct time of year, does not require additional inputs for establishment, such as watering.

Life form	Botanical name (common synonym)	Common name (frequently used synonym)	Preferred planting form	Native (y=yes, n=no)	Notes
forb	*Penstemon spp.*	Penstemon	plug	n	Prefers full sun to partial shade; many cultivars available; spreads; drought tolerant once established
forb	*Phlox paniculata*	garden phlox	seed; plug	n	May develop disease if kept too moist
forb	*Achillea millefolium*	common yarrow	1 gal, plug	y	Aggressive; spreads quickly vegetatively
forb	*Achillea millefolium* '*Apple Blossom'*	Apple Blossom yarrow	1 gal, seed	n	Soft pink coloured blooms
forb	*Achillea millefolium 'Cerise Queen'*	cerise queen yarrow	1 gal, seed	n	Cherry pink coloured blooms
forb	*Achillea millefolium 'Laura'*	Laura yarrow	1 gal, seed	n	Red with a white centre
forb	*Achillea millefolium* 'Paprika'	paprika yarrow	1 gal, seed	n	Red with a yellowish-orange centre; more compact growth habit
forb	*Achillea millefolium 'Peggy Sue'*	Peggy Sue yarrow	1 gal, seed	n	Apricot-orange coloured blooms
forb	*Achillea millefolium 'Red Beauty'*	red beauty yarrow	1 gal, seed	n	Bright red coloured blooms

Life form	Botanical name (common synonym)	Common name (frequently used synonym)	Preferred planting form	Native (y=yes, n=no)	Notes
forb	*Achillea millefolium 'Red Velvet'*	red velvet yarrow	1 gal, seed	n	Deep rose coloured blooms; colour fades very little with time
forb	*Achillea millefolium 'Summer Pastels'*	summer pastels yarrow	1 gal, seed	n	Multicoloured flowers that range from white to cream, yellow, pink, salmon and mauve
forb	*Achillea millefolium 'Terracotta'*	terracotta yarrow	1 gal, seed	n	Flowers change from salmon-pink to rusty terracotta orange to creamy yellow
forb	*Alcea rosea*	hollyhock	seed	n	Readily self-seeds
forb	*Artemisia frigida*	pasture sagewort (sage)	plug	y	Readily spreads and persists in disturbed dry areas; seed is difficult to procure
forb	*Artemisia ludoviciana*	prairie sagewort (sage)	plug	y	Readily spreads vegetatively once established; will survive with periodic mowing and under foot traffic; seed is difficult to procure
forb	*Asclepias speciosa*	showy milkweed	plug	y	Very drought tolerant once established
forb	*Astragalus agrestis*	purple milkvetch	seed, plug	y	Withstands periodic mowing; viable seeds persist in seed bank as it colonizes grassland areas that have been seeded to turf when the area is not mowed
forb	*Astragalus canadensis*	Canada milkvetch	seed	y	Germinates from seed; quite competitive; tolerates drought

Life form	Botanical name (common synonym)	Common name (frequently used synonym)	Preferred planting form	Native (y=yes, n=no)	Notes
					and poorer soils although preferred habitat contains moister richer soils
forb	*Campanula glomerata*	clustered bellflower	seed	n	Prefers full sun but will tolerate part shade, especially in warmer weather; requires well-draining soil and regular moisture; good for open forest areas that have moister soils
forb	*Campanula persicifolia*	peach-leaved bellflower	seed	n	Prefers full sun but will tolerate part shade, especially in warmer weather; requires well-draining soil and regular moisture; good for open forest areas that have moister soils
forb	*Campanula rotundifolia*	harebell	plug, seed	y	Appears to tolerate a variety of habitats; very hardy; easily spreads
forb	*Centaurea cyanus*	cornflower (bachelor buttons)	seed	n	Annual; self-seeds; use care as may be invasive
forb	*Centaurea montana*	mountain star-thistle	seed, 1 gal	n	May be invasive; use caution with this plant; very drought tolerant; tolerant of poor soils
forb	*Cerastium tomentosum*	snow-in-summer	1 gal	n	Spreads vegetatively and also through seed; prefers poor dry soils; can be invasive, hard to

Life form	Botanical name (common synonym)	Common name (frequently used synonym)	Preferred planting form	Native (y=yes, n=no)	Notes
					control and may outcompete adjacent vegetation so use caution when using this plant
forb	*Chamerion angustifolium*	common fireweed	plug, seed	y	Seed can be difficult to procure due to its small size and cottony pappus
forb	*Cherianthus allionii*	Siberian wallflower	seed	n	Generally does not bloom the first growing season; does not volunteer often but may naturalize
forb	*Cosmos spp.*	Cosmos	seed	n	Annual; self-seeds if seed heads are left to mature; very drought tolerant; does well in poor soils; somewhat salt tolerant
forb	*Dalea purpurea*	purple prairie clover	seed, plug	y	Flowers after ~3 years when seeded; no maintenance required when seeded
forb	*Dianthus barbatus*	sweet William	seed	n	Establishes from seed; readily spreads; tolerates full sun to partial shade
forb	*Dracocelphalum thymiflorum*	thyme-leaved dragonhead	seed, plug	n	Attractive ground cover; attracts pollinators; appears to be somewhat salt tolerant
forb	*Echinacea purpurea*	eastern purple conflower	seed, 1 gal	n	Many cultivars available; does not tolerate drought but can tolerate dry conditions; cannot

Life form	Botanical name (common synonym)	Common name (frequently used synonym)	Preferred planting form	Native (y=yes, n=no)	Notes
					be waterlogged; recommend in seed mixes for naturalization; watering required for establishment of potted material
forb	*Echinops ritro*	globe thistle	1 gal, seed	n	May volunteer
forb	*Erigeron philadelphicus*	Philadelphia fleabane	seed, plug	y	Once established, spreads readily with no maintenance; establishes well from seed
forb	*Eryngium planum*	cross-thistle (sea holly)	seed, 1 gal	n	May volunteer in unwanted areas
forb	*Fragaria spp.*	strawberry	1 gal	n	Cultivated strawberries readily spread through stolons and function as a groundcover; the cultivated varieties appears to be more aggressive; ensure variety is suitable for the Calgary area
forb	*Fragaria virginiana*	wild strawberry	plug	y	Drought tolerant; tolerates poor soil
forb	*Gaillardia aristata*	gaillardia (blanket flower)	seed	y	Establishes well from seed
forb	*Galium boreale*	northern bedstraw	seed	y	Grows well from seed; one of the most persistent native forb species in areas of disturbance (e.g., remains on mowed and seeded roadsides, etc.)
forb	*Grindelia squarrosa*	curly-cup gumweed	plug, seed	y	Very salt and drought tolerant;

Life form	Botanical name (common synonym)	Common name (frequently used synonym)	Preferred planting form	Native (y=yes, n=no)	Notes
					provides forage to native pollinators
forb	*Gypsophila elegans*	annual baby's-breath	seed	n	Flowers early; readily self-seeds; ensure seed is the annual species as perennial baby's-breath is on the *Alberta Weed Control Act* and is much more aggressive than the annual species; comes in a variety of colours; may spread
forb	*Hedysarum alpinum*	alpine hedysarum	seed, plug	y	When grown from seed, no maintenance is required; does not germinate for ~4 years but once it does, it is very hardy; more appropriate for areas with filtered light (e.g., forest edges/open forest)
forb	*Hedysarum boreale*	northern hedysarum	seed, plug	y	When grown from seed, no maintenance is required; does not germinate for ~4 years but once it does, it is very hardy; more appropriate for areas with full sun (e.g., grassland)
forb	*Helianthus annuus*	annual sunflower	seed	n	Annual but may self-seed; cultivated varieties are readily available and inexpensive

Life form	Botanical name (common synonym)	Common name (frequently used synonym)	Preferred planting form	Native (y=yes, n=no)	Notes
forb	*Helianthus maximilianii*	narrow-leaved sunflower	seed	n	Readily colonizes roadsides in southeast Alberta; aggressive; salt and drought tolerant
forb	*Hemerocallis spp.*	daylily	1 gal	n	Prefers sunny areas with moist soil; ensure cultivar is appropriate for this climate; have observed abandoned gardens with very dry soil in which daylilies were thriving; do not seem affected by lily beetles like other lilies
forb	*Heterotheca villosa*	hairy golden aster	plug, seed	y	Can colonize very poor soils; somewhat salt tolerant; drought tolerant
forb	*Heuchera spp.*	coral bells	1 gal	n	Many hardy varieties of coral bells exist; varieties are tolerant of full sun to full shade; ensure cultivar is suited to habitat conditions
forb	*Liatris punctata*	dotted blazingstar	seed	y	Will establish from seed after ~4 years; does not require maintenance if seeded; prefers full sun
forb	*Linum lewisii*	blue flax	seed	y	Only native forb that easily germinates and establishes in mulch; some thatch removal may be required very

Life form	Botanical name (common synonym)	Common name (frequently used synonym)	Preferred planting form	Native (y=yes, n=no)	Notes
					infrequently to restore plant vigor
forb	*Lotus corniculatus*	bird's-foot trefoil	seed	n	Use caution as it can be weedy; drought and salt tolerant; provides forage to pollinators; good reclamation option for areas where other plants will not grow
forb	*Maianthemum stellatum* (*Smilacina stellata*)	star-flowered Solomon's-seal (star-flowered false Solomon's-seal)	seed, plug	y	Aggressive; tolerant of various habitat types; one of the last native species to die out with heavy disturbance
forb	*Malva spp.*	mallow	seed	n	Prefers full sun to part shade; short lived perennial; readily self-seeds; may spread; has volunteered in some natural areas with adjacent seed sources in residences
forb	*Monarda fistulosa*	wild bergamot	seed, plug	y	Comes up well from seed; readily spreads; does not require ongoing maintenance; provides forage to pollinators
forb	*Myosotis asiatica*	alpine forget-me-not	seed, plug	y	Grows in montane to alpine areas; tolerates drought and little soil; tolerates poor soil; readily spreads but not invasive; very early blooming

Life form	Botanical name (common synonym)	Common name (frequently used synonym)	Preferred planting form	Native (y=yes, n=no)	Notes
forb	*Nepeta spp.*	catmint	plug, 1 gal	n	Reliable perennial; hardy
forb	*Onobrychis viciifolia*	sainfoin	seed	n	Use caution as it can be weedy; drought and salt tolerant; provides forage to pollinators; good reclamation option for areas where other plants will not grow
forb	*Oxytropis sericea*	early yellow locoweed	plug, seed	y	Withstands disturbance such as periodic mowing; viable seeds persist in seed bank as this species will come up in areas that have been seeded with turf grass
forb	*Papaver nudicaule*	Iceland poppy	seed	n	Can colonize very poor soil; appears to be somewhat salt tolerant as has naturally colonized alleyways in the city
forb	*Perovskia atriplicifolia*	Russian sage	seed, 1 gal	n	Requires watering for establishment if used in potted form
forb	*Rudbeckia hirta*	black-eyed Susan	seed, 1 gal	n	Self-sustaining once established
forb	*Solidago canadensis*	Canada goldenrod	seed	y	Establishes well from seed; tolerates more shade than low goldenrod; readily spreads through rhizomes after first growing season; shown to overwinter in thick walled planters with no mulch addition

Life form	Botanical name (common synonym)	Common name (frequently used synonym)	Preferred planting form	Native (y=yes, n=no)	Notes
forb	*Solidago missouriensis*	low (Missouri) goldenrod	seed	y	Establishes well from seed; readily spreads through rhizomes; can withstand frequent disturbance such as mowing, grazing and foot traffic; viable seeds tend to persist in the seed bank and plants persist in areas seeded with turf grass
forb	*Symphyotrichum ericoides*	tufted white prairie aster	seed, plug	y	Withstands mowing and cultivation; highly drought and salt tolerant
forb	*Symphyotrichum laeve*	smooth aster	seed, plug	y	Very hardy; appears to tolerate many habitat types, including poor soils, drought and salinity; will spread but is not invasive
forb	*Thermopsis rhombifolia*	golden bean	plug	y	Can withstand periodic disturbance such as mowing; persistent as will come up in areas that have been seeded with turf grass such as roadsides; good source of early season pollinator forage
forb	*Thymus serpyllum*	creeping thyme	seed	n	Withstands drought; attractive groundcover; seed is readily available
forb	*Vicia americana*	American vetch	seed, plug	y	Persists in areas adjacent to disturbance;

Life form	Botanical name (common synonym)	Common name (frequently used synonym)	Preferred planting form	Native (y=yes, n=no)	Notes
					volunteers in areas without human input
grass	*Agrostis scabra*	rough hair grass (hair bentgrass)	seed	y	Typically grows around wetlands; drought tolerant; provides early successional cover in restoration projects; low-growing
grass	*Bromus ciliatus*	fringed brome	seed	y	More of a parkland/montane species but good for restoration due to aggressive nature
grass	*Bromus marginatus*	mountain brome	seed	y	Although it is a more of a southwest Alberta montane species, it works well in urban restoration as it is competitive; prefers full sun to very light partial shade
grass	*Calamovilfa longifolia*	sand grass	seed	y	Good for areas with silt and sand
grass	*Deschampsia cespitosa*	tufted hair grass	seed	y	Drought tolerant; tolerates poor soils; grows in full sun to shade
grass	*Elymus canadensis*	Canada wild rye	seed	y	Aggressive but works well in seed mixes; will form monoculture if seeded first as a cover crop
grass	*Elymus glaucus*	smooth wild rye	seed	y	Drought and salt tolerant; ensure native species as required vs. nativar
grass	*Elymus lanceolatus*	northern wheatgrass	seed	y	Will colonize drier microclimates in

Life form	Botanical name (common synonym)	Common name (frequently used synonym)	Preferred planting form	Native (y=yes, n=no)	Notes
					mesic prairie grassland
grass	*Elymus trachycaulus spp. subsecundum*	awned wheatgrass	seed	y	Similar characteristics to slender wheatgrass but not as aggressive; may be due to genetics or awns
grass	*Elymus trachycaulus ssp. trachycaulus*	slender wheatgrass	seed	y	Aggressive cultivars are available
grass	*Festuca saximontana*	Rocky Mountain fescue	seed	y	Provides early successional cover when used in a seed mix; retains green colour until late in season, sometimes even under snow; ungulates preferentially graze on this species and other native fescues during winter
grass	*Koeleria macrantha*	June grass	seed	y	Ensure that short stature of plant is considered during restoration work so that it is not shaded out by other species
grass	*Leymus arenarius*	blue lyme grass	seed	n	Some taxonomic confusion as often synonymous with smooth wild rye but this non-native species appears more robust and blue; very aggressive; drought

Life form	Botanical name (common synonym)	Common name (frequently used synonym)	Preferred planting form	Native (y=yes, n=no)	Notes
					tolerant; very salt tolerant
grass	*Lolium multiflorum*	Italian (annual) ryegrass	seed	n	Establishes quickly; will persist if left to self-seed; intensive breeding has made this grass able to overwinter; can substitute perennial ryegrass
grass	*Nasella viridula*	green needle grass	seed	y	Very drought tolerant; colonizes open areas next to disturbances; tolerant of disturbance; awns can cause seeds to stick to clothing
grass	*Pascopyrum smithii*	western wheatgrass	seed	y	Prefers more moisture than northern wheatgrass; common in mesic grasslands
grass	*Poa palustris*	fowl bluegrass	seed	y	Common on wetland edges; prefers moisture but is very drought tolerant; provides good coverage and weed suppression in restoration applications
grass	*Puccinellia distans*	spreading alkali grass	seed	n	Very salt tolerant; native and introduced elements in the USA, northwest BC and Alaska
grass	*Puccinellia distans* 'Fults'	'Fults' alkali grass	seed	n	Variety cultivated from specimen at a golf course in the USA; very salt tolerant

Life form	Botanical name (common synonym)	Common name (frequently used synonym)	Preferred planting form	Native (y=yes, n=no)	Notes
grass	*Puccinellia nuttalliana*	Nuttall's salt-meadow (alkali) grass	seed	y	Does very well in harsh roadside conditions such as medians of busy main roads; some taxonomic issues as lab tests for species confirmation are inconsistent with Nuttall's salt-meadow grass and spreading alkali grass
shrub	*Crataegus chrysocarpa*	round-leaved hawthorn	1 gal+	y	Appears more like a smaller tree as tends to be more single-stemmed; provides forage to pollinators and birds; fruit is edible for humans; large thorns present; many cultivars available
shrub	*Crataegus spp.*	hawthorn	1 gal+	n	Many hawthorn cultivars exist which have interesting flowers (e.g., multiple-whorled blooms), flower colours (e.g., pink) different bark colours and lack thorns, unlike the native hawthorn; ensure the cultivar is appropriate for the habitat type
shrub	*Dasiphora fruticosa*	shrubby cinquefoil	1 gal	y	Drought tolerant once established; does well next to disturbance

Life form	Botanical name (common synonym)	Common name (frequently used synonym)	Preferred planting form	Native (y=yes, n=no)	Notes
shrub	*Elaeagnus commutata*	wolfwillow	1 gal	y	Readily suckers; do not plant near hard infrastructure
shrub	*Lonicera dioica*	twining honeysuckle	1 gal	y	Although it is common in forest, it can be found in forest edges; drought tolerant; tolerant of full sun to part shade
shrub	*Paeonia spp.*	peony	1 gal	n	Plant in fall; very low maintenance one established; many colours available; wide range in blooming times
shrub	*Physocarpus spp.*	ninebark	1 gal+	n	Many cultivars available; ensure cultivar is appropriate for habitat type and Calgary area
shrub	*Prunus glandulosa*	dwarf flowering almond	1 gal+	y	Very similar to flowering almond except much smaller in size; both tolerate urban conditions; will naturalize; may form fruit that squirrels utilize
shrub	*Prunus triloba*	flowering almond	1 gal+	n	One of the first flowers to emerge in spring; flowers emerge prior to the leaves; provides early season forage to pollinators; very large dense growing shrub; provides wildlife habitat due to dense growth;

Life form	Botanical name (common synonym)	Common name (frequently used synonym)	Preferred planting form	Native (y=yes, n=no)	Notes
					grows best in full sun and moist soil; seems tolerant of partial shade and drier conditions; does not volunteer often; will spread and sucker in planted area but does not spread into further areas
shrub	*Prunus virginiana*	choke cherry	1 gal	y	Common in grasslands and forests within Calgary; very tolerant of various conditions
shrub	*Ribes aureum*	golden currant	plug, 1 gal	y	Drought tolerant once established; provides early season forage to pollinators
shrub	*Ribes oxyacanthoides*	northern gooseberry	plug, 1 gal	y	Drought tolerant once established; provides early season forage to pollinators
shrub	*Rosa woodsii*	common wild rose	1 gal	y	Very tolerant of disturbance and foot traffic
shrub	*Rubus spp.*	raspberry	1 gal	n	Can use native or cultivated raspberry; both the native species and cultivars are very aggressive
shrub	*Salix brachycarpa 'Blue Fox'*	blue fox willow	1 gal	n	Drought tolerant; tolerates poor soils, full sun to part shade; some salinity tolerance; provides early season forage for pollinators

Life form	Botanical name (common synonym)	Common name (frequently used synonym)	Preferred planting form	Native (y=yes, n=no)	Notes
shrub	*Salix pentandra*	laurel willow	plug, 1 gal+	n	Will volunteer; prefers moist ground but drought tolerant once established; very large and tree-like
shrub	*Shepherdia argentea*	thorny buffaloberry	1 gal	y	Very drought tolerant; salt tolerant
shrub	*Spiraea japonica*	magic carpet spirea	1 gal	n	Cutting to the base prior to flowering helps encourage new growth and blooms; does well, in average soils even when neglected; tolerates full sun to partial shade; suckers readily around planting area; leaves are bright green initially and fade to maroon in fall
shrub	*Spiraea nipponica*	snowmound spirea	1 gal+	n	Tends to do well, even when neglected; appears drought tolerant, once established; tolerates full sun to partial shade; would be self-sustaining in areas other than those with poor very dry soils; does not tend to volunteer
shrub	*Symphoricarpos occidentalis*	buckbrush	1 gal	y	Very tolerant of disturbance and can be weedy at times; only plant in inhospitable habitat

Life form	Botanical name (common synonym)	Common name (frequently used synonym)	Preferred planting form	Native (y=yes, n=no)	Notes
					types as comes in on its own
shrub	*Syringa villosa*	villosa (Japanese) (late) lilac	1 gal+	n	Most salt tolerant lilac; does not volunteer as often as common lilac; slower growing than common lilac
shrub	*Syringa vulgaris*	common lilac	1 gal+	n	Grows quickly; provides pollinator forage; blooms earlier than villosa lilac
shrub	*Viburnum lantana*	wayfaring tree	1 gal+	n	May volunteer so should be cautious when using this tree
shrub	*Viburnum lentago*	nannyberry	1 gal+	n	Native to eastern north America; would be more appropriate for open forest naturalization; edible berries; provides pollinator and wildlife forage
shrub	*Viburnum opulus*	snowball bush	1 gal+	n	This is not to be confused with our native high-bush cranberry; much rounder flower clusters; our native species requires more boggy conditions; this shrub can be used in naturalization as it does not require the boggy conditions that the native shrub does
tree	*Populus balsamifera*	balsam poplar	plug, 1 gal	y	Ensure tree is not planted in an area with underground infrastructure as

Life form	Botanical name (common synonym)	Common name (frequently used synonym)	Preferred planting form	Native (y=yes, n=no)	Notes
					deep vertical roots may damage pipes, etc.
tree	*Populus balsamifera 'Paskapoo'*	Paskapoo poplar	1 gal+	n	Somewhat native as developed from a Calgary specimen; smaller tree than standard balsam poplar; additional drought tolerance compared to balsam poplar; does not readily sucker; less snow damage due to lateral branching
tree	*Populus tremula 'Erecta'*	Swedish columnar aspen	1 gal+	n	Roots spread laterally instead of vertically so suckering will occur in adjacent areas;
vine	*Humulus lupulus*	common hop	1 gal	n	Grows very large; tolerates full sun to partial shade; drought resistant; may spread; female plants attract pollinators; provides vertical interest; needs something for support
vine	*Parthenocissus quinquefolia*	Virginia creeper	1 gal	n	Native to eastern and central USA; grow in full sun to part shade; can use as ground cover for erosion; do not grow in areas where other vegetation may be choked out as it is aggressive; ideal for sound wall coverage and other

Life form	Botanical name (common synonym)	Common name (frequently used synonym)	Preferred planting form	Native (y=yes, n=no)	Notes
					vertical interest; sticks to substrate; plant in permanent location; moderate salt tolerance

Moist dense naturalized forest

The intent of this plant list is to add vegetation cover and plant biodiversity into a moist shaded forest habitat type. Unlike restoration of a native plant community where the goal is to increase the amount of indigenous vegetation and make the area more closely resemble the reference habitat community, this attempts to:

- increase plant cover;
- reduce undesirable vegetation;
- increase forage for pollinators;
- reduce invasive agronomic grass cover;
- increase suckering of trees and shrubs;
- increase forest regeneration; and,
- re-establish vegetation strata layers.

An example of this type of situation would be an older, dense, moist BirthPlace forest where the mulch has decomposed. Often, these areas require some type of revegetation after the mulch has disintegrated as weeds tend to come in and colonize these areas and available resources cannot keep up with weeding.

It is very important to note that many of these non-native aggressive groundcovers, commonly used in gardens, will be invasive in certain situations. It is not recommended to use these non-native ground covers in areas that are adjacent to natural areas; however, they would be appropriate for forested areas that are isolated from natural areas, such as BirthPlace forests that are in parks where the majority of the park is manicured, except for the forested area.

Life form	Botanical name (common synonym)	Common name (frequently used synonym)	Preferred planting form	Native (y=yes, n=no)	Notes
fern	*Adiantum spp.*	maidenhair fern	1 gal	n	Numerous species/cultivars commercially available; native is rare so what is available is unlikely sourced from rare population
fern	*Matteuccia orientalis*	ostrich fern (fiddle head fern)	1 gal	n	Cultivar; similar growth habit and preferred habitat as native species; commercially available
fern	*Matteuccia struthiopteris*	ostrich fern	1 gal	y	Naturally occurs west of the Calgary area; ostrich ferns are often planted in moist shade gardens within the city
fern	*Matteuccia struthiopteris 'The King'*	the king ostrich fern	1 gal	n	Cultivar; similar growth habit and preferred habitat as native species; commercially available
forb	*Actaea rubra*	red and white baneberry	plug	y	Localized to more moist dense forest types in Calgary's foothills and parkland Natural Subregions; HCR forest health indicator species
forb	*Actea simplex 'Black Negligee'*	black negligee snakeroot	1 gal	n	Foliage matures from emerald green to deep dark purple; white flower spikes stand above foliage; does not appear to volunteer
forb	*Aegopodium podagraria 'Variegata'*	variegated Bishop's goutweed	1 gal+	n	Can be invasive; provides an attractive ground cover in sun to partial shade to shade; would not be appropriate unless contained by manicured areas or infrastructure
forb	*Agastache foeniculum*	giant hyssop	plug	y	Can withstand light partial shade; prefers

Life form	Botanical name (common synonym)	Common name (frequently used synonym)	Preferred planting form	Native (y=yes, n=no)	Notes
					richer soils; more of a parkland and foothills species
forb	*Allium schoenoprasum*	wild chives	plug	y	Can spread unwantedly; prefers moister areas
forb	*Anemone canadensis*	Canada anemone	plug	y	Can be in forests or moister grasslands; HCR forest health indicator species
forb	*Aquilegia spp.*	columbine	1 gal	n	Ensure cultivar is shade tolerant; may have some salinity tolerance
forb	*Astilbe spp.*	goat's beard	1 gal	n	Showy flowers; appears to do well in shade gardens within the Calgary area
forb	*Bergenia spp.*	bergenia	1 gal	n	Do well in the Calgary area; seem somewhat drought tolerant once established
forb	*Brunnera macrophylla*	false forget-me-not	1 gal	n	Prefers moist rich soil; ensure variegated variety does not get afternoon sun as leaves are more sensitive; good for naturalizing a woodland
forb	*Campanula rotundifolia*	harebell	plug	y	Appropriate for all habitat types, except for very shady areas
forb	*Cerastium tomentosum*	snow-in-summer	1 gal	n	More suitable to microclimate with more light; does seem to tolerate shade, although does not do as well in shade it still could provide weed mitigation, especially as taller strata layers establish
forb	*Convallaria majalis*	lily-of-the-valley	1 gal	n	Will readily spread and may be invasive; provides flowering

Life form	Botanical name (common synonym)	Common name (frequently used synonym)	Preferred planting form	Native (y=yes, n=no)	Notes
					dense ground cover; thrives in shade
forb	*Cornus canadensis*	bunchberry	plug	y	Suitable for the shadier microclimates of the forest
forb	*Dicentra spectabilis*	bleeding-heart	1 gal+	n	Many cultivars available with various flower colours and leaf shapes; does well in full to partial shade
forb	*Disporum trachycarpum*	fairy-bells	plug	y	Indicator for forest health in HCR model
forb	*Eurybia conspicua*	showy aster	plug	y	May be dominant forb on forest floor; occurrences are higher in northwestern areas of Calgary
forb	*Fragaria spp.*	strawberry	1 gal	n	Cultivated strawberries readily spread through stolons and function as a groundcover; the cultivated varieties appears to be more aggressive; ensure variety is suitable for the Calgary area
forb	*Fragaria virginiana*	wild strawberry	plug	y	Generally not present in very shaded areas; makes a good early successional ground cover in restoration; will decrease in population after forest becomes more dense
forb	*Galium odoratum*	sweet-scented bedstraw (sweet woodruff)	1 gal	n	Commercially available shade tolerant groundcover; does not seem to volunteer
forb	*Galium triflorum*	sweet-scented bedstraw	plug	y	In Calgary, found in moist shady forests in the northwest section of the city

Life form	Botanical name (common synonym)	Common name (frequently used synonym)	Preferred planting form	Native (y=yes, n=no)	Notes
forb	*Gentianella amarella*	felwort (northern gentian)	plug	y	Tends to grow in slightly more open microclimates of moist dense forests
forb	*Geranium richarsonii*	wild white geranium	plug, seed	y	Prefers moist areas
forb	*Geum aleppicum*	yellow avens	plug	y	Plug recommended due to seed handling issues; appropriate for more open areas of moist dense forest
forb	*Heracleum maximum*	cow parsnip	plug, 1 gallon	y	Can be a dominant forb within forests
forb	*Heuchera spp.*	coral bells	1 gal	n	Native species prefers full sun; cultivars are very shade tolerant; ensure cultivar is appropriate for habitat type
forb	*Hosta spp.*	hosta	1 gal	n	Shade tolerant; many cultivars with different foliage and flower aesthetics available commercially
forb	*Lamium maculatum 'Anne Greenway'*	Anne Greenway dead nettle	1 gal	n	May be invasive; attractive flowers; provides pollinator forage
forb	*Lathyrus ochroleucus*	cream-colored vetchling	plug, seed	y	Suggesting plug so that seed is not outcompeted by other restoration species; restoration through seed showed promising preliminary results in Calgary in the past; HCR forest health indicator species
forb	*Lathyrus venosus*	purple peavine	plug	y	Indicator for forest health in HCR; less common in Calgary than cream-coloured vetchling as prefers

Life form	Botanical name (common synonym)	Common name (frequently used synonym)	Preferred planting form	Native (y=yes, n=no)	Notes
					more moist shadier wooded areas
forb	*Ligularia spp.*	Ligularia	1 gal	n	Ensure species is appropriate for Calgary area; tall yellow spikes of flowers attract pollinators
forb	*Lilium philadelphicum*	western wood lily	plug, 1 gal	y	Occurs in open microclimates of moist denser forests within Calgary; localized to the western edge of the city; somewhat more challenging to propagate so source from a reputable vendor as potted material
forb	*Maianthemum stellatum* (*Smilacina stellata*)	star-flowered Solomon's-seal (star-flowered false Solomon's-seal)	plug	y	Very common forb; found in many different habitat types
forb	*Moneses uniflora*	one-flowered wintergreen	plug	y	Indicator for forest health in HCR model; toothing on leaves is helpful for identification if not in flower
forb	*Orthilia secunda*	one-sided wintergreen	plug	y	Indicator for forest health in HCR model; dark green glossy leaves aid in identification if not in flower
forb	*Pedicularis bracteosa*	western lousewort	plug	y	Appropriate for moist shady forests on the far western edge of Calgary; difficult to establish due to the host requirement; would add biodiversity to landscape
forb	*Petasites frigidus*	coltsfoot	plug	y	In Calgary, this species tends to grow in moist

Life form	Botanical name (common synonym)	Common name (frequently used synonym)	Preferred planting form	Native (y=yes, n=no)	Notes
					forests but will also grow in open moist areas elsewhere; 4 varieties which differ based on leaf shape
forb	*Pulmonaria longifolia 'Bertram Anderson'*	Bertram Anderson lungwort	1 gal	n	Drought tolerant once established; provides pollinator forage
forb	*Pyrola asarifolia*	common pink wintergreen	plug	y	Indicator for forest health in HCR model; most commonly observed wintergreen in Calgary
forb	*Pyrola chlorantha*	greenish-flowered wintergreen	plug	y	Indicator for forest health in HCR model
forb	*Solidago canadensis*	Canada goldenrod	seed, plug	y	Suitable for areas with more light penetration; provides late season forage for pollinators
forb	*Solidago gigantea*	late (tall) goldenrod	seed, plug	y	Suitable for areas with more light penetration
forb	*Symphyotrichum ciliolatum*	Lindley's aster	plug	y	Replaces smooth aster as areas become more forested, moist and shady
forb	*Symphyotrichum lanceolatum*	western willow aster	plug, seed	y	Grows in open moist areas as well as more shaded areas
forb	*Vicia americana*	American vetch	seed, plug	y	Common in grasslands and forests; seed is available but moderately expensive
forb	*Viola canadensis*	western Canada violet (Canada violet)	plug	y	Generally absent from far east end of Calgary; prefers slightly more moisture and shade than early blue violet; common in foothills and parkland open forest/forest edges

Life form	Botanical name (common synonym)	Common name (frequently used synonym)	Preferred planting form	Native (y=yes, n=no)	Notes
forb	*Zigadenus elegans*	white (mountain) camas	plug	y	Somewhat poisonous to livestock; although seems to prefer open woods, it is present in denser woodlands in the west side of the city
forb shrub (dwarf)	*Mertensia paniculata*	tall lungwort	plug	y	Grows in very damp shady forests on the western side of Calgary (e.g., Weaselhead Flats); spreads vegetatively as well as by seed; pollinated by bumble bees
forb/ shrub (dwarf)	*Rubus pubescens*	dewberry (dwarf red raspberry) (trailing raspberry)	1 gal, plug	y	Makes and excellent groundcover; provides forage for wildlife
grass	*Bromus ciliatus*	fringed brome	seed	y	Forest species; good native competitor so it is often used in restoration of other habitat types like mesic grasslands
grass	*Elymus glaucus*	smooth (blue) wild rye	seed	y	Very good for restoration as it is an excellent competitor and can tolerate a wide range of conditions; ensure cultivar is not procured for native plant restoration
grass	*Elymus trachycaulus spp. subsecundum*	awned wheatgrass	seed	y	Similar characteristics to slender wheatgrass
grass	*Elymus trachycaulus ssp. trachycaulus*	slender wheatgrass	seed	y	Ensure that source is known to ensure suitability and degree of nativity; most often observed in open areas but shade tolerant; short-lived and provides

Life form	Botanical name (common synonym)	Common name (frequently used synonym)	Preferred planting form	Native (y=yes, n=no)	Notes
					early successional cover which allows other later successional species to establish
grass	*Leymus innovatus*	hairy wild rye	plug	y	Seed is not readily available as germination is poor and ergot can be problematic; generally not used in restoration due to supply issues but a possible species to add biodiversity; naturally grows sporadically in forested areas; tends to not persist with disturbance
grass	*Nasella viridula*	green needle grass	seed	y	Appropriate for sunnier forest openings but appears to tolerate shade and found naturally in fairly dense forest within Calgary's northwest quadrant
grass	*Pascopyrum smithii*	western wheatgrass	seed	y	Tolerates moderate shade and found sporadically in Calgary's northwest forests
grass	*Poa interior*	inland bluegrass	seed, plug	y	A good addition to seed mixes and restoration plans for forested areas; not readily available but may want to use to maintain forest integrity and biodiversity versus to achieve cover; fowl bluegrass is more commonly used in restoration; in Calgary, inland bluegrass tends to only be in the moister

Life form	Botanical name (common synonym)	Common name (frequently used synonym)	Preferred planting form	Native (y=yes, n=no)	Notes
					shadier forested areas within the northwest
grass	*Poa palustris*	fowl bluegrass	seed	y	Common on wetland edges; prefers moisture but is very drought tolerant; provides good coverage and weed suppression in restoration applications; withstands open sun to partial shade
shrub	*Amelanchier alnifolia*	Saskatoon	1 gal	y	Excellent for wildlife (e.g., birds, pollinators and grazing animals); provides understory coverage
shrub	*Cornus sericea 'Cardinal'*	cardinal red twig dogwood	1 gal	n	Hardy in the Calgary area; prefers moist soil; bright red bark
shrub	*Cornus sericea 'Flaviramea'*	yellow twig dogwood	1 gal	n	Hardy in the Calgary area; prefer moist soil; bright yellow bark
shrub	*Cornus stolonifera*	red-osier dogwood	1 gal	y	Tolerates full sun to partial shade; requires moist conditions; often a dominant understory shrub
shrub	*Elaeagnus commutata*	wolfwillow	1 gal	y	Do not plant near hard infrastructure as suckers will break pathways and sidewalks
shrub	*Juniperus communis*	ground (common) juniper	1 gal, plug	y	Grows in open to dense forests and open slopes associated with foothills or parkland; quite drought tolerant; spreads but not invasive; take caution to not buy a cultivar/nativar if the native species is desired

Life form	Botanical name (common synonym)	Common name (frequently used synonym)	Preferred planting form	Native (y=yes, n=no)	Notes
shrub	*Lonicera dioica*	twining honeysuckle	1 gal	y	Common in mesic to moist forest city-wide; attractive plant and can be used in applications to increase the aesthetic appeal of the site; has a vine-like growth habit and will grow up fences and other vegetation; not invasive as does not smother other vegetation; HCR forest health indicator species
shrub	*Lonicera involucrata*	bracted honeysuckle	1 gal	y	Prefers moist shady woods; to be used in the western-most parts of the city
shrub	*Physocarpus spp.*	ninebark	1 gal+	n	Many cultivars available; ensure cultivar is appropriate for habitat type and Calgary area
shrub	*Prunus pensylvanica*	pin cherry	1 gal	y	Prefers sandy soils and as such, more common in areas with sand deposition such as within flood plains
shrub	*Prunus virginiana*	choke cherry	1 gal	y	Common in mesic grasslands to dense forests within the Calgary area; provides important pollinator and bird forage; one of the first species to flower in the spring
shrub	*Ribes aureum*	golden currant	plug, 1 gal	y	Important source of early season forage for native bees and other pollinators; fruit attracts wildlife; fruit is edible; prefers moist soil but generally can withstand drought; flowers have

Life form	Botanical name (common synonym)	Common name (frequently used synonym)	Preferred planting form	Native (y=yes, n=no)	Notes
					strong fragrance; thorns absent; common along the Elbow River approximately 30 years ago; prefers sunnier locations but was observed in the past growing in shady thickets along the river
shrub	*Ribes oxyacanthoides*	northern gooseberry	plug, 1 gal	y	Important source of early season forage for native bees and other pollinators; fruit attracts wildlife; fruit is edible; prefers moist soil but generally can withstand drought; prefers full sun to partial shade but can be found sporadically in shady forests
shrub	*Rosa acicularis*	prickly rose	1 gal	y	This species is more suitable for the foothills and parkland areas of Calgary
shrub	*Rosa woodsii*	common wild rose	1 gal	y	This species is more suitable for the prairie areas of Calgary but can be found city-wide
shrub	*Rubus idaeus*	wild red raspberry	1 gal	y	More common in the western parts of Calgary; volunteer plants are often cultivars and are more aggressive; spreads easily; native species grows in both dry open forest and dense moist forest
shrub	*Salix pentandra*	laurel willow	plug, 1 gal+	n	Will volunteer; prefers moist ground but drought tolerant once established; very large and tree-like

Life form	Botanical name (common synonym)	Common name (frequently used synonym)	Preferred planting form	Native (y=yes, n=no)	Notes
shrub	*Sambucus racemosa*	red elderberry	1 gal	y	Localized to moist forest in the north/west areas of the city
shrub	*Shepherdia canadensis*	Canada buffaloberry	1 gal	y	Grows in open dry forests, dry slopes on forest edges and shady moist forests; flowers are some of first to open in the spring and open prior to leaves
shrub	*Sorbus scopulina*	western mountain ash	1 gal	y	Do not confuse it with European mountain-ash which spreads readily and can be considered invasive; fruit attracts waxwings; appropriate for most western areas of Calgary
shrub	*Symphoricarpos albus*	snowberry	1 gal	y	Not as weedy as buckbrush; grows in healthier shady forests and thickets
shrub	*Viburnum opulus spp. trilobum*	high-bush cranberry	1 gal	y	Occurs in more boggy forest types in Calgary; fairly uncommon, likely due to watercourse channelization and wetland disturbance; provides good wildlife habitat and forage as fruit often remains throughout winter; large population present in Elbow Island Park; ensure that native species is procured
shrub (dwarf)	*Arctostaphylos uva-ursi*	common bearberry	1 gal, plug	y	Effective as a ground cover; prefers more open areas but observed in shady moist forest within the city; HCR grassland health indicator species

Life form	Botanical name (common synonym)	Common name (frequently used synonym)	Preferred planting form	Native (y=yes, n=no)	Notes
shrub (dwarf)	*Linnaea borealis*	twinflower	plug, 1 gal	y	Excellent fragrant groundcover; prefers foothills and parkland areas of the city
shrub (dwarf)	*Spiraea betulifolia*	white meadowsweet	plug, 1 gal	y	Cultivated spiraeas are very common and need to ensure origin; occurs from beltline west in open and shady forests
tree	*Betula occidentalis*	water birch	1 gal	y	Very common in all forest types and along shores in Calgary
tree	*Picea pungens*	Colorado (blue) spruce	1 gal+	n	Drought tolerant once established; could be used as a substitute for white spruce in a naturalized habitat type
tree	*Pinus contorta*	lodgepole pine	plug, 1 gal	y	Not common in the Calgary area but scattered trees occur in the most western portion of the city within dense forested areas and on north-facing slopes; tree-planting style plugs for reforestation are available for mass plantings
tree	*Populus balsamifera*	balsam poplar	plug, 1 gal	y	Ensure native species versus cultivar/nativar as desired; smaller trees have a higher survival rate as they do not get as shocked when planted; larger sized trees can be planted but shock needs to be mitigated for with consistent watering; very common
tree	*Populus tremuloides*	(trembling) aspen	plug, 1 gal	y	Present in open forest but tends to prefer denser forests in

Life form	Botanical name (common synonym)	Common name (frequently used synonym)	Preferred planting form	Native (y=yes, n=no)	Notes
					parkland and foothills habitat types
tree	*Pseudotsuga menziesii*	Douglas-fir	plug, 1 gal	y	Calgary's northwest contains the eastern-most population of this species; population appears to be decreasing with white spruce replacing the evergreen component in the forest type; restoration activities for this species need to consider local genetics and if the population will persist
vine	*Clematis occidentalis*	purple clematis	1 gal	y	Can add diversity to forest structure due to its vining growth form
vine	*Humulus lupulus*	common hop	1 gal	n	Grows very large; tolerates full sun to partial shade; drought resistant; may spread; female plants attract pollinators; appropriate for sunnier microclimates; provides vertical interest; needs support structure

Xeric naturalized grassland

The plant species listed below are for restoration work in xeric grassland where the goal of the restoration is to ensure a self-sustaining landscape. The goal of the landscape is not to increase nativity but, rather, provide plant cover and increase aesthetics. Additional biodiversity and pollinator forage will provide other ecological benefits to this landscape.

These types of grasslands occur much more commonly in the eastern parts of the city. These areas are often characterized by soils with less organic content that retain little moisture. Xeric grasslands containing more native species are characterized by shorter vegetation. If an area that naturally would have had a xeric prairie grassland reference vegetation community has been compromised by disturbance, naturalization using a combination of hardy cultivars and native plant

species may be the most effective option to create a low input landscape that is resistant to weed populations. This is similar to xeriscaping where drought tolerant plants are used in a garden setting; however, the aim of this landscape is to provide some sort of functional vegetation cover that improves our urban ecosystem while decreasing maintenance.

The plants in the list below can withstand poor soils and some disturbance pressure, whether it be adjacent or direct, such as foot traffic. Depending on the situation and site-specific goals, a combination of hardy native plants and non-native cultivars may be used. Lastly, some species that are not commonly found within the city but are present in Alberta are also suggested as they are very tolerant of drought, poor soils, disturbance and do not require ongoing inputs to thrive.

Life form	Botanical name (common synonym)	Common name (frequently used synonym)	Preferred planting form	Native (y=yes, n=no)	Notes
forb	*Achillea millefolium*	common yarrow	plug, seed	y	Can withstand highly disturbed areas; drought tolerant; spreads readily vegetatively; often first to establish in harsh environments with poor soils
forb	*Achillea millefolium* '*Apple Blossom'*	Apple Blossom yarrow	1 gal, seed	n	Soft pink coloured blooms
forb	*Achillea millefolium 'Cerise Queen'*	cerise queen yarrow	1 gal, seed	n	Cherry pink coloured blooms
forb	*Achillea millefolium 'Laura'*	Laura yarrow	1 gal, seed	n	Laura yarrow is red with white centres
forb	*Achillea millefolium* 'Paprika'	paprika yarrow	1 gal, seed	n	Paprika yarrow is brightly red coloured with orange centres; shorter compact growth habit than common yarrow
forb	*Achillea millefolium 'Peggy Sue'*	Peggy Sue yarrow	1 gal, seed	n	Apricot-orange coloured blooms
forb	*Achillea millefolium 'Red Beauty'*	red beauty yarrow	1 gal, seed	n	Bright red coloured blooms
forb	*Achillea millefolium 'Red Velvet'*	red velvet yarrow	1 gal, seed	n	Deep rose coloured blooms; colour fades very little with time

Life form	Botanical name (common synonym)	Common name (frequently used synonym)	Preferred planting form	Native (y=yes, n=no)	Notes
forb	*Achillea millefolium 'Summer Pastels'*	summer pastels yarrow	1 gal, seed	n	Multicoloured flowers that range from white to cream, yellow, pink, salmon and mauve
forb	*Achillea millefolium 'Terracotta'*	terracotta yarrow	1 gal, seed	n	Flowers change from salmon-pink to rusty terracotta orange to creamy yellow
forb	*Alcea rosea*	hollyhock	seed	n	Readily self-seeds
forb	*Allium textile*	prairie onion	plug	y	Found in dry open prairie; appropriate for east side of Calgary
forb	*Anemone cylindrica*	long-fruited anemone	plug	y	Similar to cut-leaved anemone preferences
forb	*Anemone multifida*	cut-leaved anemone	plug	y	More drought tolerant than Canada anemone; prefers more sun than Canada anemone
forb	*Anemone patens*	prairie crocus	plug	y	Ensure taller vegetation will not outcompete and smother prairie crocus; excellent early season pollinator forage; do not confuse with commercially available crocus bulbs
forb	*Antennaria parvifolia*	small-leaved everlasting	plug, seed	y	Colonizes open areas such as upper escarpments, trail edges and blowouts; great groundcover as forms matts; requires full sun; will come up from seed but requires a few years to germinate, mature and flower
forb	*Arnica fulgens*	shining arnica	plug	y	Prefers full sun
forb	*Artemisia frigida*	pasture sagewort (sage)	plug	y	Tends to increase with grazing in xeric grasslands; use with

Life form	Botanical name (common synonym)	Common name (frequently used synonym)	Preferred planting form	Native (y=yes, n=no)	Notes
					caution as it is an increaser species
forb	*Artemisia ludoviciana*	prairie sagewort (sage)	plug	y	Seed difficult to harvest; readily spreads vegetatively
forb	*Asclepias speciosa*	showy milkweed	plug	y	Only genus that monarch caterpillars feed on; drought tolerant; can form large patches
forb	*Astragalus agrestis*	purple milkvetch	plug, seed	y	Can withstand mowing; seems to persist in seed bank; appears to spread by seed in disturbed areas
forb	*Astragalus bisulcatus*	two-grooved milkvetch	plug	y	All milkvetches benefit pollinators; drought tolerant; quite showy
forb	*Astragalus crassicarpus*	ground-plum	plug	y	As with other milkvetches, it is good pollinator forage
forb	*Astragalus pectinatus*	narrow-leaved milkvetch	plug	y	Very drought tolerant; may have some salinity tolerance
forb	*Campanula rotundifolia*	harebell	plug	y	Only plant that one native bee feeds on in Alberta; spreads readily; blooms throughout the growing season
forb	*Centaurea cyanus*	cornflower (bachelor buttons)	seed	n	Annual; self-seeds; use care as may be invasive; suitable for early successional ground cover
forb	*Centaurea montana*	mountain star-thistle	seed, 1 gal	n	May be invasive; use caution with this plant
forb	*Cerastium tomentosum*	snow-in-summer	plug, 1 gal	n	Somewhat salt tolerant; very drought tolerant once established; caution advised as once established, this plant

Life form	Botanical name (common synonym)	Common name (frequently used synonym)	Preferred planting form	Native (y=yes, n=no)	Notes
					can spread into unwanted areas; recommend keeping it contained
forb	*Cherianthus allionii*	Siberian wallflower	seed	n	Generally does not bloom the first growing season; does not volunteer often but may naturalize so caution advised
forb	*Cirsium undulatum*	wavy-leaved thistle	seed, plug	y	Generally not used in restoration due to the abundance of weedy non-native thistles; provides forage for pollinators and seeds for birds; not invasive; population is likely decreasing due to control efforts targeting other thistles and mistakenly targeting wavy-leaved thistle; requires full sun
forb	*Coryphantha vivipara*	cushion cactus	plug	y	Generally found east of Calgary; prefers rocky soils; seems to be somewhat saline tolerant; persists in remnant prairie with adjacent roadsides; good for areas that need self-sustaining vegetation but lack human access
forb	*Cosmos spp.*	cosmos	seed	n	Annual; self-seeds if seed heads are left to mature; very drought tolerant; does well in poor soils; somewhat salt tolerant
forb	*Cymopterus glomeratus*	plains spring parsley	plug	y	Early season pollinator forage; very short and

Life form	Botanical name (common synonym)	Common name (frequently used synonym)	Preferred planting form	Native (y=yes, n=no)	Notes
					requires sunny location so cannot be paired with dense tall plantings; can function as a groundcover
forb	*Dalea purpurea*	purple prairie clover	plug, seed	y	Drought resistant; nitrogen fixing as it is a legume; requires ~4 years to establish and grow from seed
forb	*Dianthus barbatus*	sweet William	seed	n	Establishes well from seed; readily spreads; tolerates full sun to partial shade
forb	*Dracocephalum thymiflorum*	thyme-leaved dragonhead	seed, plug	n	Will colonize bare disturbed areas; not weedy in the Calgary-area; appears to be somewhat salt tolerant; highly drought tolerant; attracts pollinators
forb	*Echinops ritro*	globe thistle	1 gal	n	Salt and drought tolerant; will self-seed; use caution as may volunteer into unwanted areas
forb	*Erigeron caespitosus*	tufted fleabane	plug	y	Common in dry open grassland
forb	*Erigeron philadelphicus*	Philadelphia fleabane	seed, plug	y	Germinates well from seed
forb	*Eriogonum flavum*	yellow umbrella-plant	plug	y	Prevalent on open dry slopes in prairie grassland
forb	*Eryngium planum*	cross-thistle (sea holly)	seed, 1 gal	n	May volunteer in unwanted areas
forb	*Eschscholzia californica*	California poppy	seed	n	Annual; somewhat saline tolerant; seed easily available
forb	*Fragaria spp.*	strawberry	1 gal	n	Cultivated strawberries readily spread through stolons and function as a groundcover; the

Life form	Botanical name (common synonym)	Common name (frequently used synonym)	Preferred planting form	Native (y=yes, n=no)	Notes
					cultivated varieties appears to be more aggressive; ensure variety is suitable for the Calgary area
forb	*Fragaria virginiana*	wild strawberry	plug	y	Excellent ground cover; spreads by stolons
forb	*Gaillardia aristata*	gaillardia (blanket-flower)	plug, 1 gal	y	Ensure using native plant vs. nativar in native restoration situations; HCR grassland health indicator
forb	*Galium boreale*	northern bedstraw	plug	y	Withstands shade and full sun; drought tolerant; one of last native plants to die out with disturbance
forb	*Geum triflorum*	three-flowered avens	plug	y	Ensure it does not get shaded out during restoration planning; indicator of healthy grassland in the Calgary area through the HCR model
forb	*Glycyrrhiza lepidota*	wild licorice	plug	y	Prefers well drained areas with periodic moisture such as edges of escarpments
forb	*Grindelia squarrosa*	curly-cup gumweed	plug	y	Very important resource for pollinators; salt and drought tolerant; not thought of for decorative purposes but the flowers are yellow, daisy-like and showy
forb	*Hedysarum boreale*	northern hedysarum	plug, seed	y	More drought tolerant than alpine hedysarum; takes ~4 years to grow and flower from collected

Life form	Botanical name (common synonym)	Common name (frequently used synonym)	Preferred planting form	Native (y=yes, n=no)	Notes
					seed due to hard seed coat; dark pink flowers; population extends more east in Calgary than alpine hedysarum
forb	*Helianthus annuus*	common annual sunflower	seed	y	Annual so needs to be able to self-seed; can be used as somewhat of an early succession cover crop; ensure genetic origin is known as most annual sunflowers are cultivars that have been bred extensively for the horticultural industry; can grow in very poor soils or substrates with little to no topsoil (e.g., road crush); very drought tolerant
forb	*Helianthus annuus* cultivar	annual sunflower	seed	n	Many annual sunflower cultivars exist; saline tolerance differs between cultivars
forb	*Helianthus maximilianii*	narrow-leaved sunflower	seed	n	Readily colonizes roadsides in southeast Alberta; aggressive; salt and drought tolerant
forb	*Helianthus pauciflorus ssp. subrhomboideus*	rhombic-leaved sunflower	plug	y	Drought and disturbance tolerant; very good late season pollinator forage
forb	*Helianthus petiolaris*	prairie sunflower	seed	y	Similar to common annual sunflower
forb	*Heterotheca villosa*	golden aster (hairy golden aster)	plug, seed	y	Usually found in small patches; low in stature and aids as a groundcover; drought

Life form	Botanical name (common synonym)	Common name (frequently used synonym)	Preferred planting form	Native (y=yes, n=no)	Notes
					tolerant; some salt tolerance
forb	*Heuchera spp.*	coral bells	1 gal	n	Many hardy varieties of coral bells exist; varieties are tolerant of full sun to full shade; ensure cultivar is suited to habitat conditions
forb	*Liatris punctata*	dotted blazingstar	plug, seed	y	Establishes from seed but takes multiple years to flower; can withstand taller adjacent vegetation once established; HCR grassland health indicator species
forb	*Linum lewisii*	blue flax	seed	y	Very hardy; provides excellent early coverage; aesthetically pleasing; good forage for native pollinators; germinates quickly; inexpensive
forb	*Linum rigidum*	yellow flax	seed, plug	y	Lower growing than blue flax; much less common in Calgary than blue flax but present on xeric slopes (e.g., Tuscany)
forb	*Lithospermum incisum*	narrow-leaved puccoon	plug	y	Less common in Calgary than woolly gromwell; prefers drier more open sites
forb	*Lotus corniculatus*	bird's-foot trefoil	seed	n	Use caution as it can be weedy; drought and salt tolerant; provides forage to pollinators; good reclamation option for areas where other plants will not grow

Life form	Botanical name (common synonym)	Common name (frequently used synonym)	Preferred planting form	Native (y=yes, n=no)	Notes
forb	*Maianthemum stellatum* (*Smilacina stellata*)	star-flowered Solomon's-seal (star-flowered false Solomon's-seal)	plug	y	Very common forb; found in many different habitat types
forb	*Musineon divaricatum*	leafy musineon	plug	y	Early season pollinator forage; very short and requires sunny location so cannot be paired with dense tall plantings; can function as a groundcover
forb	*Nepeta spp.*	catmint	1 gal	n	Reliable perennial; hardy
forb	*Oenothera suffrutescens* (*Gaura coccinea*)	scarlet butterflyweed (scarlet gaura)	plug	y	Very drought tolerant; readily comes up after spring rains on the edges of dirt roads; salt and drought tolerant; likely pollinated primarily by moths at night
forb	*Onobrychis viciifolia*	sainfoin	seed	n	Use caution as it can be weedy; drought and salt tolerant; provides forage to pollinators; good reclamation option for areas where other plants will not grow
forb	*Opuntia fragilis*	brittle prickly-pear (jumping cactus)	plug	y	Generally found east of Calgary; seems to be somewhat saline tolerant; good for areas that need self-sustaining vegetation but lack human access; often breaks off when disturbed
forb	*Opuntia polyacantha*	prickly-pear	plug	y	Generally found east of Calgary; seems to be somewhat saline

Life form	Botanical name (common synonym)	Common name (frequently used synonym)	Preferred planting form	Native (y=yes, n=no)	Notes
					tolerant; good for areas that need self-sustaining vegetation but lack human access
forb	*Oxytropis sericea*	early yellow locoweed	plug	y	Drought tolerant; will handle being mowed; frequently comes up in areas that are mowed only periodically later in the season; seeds in seed bank persist
forb	*Oxytropis splendens*	showy locoweed	plug	y	Very drought tolerant; prefers more xeric microclimates with short vegetation; common along dry areas with little soil organics (e.g., sandy, gravelly and silty shores); HCR grassland health indicator species
forb	*Packera cana* (*Senecio canus*)	prairie groundsel	plug	y	Prefers open dry prairie; attractive silver foliage and yellow flowers
forb	*Papaver nudicaule*	Iceland poppy	seed	n	Can colonize very poor soil; appears to be somewhat salt tolerant as has naturally colonized alleyways in the city
forb	*Penstemon nitidus*	smooth blue beardtongue	plug	y	Naturally found on sparsely vegetated xeric escarpments in Calgary
forb	*Perovskia atriplicifolia*	Russian sage	seed, 1 gal	n	Requires watering for establishment if used in potted form
forb	*Perovskia atriplicifolia*	Russian sage	1 gal, seed	n	Moderately salt tolerant and tolerates dry to average moisture levels; good

Life form	Botanical name (common synonym)	Common name (frequently used synonym)	Preferred planting form	Native (y=yes, n=no)	Notes
					for median beds and traffic circles
forb	*Phlox hoodii*	moss phlox	plug	y	Great groundcover; needs sun so cannot be paired with other tall dense plantings; provides early season pollinator forage; ensure that it is the native species as many cultivars are available
forb	*Phlox subulata*	moss (creeping) phlox	plug, 1 gal	n	Some salt tolerance; drought tolerant; many cultivars available at garden centres/nurseries; most commonly has pink flowers; flowers in late spring/early summer; requires full sun to light shade
forb	*Potentilla concinna*	early cinquefoil	plug	y	One of the first plants to bloom in spring
forb	*Potentilla pensylvanica*	prairie cinquefoil	plug	y	Native pollinator forage; aesthetically pleasing
forb	*Psoralea esculenta*	Indian breadroot	plug	y	In Calgary, this species is an indicator of healthy grassland; usually not available but included as it is an indicator species in the HCR model
forb	*Ratibida columnifera*	prairie coneflower	plug, seed	y	Very drought tolerant; forage for native pollinators
forb	*Sedum acre*	'Goldmoss' stonecrop	plug, 1 gal	n	Excellent ground cover; volunteers in areas along back alleys and anywhere where other vegetation cannot compete due to thin

Life form	Botanical name (common synonym)	Common name (frequently used synonym)	Preferred planting form	Native (y=yes, n=no)	Notes
					poor soils; appears to be most salt tolerant of sedums; can be used in rock gardens and as a lawn replacement; often present in pre-grown sedum matts
forb	*Sempervivum tectorum*	hen and chicks (house leek)	plug	n	Tolerates thin poor soil; spreads vegetatively by offsets (e.g., chicks); forms ground cover; commercially available; prefers full sun; plant dies after blooming and can be removed to maintain ground cover but will still spread if no maintenance is performed; ensure cultivar is appropriate for growing zone
forb	*Solidago missouriensis*	low (Missouri) goldenrod	seed, plug	y	Ensure restoration plans take into account smaller stature of this goldenrod; very drought tolerant
forb	*Solidago rigida*	stiff goldenrod	plug	y	Grows in dry open areas; good late season pollinator forage
forb	*Sphaeralcea coccinea*	scarlet mallow	plug	y	Showy orange flowers; colonizes open dry prairie and roadsides; due to vegetative spread, it can act as a ground cover; drought tolerant with likely some salt tolerance
forb	*Stachys pectinata*	lamb's-ear	1 gal	n	Moderately salt tolerant and drought tolerant; fuzzy silver

Life form	Botanical name (common synonym)	Common name (frequently used synonym)	Preferred planting form	Native (y=yes, n=no)	Notes
					leaves provide texture to landscape design
forb	*Symphyotrichum ericoides*	tufted white prairie aster	seed, plug	y	Withstands mowing and other disturbances; very hardy
forb	*Symphyotrichum falcatum*	creeping white prairie aster	seed, plug	y	Establishes from seed; plugs speed up establishment; prefers open dry areas
forb	*Symphyotrichum laeve*	smooth aster	plug, seed	y	Very hardy and drought tolerant
forb	*Thermopsis rhombifolia*	golden bean	plug	y	Early season pollinator forage; can function somewhat as a ground cover
forb	*Thymus serpyllum*	creeping thyme	seed	n	Withstands drought; attractive groundcover; seed is readily available
forb	*Vicia americana*	American vetch	seed, plug	y	Common in grasslands and open woods; nitrogen fixing; seed is moderately expensive
forb	*Zigadenus venenosus*	death camas	plug	y	Very poisonous to livestock
grass	*Agrostis scabra*	rough hair grass (hair bentgrass)	seed	y	Drought tolerant; common on wetland edges; drought tolerant; not common in abundance in areas other than wetland edges, provides good native early to mid-successional coverage in restoration
grass	*Bouteloua gracilis*	blue grama	seed	y	Warm season grass and therefore, must ensure that cool season grasses do not outcompete it in restoration activities; mid-successional but

Life form	Botanical name (common synonym)	Common name (frequently used synonym)	Preferred planting form	Native (y=yes, n=no)	Notes
					slightly earlier successional than needle-and-thread and porcupine grass; does well from seed under the right conditions
grass	*Calamagrostis x acutiflora* Karl Foerster'	Karl Foerster Reed Grass	1 gal, 2 gal	n	Aesthetically pleasing feature plant in areas with drought and salt stress; use caution when overwintering in containers
grass	*Calamovilfa longifolia*	sand grass	seed	y	Excellent for sites with silty/sandy soils; very drought tolerant
grass	*Deschampsia cespitosa*	tufted hair grass	seed	y	Drought tolerant; highly tufted; can create drought tolerant "turf" if seeded at a very high rate so tufting is obscured; can withstand mowing after establishment
grass	*Elymus* hybrid	AC Saltlander green wheatgrass	seed	n	Very salt and drought tolerant; aggressive; bred from a naturally occurring wheatgrass hybrid; use caution and assess adjacent land use before using this plant
grass	*Elymus lanceolatus*	northern wheatgrass	seed	y	Will colonize drier microclimates in mesic prairie grassland
grass	*Elymus trachycaulus spp. subsecundum*	awned wheatgrass	seed	y	Similar characteristics to slender wheatgrass but not as aggressive; may be due to genetics or awns
grass	*Elymus trachycaulus spp. trachycaulus*	slender wheatgrass	seed	y	Many cultivars of slender wheatgrass exist; commercially available slender wheatgrass tends to

Life form	Botanical name (common synonym)	Common name (frequently used synonym)	Preferred planting form	Native (y=yes, n=no)	Notes
					be more aggressive than the wild type
grass	*Festuca campestris*	mountain (foothills) rough fescue	plug	y	Easily outcompeted; seed is usually wild collected as it is hard to propagate consistently; use with caution in areas that have the potential to be restored to rough fescue grassland (e.g., remnant fescue patches present, supported rough fescue grassland in the past, surrounded by rough fescue grassland, etc.); rare in urban and disturbed environments; plugs can be used to provide a competitive advantage
grass	*Festuca idahoensis*	bluebunch (Idaho) fescue	seed	y	Wild species has bluish coloured leaves; many cultivars have green versus blue foliage; looks similar to the non-native *Festuca ovina* 'Elijah blue'
grass	*Festuca ovina*	sheep fescue	seed	n	Salt and drought tolerant; more aggressive than Rocky Mountain fescue; 'Elijah blue' commonly used as decorative cultivar
grass	*Festuca saximontana*	Rocky Mountain fescue	seed	y	Provides early successional cover when used in a seed mix; retains green colour until late in season, sometimes

Life form	Botanical name (common synonym)	Common name (frequently used synonym)	Preferred planting form	Native (y=yes, n=no)	Notes
					even under snow; ungulates preferentially graze on this species and other native fescues during winter
grass	*Hesperostipa comata* (*Stipa comata*)	needle-and-thread	seed	y	Long awns make cleaning difficult; mid-succession species so if in a seed mix, requires early successional coverage to control weeds but not enough coverage to prevent establishment; could be planted as plugs to aid in establishment; less common in Calgary than western porcupine grass; other grasses it commonly grows alongside with include blue grama, green needlegrass, northern wheatgrass, June grass and Rocky Mountain fescue
grass	*Hesperostipa curtiseta* (Stipa curtiseta)	western porcupine grass	seed	y	Long awns make cleaning difficult; mid-succession species so if in a seed mix, requires early successional coverage to control weeds but not enough coverage to prevent establishment; could be planted as plugs to aid in establishment; more common in Calgary than needle-and-thread; other grasses it commonly

Life form	Botanical name (common synonym)	Common name (frequently used synonym)	Preferred planting form	Native (y=yes, n=no)	Notes
					grows alongside with include blue grama, green needlegrass, northern wheatgrass, June grass and Rocky Mountain fescue
grass	*Koeleria macrantha*	June grass	seed	y	Ensure that short stature of plant is considered during restoration work so that it is not shaded out by other species
grass	*Leymus arenarius*	blue lyme grass	seed	n	Some taxonomic confusion as often synonymous with smooth wild rye but this non-native species appears more robust and blue
grass	*Lolium multiflorum*	Italian (annual) ryegrass	seed	n	Establishes quickly; will persist if left to self-seed; intensive breeding has made this grass able to overwinter; can substitute perennial ryegrass
grass	*Lolium multiflorum*	Italian (annual) ryegrass	seed	n	Establishes quickly; drought and salt tolerant but less so than some other species; will self-seed and persist; intense propagation has made this species more able to overwinter and act as a perennial; can substitute perennial ryegrass
grass	*Nasella viridula*	green needle grass	seed	y	Very drought tolerant; colonizes open areas next to disturbances; tolerant of disturbance; awns can

Life form	Botanical name (common synonym)	Common name (frequently used synonym)	Preferred planting form	Native (y=yes, n=no)	Notes
					cause seeds to stick to clothing
grass	*Pascopyrum smithii*	western wheatgrass	seed	y	Prefers more moisture than northern wheatgrass; common in mesic grasslands
grass	*Poa palustris*	fowl bluegrass	seed	y	Common on wetland edges; prefers moisture but is very drought tolerant; provides good coverage and weed suppression in restoration applications
grass	*Pseudoroegneria spicata*	bluebunch wheatgrass	seed	y	Good for open xeric areas that require soil binding to prevent erosion; awnless variety better for restoration or alternatively, awned variety that has been cleaned to remove the awns
grass	*Puccinellia distans*	spreading alkali grass	seed	n	Very salt tolerant; native and introduced elements in the USA, northwest BC and Alaska
grass	*Puccinellia distans* 'Fults'	'Fults' alkali grass	seed	n	Variety cultivated from specimen at a golf course in the USA; very salt tolerant
grass	*Schizachyrium scoparium*	little bluestem	plug, seed	y	Restoration of this species which is provincially tracked on the Watch List may be desired if development is going to disturb a population; in xeric areas, this species forms rare vegetation communities with sand

Life form	Botanical name (common synonym)	Common name (frequently used synonym)	Preferred planting form	Native (y=yes, n=no)	Notes
					grass and blue grama which are provincially tracked
sedge	*Carex filifolia*	thread-leaved sedge	plug	y	May be the only plant in the area growing on steep, dry eroded slopes; may be beneficial in slope restoration
shrub	*Artemisia cana*	silver sagebrush	1 gal	y	Low growing attractive shrub with silver foliage; does well in Calgary area although naturally found southeast of the city
shrub	*Artemisia tridentata*	big sagebrush	1 gal	y	Taller than silver sagebrush; rare and provincially tracked in Alberta; found naturally in the far southwest corner of the province; commercial propagation of this species has occurred and plantings do very well in the Calgary area
shrub	*Dasiphora fruticosa*	shrubby cinquefoil	1 gal	y	One of the few common shrubs in xeric grasslands
shrub	*Hippophae rhamnoides* 'Indian Summer'	'Indian Summer' sea buckthorn	1 gal	n	Does not tolerate shady sites; cultivar is tolerant of drought and nutrient poor soils due to its ability to fix nitrogen; female plants produce fruit; provides early pollen source to pollinators and berries for birds in the winter; can be somewhat invasive; very similar

Life form	Botanical name (common synonym)	Common name (frequently used synonym)	Preferred planting form	Native (y=yes, n=no)	Notes
					in characteristics to thorny buffaloberry
shrub	*Lonicera dioica*	twining honeysuckle	1 gal	y	Although it is more common in forest, it is very tolerant of drought and full sun
shrub	*Ribes oxyacanthoides*	northern gooseberry	plug, 1 gal	y	Important source of early season forage for native bees and other pollinators; fruit attracts wildlife; fruit is edible; prefers moist soil but generally can withstand some drought; full sun to part shade tolerant
shrub	*Rosa arkansana*	prairie rose	plug, 1 gal	y	Common in grasslands and areas with little other vegetation cover; dies back to the ground each year; short in stature
shrub	*Salix brachycarpa 'Blue Fox'*	blue fox willow	1 gal	n	Drought tolerant; tolerates poor soils, full sun to part shade; some salinity tolerance; provides early season forage for pollinators
shrub	*Shepherdia argentea*	thorny buffaloberry	1 gal	y	Infrequent in grassland but small populations may occur; very drought tolerant; often found at the top of escarpments
shrub	*Symphoricarpos occidentalis*	buckbrush	1 gal	y	Tend to not use in restoration work unless nothing else will grow; increases and becomes weedy while out-competing other more desirable

Life form	Botanical name (common synonym)	Common name (frequently used synonym)	Preferred planting form	Native (y=yes, n=no)	Notes
					forage species; provides early season pollinator forage; do not confuse with snowberry
shrub (dwarf)	*Gutierrezia sarothrae*	broomweed	plug	y	Provides groundcover and forage to native pollinators
shrub (dwarf)	*Juniperus horizontalis*	creeping juniper	plug, 1 gal	y	Suitable for dry sandy slopes within xeric grassland; stabilizes soil
vine	*Humulus lupulus*	common hop	1 gal	n	Fair salt tolerance; very drought tolerant; can be used to add vertical interest and insulate sound walls; requires something to climb on; use caution when using this plant as it may volunteer in adjacent natural areas
vine	*Parthenocissus quinquefolia*	Virginia creeper	1 gal	n	Native to eastern and central USA; grow in full sun to part shade; can use as ground cover for erosion; do not grow in areas where other vegetation may be choked out as it is aggressive; ideal for sound wall coverage and other vertical interest; sticks to substrate; plant in permanent location; moderate salt tolerance

Salt and drought tolerant species for naturalized roadsides and boulevards

The intent of this plant list is provide a list of species that will do well in Calgary's challenging urban environment, specifically for areas that are along roadsides or pathways that are cleared in winter months. The form of restoration that occurs in these environments is generally along the continuum of reclamation to naturalization. It is highly unlikely that these environments can be transformed to a healthy native plant community due to ongoing disturbance and salt loading. Generally, it would be not a wise use of resources to attempt a full restoration on an area such as this.

As these types of areas contain very poor disturbed soils and often experience salt spray and salt loading, maintenance is an issue and tends to be very intensive, high input and expensive. This list attempts to outline plant species that do better in these harsh roadside conditions, versus standard roadside turf grass mixes. This is meant to reduce the maintenance costs and inputs while also increasing habitat value for wildlife such as pollinators. Depending on how severe the soil has been compromised as well as the weather, additional measures of site preparation will aid in plant establishment, although they are not necessary in many cases. Even if site preparation is rather extensive, the plants selected below are very hardy once established and will not require ongoing watering or soil inputs to thrive. Initial plant and installation cost may be high; however, ongoing costs significantly drop off after establishment.

Additionally, different degrees of salt tolerance are noted. Some plants that appear to have salt tolerance or moderate salt tolerance would be appropriate for traffic circles, road edges, pathway edges that experience de-icing activities and median planters. Species that have very high salt tolerance can be used on middle medians almost at road level and medians directly adjacent to high volume, heavy traffic roads where de-icing is a regular part of winter maintenance. Although species of varying heights and widths are recommended, plant selection must account for various height restrictions and setbacks to accommodate line of sight along roadways, in traffic circles and pathway setback distances.

In some cases, an occasional mowing and thatch removal will invigorate the plants but this would be done every few years, and often not at all, depending on the species. This can also aid in fire mitigation; however, many of the species listed below tend to not desiccate as early as standard turf species and as such, do not pose much of a fire risk in comparison to tall desiccated turf grass and unwanted weeds.

Although some of the species listed below are included in select types of turf mixes and sod, the plants that are cited below should not to be mowed on a regular basis like turf grass. Additionally, many of the turf species that have been used for these environments in the past seem to require ongoing maintenance and replacement as they come in adequately at first, then die off with time. This is because a lot of the research on these turf species comes from climates that are unlike ours where there may be salt loading but Chinooks are lacking so they do not experience the drought stress as they do in the Calgary area. The drought stress combined with taxonomic discrepancies

contribute to the issues with species that are advertised as salt and drought hardy where most of the research has come from the United States.

It is important to note that naturalized boulevards and roadsides can contain hardy native or non-native cultivars; however, the use of non-native species needs to be balanced by the risk of spread to other ecologically healthy areas, especially Natural Environment Parks. Species listed below are classified as to whether they are native to the area or if they are non-native. Notes are provided on the species and in some cases, outline situations in which certain plants should only be used or not be used. For example, some plant species can be invasive in certain settings but may be appropriate for use in contained areas that are separated from Natural Environment Parks. In that case, the risk of using the plant is less than the biodiversity, wildlife and climate benefits it will bring to this type of landscape application. Additionally, some non-native plants have a low risk of volunteering in other areas, especially if they do not readily self-seed. Regardless, the recommendations are based on restoration and botanical survey work experience within the Calgary area and Alberta. Plants that are cited as potential species to use in this landscaping application have in been introduced within Alberta and Calgary, either due to horticultural and/or agricultural activities. Often, these species are quite common as garden plants. Regardless, no plants are cited that are being consistently and actively controlled by The City of Calgary, even if they are a non-regulated horticultural species (e.g., *Caragana spp.*).

For completeness, it should be mentioned that any species on the *Alberta Weed Control Act* is not recommended for obvious reasons. If plant statuses change, an updated version of this document will be released, as warranted. As the plant species below are either common garden plants, agricultural species and have been researched extensively, the risk of causing invasive issues is low if the usage practices in the notes section are followed. If there is concern about a non-native species volunteering in an adjacent area that negatively affects the ecological health of that area, then it should not be used.

For the purpose of this document, native also means that the species is native to Alberta; however, it may not be found naturally in the Calgary area. Lastly, the use of a suite of various species does increase restoration success and allow for earlier coverage, which, in an urban environment, is important. The use of non-native species in this application may increase the aesthetic appeal of the early plant coverage, which again, is more important in an urban environment than in a rural area.

Life form	Botanical name (common synonym)	Common name (frequently used synonym)	Preferred planting form	Native (y=yes, n=no)	Notes
forb	*Achillea millefolium*	common yarrow	plug, seed	y	Can withstand highly disturbed areas; drought and salt tolerant; spreads readily vegetatively; often first to establish in harsh environments with poor soils
forb	*Achillea millefolium* 'Paprika'	paprika yarrow	1 gal, seed	n	Paprika yarrow is noted due to its bright colour and shorter compact growth habit; commonly sold as potted material although seeds are available; recommended for traffic circles and other roadway features
forb	*Antennaria parvifolia*	small-leaved everlasting	plug, seed	y	Will come up from seed but requires a few years to germinate, mature and flower; plug recommended to ensure that it does not get shaded out initially; comes up from seed in areas adjacent to disturbance and naturally occurring open areas
forb	*Antennaria rosea*	rosy everlasting	plug	y	Will come up from seed but requires a few years to germinate, mature and flower; plug recommended due to challenging environment; likely less salt tolerant than small-leaved everlasting
forb	*Artemisia schmidtiana* 'Silver Mound'	silver mound artemisia	1 gal	n	Less hardy than native drought and salt tolerant sages; may be used if native sages are not available for procurement
forb	*Asclepias speciosa*	showy milkweed	plug	y	Only genus that monarch caterpillars feed on; can form large patches
forb	*Campanula rotundifolia*	harebell	plug	y	Only plant that one native bee feeds on in Alberta; spreads readily; blooms

Life form	Botanical name (common synonym)	Common name (frequently used synonym)	Preferred planting form	Native (y=yes, n=no)	Notes
					throughout the growing season; very hardy plant
forb	*Cerastium tomentosum*	snow-in-summer	plug, 1 gal	n	Somewhat salt tolerant; very drought tolerant once established; caution advised as once established, this plant can spread into unwanted areas; recommend keeping it contained
forb	*Chenopodium salinum*	oak-leaved (Rocky Mountain) goosefoot	plug, seed	y	Naturally colonizes very salty roadsides; low growing; good candidate to include in other middle median edges along with some showier taller species; not showy but very salt and drought tolerant
forb	*Dalea purpurea*	purple prairie clover	plug, seed	y	Drought resistant; salt tolerant although research seems to be inconsistent regarding the degree of salt tolerance
forb	*Dracocephalum thymiflorum*	thyme-leaved dragonhead	seed, plug	n	Will colonize bare disturbed areas; not weedy in the Calgary-area; appears to be somewhat salt tolerant; highly drought tolerant; attracts pollinators
forb	*Echinops ritro*	globe thistle	1 gal	n	Salt and drought tolerant; will self-seed; can deadhead to extend blooming time
forb	*Erigeron compositus*	cut-leaved fleabane	plug	y	Can function as somewhat of a ground cover; very drought tolerant; likely some salinity tolerance
forb	*Eryngium planum*	cross-thistle (sea holly)	1 gal	n	Be cautious when using this plant as it can volunteer in adjacent Natural Environment Parks
forb	*Eschscholzia californica*	California poppy	seed	n	Annual; somewhat saline tolerant; seed easily available

Life form	Botanical name (common synonym)	Common name (frequently used synonym)	Preferred planting form	Native (y=yes, n=no)	Notes
forb	*Gaillardia aristata*	gaillardia (blanket-flower)	plug, 1 gal, seed	y	Many different cultivars (e.g., variations on amount of red, orange and yellow) available at garden centres and nurseries; native species is salt tolerant; cultivars appear to be salt tolerant as well but would ensure that the salt tolerance of cultivars is investigated before purchasing; germinates well from seed but appears to take 1-2 years before flowering
forb	*Galium boreale*	northern bedstraw	plug, seed	y	Withstands shade, full sun and some disturbance; seems to be one of the last native plants to die out in urban parks; likely somewhat salt tolerant but research indicates inconsistent results regarding salinity tolerance; would be good to trial in raised median beds and traffic circles where there is salt and disturbance pressure but not to the level experienced by middle medians along main roadways
forb	*Geum triflorum*	three-flowered avens	plug	y	Prefers full sun; flowers after ~2 years or more of growth; distribution in saline grasslands indicates some salt tolerance; can act as a groundcover
forb	*Glycyrrhiza lepidota*	wild licorice	plug	y	Prefers well drained areas with periodic moisture such as edges of escarpments; somewhat salt tolerant

Life form	Botanical name (common synonym)	Common name (frequently used synonym)	Preferred planting form	Native (y=yes, n=no)	Notes
forb	*Grindelia squarrosa*	curly-cup gumweed	plug, seed	y	Very important resource for pollinators; very salt tolerant and thrives in alkaline flats
forb	*Hedysarum boreale*	northern hedysarum	plug, seed	y	Requires ~4 years to grow and flower from collected seed due to hard seed coat; somewhat salt tolerant; more salt and drought tolerant than alpine hedysarum
forb	*Helianthus annuus*	common annual sunflower	seed, plug	y	Annual so needs to be able to self-seed; can be used as somewhat of an early succession cover crop; ensure genetic origin is known as most annual sunflowers are cultivars that have been bred extensively for the horticultural industry; can grow in very poor soils or substrates with little to no topsoil (e.g., road crush); very drought tolerant and moderately salt tolerant; have been unable to procure native annual sunflower seed in large quantity
forb	*Helianthus annuus* cultivar	annual sunflower	seed	n	Many annual sunflower cultivars exist; saline tolerance differs between cultivars
forb	*Helianthus maximilianii*	narrow-leaved sunflower	seed	n	Colonizes roadsides in southeast Alberta and as such, would likely be a good species for Calgary roadsides
forb	*Helianthus pauciflorus ssp. subrhomboideus*	rhombic-leaved sunflower	plug, seed	y	Drought and disturbance tolerant; somewhat salt tolerant
forb	*Helianthus petiolaris*	prairie sunflower	plug, seed	y	Similar to common annual sunflower

Life form	Botanical name (common synonym)	Common name (frequently used synonym)	Preferred planting form	Native (y=yes, n=no)	Notes
forb	*Heterotheca villosa*	golden aster (hairy golden aster)	plug, seed	y	Low in stature and aids as a groundcover; drought tolerant; colonizes roadsides and disturbed areas; salinity tolerance; salt spray tolerant
forb	*Liatris punctata*	dotted blazingstar	plug, seed	y	Establishes from seed but takes multiple years to flower; can withstand taller adjacent vegetation once established; HCR grassland health indicator species; somewhat salt tolerant
forb	*Linum lewisii*	blue flax	seed	y	Provides excellent early coverage; aesthetically pleasing; good forage for native pollinators; germinates quickly; inexpensive; high salt and drought tolerance; tolerates poor soils; stands bloom multiple times throughout the growing season; use high percentage by weight in seed mix due to inexpensive price and hardiness; readily self-seeds; perennial
forb	*Lotus corniculatus*	bird's-foot trefoil	seed	n	Introduced as a drought and salt tolerant low-bloat cattle forage; provides significant floral resources to pollinators; not weedy in Calgary area but use with caution and away from healthy Natural Environment Parks; seed before July 1 to allow for adequate blooming time; functions somewhat as a ground cover due to its spreading growth habit
forb	*Mentzelia decapetala*	sand-lily	plug, seed	y	Native to southeastern Alberta; naturally grows in dry alkaline soil; appears to tolerate Calgary's climate as

Life form	Botanical name (common synonym)	Common name (frequently used synonym)	Preferred planting form	Native (y=yes, n=no)	Notes
					has thrived when imported soils contained seed
forb	*Nepeta spp.*	cat mint	plug, 1 gal	n	Somewhat salt tolerant and fairly drought tolerant; appears tolerant to salt spray and some soil salinity due to its ability to overwinter in median planters
forb	*Oenothera biennis*	yellow evening-primrose	seed, plug	y	Has colonized edges of regional pathways so appears to have some salt tolerance; very drought tolerant
forb	*Oenothera suffrutescens* (*Gaura coccinea*)	scarlet butterflyweed (scarlet gaura)	plug	y	Very drought tolerant; salt tolerant due to its ability to colonize saline prairie and roadsides
forb	*Onobrychis viciifolia*	sainfoin	seed	n	Introduced as a drought and salt tolerant low-bloat cattle forage; not weedy in Calgary area but use with caution and away from healthy Natural Environment Parks; seed before July 1 to allow for adequate blooming time; taller pink blooms can make for aesthetically pleasing roadways in areas that vegetation has a difficult time persisting in
forb	*Oxytropis sericea*	early yellow locoweed	plug	y	Drought and salt tolerant; will tolerate occasional mowing; frequently comes up within turf grass on roadsides in the city's northwest where the seed bank has persisted
forb	*Oxytropis splendens*	showy locoweed	plug	y	Drought tolerant; likely somewhat salt tolerant; HCR grassland health indicator species
forb	*Perovskia atriplicifolia*	Russian sage	1 gal, seed	n	Moderately salt tolerant and tolerates dry to average

Life form	Botanical name (common synonym)	Common name (frequently used synonym)	Preferred planting form	Native (y=yes, n=no)	Notes
					moisture levels; good for median beds and traffic circles
forb	*Phlox hoodii*	moss phlox	plug	y	Functions well as a groundcover; is somewhat salt tolerant due to its ability to grow in saline prairie; one of first plants to flower in spring; provides early source of pollinator forage; requires full sun
forb	*Phlox subulata*	moss (creeping) phlox	plug, 1 gal	n	Some salt tolerance; drought tolerant; many cultivars available at garden centres/nurseries; most common cultivar has pink flowers; flowers in late spring/early summer; requires full sun to light shade
forb	*Potentilla anserina*	silverweed	plug	y	Does better in moister conditions but tolerates drought; could add to ground cover due its spreading ability via stolons
forb	*Sedum acre*	'Goldmoss' stonecrop	plug, 1 gal	n	Excellent ground cover; volunteers in areas along back alleys and anywhere where other vegetation cannot compete due to thin poor soils; appears to be most salt tolerant of sedums; can be used in rock gardens and as a lawn replacement; often present in pre-grown sedum matts
forb	*Solidago canadensis*	Canada goldenrod	seed, plug	y	Salt and drought tolerant although low goldenrod is more tolerant of saline, poor dry soils
forb	*Solidago missouriensis*	low (Missouri) goldenrod	seed, plug	y	Drought and salt tolerant; ensure that short stature of plant is accounted for in

Life form	Botanical name (common synonym)	Common name (frequently used synonym)	Preferred planting form	Native (y=yes, n=no)	Notes
					planting plan so that it is not outcompeted
forb	*Solidago mollis*	velvety goldenrod	plug	y	On provincial Watch List; colonizes dry saline prairie and roadsides mostly south of Calgary; likely a candidate to try in a roadside application; availability somewhat limited
forb	*Solidago rigida*	stiff goldenrod	plug	y	Grows in dry open areas; salt and drought tolerant; more difficult to procure than other more common goldenrods
forb	*Sphaeralcea coccinea*	scarlet mallow	plug	y	Showy orange flowers; colonizes open dry prairie and roadsides; due to vegetative spread, it can act as a ground cover; drought tolerant; some salinity tolerance
forb	*Stachys pectinata*	lamb's-ear	1 gal	n	Moderately salt tolerant and drought tolerant; fuzzy silver leaves provide texture to landscape design
forb	*Symphyotrichum ericoides*	tufted white prairie aster	seed, plug	y	Very salt tolerant; drought and inundation tolerant; withstands mowing and other disturbances; common in peripheral low prairie area of saline prairie wetlands
forb	*Symphyotrichum falcatum*	creeping white prairie aster	seed, plug	y	Salt and drought tolerant; establishes from seed; plugs speed up establishment; prefers open dry areas
forb	*Symphyotrichum laeve*	smooth aster	plug, seed	y	Drought and salt tolerant; hardy and can withstand disturbance pressure
forb	*Thermopsis rhombifolia*	golden bean	plug	y	Early season pollinator forage; can function somewhat as a ground cover; salt and drought tolerant

Life form	Botanical name (common synonym)	Common name (frequently used synonym)	Preferred planting form	Native (y=yes, n=no)	Notes
forb	*Thymus serpyllum*	creeping thyme	plug, seed	n	Prefers full sun; excellent ground cover; provides pollinator resources; tolerant of salt, drought and poor soils although can grow in more hospitable environments; very aromatic
forb	*Vicia villosa*	hairy vetch	seed	n	Low cost; moderate alkalinity tolerance; use carefully as it may be invasive although it has not been observed to volunteer in the Calgary area; good for erosion control and conditioning soil; may not persist on roadsides due to a lack of snow cover; can be used for erosion control
grass	*Agrostis scabra*	rough hair grass (hair bentgrass)	seed	y	Drought and salt tolerant although not common in abundance in areas other than wetland edges, provides good native early to mid-successional coverage in restoration
grass	*Bouteloua gracilis*	blue grama	seed	y	Warm season grass and therefore, must ensure that cool season grasses do not outcompete it in restoration activities; mid-successional but slightly earlier successional than needle-and-thread and western porcupine grass; does well from seed under the right conditions
grass	*Calamagrostis x acutiflora* Karl Foerster'	Karl Foerster Reed Grass	1 gal, 2 gal	n	Aesthetically pleasing feature plant in areas with drought and salt stress; use caution when overwintering in containers
grass	*Calamovilfa longifolia*	sand grass	seed	y	Excellent for sites with silty/sandy soils; very

Life form	Botanical name (common synonym)	Common name (frequently used synonym)	Preferred planting form	Native (y=yes, n=no)	Notes
					drought tolerant; some salinity tolerance
grass	*Deschampsia cespitosa*	tufted hair grass	seed	y	Drought and salt tolerant but often characterized as a low-lying land species as it thrives in areas that are sporadically moist; can create drought tolerant "turf" if seeded at a very high rate so tufting is obscured; can withstand mowing after establishment
grass	*Distichlis spicata* (*Distichlis spicata*)	saltgrass	plug, seed	y	Generally does not colonize well from seed as it is outcompeted; has volunteered along roadsides; spreads well from plug plantings; does not require mowing due to its short stature
grass	*Elymus* hybrid	AC Saltlander green wheatgrass	seed	n	Very salt and drought tolerant; aggressive; bred from a naturally occurring wheatgrass hybrid; use caution and assess adjacent land use before using this plant
grass	*Elymus lanceolatus*	northern wheatgrass	seed	y	Will colonize drier microclimates in mesic prairie grassland; some salinity tolerance; very drought tolerant
grass	*Elymus trachycaulus ssp. trachycaulus*	slender wheatgrass	seed	y	Cultivars available so ensure genetic origin is appropriate for the context; very salt and drought tolerant; withstands periodic inundation; tall, robust and early successional
grass	*Festuca idahoensis*	bluebunch (Idaho) fescue	seed	y	Drought tolerant; weakly saline tolerant
grass	*Festuca ovina*	sheep fescue	seed	n	Salt and drought tolerant; more aggressive than Rocky

Life form	Botanical name (common synonym)	Common name (frequently used synonym)	Preferred planting form	Native (y=yes, n=no)	Notes
					Mountain fescue; 'Elijah blue' commonly used as decorative cultivar
grass	*Festuca saximontana*	Rocky Mountain fescue	seed	y	Provides early successional cover when used in a seed mix; retains green colour until late in season, sometimes even under snow; salt and drought tolerant; some initial moisture required for germination and persistence
grass	*Hesperostipa comata* (*Stipa comata*)	needle-and-thread	seed	y	Mid-succession species so if in a seed mix, requires early successional coverage to control weeds but not enough coverage to prevent establishment; could be planted as plugs to aid in establishment; less common in Calgary than western porcupine grass; somewhat tolerant of saline soils; drought tolerant; long awns similar to western porcupine grass
grass	*Hesperostipa curtiseta* (Stipa curtiseta)	western porcupine grass	seed	y	Long awns make cleaning difficult; mid-succession species so if in a seed mix, requires early successional coverage to control weeds but not enough coverage to prevent establishment; could be planted as plugs to aid in establishment; more common in Calgary than needle-and-thread; moderately saline tolerant; drought tolerant
grass	*Koeleria macrantha*	June grass	seed	y	Ensure that short stature of plant is considered during restoration work so that it is not shaded out by other

Life form	Botanical name (common synonym)	Common name (frequently used synonym)	Preferred planting form	Native (y=yes, n=no)	Notes
					species; somewhat salinity tolerant
grass	*Leymus arenarius*	blue lyme grass	seed	n	Some taxonomic confusion as often synonymous with smooth wild rye but this non-native species appears more robust and blue
grass	*Lolium multiflorum*	Italian (annual) ryegrass	seed	n	Establishes quickly; drought and salt tolerant but less so than some other species; will self-seed and persist; intense propagation has made this species more able to overwinter and act as a perennial; can substitute perennial ryegrass
grass	*Nasella viridula*	green needle grass	seed	y	Very drought tolerant; colonizes open areas next to disturbances; tolerant of disturbance; awns can cause seeds to stick to clothing; salinity tolerant
grass	*Pascopyrum smithii*	western wheatgrass	seed	y	Prefers more moisture than northern wheatgrass; somewhat salt tolerant; generally lower growing than slender wheatgrass
grass	*Poa palustris*	fowl bluegrass	seed	y	Common on wetland edges; prefers moisture but is very drought tolerant; provides good coverage and weed suppression in restoration applications; tolerant of moderately saline soils
grass	*Puccinellia distans*	spreading alkali grass	seed	n	Native and introduced elements in the USA, northwest BC and Alaska
grass	*Puccinellia distans* 'Fults'	'Fults' alkali grass	seed	n	Variety cultivated from specimen at a golf course in the USA; very salinity tolerant

Life form	Botanical name (common synonym)	Common name (frequently used synonym)	Preferred planting form	Native (y=yes, n=no)	Notes
grass	*Puccinellia nuttalliana*	Nuttall's salt-meadow (alkali) grass	seed	y	Does very well in harsh roadside conditions such as medians of busy main roads; some taxonomic issues as lab tests for species confirmation are inconsistent with Nuttall's salt-meadow grass and spreading alkali grass
grass	*Schizachyrium scoparium*	little bluestem	seed, plug, 1 gal	y	This species is provincially tracked on the Watch List (i.e., natural populations); forms a small portion of the plant community in saline ecosites; commercially available, usually as potted material; winter interest due as it turns reddish-coloured in the fall; warm season grass
grass	*Spartina gracilis*	alkali cord grass	plug	y	Can assist in erosion control; best propagated vegetatively; appears to tolerate dry conditions as well as moist conditions
shrub	*Artemisia cana*	silver sagebrush	1 gal	y	Low growing attractive shrub with silver foliage; does well in Calgary area although naturally found southeast of the city
shrub	*Artemisia tridentata*	big sagebrush	1 gal	y	Taller than silver sagebrush; rare and provincially tracked in Alberta; found naturally in the far southwest corner of the province; commercial propagation of this species has occurred and plantings do very well in the Calgary area
shrub	*Dasiphora fruticosa*	shrubby cinquefoil	1 gal	y	Does best in full sun
shrub	*Dasiphora fruticosa*	Hachmann's Giant	1 gal	n	Flowers fade in full sun; greenish-grey foliage turning to light green at maturity;

Life form	Botanical name (common synonym)	Common name (frequently used synonym)	Preferred planting form	Native (y=yes, n=no)	Notes
	'Hachmann's Gigant'	shrubby cinquefoil l			large pale yellow flowers; many of the cultivars that have different coloured flowers are not salt tolerant but this one is tolerant of road salt
shrub	*Ericameria nauseosa*	rabbitbrush	plug, seed, 1 gal	y	Grows west and east of the Calgary area; it is early- to mid-seral/successional, salt and drought tolerant, grows rapidly, is deep-rooted and can tolerate poor saline soils; candidate for roadside naturalization in Calgary; provides forage for pollinators, birds and ungulates in winter
shrub	*Hippophae rhamnoides* 'Indian Summer'	'Indian Summer' sea buckthorn	1 gal	n	Does not tolerate shady sites; cultivar is tolerant of drought and nutrient poor soils due to its ability to fix nitrogen; female plants produce fruit; provides early pollen source to pollinators and berries for birds in the winter; can be somewhat invasive; very similar in characteristics to thorny buffaloberry
shrub	*Pinus mugo var Mughus*	Mugo pine	3 gal	n	Requires watering for establishment but after establishment, drought tolerant; salt tolerance results inconsistent in literature; works well in parking lots and as such, appears to be tolerant of some road salt; may grow larger than expected
shrub	*Rhus trilobata*	skunkbush	1 gal, 2 gal	y	Naturally found in southern Alberta prairies; drought tolerant; salt tolerance not mentioned in literature but

Life form	Botanical name (common synonym)	Common name (frequently used synonym)	Preferred planting form	Native (y=yes, n=no)	Notes
					found in saline ephemeral wetlands
shrub	*Shepherdia argentea*	thorny buffaloberry	1 gal	y	Very salt and drought tolerant; often used as plantings in parking lot medians due to high salt tolerance; berries are valuable wildlife forage
shrub	*Symphoricarpos occidentalis*	buckbrush	1 gal	y	Tends to come in on its own in natural areas; somewhat salt tolerant and can be used in medians; low growth tends to catch garbage in roadway plantings; do not confuse with snowberry; cultivars available but little information available regarding cultivar performance in the Calgary area
shrub	*Syringa villosa*	villosa (Japanese) (late) lilac	1 gal+	n	Most salt tolerant lilac; does not seem to volunteer as much as common lilac; slower growing than common lilac
shrub (dwarf)	*Atriplex canescens*	four-wing (Nuttall's) salt bush	plug	y	Now on provincial Watch List; common in southeast Alberta; may be a candidate for roadside and median naturalization
shrub (dwarf)	*Juniperus horizontalis*	creeping juniper	plug, 1 gal	y	Salt and salt spray tolerant; native species tends to be lower growing than various salt and drought tolerant counterparts
shrub (dwarf)	*Juniperus horizontalis* 'Wiltoni' or 'Blue Rug'	'Wintoni' or 'Blue Rug' creeping juniper	1 gal	y	Salt and salt spray tolerant; native species tends to be lower growing than various salt and drought tolerant counterparts
vine	*Humulus lupulus*	common hop	1 gal	n	Fair salt tolerance; very drought tolerant; can be used to add vertical interest and insulate sound walls;

Life form	Botanical name (common synonym)	Common name (frequently used synonym)	Preferred planting form	Native (y=yes, n=no)	Notes
					requires something to climb on; use caution when using this plant as it may volunteer in adjacent natural areas
vine	*Parthenocissus quinquefolia*	Virginia creeper	1 gal	n	Native to eastern and central USA; grow in full sun to part shade; can use as ground cover for erosion; do not grow in areas where other vegetation may be choked out as it is aggressive; ideal for sound wall coverage and other vertical interest; sticks to substrate; plant in permanent location; moderate salt tolerance

Naturalized mulch shrub bed

Mulch can be beneficial for weed suppression and soil moisture retention in certain landscape applications; however, in areas that are not highly manicured, it can be difficult to maintain. As mulch does inhibit some weed growth, it also prevents desired plants from spreading vegetatively (e.g., rhizomes, stolons, etc.) and through sexual reproduction (e.g., seed). The breakdown of mulch also uses a lot of soil nitrogen and in a relatively unmaintained landscape where soil amendments are not part of the regular maintenance regime, it can cause nitrogen deficiency in plants. Although mulch does impede weed growth, many of the more aggressive perennial weeds readily colonize mulch and once they are established, they are difficult to eliminate, especially without negatively affecting the desirable vegetation.

Due to the added pressure of city growth and budget cuts, resources are limited. Due to this, The City of Calgary has been naturalizing selected shrub beds in order to reduce costs and labour associated with weeding, mulch replacement and fertilizer application.

As funds are insufficient to support many highly maintained landscapes, the removal of all mulch is not feasible due to the effort required to remove and transport it off site and as such, plants are required that can tolerate nutrient deficient soils. Seed that can effectively germinate in mulch and suppress weed growth is also required but there are a limited number of species that can perform this task.

Plants are identified below that can be used to initially transform a shrub bed into a low-maintenance naturalized site. Species that are identified as being in the preferred form of seed should be seeded and lightly raked into the mulch whereas potted material can be planted within the mulch and is tolerant of poor soils.

It should be noted that the removal of the very coarse mulch in the upper mulch layer will increase seed germination. Additionally, approximately one week prior to seeding, treatment with a high nitrogen fertilizer can help break down the mulch, provide nitrogen to the existing plants and speed up the naturalization process.

Additional species can be added to increase biodiversity as mulch breaks down.

Life form	**Botanical name (common synonym)**	**Common name (frequently used synonym)**	**Preferred planting form**	**Native (y=yes, n=no)**	**Notes**
forb	*Achillea millefolium*	common yarrow	1 gal, plug	y	Plant within seeded mulched area of shrub bed
forb	*Achillea millefolium* cultivar	yarrow (coloured cultivar)	1 gal, plug, seed	n	Coloured yarrow cultivars add aesthetic appeal to the shrub bed and are very hardy, like the native yarrow; coloured yarrow seed is readily available so could test its ability to germinate in mulch
forb	*Clarkia spp.* (*Godetia spp.*)	clarkia (godetia)	seed	n	Annual; will assist in building up organics in soil; often will self-seed; full sun to shade tolerant; ensure species is appropriate for the Calgary area; readily colonizes mulch; shade tolerant
forb	*Linum lewisii*	blue flax	seed	y	Only native forb that easily germinates and establishes in mulch; some thatch removal may be required very infrequently to restore plant vigor
grass	*Deschampsia cespitosa*	tufted hair grass	seed	y	Later successional than other grasses but will provide some additional cover; should not rely on it for weed suppression but instead, for biodiversity after initial early successional species establish

Life form	Botanical name (common synonym)	Common name (frequently used synonym)	Preferred planting form	Native (y=yes, n=no)	Notes
grass	*Elymus trachycaulus ssp. trachycaulus*	slender wheatgrass	seed	y/n	Ensure source of slender wheatgrass seed is appropriate to the Calgary area; one of the very few native species that will colonize mulch from seed
grass	*Lolium multiflorum*	Italian (annual) ryegrass	seed	n	Very quick to establish and will self-seed and overwinter (i.e., due to intense propagation and breeding); readily colonizes mulch

Native wetland peripheral low prairie zone-fresh water

These native species are appropriate for a Class I wetland (e.g., saturated for a less than one week per year) or the peripheral prairie zone of a more permanent, higher class wetland. Wetlands that are more saline in nature are found in the eastern portion of the Calgary area whereas freshwater wetlands are predominantly associated with the western part of the city. Additionally, these freshwater wetland edges tend to contain woody vegetation which, in the eastern part of the city, is usually sparse or absent as the wetland edges are vegetated with mostly salt tolerant graminoids.

This list contains all native species. This plant list is suitable for restoration work that aims to restore the area to a more native reference vegetation community. Likely, the vegetation community is somewhat intact but requires improvements to increase ecosystem health or the vegetation community has undergone ongoing maintenance such as weed control to better increase the chances that the restoration will be successful. Alternatively, the wetland may be in a natural area or Natural Environment Park and as such, the intent is to keep the area, and surrounding area vegetation native.

Additionally, there is overlap in plant species between wetland zones as the intent of the plant list is to identify species that will thrive in these particular environments. Naturally, a species may not be as dominant as others but if it is applicable and will grow in this habitat type, it is listed.

It should be noted that the plant list is different than the one indicated by Stewart and Kantrud (1971). This is because of the overlap of the three Natural Subregions within Calgary and how this allows for the presence of prairie, foothills and parkland species. Lastly, although many of the species that are indicated by Stewart and Kantrud (1971) are accurate for the Calgary area, there

are discrepancies as the paper examined areas that are outside of Calgary. The plant list below reflects the appropriate species for the Calgary area.

Life form	Botanical name (common synonym)	Common name (frequently used synonym)	Preferred planting form	Notes
forb	*Achillea millefolium*	common yarrow	plug, seed	Can withstand highly disturbed areas; drought tolerant; spreads readily vegetatively; often first to establish in harsh environments with poor soils; found in all habitat types, except for areas that experience soil saturation for long periods of time
forb	*Agastache foeniculum*	giant hyssop	plug	Can withstand light partial shade; prefers mesic richer soils
forb	*Allium schoenoprasum*	wild chives	plug	Can spread unwantedly; prefers moister areas
forb	*Anemone canadensis*	Canada anemone	plug	Commonly found along outer wetland edges in the north and western portions of the city
forb	*Arnica fulgens*	shining arnica	plug	Commonly found in peripheral low prairie wetland zones in southeast Alberta
forb	*Artemisia ludoviciana*	prairie sagewort (sage)	plug	Seed difficult to harvest; readily spreads vegetatively
forb	*Astragalus canadensis*	Canada milkvetch	seed	Germinates easily from seed; nitrogen fixing as legume; does well on riparian areas but tolerant of grassland conditions
forb	*Chamerion angustifolium*	common fireweed	plug, seed	Does well in open forest and riparian edges
forb	*Drymocallis arguta*	white cinquefoil	seed, plug	Comes up well from seed
forb	*Fragaria virginiana*	wild strawberry	plug	Excellent ground cover; will not grow in areas with taller vegetation; spreads by stolons
forb	*Galium boreale*	northern bedstraw	plug	Tolerant of many habitat types; does not withstand saturation for long periods of time
forb	*Glycyrrhiza lepidota*	wild licorice	plug	Prefers well drained areas with periodic moisture such as edges of escarpments and peripheral low prairie areas
forb	*Linum lewisii*	blue flax	seed	Very hardy; provides excellent early coverage; aesthetically pleasing;

Life form	Botanical name (common synonym)	Common name (frequently used synonym)	Preferred planting form	Notes
				good forage for native pollinators; germinates quickly; inexpensive; good ground cover
forb	*Maianthemum stellatum* (*Smilacina stellata*)	star-flowered Solomon's-seal (star-flowered false Solomon's-seal)	plug	Does well in riparian areas; tolerates more disturbance than many other native plants
forb	*Oxytropis splendens*	showy locoweed	plug	Naturally colonizes open areas along shores
forb	*Solidago canadensis*	Canada goldenrod	seed, plug	New taxonomy findings are breaking this species into 2 separate species; very hardy; excellent late season forage for pollinators; plugs more expensive; spreads readily once established; naturally colonizes riparian areas
forb	*Symphyotrichum ericoides*	tufted white prairie aster	seed, plug	Withstands mowing and other disturbances; very hardy; naturally colonizes wetland edges
grass	*Agrostis scabra*	rough hair grass (hair bentgrass)	seed	Common on wetland edges; drought tolerant; not common in abundance in areas other than wetland edges, provides good native early to mid-successional coverage in restoration
grass	*Bromus ciliatus*	fringed brome	seed	More of a parkland/montane species but good for restoration due to aggressive nature
grass	*Bromus marginatus*	mountain brome	seed	Although it is a more of a southwest montane species, it works well in urban restoration as it is competitive; prefers full sun to light partial shade
grass	*Calamovilfa longifolia*	sand grass	seed	Excellent for sites with silty/sandy soils; very drought tolerant; common on shores
grass	*Deschampsia cespitosa*	tufted hair grass	seed	Drought tolerant; highly tufted
grass	*Elymus canadensis*	Canada wild rye	seed	Aggressive but works well in seed mixes; will form monoculture if seeded first as a cover crop; more effective to include in the seed mix

Life form	Botanical name (common synonym)	Common name (frequently used synonym)	Preferred planting form	Notes
grass	*Elymus trachycaulus spp. subsecundum*	awned wheatgrass	seed	Similar characteristics to slender wheatgrass but not as aggressive; may be due to genetics or awns
grass	*Elymus trachycaulus ssp. trachycaulus*	slender wheatgrass	seed	Use plant material propagated or collected from plants in the wild and as close to the wild type as possible; many cultivars of slender wheatgrass exist; commercially available slender wheatgrass tends to be more aggressive than the wild type; a dominant species in peripheral low prairie
grass	*Festuca idahoensis*	bluebunch (Idaho) fescue	seed	Ensure cultivars are not used in restoration work; wild species has bluish-coloured leaves; looks similar to the non-native *Festuca ovina* 'Elijah blue'; appears to do well when seeded around wetland edges
grass	*Festuca saximontana*	Rocky Mountain fescue	seed	Provides early successional cover when used in a seed mix; can withstand short periods of saturation and drought; needs early season moisture to germinate and persist
grass	*Koeleria macrantha*	June grass	seed	Ensure that short stature of plant is considered during restoration work so that it is not shaded out by other species; good addition to peripheral low prairie and riparian seed mixes to ensure vegetation cover during times of drought
grass	*Nasella viridula*	green needle grass	seed	Very drought tolerant; colonizes open areas next to disturbances; can withstand short periods of saturation; naturally colonizes wetland edges
grass	*Pascopyrum smithii*	western wheatgrass	seed	A dominant species in peripheral low prairie
grass	*Poa palustris*	fowl bluegrass	seed	Common on wetland edges; prefers moisture but is very drought tolerant; provides good coverage and weed suppression in restoration applications; dominant species in wet meadow zone of wetlands but will grow in peripheral low prairie

Life form	Botanical name (common synonym)	Common name (frequently used synonym)	Preferred planting form	Notes
shrub	*Amelanchier alnifolia*	Saskatoon	1 gal	Common in riparian areas and around wetlands in forested areas
shrub	*Elaeagnus commutata*	wolfwillow	1 gal	Forms extensive thickets in riparian areas
shrub	*Ribes aureum*	golden currant	plug, 1 gal	Important source of early season forage for native bees and other pollinators; fruit attracts wildlife; fruit is edible; prefers moist soil but generally can withstand some drought; full sun to light shade tolerance; flowers have strong fragrance; thorns absent
shrub	*Ribes oxyacanthoides*	northern gooseberry	plug, 1 gal	Important source of early season forage for native bees and other pollinators; fruit attracts wildlife; fruit is edible; prefers moist soil but generally can withstand some drought; full sun to part shade tolerance
shrub	*Rosa acicularis*	prickly rose	1 gal	Not a dominant species in prairie wetlands but common in riparian forest
shrub	*Rosa woodsii*	common wild rose	1 gal	Dominant species in peripheral low prairie areas
shrub	*Shepherdia argentea*	thorny buffaloberry	1 gal	Naturally colonizes upper shores
shrub	*Symphoricarpos occidentalis*	buckbrush	1 gal	Tend to not use in restoration work unless nothing else will grow; increases and becomes weedy while out-competing other more desirable forage species; provides mid-season pollinator forage; dominant plant in peripheral low prairie zones
tree	*Populus balsamifera*	balsam poplar	plug	Dominant component of forests in riparian areas; common around wetlands in forested areas
shrub	*Salix bebbiana*	beaked (Bebb's) willow	plug, 1 gal	Beaked willow tends to prefer the drier portions of riparian areas; naturally colonizes peripheral low prairie zones and upper riparian areas
shrub	*Salix exigua*	narrow-leaf willow	plug, 1 gal	Tolerant of saturation; fairly drought tolerant once established

Life form	Botanical name (common synonym)	Common name (frequently used synonym)	Preferred planting form	Notes
shrub	*Salix interior*	sandbar willow	plug, 1 gal	Tolerant of saturation; fairly drought tolerant once established
shrub	*Cornus stolonifera*	red-osier dogwood	1 gal	Very common in outer riparian areas

Native wetland wet meadow zone-fresh water

These native species are appropriate for a Class II wetland (e.g., saturated for a few weeks per year) or the wet meadow zone of a more permanent, higher class wetland. Wetlands that are more saline in nature are found in the eastern portion of the Calgary area whereas freshwater wetlands are generally associated with the northern and western parts of the city. Additionally, these freshwater wetland edges tend to contain woody vegetation which, in the eastern part of the city, is usually sparse or absent as the wetland edges are vegetated with mostly salt tolerant graminoids.

This list contains all native species. This plant list is suitable for restoration work that aims to restore the area to a more native reference vegetation community. Likely, the vegetation community is somewhat intact but requires improvements to increase ecosystem health or the vegetation community has undergone ongoing maintenance such as weed control to better increase the chances that the restoration will be successful. Alternatively, the wetland may be in a natural area or Natural Environment Park and as such, the intent is to keep the area, and surrounding area vegetation native.

Additionally, there is overlap in plant species between wetland zones as the intent of the plant list is to identify species that will thrive in these particular environments. Naturally, a species may not be as dominant as others but if it is applicable and will grow in this habitat type, it is listed.

It should be noted that the plant list is different than the one indicated by Stewart and Kantrud (1971). This is because of the overlap of the three Natural Subregions within Calgary and how this allows for the presence of prairie, foothills and parkland species. Although many of the species that are indicated by Stewart and Kantrud (1971) are accurate for the Calgary area, there are discrepancies as the paper examined areas that are outside of Calgary. The plant list below reflects the appropriate species for the Calgary area.

As per all of the plant lists, the species indicated below are generally available or could be made available in the recommended form. Sedge and rushes generally come in on their own. Seed collection and handling is also difficult so species that are more appropriate to provide early successional cover for restoration projects are focused on.

Life form	Botanical name (common synonym)	Common name (frequently used synonym)	Preferred planting form	Notes
forb	*Agastache foeniculum*	giant hyssop	plug	Prefers rich soils; tolerates some inundation
forb	*Allium schoenoprasum*	wild chives	plug	Can spread unwantedly; tolerates some inundation
forb	*Arnica fulgens*	shining arnica	plug, seed	In xeric prairie areas, especially those of southeast Alberta, this plant is a common indicator of the fresh water or slightly brackish wetland wet meadow zone
forb	*Astragalus canadensis*	Canada milkvetch	seed	Germinates easily from seed; nitrogen fixing as legume; does well on riparian areas but tolerant of grassland conditions
forb	*Epilobium ciliatum*	northern willowherb	seed	Comes in commonly on its own; drought tolerant and will colonize abandoned planters; small pink flowers are aesthetically pleasing; provides pollinator forage; split pods and seeds with cottony pappus provide winter interest
forb	*Geum aleppicum*	yellow avens	plug, seed	Provides pollinator forage; will grow in moist grasslands in the western portion of the city as well
forb	*Mentha arvensis*	wild mint	forb	Readily spreads; ensure species is native wild mint as many mint cultivars are available
forb	*Penstemon gracilis*	lilac-flowered beardtongue	plug	In xeric prairie areas, especially those of southeast Alberta, this plant is a common indicator of the fresh water or slightly brackish wetland wet meadow zone
forb	*Petasites frigidus*	coltsfoot	plug	In Calgary, this species tends to grow in moist forests but will also grow in open moist areas elsewhere; 4 varieties which differ based on leaf shape
forb	*Ranunculus macounii*	Macoun's buttercup	plug, seed	Tends to disappear from areas with regular disturbance
forb	*Rumex occidentalis*	western dock	seed	Comes in on its own; likely would not use in restoration but is a common component of wet meadows; could use for coverage and biodiversity

Life form	Botanical name (common synonym)	Common name (frequently used synonym)	Preferred planting form	Notes
forb	*Stachys pilosa*	marsh hedge-nettle	forb	Provides good pollinator forage; do not confuse with other species in the mint family
forb	*Triantha* (Tofieldia) *glutinosa*	sticky false asphodel	plug	Occurs in boggy areas in the west and north parts of Calgary
grass	*Agrostis scabra*	rough hair grass (hair bentgrass)	seed	Common on wetland edges; drought tolerant; not common in abundance in areas other than wetland edges, provides good native early to mid-successional coverage in restoration
grass	*Anthoxanthum hirtum* (*Hierochloe hirta*) (*Hierochloe odorata*)	sweet grass	plug	Not very dominant in the Calgary area; found in areas with better ecological health; seed does not seem to establish well
grass	*Bromus ciliatus*	fringed brome	seed	More of a parkland/montane species but good for restoration due to aggressive nature
grass	*Bromus marginatus*	mountain brome	seed	Although it is a more of a southwest montane species, it works well in urban restoration as it is competitive; prefers full sun to very light partial shade
grass	*Calamagrostis canadensis*	bluejoint (Canada reedgrass)	seed	Seed may be difficult to procure as it is often wild-harvested from cut-blocks
grass	*Calamagrostis stricta*	narrow reed grass	seed	Similar to northern reed grass but smaller with a shorter, less dense panicle; naturally occurs in the more western and northern parts of the city; could be used as a substitute for northern reed grass
grass	*Calamagrostis stricta ssp. inexpansa*	northern reed grass	seed	Do not confuse with reed canary grass which is invasive
grass	*Calamovilfa longifolia*	sand grass	seed	Excellent for sites with silty/sandy soils; very drought tolerant; common on shores
grass	*Deschampsia cespitosa*	tufted hair grass	seed	Drought tolerant; highly tufted
grass	*Elymus canadensis*	Canada wild rye	seed	Aggressive but works well in seed mixes; will form monoculture if seeded first as a cover crop

Life form	Botanical name (common synonym)	Common name (frequently used synonym)	Preferred planting form	Notes
grass	*Elymus trachycaulus spp. subsecundum*	awned wheatgrass	seed	Similar characteristics to slender wheatgrass but not as aggressive; may be due to genetics or awns
grass	*Elymus trachycaulus ssp. trachycaulus*	slender wheatgrass	seed	Use plant material propagated or collected from plants in the wild and as close to the wild type as possible; many cultivars of slender wheatgrass exist; commercially available slender wheatgrass tends to be more aggressive than the wild type; a dominant species in peripheral low prairie
grass	*Festuca idahoensis*	bluebunch (Idaho) fescue	seed	Ensure cultivars are not used in restoration work; wild species has bluish coloured leaves; looks similar to the non-native *Festuca ovina* 'Elijah blue'; appears to do well when seeded around wetland edges
grass	*Festuca saximontana*	Rocky Mountain fescue	seed	Provides early successional cover when used in a seed mix; can withstand short periods of saturation and drought
grass	*Koeleria macrantha*	June grass	seed	Ensure that short stature of plant is considered during restoration work so that it is not shaded out by other species; good addition to peripheral low prairie and other riparian seed mixes at a low % by weight to ensure vegetation cover during times of drought
grass	*Nasella viridula*	green needle grass	seed	Very drought tolerant; colonizes open areas next to disturbances; can withstand short periods of saturation; naturally colonizes wetland edges
grass	*Pascopyrum smithii*	western wheatgrass	seed	A dominant species in peripheral low prairie
grass	*Poa palustris*	fowl bluegrass	seed	Common on wetland edges; prefers moisture but is very drought tolerant; provides good coverage and weed suppression in restoration applications; dominant species in wet meadow zone of wetlands but will grow in peripheral low prairie

Life form	Botanical name (common synonym)	Common name (frequently used synonym)	Preferred planting form	Notes
grass	*Poa secunda* (*Poa juncifolia*)	Sandberg bluegrass (alkali bluegrass)	seed	Ensure plant's origin is correctly aligned with a moister habitat type since many species have been grouped together as *Poa secunda*; some alkalinity tolerance but not as tolerant as species that dominate saline wetlands in the Calgary area
grass	*Spartina gracilis*	alkali cord grass	seed, plug	Naturally occurs sporadically in both freshwater riparian and alkaline riparian areas
grass	*Spartina pectinata*	prairie cord grass	plug, seed	It is currently on the provincial Tracking List; found to be more common in the province than originally thought and is supposed to be off the next edition of the Tracking List; very good for bank stabilization; not as easily outcompeted as other species due to its tall stature
rush	*Juncus alpinoarticulatus*	alpine rush	seed, plug	As it is present in areas that are dry most of the year, seed storage does not likely have to be in frozen water and, as such, good candidate for restoration; common in all areas except for xeric prairies
rush	*Juncus balticus*	wire (Baltic) rush	seed, plug	Tends to come in on its own; seed is available; appears to tolerate more drought than some other wet meadow species
rush	*Juncus bufonius*	toad rush	seed, plug	Early successional annual; likely good candidate for early coverage; produces a lot of seed
rush	*Juncus ensifolius*	equitant-leaved rush	plug	Grows in moist to wet areas; rhizomatous; soil binding abilities; more suitable for north and west areas of Calgary
rush	*Juncus longistylis*	long-styled rush	plug	Establishes best through root fragments; good soil stabilizer
rush	*Juncus nodosus*	knotted rush	plug, seed	Tolerant of disturbance, including foot traffic and grazing; found in moist to wet areas; effectively binds soil

Life form	Botanical name (common synonym)	Common name (frequently used synonym)	Preferred planting form	Notes
rush	*Juncus tenuis*	slender rush	plug, seed	Found in moist to wet areas; contributes to bank stabilization and biodiversity
rush	*Juncus torreyi*	Torrey's rush	plug, seed	Tolerant of disturbance, including foot traffic and grazing; found in moist to wet areas; effectively binds soil; very similar to knotted rush except larger in size
sedge	*Carex capillaris*	hair-like sedge	plug	Generally, sedges tend to come in on their own; seed handling and storage is difficult; if require additional biodiversity, this would be a candidate for planting in areas outside of the eastern portion of Calgary; naturally absent from prairie areas; occurs naturally in areas that have better riparian health scores
sedge	*Carex lasiocarpa*	hairy-fruited sedge	plug	Common; valuable for soil binding; seed handling and storage is difficult
shrub	*Amelanchier alnifolia*	Saskatoon	1 gal	Common in riparian areas and around wetlands in forested areas
shrub	*Cornus stolonifera*	red-osier dogwood	1 gal	Very common in outer riparian areas
shrub	*Elaeagnus commutata*	wolfwillow	1 gal	Forms extensive thickets in riparian areas
shrub	*Ribes aureum*	golden currant	plug, 1 gal	Important source of early season forage for native bees and other pollinators; fruit attracts wildlife; fruit is edible; prefers moist soil but generally can withstand some drought; full sun to light shade tolerant; flowers have strong fragrance; thorns absent
shrub	*Ribes oxyacanthoides*	northern gooseberry	plug, 1 gal	Important source of early season forage for native bees and other pollinators; fruit attracts wildlife; fruit is edible; prefers moist soil but generally can withstand some drought; full sun to part shade tolerant
shrub	*Salix bebbiana*	beaked (Bebb's) willow	plug, 1 gal	Beaked willow tends to prefer the drier portions of riparian areas; naturally colonizes peripheral low

Life form	Botanical name (common synonym)	Common name (frequently used synonym)	Preferred planting form	Notes
				prairie zones and upper riparian areas
shrub	*Salix discolor*	pussy willow	plug, 1 gal	Ensure that shrub is not highly visible as it likely will be harvested by the public for decorative purposes
shrub	*Salix exigua*	narrow-leaf willow	plug, 1 gal	Tolerant of saturation; fairly drought tolerant once established
shrub	*Salix interior*	sandbar willow	plug, 1 gal	Tolerant of saturation; fairly drought tolerant once established
tree	*Populus balsamifera*	balsam poplar	plug	Dominant component of forests in riparian areas; common around wetlands in forested areas

Native wetland shallow marsh zone-fresh water

These native species are appropriate for a Class III wetland or the shallow marsh zone of a higher class wetland. Class III wetlands have a central zone that is saturated for a few months per year. The shallow marsh zone is normally wet starting from snow melt in the early spring. If rainfall does not occur regularly throughout the summer, the shallow marsh zone will be dry by September. It may even be dry earlier if hot temperatures are combined with drought.

Wetlands that are more saline in nature are found in the eastern portion of the Calgary area whereas freshwater wetlands are generally associated with the western part of the city. In the Calgary area, plants that are adapted for the shallow marsh zone often will be observed in both fresh water and saline wetlands, likely as a result of the increased volume of water decreasing the salinity concentration.

This list contains all native species. This plant list is suitable for restoration work that aims to restore the area to a more native reference vegetation community. Likely, the vegetation community is somewhat intact but requires improvements to increase ecosystem health or the vegetation community has undergone ongoing maintenance such as weed control to better increase the chances that the restoration will be successful. Alternatively, the wetland may be in a natural area or Natural Environment Park and as such, the intent is to keep the area, and surrounding area vegetation native.

It should be noted that in riparian areas, weed control follows provincial guidelines and weed control that deviates from this legislation requires a permit. Provincial legislation (Alberta Government 2010) restricts how much an area can be treated based on its distance from open

water. In the case of a Class III wetland, the shallow marsh zone will be obvious in the early growing season and appear as open water when it is at its maximum water volume. Fortunately, invasive plant species are not as problematic in the shallow marsh zone as most weeds cannot withstand water inundation and the associated anaerobic conditions for extended periods of time.

Additionally, there is overlap in plant species between wetland zones as the intent of the plant list is to identify species that will thrive in these particular environments. Naturally, a species may not be as dominant as others but if it is applicable and will grow in this habitat type, it is listed.

It should be noted that the plant list is different than the one indicated by Stewart and Kantrud (1971). This is because of the overlap of the three Natural Subregions within Calgary and how this allows for the presence of prairie, foothills and parkland species. Although many of the species that are indicated by Stewart and Kantrud (1971) are accurate for the Calgary area, there are discrepancies as the paper examined areas that are outside of Calgary. The plant list below reflects the appropriate species for the Calgary area.

As per all of the plant lists, the species indicated below are generally available or potentially could be made available in the recommended form.

It is often appropriate to allow for natural recovery of the shallow marsh zone. From observations in the Calgary area, this establishment takes approximately 4 years to establish on its own without human interference. This is because seed collection and storage becomes more difficult as plants become more hydrophytic. It is also difficult to seed and plant species when standing water is present. Soils become compromised due to compaction and admixing as even planting and seeding by hand can significantly rut wet soils. Soil reuse from similar areas or the same wetland area, preconstruction, tends to result in better vegetation establishment, especially when soil handling best practices are implemented.

Although natural recovery combined with soil reuse and best handling practices is often sufficient for revegetation of the shallow marsh zone, there are instances where supplemental restoration techniques such as seeding and planting are warranted. These situations may arise when:

- the soil is in poor health;
- adjacent construction activities are causing a weed colonization risk to the open wetland soils;
- the site is to be restored to a very pristine wetland so restoration is aiming to achieve maximum biodiversity and similarity to the reference vegetation community;
- the soil is not stable and requires vegetation to bind soils quicker than the vegetation would establish on its own; and,
- the water quality of the wetland is very important and as such, rapid vegetation establishment is required to ensure minimal sediment loading into the waterbody.

In addition to the seed handling becoming more difficult as the plants become more hydrophytic in nature, construction timing becomes more complex. This is because species in these wetlands/wetland areas require additional moisture; however, they need to be restored in a way so

that the plants and/or seed does not wash away. This requires careful construction phasing so that seeding and planting is not performed when the wetland contains or is about to contain its maximum water volume.

Life form	Botanical name (common synonym)	Common name (frequently used synonym)	Preferred planting form	Notes
forb	*Alisma triviale*	broad-leaved water-plantain	plug	Good for early successional coverage
forb	*Allium schoenoprasum*	wild chives	plug	Can spread unwantedly; tolerates a wide range of conditions, including inundation to relatively dry conditions
forb	*Arnica fulgens*	shining arnica	plug, seed	In xeric prairie areas, especially those of southeast Alberta, this plant is a common indicator of the fresh water or slightly brackish wetland wet meadow zone
forb	*Epilobium ciliatum*	northern willowherb	seed	Comes in commonly on its own; drought tolerant and will colonize abandoned planters; small pink flowers are aesthetically pleasing; provides pollinator forage; split pods and seeds with cottony pappus provide winter interest
forb	*Limosella aquatica*	mudwort	plug	Can grow submerged in water or emergent on mudflats
forb	*Mentha arvensis*	wild mint	forb	Readily spreads; ensure species is native wild mint as many mint cultivars are available
forb	*Pedicularis groenlandica*	elephant's-head	plug	Grows in boggy locations; showy plant; provides pollinator forage
forb	*Persicaria amphibia*	water smartweed	plug	Not commonly used in restoration; may provide good early coverage; tolerant of fluctuating water conditions and as such, may be a good species to use in response to climate change
forb	*Petasites frigidus*	coltsfoot	plug	In Calgary, this species tends to grow in moist forests but will also grow in open moist areas elsewhere; 4 varieties which differ based on leaf shape
forb	*Potamogeton natans*	floating-leaf pondweed	plug, 1 gal	Provides waterfowl forage; occurs from the shallow marsh and inwards

Life form	Botanical name (common synonym)	Common name (frequently used synonym)	Preferred planting form	Notes
				into deeper water; reproduces mostly from rhizomes and rhizome fragments; require specialized aquatic plant grower for procurement
forb	*Ranunculus macounii*	Macoun's buttercup	plug, seed	Tends to disappear from areas with regular disturbance
forb	*Ranunculus sceleratus*	celery-leaved buttercup	plug	Annual; may be appropriate for early season coverage; commercially available; plug is suggested as once plant is established, it will self-seed
forb	*Sagittaria cuneata*	arum-leaved arrowhead	plug	Appropriate for all areas of Calgary
forb	*Sparganium angustifolium*	narrow-leaved bur-reed	plug, seed	Plug recommended as seed is likely to be washed away; how successful this species establishes from seed in the Calgary area is unknown; more common in the prairie than giant bur-reed
forb	*Sparganium eurycarpum*	giant bur-reed	plug, seed	Plug recommended as seed is likely to be washed away; how successful this species establishes from seed in the Calgary area is unknown; more naturally localized to western and northern areas of the city
forb	*Stachys pilosa*	marsh hedge-nettle	plug	Provides good pollinator forage; do not confuse with other species in the mint family; more appropriate for wet meadow zone so should be planted at transition
forb	*Tephroseris palustris*	marsh ragwort	plug	More of a parkland/foothills species so appropriate for the west and north areas of Calgary; provides pollinator forage
forb	*Typha latifolia*	common cattail	plug, 1 gal	Dominant in the deep marsh zone but commonly found in the shallow marsh zone;
forb	*Utricularia vulgaris*	common bladderwort	plug	Carnivorous plant; available at select aquatic nursery locations; likely not going to be used in restoration unless goal of restoration is to replicate the natural wetland environment

Life form	Botanical name (common synonym)	Common name (frequently used synonym)	Preferred planting form	Notes
forb	*Veronica anagallis-aquatica*	speedwell	plug	This plant in the Calgary area was thought to be *Veronica catenata* and was classified as rare and on the Provincial Tracking List; the taxonomy was not consistent with that species so it was re-evaluated by the province; this speedwell is found throughout the entire city in standing shallow water in fresh water wetlands in slower moving areas of watercourses
forb	*Veronica peregrena*	hairy speedwell	plug, seed	Annual; more common in prairie areas; often do not see plant in flower and can identify it from the heart-shaped seed capsule that are sessile and occur along the stem, unlike other speedwells where their flowers occur in racemes at the plant apex; may be good for early successional coverage
grass	*Agrostis scabra*	rough hair grass (hair bentgrass)	seed	Provides good native early to mid-successional coverage in restoration; more appropriate for wet meadow zone but will provide coverage in transition zones
grass	*Alopecurus aequalis*	short-awn foxtail	seed	Generally not commonly used in restoration but may be useful in certain applications
grass	*Anthoxanthum hirtum* (*Hierochloe hirta*) (*Hierochloe odorata*)	sweet grass	plug	Not very dominant in the Calgary area; found in areas with better ecological health; seed does not seem to establish well; more appropriate for wet meadow zone but may provide coverage in transition zones
grass	*Beckmannia syzigachne*	slough grass	seed, plug	Water fowl seed predation is a large component of why this species seem to fail to establish in restoration projects; often species placement is in a wetland zone that is too dry to support slough grass
grass	*Calamagrostis canadensis*	bluejoint (Canada reedgrass)	seed	Seed may be difficult to procure as it is often wild-harvested from cut-blocks; more appropriate for wet

Life form	Botanical name (common synonym)	Common name (frequently used synonym)	Preferred planting form	Notes
				meadow zone but will provide transitional coverage
grass	*Calamagrostis stricta*	narrow reed grass	seed	Similar to northern reed grass but smaller with a shorter, less dense panicle; naturally occurs in the more western and northern parts of the city; could be used as a substitute for northern reed grass
grass	*Calamagrostis stricta ssp. inexpansa*	northern reed grass	seed	Do not confuse with reed canary grass which is invasive; more appropriate for wet meadow zone but will provide coverage in transitional areas
grass	*Deschampsia cespitosa*	tufted hair grass	seed	Drought tolerant; highly tufted; good for transitional zones
grass	*Elymus canadensis*	Canada wild rye	seed	Aggressive but works well in seed mixes; will form monoculture if seeded first as a cover crop; good for transitional zones
grass	*Glyceria grandis*	common tall manna grass	seed, plug	Prefers wetter conditions than fowl manna grass; will often see them in the field with the tall manna grass closer to the wetland centre
grass	*Glyceria striata*	fowl manna grass	seed, plug	Prefers drier conditions than common tall manna grass; will often see them side by side with the tall manna grass closer to the wetland centre
grass	*Poa palustris*	fowl bluegrass	seed	Common on wetland edges; prefers moisture but is very drought tolerant; provides good coverage and weed suppression in restoration applications; dominant species in wet meadow zone but will provide transitional vegetation cover in peripheral low prairie zone and drier area of shallow marsh zone
grass	*Scolochloa festucacea*	spangletop	plug, seed	Locally rare in the Calgary area; naturally occurring populations protected in northeast wetlands
grass	*Spartina gracilis*	alkali cord grass	seed, plug	Naturally occurs sporadically in both freshwater and alkaline riparian areas; have observed it in the dried portion of the shallow marsh zone,

Life form	Botanical name (common synonym)	Common name (frequently used synonym)	Preferred planting form	Notes
				although it is more common in the outer wetland zones
grass	*Spartina pectinata*	prairie cord grass	plug, seed	It is currently on the provincial Tracking List; found to be more common in the province than originally thought and is supposed to be off the next edition of the Tracking List; very good for bank stabilization; not as easily outcompeted as other species due to its tall stature; seems to tolerate wetter conditions than alkali cord grass
rush	*Eleocharis acicularis*	needle spike-rush	plug	Forms short dense mats; usually in shallower water than creeping spike-rush; rhizomatous; stabilizes soil and banks; provides forage to water fowl
rush	*Eleocharis palustris*	creeping spike-rush	plug	Often the dominant emergent vegetation species; usually more towards the centre of the wetland versus needle spike-rush; rhizomatous; stabilizes soil and banks; provides forage to water fowl
rush	*Juncus alpinoarticulatus*	alpine rush	seed, plug	As it is present in areas that are dry most of the year, seed storage does not likely have to be in frozen water and, as such, good candidate for restoration; common in all areas except for xeric prairies
rush	*Juncus balticus*	wire (Baltic) rush	seed, plug	Tends to come in on its own; seed is available; appears to tolerate more drought than some other wet meadow species; dominant wet meadow species but provides coverage for transition zones
rush	*Juncus bufonius*	toad rush	seed, plug	Early successional annual; likely good candidate for early coverage; produces a lot of seed
rush	*Juncus ensifolius*	equitant-leaved rush	plug	Grows in moist to wet areas; rhizomatous; soil binding abilities; more suitable for north and west areas of Calgary

Life form	Botanical name (common synonym)	Common name (frequently used synonym)	Preferred planting form	Notes
rush	*Juncus longistylis*	long-styled rush	plug	Establishes best through root fragments; good soil stabilizer
rush	*Juncus nodosus*	knotted rush	plug, seed	Tolerant of disturbance, including foot traffic and grazing; found in moist to wet areas; effectively binds soil
rush	*Juncus tenuis*	slender rush	plug, seed	Found in moist to wet areas; contributes to bank stabilization and biodiversity
rush	*Juncus torreyi*	Torrey's rush	plug, seed	Tolerant of disturbance, including foot traffic and grazing; found in moist to wet areas; effectively binds soil; very similar to knotted rush except larger in size
rush	*Scirpus microcarpus*	small-fruited bulrush	plug	Grows in shallow standing water in the shallow marsh area inward into deeper more permanent open water
sedge	*Carex aquatilis*	water sedge	plug, seed	Common in the Calgary area
sedge	*Carex atherodes*	awned sedge	plug, seed	Very common in the Calgary area; key to identification is the presence of the hairy basal sheath
sedge	*Carex capillaris*	hair-like sedge	plug	Generally, sedges tend to come in on their own; seed handling and storage is difficult; if require additional biodiversity, this would be a candidate for planting in areas outside of the eastern portion of Calgary; naturally absent from prairie areas; occurs naturally in areas that have better riparian health scores
sedge	*Carex lasiocarpa*	hairy-fruited sedge	plug	Common; valuable for soil binding; seed handling and storage is difficult
sedge	*Carex utriculata*	small bottle sedge	plug, seed	Common in the Calgary area
shrub	*Alnus incana*	alder	1 gal+	More tree-like; tends to be more localized to the foothills and parkland areas of Calgary; restoration activity due to flood repair has resulted in alder being planted in many riparian areas within the city

Life form	Botanical name (common synonym)	Common name (frequently used synonym)	Preferred planting form	Notes
shrub	*Amelanchier alnifolia*	Saskatoon	1 gal	Common in riparian areas and around wetlands in forested areas
shrub	*Cornus stolonifera*	red-osier dogwood	1 gal	Very common in outer riparian areas
shrub	*Elaeagnus commutata*	wolfwillow	1 gal	Forms extensive thickets in riparian areas
shrub	*Ribes aureum*	golden currant	plug, 1 gal	Important source of early season forage for native bees and other pollinators; fruit attracts wildlife; fruit is edible; performed very well in bank restoration for flood repairs along the Elbow River and therefore, tolerates inundation and drought; full sun to light shade tolerance; flowers have strong fragrance; thorns absent
shrub	*Salix bebbiana*	beaked (Bebb's) willow	plug, 1 gal	Beaked willow tends to prefer the drier portions of riparian areas; naturally colonizes peripheral low prairie zones and upper riparian areas
shrub	*Salix candida*	hoary willow	plug, 1 gal	May grow in transition wet meadow zone
shrub	*Salix discolor*	pussy willow	plug, 1 gal	Ensure that shrub is not highly visible as it likely will be harvested by the public for decorative purposes
shrub	*Salix exigua*	narrow-leaf willow	plug, 1 gal	Tolerant of saturation; fairly drought tolerant once established
shrub	*Salix famelica* (*Salix lutea*)	hungry (yellow) willow	plug, 1 gal	Common in the Calgary area; more often known as yellow willow; hungry willow is a synonym for yellow willow, but it is not used regularly
shrub	*Salix interior*	sandbar willow	plug, 1 gal	Tolerant of saturation; fairly drought tolerant once established
shrub	*Salix lasiandra* (*Salix lucida*)	shining willow	plug, 1 gal	Common in the Calgary area
shrub	*Salix planifolia*	flat-leaved willow	plug, 1 gal	Hybridizes with pussy willow
shrub	*Salix pseudomonticola*	false mountain willow	plug, 1 gal	Tends to be recognized by its dark reddish-brown branches, glandular leaf margins and reddish-coloured young leaves

Life form	Botanical name (common synonym)	Common name (frequently used synonym)	Preferred planting form	Notes
shrub	*Salix serissima*	autumn willow	plug, 1 gal	Occurs sporadically and generally does not form large stands

Native wetland deep marsh zone-fresh water

These native species are appropriate for a fresh water Class IV wetland or the outer zone of a permanent Class V lake/pond. Class IV wetlands are semi-permanent wetlands and have a central deep marsh zone that holds water most years, except in times of drought. Class IV wetlands may dry up every 5 to 10 years, based on climate and associated hydrological cycles.

Wetlands that are more saline in nature are found in the eastern portion of the Calgary area whereas freshwater wetlands are generally associated with the western part of the city. Additionally, stormwater runoff into semi-permanent wetlands can increase the salinity of naturally freshwater wetlands.

This list contains all native species. Most introduced species that can withstand semi-permanent water are either native or prohibited noxious weeds regulated under the *Alberta Weed Control Act*. Many non-native hydrophytic species are annual and do not persist/self-seed as they are not adapted to the cold winters in the Calgary area and as such, they are similar to bedding plants as they only provide vegetation cover and visual aesthetics in the growing season. The non-native perennial species that were introduced into this region are showy and have been brought in through the horticultural business for water gardens and ponds. Unfortunately, many of the perennial non-native species that could overwinter in this region have become very invasive, to the detriment of naturally occurring native plant communities [e.g., flowering rush (*Butomus umbellatus*) and yellow iris (*Iris pseudacorus*)].

Generally, the approach taken to restore the deep marsh zone in wetlands is natural recovery. From observations in the Calgary area, this establishment takes approximately 4 years without human interference.

Seed collection and storage becomes more difficult as plants become more hydrophytic and as such, plant selection is limited, although some companies specialize in native emergent and aquatic vegetation. It is also difficult to seed and plant species when standing water is present. Soils become compromised due to compaction and admixing as even planting and seeding by hand can significantly rut wet soils.

In the deep marsh zone specifically, it is fairly consistently composed of open water with aquatic and emergent vegetation. This does not allow for seeding as essentially, seeds get washed away. Also, aquatic plants often do not remain where they are planted due to water movement and the time it takes for the roots to become integrated into the sediment. Soil reuse from similar areas or

the same wetland area, preconstruction, often results in better vegetation establishment, especially when soil handling best practices are implemented.

Although natural recovery combined with soil reuse and best handling practices is often sufficient for revegetation of the deep marsh zone, there are instances where supplemental restoration techniques such as seeding and planting are warranted. These situations may arise when:

- the soil is in poor health;
- adjacent construction activities are causing a weed colonization risk to the open wetland soils;
- the site is to be restored to a very pristine wetland so restoration is aiming to achieve maximum biodiversity and similarity to the reference vegetation community;
- the soil is not stable and requires vegetation to bind soils quicker than the vegetation would establish on its own; and,
- the water quality of the wetland is very important and as such, rapid vegetation establishment is required to ensure minimal sediment loading into the waterbody.

Another instance where restoration of the deep marsh zone is warranted is in the complete construction of Class IV wetlands, which may or may not be responsible for collecting stormwater. The need to maximize biodiversity and hydrophytic plant life would be combined with some or all of the other factors listed above.

It is crucial during the construction of this wetland type to properly time restoration work so aquatic plants establish. As discussed in the timing section, plants should be planted during dormancy, when the ground is thawed and prior to the pond being at its maximum high water level. Seeding cannot be performed in a deep marsh zone in times other than drought or prior to the diversion of water into the basin, if completely constructed . Also, the seed will likely get washed away before it germinates and has enough of a root system to keep it in place. Seed handling and storage for hydrophytic vegetation is also normally out of scope for the general contractor. In cases where the wetland is constructed, hydrophytic plants need hydrophytic conditions to survive and as such, planting deep marsh species in a dry wetland will cause plant mortality. Also, diverting large water volumes into the wetland prior to plant root establishment can cause plant loss and as such, plants should be rooted and established prior to maximum water inputs.

The plants indicated below are all native. Emphasis is on plants that are rooted to the bottom sediment and not entirely aquatic [e.g., duckweed (*Lemna spp.*)]. Also, pondweeds (*Potamogeton spp.*) are not covered in depth although there are a few common examples below.

Life form	Botanical name (common synonym)	Common name (frequently used synonym)	Preferred planting form	Notes
forb	*Alisma triviale*	broad-leaved water-plantain	plug	Good for early successional coverage
forb	*Hippuris vulgaris*	common mare's-tail	plug, 1 gal	Growth starts underwater until becomes emergent
forb	*Persicaria amphibia*	water smartweed	plug	Not commonly used in restoration; may provide good early coverage; tolerant of fluctuating water conditions and as such, may be a good species to use in response to climate change
forb	*Potamogeton natans*	floating-leaf pondweed	plug, 1 gal	Provides waterfowl forage; occurs from the shallow marsh and inwards into deeper water; reproduces mostly from rhizomes and rhizome fragments
forb	*Potamogeton richardsonii*	clasping-leaf pondweed	plug, 1 gal	One of the more visible pondweeds
forb	*Ranunculus aquatilis*	large-leaved white water crowfoot	plug, 1 gal	Provides habitat to fish and aquatic invertebrates
forb	*Ranunculus gmelinii*	yellow water crowfoot	plug, 1 gal	Provides habitat to fish and aquatic invertebrates
forb	*Sagittaria cuneata*	arum-leaved arrowhead	plug	Appropriate for all areas of Calgary
forb	*Sparganium angustifolium*	narrow-leaved bur-reed	plug	Plug recommended as seed is likely to be washed away; how successful this species establishes from seed in the Calgary area is unknown; more common in the prairie than giant bur-reed
forb	*Sparganium eurycarpum*	giant bur-reed	plug, seed	Plug recommended as seed is likely to be washed away; how successful this species establishes from seed in the Calgary area is unknown; more naturally localized to western and northern areas of the city
forb	*Tephroseris palustris*	marsh ragwort	plug	More of a parkland/foothills species so appropriate for the west and north areas of Calgary; provides pollinator forage
forb	*Typha latifolia*	common cattail	plug, 1 gal	Dominant in the deep marsh zone but commonly found in the shallow marsh zone

Life form	Botanical name (common synonym)	Common name (frequently used synonym)	Preferred planting form	Notes
forb	*Utricularia vulgaris*	common bladderwort	plug	Carnivorous plant; available at select aquatic nursery locations; likely not going to be used in restoration unless goal of restoration is to replicate the natural wetland environment
forb	*Veronica anagallis-aquatica*	speedwell	plug	This plant in the Calgary area was thought to be *Veronica catenata* and was classified as rare and on the Provincial Tracking List; the taxonomy was not consistent with that species so it was re-evaluated by the province; this speedwell is found throughout the entire city in standing shallow water in fresh water wetlands, in slow moving watercourses and along banks
rush	*Eleocharis acicularis*	needle spike-rush	plug	More commonly found in shallow marsh zone but appropriate for transition zone or shallower Class IV wetland
rush	*Eleocharis palustris*	creeping spike-rush	plug	More commonly found in the shallow marsh zone but appropriate for transition zone; stabilizes soil and banks; provides forage to water fowl
rush	*Juncus tenuis*	slender rush	plug	Found in moist to wet areas; contributes to bank stabilization and biodiversity; more appropriate for transition zone
rush	*Juncus torreyi*	Torrey's rush	plug	Tolerant of disturbance, including foot traffic and grazing; found in moist to wet areas; effectively binds soil; very similar to knotted rush except larger in size; more appropriate for transition zone
rush	*Schoenoplectus acutus*	great (hardstem) bulrush	plug, 1 gal	Dominant in the deep marsh zone
rush	*Schoenoplectus tabernaemontani*	common great bulrush	plug, 1 gal	Dominant in the deep marsh zone
rush	*Scirpus microcarpus*	small-fruited bulrush	plug	Common in shallow marsh to deep marsh zone
sedge	*Carex aquatilis*	water sedge	plug	Common in the Calgary area; best for transition zone

Life form	Botanical name (common synonym)	Common name (frequently used synonym)	Preferred planting form	Notes
sedge	*Carex atherodes*	awned sedge	plug	Very common in the Calgary area; key to identification is the presence of the hairy basal sheath; best for transition zone
sedge	*Carex utriculata*	small bottle sedge	plug, seed	Common in the Calgary area
shrub	*Salix exigua*	narrow-leaf willow	plug, 1 gal	May grow sporadically in deep marsh zone
shrub	*Salix interior*	sandbar willow	plug, 1 gal	May grow sporadically in the deep marsh zone

Permanent ponds and lakes open water central zone-fresh water

Class V wetlands are the lakes that are commonly used for recreation such as boating and water skiing. They do not regularly dry up as their central deep zone is deeper than 2 m. If they are naturally occurring and have not been extensively altered or disturbed, they have the regular wetland zone configuration of the outer peripheral low prairie zone, the wet meadow zone, the shallow marsh zone, the deep marsh zone and the permanent open water zone. If the outer zones are not intact or present, the lake may have experienced shoreline alteration such as homes built on the shoreline, boat dock construction, hardening of the banks for recreational purposes and/or mowing of banks. Other factors can influence the presence and intactness of the outer wetland zones. These hydrological modifications include damming and changing the natural water flow pattern to raise water levels or reduce them such as in the case of using the water for irrigation purposes. Man-made lakes also tend to not have intact wetland zones as the outer zones have been minimized through grading and modifications to eliminate the shallower outer areas.

Restoration of the open water central zones of permanent lakes is not feasible or warranted. Restoration is not required as aquatic vegetation in the deep marsh zone will spread into the central permanent open water zone of Class V ponds and lakes. Emergent vegetation is also reduced in the central zone due to water depth. Plants that are visible are entirely aquatic or have a small emergent portion whereas the rest of the plant is submerged.

Upper bank of riparian area-watercourses

This list contains native plant species that are appropriate for the upper bank of watercourses within the city of Calgary. This bank area is the slope leading down to the watercourse that is regularly influenced by water but is only submerged during spring run-off and frequent high volume precipitation events.

It is important to note that species appropriate for very infrequent flooding such as the flood plain area and riparian forest have been covered in the previous lists. Watercourses are also not saline, although some salt loading occurs through stormwater outfalls, but the volume of water in the watercourse combined with effective stormwater management mitigates salinity.

The plant list is entirely native as naturalization of upper banks is not feasible or warranted. Native plants are the most effective in flood mitigation and binding soils. Additionally, plants that are not native that are aggressive enough to overwinter or colonize on their own through abundant seed production have been legislated under the *Alberta Weed Control Act* in the past. These non-native introductions, mostly through the horticultural industry for water gardens and backyard ponds, have caused drastic modifications to native plant communities and decreased riparian health. Due to this reason, non-native plants that could be used for naturalization such as water cress (*Nasturtium officinale*) are not recommended due to the environmental risk, the lack of appropriate non-native perennials and self-seeding annuals and the abundance of native plants that tolerate hydrophytic conditions.

Species appropriate for bioengineering, abbreviated BE, are also noted and can be installed in a live stake or TRS form, of which the TRS is more highly recommended as its harvest and installation is not as time sensitive as in the case of using live stakes. A forthcoming document from Water Resources will outline the advantages and limitations of individual species used in bioengineering.

If species are not planted into continuously moist soil, watering or irrigation should be implemented to ensure maximum survival. Once established, the majority of upper bank species are somewhat drought tolerant. Irrigation, if feasible, is a better option for watering, both for water usage and plant establishment as well as access. Access is often limited along riparian areas.

Life form	Botanical name (common synonym)	Common name (frequently used synonym)	Preferred planting form	Notes
forb	*Agastache foeniculum*	giant hyssop	plug	Prefers rich soils; tolerates some inundation
forb	*Allium schoenoprasum*	wild chives	plug	Can spread unwantedly; tolerates a wide range of conditions, including inundation to relatively dry conditions
forb	*Astragalus canadensis*	Canada milkvetch	seed	Germinates easily from seed; nitrogen fixing as legume; does well on riparian areas but tolerant of grassland conditions
forb	*Epilobium ciliatum*	northern willowherb	seed	Comes in commonly on its own; drought tolerant; small pink flowers are aesthetically pleasing; provides pollinator forage; split pods and

Life form	Botanical name (common synonym)	Common name (frequently used synonym)	Preferred planting form	Notes
				seeds with cottony pappus provide winter interest
forb	*Geum aleppicum*	yellow avens	plug, seed	Provides pollinator forage; will grow in moist grasslands in the western portion of the city as well
forb	*Mentha arvensis*	wild mint	forb	Readily spreads; ensure species is native wild mint as many mint cultivars are available
forb	*Pedicularis groenlandica*	elephant's-head	plug	Grows in boggy locations; showy plant; provides pollinator forage
forb	*Petasites frigidus*	coltsfoot	plug	In Calgary, this species tends to grow in moist forests but will also grow in moist areas elsewhere; 4 varieties which differ based on leaf shape
forb	*Prunus pensylvanica*	pin cherry	plug, 1 gal+	Occurs sporadically in Calgary's northwest
forb	*Ranunculus macounii*	Macoun's buttercup	plug, seed	Tends to disappear from areas with regular disturbance
forb	*Ranunculus sceleratus*	celery-leaved buttercup	plug	Annual; may be appropriate for early season coverage; commercially available; suggest plug as once established, will self-seed
forb	*Stachys pilosa*	marsh hedge-nettle	forb	Provides good pollinator forage; do not confuse with other species in the mint family
forb	*Tephroseris palustris*	marsh ragwort	plug	More of a parkland/foothills species so appropriate for the west and north areas of Calgary; provides pollinator forage
grass	*Achnatherum hymenoides*	Indian rice grass	seed, plug	Naturally colonizes open banks with silt depositions
grass	*Agrostis scabra*	rough hair grass (hair bentgrass)	seed	Common on wetland edges; drought tolerant; not common in abundance in areas other than wetland edges, provides good native early to mid-successional coverage in restoration
grass	*Agrostis scabra*	rough hair grass (hair bentgrass)	seed	Provides native early to mid-successional coverage in restoration
grass	*Anthoxanthum hirtum* (*Hierochloe hirta*)	sweet grass	plug	Not very dominant in the Calgary area; found in areas with better

Life form	Botanical name (common synonym)	Common name (frequently used synonym)	Preferred planting form	Notes
	(*Hierochloe odorata*)			ecological health; seed does not seem to establish well
grass	*Bromus ciliatus*	fringed brome	seed	More of a parkland/montane species but good for restoration due to aggressive nature
grass	*Bromus marginatus*	mountain brome	seed	Although it is a more of a southwest montane species, it works well in urban restoration as it is competitive; prefers full sun to very light partial shade
grass	*Calamagrostis canadensis*	bluejoint (Canada reedgrass)	seed	Seed may be difficult to procure as it is often wild-harvested from cut-blocks; will grow on shores and out into water
grass	*Calamagrostis stricta*	narrow reed grass	seed	Similar to northern reed grass but smaller with a shorter, less dense panicle; naturally occurs in the more western and northern parts of the city; could be used as a substitute for northern reed grass
grass	*Calamagrostis stricta ssp. inexpansa*	northern reed grass	seed	Do not confuse with reed canary grass which is invasive
grass	*Deschampsia cespitosa*	tufted hair grass	seed	Drought tolerant; highly tufted
grass	*Elymus canadensis*	Canada wild rye	seed	Aggressive but works well in seed mixes; will form monoculture if seeded first as a cover crop
grass	*Elymus trachycaulus spp. subsecundum*	awned wheatgrass	seed	Similar characteristics to slender wheatgrass but not as aggressive; may be due to genetics or awns
grass	*Elymus trachycaulus ssp. trachycaulus*	slender wheatgrass	seed	Use plant material propagated or collected from plants in the wild and as close to the wild type as possible; many cultivars of slender wheatgrass exist; commercially available slender wheatgrass tends to be more aggressive than the wild type
grass	*Festuca saximontana*	Rocky Mountain fescue	seed	Provides early successional cover when used in a seed mix; can withstand short periods of saturation and drought

Life form	Botanical name (common synonym)	Common name (frequently used synonym)	Preferred planting form	Notes
grass	*Glyceria grandis*	common tall manna grass	seed, plug	Prefers wetter conditions than fowl manna grass; will often see them in the field with the tall manna grass closer to the wetland centre
grass	*Koeleria macrantha*	June grass	seed	Good addition to riparian seed mixes as it will provide coverage in times of drought
grass	*Nasella viridula*	green needle grass	seed	Very competitive; good species for smooth brome suppression
grass	*Pascopyrum smithii*	western wheatgrass	seed	Common on shores
grass	*Poa palustris*	fowl bluegrass	seed	Drought tolerant although prefers additional moisture
grass	*Poa secunda* (*Poa juncifolia*)	Sandberg bluegrass (alkali bluegrass)	seed	Ensure plant's origin is correctly aligned with a moister habitat type since many species have been grouped together as *Poa secunda*
grass	*Spartina gracilis*	alkali cord grass	seed, plug	Naturally occurs sporadically in both freshwater and alkaline riparian areas
grass	*Spartina pectinata*	prairie cord grass	plug, seed	It is currently on the provincial Tracking List; found to be more common in the province than originally thought and is supposed to be off the next edition of the Tracking List; very good for bank stabilization; not as easily outcompeted as other species due to its tall stature; appears to tolerate wetter conditions than alkali chord grass
rush	*Juncus balticus*	wire (Baltic) rush	seed, plug	Tends to come in on its own; seed is available; appears to tolerate more drought than other species which is why it was included on the upper bank list
rush	*Juncus nodosus*	knotted rush	plug, seed	Tolerant of disturbance, including foot traffic and grazing; found in moist to wet areas; effectively binds soil; similar habitat niche to wire rush
rush	*Juncus torreyi*	Torrey's rush	plug, seed	Tolerant of disturbance, including foot traffic and grazing; found in moist to wet areas; effectively binds

Life form	Botanical name (common synonym)	Common name (frequently used synonym)	Preferred planting form	Notes
				soil; very similar to knotted rush except larger in size
sedge	*Carex capillaris*	hair-like sedge	plug	Generally, sedges tend to come in on their own; seed handling and storage is difficult; if require additional biodiversity, this would be a candidate for planting in areas outside of the eastern portion of Calgary; naturally absent from prairie areas; occurs in areas that have better riparian health scores
shrub	*Alnus incana*	alder	1 gal+	More tree-like; tends to be localized to the foothills and parkland areas of Calgary; restoration activity due to flood repair has resulted in alder being planted in many riparian areas within the city
shrub	*Amelanchier alnifolia*	Saskatoon	1 gal+	Common in riparian areas on the upper bank, within forested areas, in flood plains and mesic grasslands
shrub	*Cornus stolonifera*	red-osier dogwood	1 gal+, BE	Very common in riparian areas, open forests, moist dense forests and on flood plains
shrub	*Elaeagnus commutata*	wolfwillow	1 gal+	Forms extensive thickets in riparian areas; also common in forests and floodplains; sporadic in grasslands
shrub	*Prunus virginiana*	choke cherry	plug, 1 gal+	Common in forested areas, flood plains and riparian areas
shrub	*Ribes aureum*	golden currant	plug, 1 gal+	Important source of early season forage for native bees and other pollinators; fruit attracts wildlife; prefers moist soil but can withstand some drought; full sun to light shade tolerant; used to be common along the Elbow River until more development occurred; it has now been planted as part of the flood repairs
shrub	*Ribes oxyacanthoides*	northern gooseberry	plug, 1 gal	Important source of early season forage for native bees and other pollinators; fruit attracts wildlife; fruit is edible; prefers moist soil but can withstand some drought; full sun to part shade tolerant

Life form	Botanical name (common synonym)	Common name (frequently used synonym)	Preferred planting form	Notes
shrub	*Salix bebbiana*	beaked (Bebb's) willow	plug, 1 gal+, BE	Prefers the drier portions of banks
shrub	*Salix candida*	hoary willow	plug, 1 gal+, BE	Performance in bioengineering has not been confirmed
shrub	*Salix discolor*	pussy willow	plug, 1 gal+, BE	Ensure that shrub is not highly visible as it likely will be harvested by the public for decorative purposes
shrub	*Salix exigua*	narrow-leaf willow	plug, 1 gal+, BE	One of the most tolerant willows as related to bioengineering activities; harvest and installation of live stakes outside of dormancy have been able to establish, unlike most other willow species
shrub	*Salix famelica* (*Salix lutea*)	hungry (yellow) willow	plug, 1 gal+, BE	Common in the Calgary area; more often known as yellow willow; hungry willow is a synonym for yellow willow, but it is not used regularly
shrub	*Salix interior*	sandbar willow	plug, 1 gal+, BE	One of the most tolerant willows as related to bioengineering activities; harvest and installation of live stakes outside of dormancy have been able to establish, unlike most other willow species
shrub	*Salix lasiandra* (*Salix lucida*)	shining willow	plug, 1 gal+, BE	Common in the Calgary area
shrub	*Salix petiolaris*	basket willow	plug, 1 gal+, BE	Common in the Calgary area
shrub	*Salix planifolia*	flat-leaved willow	plug, 1 gal+, BE	Hybridizes with pussy willow
shrub	*Salix pseudomonticola*	false mountain willow	plug, 1 gal+, BE	Tends to be recognized by its dark reddish-brown branches, glandular leaf margins and reddish-coloured young leaves
shrub	*Salix serissima*	autumn willow	plug, 1 gal+, BE	Occurs sporadically and generally does not form large stands
tree	*Populus balsamifera*	balsam poplar	plug, 1 gal+, BE	Dominant component of forests in riparian areas; common around wetlands in forested areas
vine	*Clematis ligusticifolia*	western clematis	1 gal+	Provides pollinator forage; provides vertical and winter interest

Lower bank of riparian area-watercourses

This list contains native plant species that are appropriate for the lower bank of watercourses within the city of Calgary. This is the area that is directly adjacent to open water. This area experiences more frequent inundation than the upper bank area and is entirely under water during spring runoff and large precipitation events.

The plant list is entirely native as naturalization of the lower banks of riparian areas is not feasible or warranted. Native plants are the most effective in flood mitigation and binding soils. Additionally, plants that are not native that are aggressive enough to overwinter or colonize on their own through abundant seed production have been legislated under the *Alberta Weed Control Act* in the past. These non-native introductions, mostly through the horticultural industry for water gardens and backyard ponds, have caused drastic modifications to native plant communities and decreased riparian health. Due to this reason, non-native plants that could be used for naturalization such as water cress (*Nasturtium officinale*) are not recommended due to the environmental risk, the lack of appropriate non-native perennials and self-seeding annuals and the abundance of native plants that tolerate hydrophytic conditions.

Species appropriate for bioengineering, abbreviated BE, are also noted and can be installed in a live stake or TRS form, of which the TRS is more highly recommended as its harvest and installation is not as time sensitive compared to the TRS. A forthcoming document from Water Resources will outline the advantages and limitations of individual species used in bioengineering.

If species are not planted into continuously moist soil, watering or irrigation should be implemented to ensure maximum survival. Generally, the soils on the lower bank next to open water should be continuously moist; however, this may not occur during times of drought and/or associated human activities related to water saving such as reducing water output from reservoirs. If feasible, irrigation should be implemented in order to ensure plant survival.

Planting and seeding times should be phased appropriately to allow the plants to bind the soil prior to spring run-off. This will ensure that the majority of the material does not wash away during times where water velocity is maximized.

Species that are more aquatic in nature, such as pondweeds, are not outlined below. Watercourses occur naturally, although anthropogenic modifications may be present and as such, they tend not to be man-made such as the created wetlands mentioned above. The open water portion of watercourses is also governed by the provincial and federal government. These two factors combined with the water velocity present in watercourses and the wide range of lands that are connected by rivers and streams do not make restoration of the watercourse bed feasible or warranted. Fish habitat work is often performed within rivers and streams but this involves the placement of root balls, rocks and other natural materials and seldomly involves a revegetation element.

Life form	Botanical name (common synonym)	Common name (frequently used synonym)	Preferred planting form	Notes
forb	*Alisma triviale*	broad-leaved water-plantain	plug	Good for early successional coverage
forb	*Allium schoenoprasum*	wild chives	plug	Can spread unwantedly; tolerates some inundation
forb	*Epilobium ciliatum*	northern willowherb	seed	Comes in commonly on its own; small pink flowers are aesthetically pleasing; pollinator forage; split pods and seeds with cottony pappus provide winter interest
forb	*Geum aleppicum*	yellow avens	plug, seed	Provides pollinator forage; tolerates some inundation
forb	*Hippuris vulgaris*	common mare's-tail	plug, 1 gal	Growth starts underwater until becomes emergent
forb	*Mentha arvensis*	wild mint	forb	Readily spreads; ensure species is native wild mint as many mint cultivars are available
forb	*Pedicularis groenlandica*	elephant's-head	plug	Grows in boggy locations; showy plant; provides pollinator forage
forb	*Persicaria amphibia*	water smartweed	plug	Not commonly used in restoration; may provide good early coverage; tolerant of fluctuating water conditions and as such, may be a good species to use in response to climate change
forb	*Petasites frigidus*	coltsfoot	plug	In Calgary, this species tends to grow in moist forests but will also grow in moist areas elsewhere; 4 varieties which differ based on leaf shape
forb	*Ranunculus macounii*	Macoun's buttercup	plug, seed	Tends to disappear from areas with regular disturbance
forb	*Ranunculus sceleratus*	celery-leaved buttercup	plug	Annual; may be appropriate for early season coverage; commercially available; suggest plug as once established, will self-seed
forb	*Sagittaria cuneata*	arum-leaved arrowhead	plug	Appropriate for all areas of Calgary
forb	*Sparganium angustifolium*	narrow-leaved bur-reed	plug, seed	Plug recommended as seed is likely to be washed away; how successful this species establishes from seed in the Calgary area is unknown; more common in the prairie than giant bur-reed

Life form	Botanical name (common synonym)	Common name (frequently used synonym)	Preferred planting form	Notes
forb	*Sparganium eurycarpum*	giant bur-reed	plug, seed	Plug recommended as seed is likely to be washed away; how successful this species establishes from seed in the Calgary area is unknown; more naturally localized to western and northern areas of the city
forb	*Stachys pilosa*	marsh hedge-nettle	forb	Provides good pollinator forage; may be on lower or upper bank
forb	*Tephroseris palustris*	marsh ragwort	plug	More of a parkland/foothills species so appropriate for the west and north areas of Calgary; provides pollinator forage
forb	*Typha latifolia*	common cattail	plug, 1 gal	Not as common along watercourses as in wetlands; may be present on lower bank and areas where sediment has accumulated
forb	*Veronica anagallis-aquatica*	speedwell	plug	This plant in the Calgary area was thought to be *Veronica catenata* and was classified as rare on the provincial Tracking List; the taxonomy was not consistent with that species so it was re-evaluated by the province; this speedwell is found throughout the entire city in standing water and wet soils
grass	*Agrostis scabra*	rough hair grass (hair bentgrass)	seed	May grow next to open water; drought tolerant
grass	*Alopecurus aequalis*	short-awn foxtail	seed	Generally not commonly used in restoration but may be useful in certain applications
grass	*Anthoxanthum hirtum* (*Hierochloe hirta*) (*Hierochloe odorata*)	sweet grass	plug	Not very dominant in the Calgary area; found in areas with better ecological health; seed does not seem to establish well
grass	*Beckmannia syzigachne*	slough grass	seed, plug	Water fowl seed predation is a large component of why this species seem to fail to establish in restoration projects; often species placement in restoration is problematic as this species is often put in places where it is too dry to support it

Life form	Botanical name (common synonym)	Common name (frequently used synonym)	Preferred planting form	Notes
grass	*Bromus ciliatus*	fringed brome	seed	More of a parkland/montane species but good for restoration due to aggressive nature
grass	*Bromus marginatus*	mountain brome	seed	Although it is a more of a southwest montane species, it works well in urban restoration as it is competitive; prefers full sun to very light partial shade
grass	*Calamagrostis canadensis*	bluejoint (Canada reedgrass)	seed	Seed may be difficult to procure as it is often wild-harvested from cut-blocks
grass	*Calamagrostis stricta*	narrow reed grass	seed	Similar to northern reed grass but smaller with a shorter, less dense panicle; naturally occurs in the more western and northern parts of the city; could be used as a substitute for northern reed grass
grass	*Calamagrostis stricta ssp. inexpansa*	northern reed grass	seed	Do not confuse with reed canary grass which is invasive
grass	*Deschampsia cespitosa*	tufted hair grass	seed	Drought tolerant; highly tufted
grass	*Elymus canadensis*	Canada wild rye	seed	Aggressive but works well in seed mixes; will form monoculture if seeded first as a cover crop; will grow in dry to wet areas
grass	*Elymus trachycaulus spp. subsecundum*	awned wheatgrass	seed	Similar characteristics to slender wheatgrass but not as aggressive; may be due to genetics or awns
grass	*Elymus trachycaulus ssp. trachycaulus*	slender wheatgrass	seed	Use plant material propagated or collected from plants in the wild and as close to the wild type as possible; many cultivars of slender wheatgrass exist; commercially available slender wheatgrass tends to be more aggressive than the wild type
grass	*Festuca saximontana*	Rocky Mountain fescue	seed	Provides early successional cover when used in a seed mix; can withstand short periods of saturation and drought
grass	*Glyceria grandis*	common tall manna grass	seed, plug	Prefers wetter conditions than fowl manna grass

Life form	Botanical name (common synonym)	Common name (frequently used synonym)	Preferred planting form	Notes
grass	*Glyceria striata*	fowl manna grass	seed, plug	Prefers drier conditions than common tall manna grass
grass	*Koeleria macrantha*	June grass	seed	Although June grass is associated with xeric areas, it will tolerate shore conditions and does well with extra moisture
grass	*Nasella viridula*	green needle grass	seed	Very drought tolerant; colonizes open areas next to disturbances; can withstand short periods of saturation
grass	*Pascopyrum smithii*	western wheatgrass	seed	A dominant species in peripheral low prairie
grass	*Poa palustris*	fowl bluegrass	seed	Common on wetland edges; prefers moisture but is very drought tolerant; provides good coverage and weed suppression in restoration applications
grass	*Poa secunda* (*Poa juncifolia*)	Sandberg bluegrass (alkali bluegrass)	seed	Ensure plant's origin is correctly aligned with a moister habitat type since many species have been grouped together as *Poa secunda*
grass	*Spartina gracilis*	alkali cord grass	seed, plug	Naturally occurs sporadically in both freshwater and alkaline riparian areas
grass	*Spartina pectinata*	prairie cord grass	plug, seed	It is currently on the provincial Tracking List; found to be more common in the province than originally thought and is supposed to be off the next edition of the Tracking List; very good for bank stabilization; not as easily outcompeted as other species due to its tall stature; seems to tolerate wetter conditions than alkali cord grass
rush	*Eleocharis acicularis*	needle spike-rush	plug	Forms short dense mats; usually in shallower water than creeping spike-rush; rhizomatous; stabilizes soil and banks; provides forage to water fowl
rush	*Eleocharis palustris*	creeping spike-rush	plug	Stabilizes soil and banks; provides forage to water fowl
rush	*Juncus alpinoarticulatus*	alpine rush	seed, plug	As it is present in areas that are dry most of the year, seed storage does

Life form	Botanical name (common synonym)	Common name (frequently used synonym)	Preferred planting form	Notes
				not likely have to be in frozen water and, as such, good candidate for restoration
rush	*Juncus balticus*	wire (Baltic) rush	seed, plug	Tends to come in on its own; seed is available; appears to tolerate more drought than some other rush species
rush	*Juncus bufonius*	toad rush	seed, plug	Early successional annual; likely good candidate for early coverage; produces a lot of seed
rush	*Juncus ensifolius*	equitant-leaved rush	plug	Grows in moist to wet areas; rhizomatous; soil binding abilities; more suitable for north and west areas of Calgary
rush	*Juncus longistylis*	long-styled rush	plug	Establishes best through root fragments; good soil stabilizer
rush	*Juncus nodosus*	knotted rush	plug, seed	Tolerant of disturbance, including foot traffic and grazing; found in moist to wet areas; effectively binds soil
rush	*Juncus tenuis*	slender rush	plug, seed	Found in moist to wet areas; contributes to bank stabilization and biodiversity
rush	*Juncus torreyi*	Torrey's rush	plug, seed	Tolerant of disturbance, including foot traffic and grazing; found in moist to wet areas; effectively binds soil; very similar to knotted rush except larger in size
rush	*Schoenoplectus acutus*	great (hardstem) bulrush	plug, 1 gal	More common in wetlands; will grow into open water
rush	*Schoenoplectus tabernaemontani*	common great bulrush	plug, 1 gal	More common in wetlands; will grow into open water
rush	*Scirpus microcarpus*	small-fruited bulrush	plug	More common along watercourses than common great bulrush and great bulrush; appropriate for area adjacent to open water
sedge	*Carex aquatilis*	water sedge	plug	Common in the Calgary area
sedge	*Carex atherodes*	awned sedge	plug, seed	Very common in the Calgary area; key to identification is the presence of the hairy basal sheath

Life form	Botanical name (common synonym)	Common name (frequently used synonym)	Preferred planting form	Notes
sedge	*Carex capillaris*	hair-like sedge	plug	Absent from prairie areas; occurs naturally in areas that have better riparian health scores
sedge	*Carex lasiocarpa*	hairy-fruited sedge	plug	Common; valuable for soil binding; seed handling and storage is difficult
sedge	*Carex utriculata*	small bottle sedge	plug, seed	Common in the Calgary area
shrub	*Cornus stolonifera*	red-osier dogwood	1 gal, BE	Population in Calgary has been impacted from harvesting for flood repairs
shrub	*Elaeagnus commutata*	wolfwillow	1 gal	Forms extensive thickets in riparian areas
shrub	*Ribes aureum*	golden currant	plug, 1 gal	Does very well when planted on lower banks; used to occur all along the Elbow River but development impacted population; flood repairs have restored population in the centre city; provides early season pollinator forage; provides wildlife forage
shrub	*Salix bebbiana*	beaked (Bebb's) willow	plug, 1 gal, BE	More tolerant of drier soils compared to other willow species
shrub	*Salix candida*	hoary willow	plug, 1 gal, BE	Less common in Calgary
shrub	*Salix discolor*	pussy willow	plug, 1 gal	Ensure that shrub is not highly visible as it likely will be harvested by the public for decorative purposes
shrub	*Salix exigua*	narrow-leaf willow	plug, 1 gal, BE	More tolerant of harvest and installation after breaking dormancy compared to other species
shrub	*Salix famelica* (*Salix lutea*)	hungry (yellow) willow	plug, 1 gal, BE	Common in the Calgary area; more often known as yellow willow; hungry willow is a synonym for yellow willow, but it is not used regularly
shrub	*Salix interior*	sandbar willow	plug, 1 gal, BE	More tolerant of harvest and installation after breaking dormancy compared to other species
shrub	*Salix lasiandra* (*Salix lucida*)	shining willow	plug, 1 gal, BE	Common in the Calgary area

Life form	Botanical name (common synonym)	Common name (frequently used synonym)	Preferred planting form	Notes
shrub	*Salix petiolaris*	basket willow	plug, 1 gal+, BE	Common in the Calgary area
shrub	*Salix planifolia*	flat-leaved willow	plug, 1 gal, BE	Hybridizes with pussy willow
shrub	*Salix pseudomonticola*	false mountain willow	plug, 1 gal, BE	Tends to be recognized by its dark reddish-brown branches, glandular leaf margins and reddish-coloured young leaves
shrub	*Salix serissima*	autumn willow	plug, 1 gal, BE	Occurs sporadically and generally does not form large stands
tree	*Populus balsamifera*	balsam poplar	plug, 1 gal+, BE	Dominant component of forests in riparian areas; common around wetlands in forested areas

Native wetland peripheral low prairie zone-saline water

These native species are appropriate for a saline Class I wetland (e.g., saturated for a less than one week per year) or the peripheral prairie zone of a more permanent, higher class wetland. Wetlands that are more saline in nature are found in the eastern portion of the Calgary area whereas freshwater wetlands are generally associated with the western part of the city. These eastern wetlands generally do not have as much woody vegetation cover as freshwater wetlands.

The degree of salinity is not differentiated in this document; however, the notes portion provides information on the degree of salt tolerance each plant has. Many wetlands collect storm water and due to road de-icing, a lot of salt runoff inevitably ends up within the wetland. Essentially, the assumption is that these wetlands are very saline in nature. Also, all plants in the list are commonly seen in the Calgary area in Class I wetlands or the peripheral low prairie area of a higher class wetland.

This list contains all native species. This plant list is suitable for restoration work that aims to restore the area to a more native reference vegetation community. Likely, the vegetation community is somewhat intact but requires improvements to increase ecosystem health or the vegetation community has undergone ongoing maintenance such as weed control to better increase the chances that the restoration will be successful. Alternatively, the wetland may be in a natural area or Natural Environment Park and as such, the intent is to keep the area, and surrounding area vegetation native.

Additionally, there is overlap in plant species between wetland zones as the intent of the plant list is to identify species that will thrive in these particular environments. Naturally, a species may not be as dominant as others but if it is applicable and will grow in this habitat type, it is listed.

It should be noted that the plant list is different than the one indicated by Stewart and Kantrud (1971). This is because of the overlap of the three Natural Subregions within Calgary and how this allows for the presence of prairie, foothills and parkland species. Although many of the species that are indicated by Stewart and Kantrud (1971) are accurate for the Calgary area, there are discrepancies as the paper examined areas that are outside of Calgary. The plant list below reflects the appropriate species for the Calgary area.

Life form	Botanical name (common synonym)	Common name (frequently used synonym)	Preferred planting form	Notes
forb	*Lysimachia maritima* (*Glaux maritima*)	sea milkwort	plug	High salinity tolerance; sourcing may be difficult
forb	*Achillea millefolium*	common yarrow	plug, seed	Can withstand highly disturbed areas; drought and salt tolerant; spreads readily vegetatively; often first to establish in harsh environments with poor soils
forb	*Androsace occidentalis*	western fairy candelabra	seed, plug	Moderately salt tolerant; annual; may be difficult to procure; adds floral biodiversity; could include in seed mix for early coverage
forb	*Artemisia ludoviciana*	prairie sagewort	plug, seed	Highly salt tolerant; often delineates peripheral low prairie zone/Class I wetlands with saline soils
forb	*Asclepias speciosa*	showy milkweed	plug	Only genus of plant that monarch caterpillars feed on; can form large patches; somewhat tolerant to saline soils
forb	*Chenopodium salinum*	oak-leaved (Rocky Mountain) goosefoot	plug, seed	Naturally colonizes open salty soils; not very aesthetically pleasing but possibility for coverage in areas where other plants will not grow
forb	*Epilobium ciliatum*	northern willowherb	seed	Moderate salinity tolerance; drought tolerant; provides pollinator forage and winter interest; may be difficult to source; readily establishes from seed
forb	*Grindelia squarrosa*	curly-cup gumweed	plug, seed	Very important resource for pollinators; very salt tolerant and thrives in alkaline flats

Life form	Botanical name (common synonym)	Common name (frequently used synonym)	Preferred planting form	Notes
forb	*Heterotheca villosa*	golden aster (hairy golden aster)	plug, seed	Low in stature and aids as a groundcover; salt and drought tolerant
forb	*Linum lewisii*	blue flax	seed	Provides excellent early coverage; aesthetically pleasing; good forage for native pollinators; germinates quickly; not dominant in wetlands but good candidate for restoration of outer wetland zone due to low cost, salt tolerance and hardiness
forb	*Mentzelia decapetala*	sand-lily	plug, seed	Native to southeastern Alberta; naturally grows in alkaline soils; will grow in Calgary area as has colonized imported dry saline soils due to presence in seed bank
forb	*Oenothera suffrutescens* (*Gaura coccinea*)	scarlet butterflyweed (scarlet gaura)	plug	Not dominant but will add pollinator forage to restoration
forb	*Potentilla anserina*	silverweed	plug	Forms ground cover; spreads by stolons; very salt tolerant; commonly found on outer saline wetland zones; flowers provide pollinator forage; drought tolerant
forb	*Solidago missouriensis*	low (Missouri) goldenrod	seed, plug	Very common in this habitat type; very salt tolerant; tolerant of disturbance
forb	*Sphaeralcea coccinea*	scarlet mallow	plug	Salt tolerant; not dominant in this habitat type; will add pollinator forage for restoration
forb	*Symphyotrichum ericoides*	tufted white prairie aster	seed, plug	Very salt tolerant; dominant in this habitat type
forb	*Symphyotrichum laeve*	smooth aster	plug, seed	Drought and salt tolerant; hardy and can withstand disturbance pressure; not dominant in this habitat type but may be common; adds additional floral diversity
forb	*Thermopsis rhombifolia*	golden bean	plug	Dominant in this wetland class and in wet meadow zones/Class II wetlands; medium salt tolerance
grass	*Agrostis scabra*	rough hair grass (hair bentgrass)	seed	Very salt tolerant; dominant species in saline peripheral low prairie zones
grass	*Deschampsia cespitosa*	tufted hair grass	seed	Very salt tolerant; dominant in this habitat type

Life form	Botanical name (common synonym)	Common name (frequently used synonym)	Preferred planting form	Notes
grass	*Distichlis spicata* (*Distichlis spicata*)	saltgrass	plug	One of the most salt tolerant plant species; dominates saline wetlands; generally does not colonize well from seed as it is outcompeted; spreads well from plug plantings
grass	*Elymus trachycaulus ssp. trachycaulus*	slender wheatgrass	seed	Cultivars available so ensure genetic origin is appropriate for the context; tall, robust and early successional; dominant in moderately saline wetlands
grass	*Festuca saximontana*	Rocky Mountain fescue	seed	Provides early successional cover when used in a seed mix; retains green colour until late in season, sometimes even under snow; moderate to high salinity tolerance; some initial moisture required for germination and persistence
grass	*Koeleria macrantha*	June grass	seed	Somewhat salinity tolerant; more of a xeric prairie species but will do well with added moisture
grass	*Pascopyrum smithii*	western wheatgrass	seed	Somewhat salt tolerant; generally lower growing than slender wheatgrass; often found with slender and awned wheatgrass
grass	*Poa palustris*	fowl bluegrass	seed	Moderately saline tolerant; dominant in wet meadow zones/Class II wetlands; drought tolerant; good for restoration work
grass	*Puccinellia nuttalliana*	Nuttall's salt-meadow (alkali) grass	seed	Very salt tolerant; drought tolerant
grass	*Spartina gracilis*	alkali cord grass	plug	Can assist in erosion control; best propagated vegetatively
shrub	*Rosa woodsii*	common wild rose	1 gal	Moderately salt tolerant; often delineates the peripheral low prairie zone of wetlands
shrub	*Shepherdia argentea*	thorny buffaloberry	1 gal	Very salt and drought tolerant; occurs sporadically in saline prairie wetlands
shrub	*Symphoricarpos occidentalis*	buckbrush	1 gal	Moderate salinity tolerance; dominant and often delineates peripheral low prairie zone of wetlands

Native wetland wet meadow zone-saline water

These native species are appropriate for the central zone of a saline Class II wetland (e.g., saturated for a few weeks per year) or the peripheral prairie zone of a more permanent, higher class wetland. Wetlands that are more saline in nature are found in the eastern portion of the Calgary area whereas fresh water wetlands are generally associated with the western part of the city. These eastern wetlands generally do not have as much woody vegetation cover as freshwater wetlands.

The degree of salinity is not differentiated in this document; however, the notes portion provides information on the degree of salt tolerance each plant has. Many wetlands collect storm water and due to road de-icing, a lot of salt inevitably ends up within the wetland. Essentially, the assumption is that these wetlands are quite saline in nature.

This list contains all native species. This plant list is suitable for restoration work that aims to restore the area to a more native reference vegetation community. Likely, the vegetation community is somewhat intact but requires improvements to increase ecosystem health or the vegetation community has undergone maintenance such as weed control to better increase the chances that the restoration will be successful. Alternatively, the wetland may be in a natural area or Natural Environment Park and as such, the intent is to keep the area, and surrounding area vegetation native.

Additionally, there is overlap in plant species between wetland zones as the intent of the plant list is to identify species that will thrive in these particular environments. Naturally, a species may not be as dominant as others but if it is applicable and will grow in this habitat type, it is listed. Urban development and anthropogenic disturbance also tends to affect the distinction between wetland zones. In areas not affected by development, the wetland zones are more distinct.

It should be noted that the plant list is different than the one indicated by Stewart and Kantrud (1971). This is because of the overlap of the three Natural Subregions within Calgary and how this allows for the presence of prairie, foothills and parkland species. Although many of the species that are indicated by Stewart and Kantrud (1971) are accurate for the Calgary area, there are discrepancies as the paper examined areas that are outside of Calgary. The plant list below reflects the appropriate species for the Calgary area.

Life form	Botanical name (common synonym)	Common name (frequently used synonym)	Preferred planting form	Notes
forb	*Achillea millefolium*	common yarrow	plug, seed	Moderate salinity tolerance; drought tolerant; spreads vegetatively; its presence on the banks of watercourses indicates that it likely can withstand some inundation

Life form	Botanical name (common synonym)	Common name (frequently used synonym)	Preferred planting form	Notes
forb	*Artemisia ludoviciana*	prairie sagewort	plug, seed	More appropriate for drier transition zone
forb	*Chenopodium salinum*	oak-leaved (Rocky Mountain) goosefoot	plug, seed	Naturally colonizes open salty soils; not very aesthetically pleasing but a candidate for areas that struggle to maintain vegetation cover
forb	*Epilobium ciliatum*	northern willowherb	seed	Moderate salinity tolerance; may be dominant in wet meadow zone/Class II wetlands
forb	*Grindelia squarrosa*	curly-cup gumweed	plug, seed	Very important resource for pollinators; extremely salt tolerant and thrives in alkaline flats; attractive plant
forb	*Lysimachia maritima* (*Glaux maritima*)	sea milkwort	plug	High salinity tolerance; sourcing may be difficult
forb	*Mentha arvensis*	wild mint	plug, seed	Moderate salinity tolerance; readily spreads vegetatively
forb	*Potentilla anserina*	silverweed	plug	Forms ground cover; spreads by stolons; very salt tolerant; drought tolerant
forb	*Rumex fueginus*	American golden dock	plug, seed	High salinity tolerance; may be dominant in wet meadow zone
forb	*Rumex triangulivalvis*	narrow-leaved dock	plug, seed	May be dominant in wet meadow zone; moderate salinity tolerance
forb	*Solidago missouriensis*	low (Missouri) goldenrod	seed, plug	More appropriate for drier transition zone into peripheral low prairie
forb	*Symphyotrichum ericoides*	tufted white prairie aster	seed, plug	Very salt tolerant; dominates peripheral low prairie zone; naturally present but more sporadic in Class II wetlands/wet meadow zone
forb	*Thermopsis rhombifolia*	golden bean	plug	Moderate salinity tolerance; often delineates wet meadow zone in xeric prairie
grass	*Agrostis scabra*	rough hair grass (hair bentgrass)	seed	Very salt tolerant; often dominant in peripheral low prairie and wet meadow zones
grass	*Deschampsia cespitosa*	tufted hair grass	seed	Very salt tolerant; often dominant in peripheral low prairie and wet meadow zones
grass	*Distichlis spicata* (*Distichlis spicata*)	saltgrass	plug	One of the most salt tolerant plant species; often delineates wet meadow

Life form	Botanical name (common synonym)	Common name (frequently used synonym)	Preferred planting form	Notes
				zone; less dominant in peripheral low prairie zone
grass	*Puccinellia nuttalliana*	Nuttall's salt-meadow (alkali) grass	seed	Very salt tolerant; drought tolerant
grass	*Spartina gracilis*	alkali cord grass	plug	Can assist in erosion control; best propagated vegetatively
grass	*Spartina pectinata*	prairie cord grass	plug, seed	It is currently on the provincial Tracking List; found to be more common in the province than originally thought and is supposed to be off the next edition of the Tracking List; not as easily outcompeted as other species due to its tall stature; generally found north of Calgary; good for restoration work
rush	*Juncus balticus*	wire (Baltic) rush	seed, plug	High salinity tolerance; tends to come in on its own; seed is available; appears to tolerate more drought than some other wet meadow species; often delineates the wet meadow zone
shrub	*Shepherdia argentea*	thorny buffaloberry	1 gal	Very salt and drought tolerant; occurs sporadically in saline prairie wetlands

Native wetland shallow marsh zone-saline water

These native species are appropriate for the central zone of a Class III wetland that is influenced by salt presence or the shallow marsh zone of a Class VI alkali pond/lake.

Class III wetlands have a central zone that is saturated for the majority of the growing season (e.g., few months per year). The shallow marsh zone is normally wet starting from snow melt in the early spring. If rainfall does not occur regularly throughout the summer, the shallow marsh zone will be dry by September. It may even be void of water earlier if hot temperatures are combined with drought.

In highly saline mud flats, which may be part of a saline wetland complex and Class VI wetlands, this zone is often the most dominant zone.

Wetlands that are naturally more saline in nature are found in the eastern portion of the Calgary area; however, road de-icing often causes the salinity in wetlands to increase due to run-off. The degree of salinity is not differentiated in this document. Instead, the notes portion provides information on the degree of salt tolerance for each plant species to aid in restoration planning.

This list contains all native species. This plant list is suitable for restoration work that aims to restore the area to a more native reference vegetation community. Likely, the vegetation community is somewhat intact but requires improvements to increase ecosystem health or the vegetation community has undergone ongoing maintenance such as weed control to better increase the chances that the restoration will be successful. Alternatively, the wetland may be in a natural area or Natural Environment Park and as such, the intent is to keep the area, and surrounding area vegetation native. As more Natural Environment Parks are being established in the city's eastern portion, the likelihood of these wetlands being in The City's park space is increasing.

It should be noted that the plant list is different than the one indicated by Stewart and Kantrud (1971). This is because of the overlap of the three Natural Subregions within Calgary and how this allows for the presence of prairie, foothills and parkland species. Although many of the species that are indicated by Stewart and Kantrud (1971) are accurate for the Calgary area, there are discrepancies as the paper examined areas that are outside of Calgary. The plant list below reflects the appropriate species for the Calgary area.

It is often appropriate to allow for natural recovery of the shallow marsh zone. From observations in the Calgary area, this establishment takes approximately 4 years without human interference. This is because seed collection and storage becomes more difficult as plants become more hydrophytic. It is also difficult to seed and plant species when standing water is present. Soils become compromised due to compaction and admixing as even planting and seeding by hand can significantly rut wet soils. Soil reuse from similar areas or the same wetland area, preconstruction, often results in better vegetation establishment, especially when soil handling best practices are implemented.

Although natural recovery combined with soil reuse and best handling practices is often sufficient for revegetation of the shallow marsh zone, there are instances where supplemental restoration techniques such as seeding and planting are warranted. These situations may arise when:

- the soil is in poor health;
- adjacent construction activities are putting a lot of invasive plants pressure on the open wetland soils;
- the site is to be restored to a more pristine wetland and in turn, a healthier ecosystem;
- the soil is not stable and requires vegetation to bind soils quicker than the vegetation would come in on its own; and,
- water quality of the wetland is important and as such, vegetation establishment is required as quickly as possible to ensure minimal sediment loading into the water.

Finally, it is important to phase restoration work so that plants are established prior to the wetland containing its maximum water volume so that the seed and/or plants do not wash away. Since areas with high alkalinity generally contain shallower water, fall seeding and planting would maximize success. This prevents the soil from being compromised as the area is dry when landscaping activities would occur. The plants are also starting to enter dormancy which allows for

increased survival. Water input through run-off and precipitation in the spring would allow for establishment, without altering the wetland significantly. For example, some supplementary watering could be done to increase establishment; however, for highly saline wetlands that are being conserved and restored, high amounts of watering would decrease salinity, change the water chemistry and in turn, change the plant community.

Life form	Botanical name (common synonym)	Common name (frequently used synonym)	Preferred planting form	Notes
forb	*Alisma triviale*	broad-leaved water-plantain	plug	Good for early successional coverage; moderate salt tolerance
forb	*Persicaria amphibia*	water smartweed	plug	Not commonly used in restoration; may provide good early coverage; tolerant of fluctuating water conditions and as such, may be a good species to use in response to climate change; moderate salt tolerance
forb	*Potamogeton natans*	floating-leaf pondweed	plug, 1 gal	Provides waterfowl forage; occurs from the shallow marsh and inwards into deeper water; reproduces mostly from rhizomes and rhizome fragments; moderate salt tolerance
forb	*Ranunculus cymbalaria*	seaside buttercup	plug	High salt tolerance; functions as an effective ground cover
forb	*Ranunculus sceleratus*	celery-leaved buttercup	plug	Moderate salt tolerance; annual; may be appropriate for early season coverage; commercially available; suggest plug as once established, will self-seed
forb	*Sagittaria cuneata*	arum-leaved arrowhead	plug	Appropriate for all areas of Calgary; moderate salt tolerance; more appropriate for wetter transition zones into deeper zones
forb	*Salicornia rubra*	samphire	plug	Dominates very high salinity/alkalinity ephemeral wetlands; emergent samphire vegetation communities are on the provincial Tracking List
forb	*Sparganium angustifolium*	narrow-leaved bur-reed	plug, seed	Plug recommended as seed is likely to be washed away; how successful this species establishes from seed in the Calgary area is unknown; more common in the prairie than

Life form	Botanical name (common synonym)	Common name (frequently used synonym)	Preferred planting form	Notes
				giant bur-reed; moderate salt tolerance
forb	*Sparganium eurycarpum*	giant bur-reed	plug, seed	Plug recommended as seed is likely to be washed away; how successful this species establishes from seed in the Calgary area is unknown; more naturally localized to western and northern areas of the city; moderate salt tolerance
forb	*Suaeda calceoliformis*	western sea-blite	plug	Very high salinity tolerance; often dominates this zone
forb	*Triglochin maritima*	seaside arrow-grass	plug	Very salt tolerant; often comes in on its own
forb	*Typha latifolia*	common cattail	plug, 1 gal	Dominant in the deep marsh zone but commonly found in the shallow marsh zone; in urban wetlands, common cattails dominate the vegetation and multiple wetland zones that are less defined in the urban environment; highly salt tolerant
forb	*Utricularia vulgaris*	common bladderwort	plug	Carnivorous plant; available at select aquatic nursery locations; likely not going to be used in restoration unless goal of restoration is to replicate the natural wetland environment; moderately salt tolerance
grass	*Agrostis scabra*	rough hair grass (hair bentgrass)	seed	Provides good native early to mid-successional coverage in restoration; more appropriate for wet meadow zone but will provide coverage in transition zones; high salt tolerance
grass	*Alopecurus aequalis*	short-awn foxtail	seed	Moderate to high salt tolerance; generally not commonly used in restoration but may be useful in this application
grass	*Beckmannia syzigachne*	slough grass	seed, plug	High salt tolerance; water fowl seed predation is a large component of why this species seem to fail to establish in restoration projects; often species placement is in a

Life form	Botanical name (common synonym)	Common name (frequently used synonym)	Preferred planting form	Notes
				wetland zone that is too dry to support slough grass
grass	*Calamagrostis stricta ssp. inexpansa*	northern reed grass	seed	Do not confuse with reed canary grass which is invasive; more appropriate for wet meadow zone but will provide coverage in transitional areas
grass	*Deschampsia cespitosa*	tufted hair grass	seed	Very high salt tolerance; drought tolerant; highly tufted
grass	*Poa palustris*	fowl bluegrass	seed	Dominant in wet meadow zone; prefers moisture but is very drought tolerant; provides good coverage and weed suppression in restoration applications; appropriate for transition zone to wet meadow; high salt tolerance
grass	*Puccinellia nuttalliana*	Nuttall's salt-meadow (alkali) grass	seed	Very salt tolerant; drought tolerant
grass	*Scolochloa festucacea*	spangletop	plug, seed	Locally rare in the Calgary area; high salt tolerance
grass	*Spartina gracilis*	alkali cord grass	seed, plug	Naturally occurs sporadically in both freshwater and alkaline riparian areas; high salt tolerance
grass	*Spartina pectinata*	prairie cord grass	plug, seed	It is currently on the provincial Tracking List; found to be more common in the province than originally thought and is supposed to be off the next edition of the Tracking List; very good for bank stabilization; not as easily outcompeted as other species due to its tall stature; seems to tolerate wetter conditions than alkali cord grass; moderate salt tolerance
rush	*Bolboschoenus maritimus* (*Scirpus paludosus*)	alkali bulrush	plug	Very highly salt tolerant; one of the most salt tolerant species of plants
rush	*Eleocharis acicularis*	needle spike-rush	plug	High salt tolerance; forms short dense mats
rush	*Eleocharis palustris*	creeping spike-rush	plug	High salt tolerance; provides forage to water fowl

Life form	Botanical name (common synonym)	Common name (frequently used synonym)	Preferred planting form	Notes
rush	*Juncus balticus*	wire (Baltic) rush	seed, plug	High salt tolerance; tends to come in on its own; seed is available; appears to tolerate more drought than some other wet meadow species; dominant wet meadow species but provides coverage for transition zones; observed growing in dry areas and standing water at the same time of year
rush	*Schoenoplectus pungens*	three-square rush	plug	Very highly salt tolerant; grows in fresh to saline water; one of the most salt tolerant plants
rush	*Scirpus microcarpus*	small-fruited bulrush	plug	Somewhat salt tolerant; grows in shallow standing water in the shallow marsh area inward into the deeper more permanent open water zone
sedge	*Carex aquatilis*	water sedge	plug	Common in the Calgary area; moderate salt tolerance
sedge	*Carex atherodes*	awned sedge	plug, seed	High salt tolerance; very common in the Calgary area; key to identification is the presence of the hairy basal sheath
sedge	*Carex utriculata*	small bottle sedge	plug	Common in the Calgary area; some salt tolerance
shrub	*Salix bebbiana*	beaked (Bebb's) willow	plug, 1 gal	May occur sporadically in saline shallow marsh zones; some salinity tolerance
shrub	*Salix candida*	hoary willow	plug, 1 gal	May grow in transition wet meadow zone; high salt tolerance
shrub	*Salix exigua*	narrow-leaf willow	plug, 1 gal	Tolerant of saturation; fairly drought tolerant once established; moderate salinity tolerance; occurs sporadically in saline wetlands
shrub	*Salix interior*	sandbar willow	plug, 1 gal	Tolerant of saturation; fairly drought tolerant once established; moderate salinity tolerance; occurs sporadically in saline wetlands
shrub	*Shepherdia argentea*	thorny buffaloberry	1 gal	Very salt and drought tolerant; occurs sporadically in saline prairie wetlands from the peripheral low prairie zone to the shallow marsh zone

Native wetland deep marsh zone-salt water

These native species are appropriate for the central zone of a brackish to sub-saline semi-permanent Class IV wetland. The habitat type where maximum salinity occurs would be in the central intermittent-alkali zone Class VI alkali pond/lake. Class IV wetlands are semi-permanent wetlands and in this case, are influenced by the presence of salt. These wetlands have a central deep marsh zone that holds water most years, except in times of drought. Class IV wetlands may dry up every 5 to 10 years, based on climate and associated hydrological cycles. The central deep marsh zone of Class IV wetlands is also less than 2 m deep.

Brackish to subsaline Class IV wetlands are very common in the Calgary area along roadsides due to the influence of the salt used in road de-icing; however, brackish to alkali wetlands naturally occur in the eastern portion of the city. Due to changes in hydrology related to the volume of road runoff, many wetlands that were once less permanent in nature have increased in permanency and classification. Many wetlands that contained fresh water have turned into alkali wetlands due to road salt inputs. In some cases, naturally occurring alkali flats that contain highly halophytic (e.g., salt tolerant) plants may have become less saline due to water inputs. These salt flats often contain rare plant communities. Regardless, most commonly the trend it that Calgary's urban wetlands become more permanent and saltier.

This list contains all native species. Most plant species that can withstand semi-permanent water and high salinity are either native or prohibited noxious weeds regulated under the *Alberta Weed Control Act* [e.g., saltcedar (*Tamarix spp.*)].

Generally, the approach taken to restore the deep marsh zone in wetlands is natural recovery. From observations in the Calgary area, this establishment takes approximately 4 years without human interference.

Seed collection and storage becomes more difficult as plants become more hydrophytic and as such, plant selection is limited, although some companies specialize in native emergent and aquatic vegetation. It is also difficult to seed and plant species when standing water is present. Soils become compromised due to compaction and admixing as even planting and seeding by hand can significantly rut wet soils.

The central deep marsh zone of brackish to sub-saline Class IV wetlands or the central intermittent-alkali zone of a Class VI alkali pond/lake is fairly consistently composed of open water with aquatic and emergent vegetation. This does not allow for seeding as essentially, seeds get washed away. Also, aquatic plants often do not remain where they are planted due to water movement and the time it takes for the roots to become integrated into the sediment. Soil reuse from similar areas or the same wetland area, preconstruction, results in better vegetation establishment, especially when soil handling best practices are implemented.

Although natural recovery combined with soil reuse and best handling practices is often sufficient for revegetation of the deep marsh zone, there are instances where supplemental restoration techniques such as seeding and planting are warranted.

It is crucial during construction of the deep marsh zone to properly time restoration work so aquatic plants take properly. As discussed in the timing section, plants should be planted during dormancy, when the ground is thawed and prior to the wetland containing its maximum water volume. Seeding cannot be performed in areas of semi-permanent water other than in times other than drought. Also, the seed will likely get washed away before it germinates and has enough of a root system to keep it in place. Seed handling and storage for hydrophytic vegetation is also normally out of scope for the general contractor. In cases where the wetland is constructed, hydrophytic plants need hydrophytic conditions to survive and as such, planting deep marsh species in a dry wetland will cause plant mortality. Also, diverting large water volumes into the wetland prior to plant root establishment can cause plant loss and as such, plants should be rooted and established prior to maximum water inputs.

The plants indicated below are all native. Emphasis is on plants that are rooted in sediment and not entirely aquatic [e.g., duckweed (*Lemna spp.*)] although some common aquatic species are cited below. Pondweeds (*Potamogeton spp.*) are also not covered in depth; however, a small number of species are outlined in the table. Lastly, non-vascular plants are common in moist and wet habitat types but are not included as they are not within the scope of this document.

Life form	Botanical name (common synonym)	Common name (frequently used synonym)	Preferred planting form	Notes
forb	*Alisma triviale*	broad-leaved water-plantain	plug	Good for early successional coverage; moderate salt tolerance
forb	*Hippuris vulgaris*	common mare's-tail	plug, 1 gal	Growth starts underwater until becomes emergent
forb	*Persicaria amphibia*	water smartweed	plug	Not commonly used in restoration; may provide good early coverage; tolerant of fluctuating water conditions and as such, may be a good species to use in response to climate change; moderate salt tolerance
forb	*Potamogeton natans*	floating-leaf pondweed	plug, 1 gal	Provides waterfowl forage; occurs from the shallow marsh and inwards into deeper water; reproduces mostly from rhizomes and rhizome fragments; moderate salt tolerance
forb	*Potamogeton richardsonii*	clasping-leaf pondweed	plug, 1 gal	One of the more visible pondweeds
forb	*Ranunculus aquatilis*	large-leaved white water crowfoot	plug, 1 gal	Provides habitat to fish and aquatic invertebrates
forb	*Ranunculus gmelinii*	yellow water crowfoot	plug, 1 gal	Provides habitat to fish and aquatic invertebrates

Life form	Botanical name (common synonym)	Common name (frequently used synonym)	Preferred planting form	Notes
forb	*Ranunculus sceleratus*	celery-leaved buttercup	plug	Moderate salt tolerance; annual; may be appropriate for early season coverage; commercially available; once established, it will self-seed
forb	*Ruppia cirrhosa*	widgeon-grass	plug, 1 gal	Most salt tolerant aquatic plant in plant lists; dominates intermittent-alkali zone of Class VI wetlands
forb	*Sagittaria cuneata*	arum-leaved arrowhead	plug	Appropriate for all areas of Calgary; moderate salt tolerance
forb	*Sparganium angustifolium*	narrow-leaved bur-reed	plug	Plug recommended as seed is likely to be washed away; how successful this species establishes from seed in the Calgary area is unknown; more common in the prairie than giant bur-reed; moderate salt tolerance
forb	*Sparganium eurycarpum*	giant bur-reed	plug, seed	Plug recommended as seed is likely to be washed away; how successful this species establishes from seed in the Calgary area is unknown; more naturally localized to western and northern areas of the city; moderate salt tolerance
forb	*Stuckenia vaginata*	large-sheath pondweed	plug	Dominant in fresh to alkaline deep water; moderate to highly salt tolerant
forb	*Tephroseris palustris*	marsh ragwort	plug	More of a parkland/foothills species so appropriate for the west and north areas of Calgary; provides pollinator forage; better for transition into shallow marsh zone
forb	*Triglochin maritima*	seaside arrow-grass	plug	Very salt tolerant; often comes in on its own
forb	*Typha latifolia*	common cattail	plug, 1 gal	Dominant in the deep marsh zone but commonly found in the shallow marsh zone; in urban wetlands, common cattails generally dominate the vegetation and multiple wetland zones that are less defined in the urban environment; highly salt tolerant
forb	*Utricularia vulgaris*	common bladderwort	plug	Carnivorous plant; available at select aquatic nursery locations; likely not going to be used in

Life form	Botanical name (common synonym)	Common name (frequently used synonym)	Preferred planting form	Notes
				restoration unless goal of restoration is to replicate the natural wetland environment; moderately salt tolerance
grass	*Beckmannia syzigachne*	slough grass	seed, plug	High salt tolerance; water fowl seed predation is a large component of why this species seem to fail to establish in restoration projects; also, often species placement is in a wetland zone that is too dry to support slough grass; dominates shallow marsh zone but often sporadically present in deep marsh zones that do not have very deep water
grass	*Scolochloa festucacea*	spangletop	plug, seed	Locally rare in the Calgary area; high salt tolerance; may grow sporadically in semi-permanent saline water
rush	*Bolboschoenus maritimus* (*Scirpus paludosus*)	alkali bulrush	plug	Very highly salt tolerant; one of the most salt tolerant species of plants
rush	*Eleocharis acicularis*	needle spike-rush	plug	High salt tolerance; forms short dense mats
rush	*Eleocharis palustris*	creeping spike-rush	plug	High salt tolerance; dominates shallow marsh/Class III wetlands but found sporadically in semi-permanent saline water; provides forage to water fowl
rush	*Schoenoplectus acutus*	great (hardstem) bulrush	plug, 1 gal	Dominant in the deep marsh zone
rush	*Schoenoplectus pungens*	three-square rush	plug	Very highly salt tolerant; grows in fresh to saline water; one of the most salt tolerant plants
rush	*Schoenoplectus tabernaemontani*	common great bulrush	plug, 1 gal	Dominant in the deep marsh zone
rush	*Scirpus microcarpus*	small-fruited bulrush	plug	Somewhat salt tolerant; grows in shallow standing water in the shallow marsh area inward into deeper more permanent open water zone

Life form	Botanical name (common synonym)	Common name (frequently used synonym)	Preferred planting form	Notes
sedge	*Carex aquatilis*	water sedge	plug	Common in the Calgary area; moderate salt tolerance
sedge	*Carex atherodes*	awned sedge	plug	High salt tolerance; very common in the Calgary area; key to identification is the presence of the hairy basal sheath
sedge	*Carex utriculata*	small bottle sedge	plug	Common in the Calgary area
shrub	*Salix exigua*	narrow-leaf willow	plug, 1 gal	Tolerant of saturation; fairly drought tolerant once established; moderate salinity tolerance; occurs sporadically in saline wetlands
shrub	*Salix interior*	sandbar willow	plug, 1 gal	Tolerant of saturation; fairly drought tolerant once established; moderate salinity tolerance; occurs sporadically in saline wetlands

Permanent ponds and lakes open water central zone-saline water

Brackish to subsaline Class V wetlands are the lakes that are commonly used for recreation such as boating and water skiing. They do not regularly dry up as their central deep zone is deeper than 2 m. If they are naturally occurring and have not been extensively altered or disturbed, they have the regular wetland zone configuration of the outer peripheral low prairie zone, the wet meadow zone, the shallow marsh zone, the deep marsh zone and the permanent open water zone. If the outer zones are not intact or present, the lake may have experienced shoreline alteration such as cabins built on the shoreline, boat dock construction, hardening of banks for recreational purposes and/or mowing of banks. Other factors can influence the presence and intactness of the outer wetland zones. These hydrological modifications include damming and changing the natural water flow pattern to raise water levels or reduce them such as in the case of reservoirs that feed irrigation canals. Man-made lakes mostly do not have intact wetland zones as the outer zones have been minimized through grading and modifications. This is due to the human desire to reduce the shallower zones which may provide breeding ground to mosquitos as well as most people do not find these shallower zones aesthetically pleasing. Additionally, the lack of shallower wetland zones provide more developable land, unfortunately at the cost of riparian health and water quality.

Restoration of the open water central zones of permanent lakes is not feasible or warranted. Restoration is not required as aquatic vegetation in the deep marsh zone will spread into the central permanent open water zone of Class V ponds and lakes. If restoration is warranted ina

permanent pond/lake, species that are cited for the shallower zones can be used, even if the shallower zones are minimized due to development. Lastly, as permanent ponds and lakes increase in salinity to become sub-saline, the central permanent open-water zone begins to lack dominant species that define this zone. Aquatic plants are present but do not delineate this zone.

Alkali ponds and lakes-Class VI wetlands

The above lists have been grouped together to include brackish to saline water. Due to road runoff, semi-permanent and permanent wetlands have increased salt content due to de-icing activities on impervious surfaces such as roads and pathways that occur in the winter. This creates artificial conditions and higher salinity in more permanent wetlands which are generally not naturally occurring.

Class VI wetlands are naturally occurring and are often visually delineated by the presence of a salt crust on the soil surface. Samphire, which appears red, can visually delineate these wetlands to the point that they are very obvious and defined in the distance. Many of these wetlands have disappeared due to development and as such, emergent samphire marshes are tracked through the province.

Class VI wetlands often do not have deep water depths and may appear as alkaline mud flats. They have the concentric ring cover types with the difference of having marginal pockets of emergent vegetation that is appropriate for less permanent wetlands/wetland zones.

Restoration of a Class VI wetland involves understanding where all zones are located based on hydrology and vegetation. After all zones are mapped, utilizing the most saline tolerant species as indicated in the above tables will guide what plant species should be restored in each zone. Restoration phasing is again crucial to success and it is recommended to seed and plant in the fall, when the wetland water volume is minimal. This also allows for the wetland to naturally take on more water in the spring. This gradual increase in water volume allows for the plants to grow and bind the soil prior and prevents seed and plants from washing away. The need to water for establishment is also significantly reduced as if the goal is to restore an alkali wetland, then watering should not be part of the regular ongoing maintenance as it will decrease the salinity of the wetland and change its chemistry and, in turn, its plant composition.

Naturalized stormpond edges

The list below contains potential plants, both native and non-native, that are appropriate for the naturalization of stormpond edges. Generally, Water Resources is the Business Unit that initiates this work; however, Calgary Parks plays a major role in this work by providing restoration expertise.

Stormponds can arise from various origins. They may be entirely constructed in a location that normally did not hold water in the past. This construction altered the hydrology of the area in order to have water flow and collect in a certain area prior to going into the stormwater sewer system. This type of origin can occur in new communities to control overland drainage or may be constructed in existing communities for flood mitigation.

Naturalization of these outer edges may be desired to increase aesthetics, prevent erosion and bind soils, decrease maintenance (e.g., mowing and weeding), provide pollinator and wildlife forage, increase riparian health, maximize vegetation cover on the banks and increase water quality. Using a mix of native and non-invasive hardy non-native species may be the best option when dealing with challenging environments such as these. It also may be the most feasible option based on costs as many non-native plant species tend to be readily available and less costly than their native species counterpart that fills the same habitat niche/vegetation strata layer.

Commonly, these stormpond edges have saline soils due to the influx of water from the road containing salt for road de-icing. They are also normally quite dry, unless there is a very large precipitation event that causes the stormpond's water volume to rise above the normal high water mark.

In addition to salt, the plants on these stormpond edges need to withstand infrequent inundation and sediment loading. The species that are appropriate for these areas overlap with the species indicated in the Low Impact Development Guidelines: Module 2 - Bioretention and Bioswales Final Report (The City of Calgary 2016).

Although plant species overlap between bioretention areas and stormwater edges, they are not the same and require a somewhat different approach. Stormponds tend to hold water whereas bioretention features are designed so that the water drains within a 24 hour to 72 hour period. Bioretention features are also vegetated throughout the entire basin and the sides whereas stormwater ponds may not be restored to include aquatic and highly hydrophytic vegetation. They also may be lined with impervious substrate, although constructing them using those methods is not as common now due to water quality issues. Vegetation along the banks contributes to water quality and decreases sediment loading, both by catching the sediment during overland drainage and by binding soils.

Another difference between stormponds and bioretention features is that the vegetation and soil structure of bioretention ponds and swales are engineered to clean the water of a certain catchment basin. This allows for the water to be much cleaner and reduces suspended sediment prior to the water entering the underground sewer utilities then eventually flowing out into a watercourse. Stormwater ponds are engineered for storage and flood mitigation and may or may not be designed to improve water quality, although the newer constructed ponds tend to be designed to somewhat improve water quality.

Additionally, the plant species that are for naturalized stormpond edges are recommended on the basis of being relatively self-sustaining and maintenance free. They need to withstand drier conditions, especially in camparison to the plant species in the basin of bioretention features. These plant species do not experience as much sediment loading as in bioretention features. Lastly, the vegetation palette for stormponds is not designed to maximize transpiration and soil porosity but instead, it is to ensure a low maintenance, well-vegetated and healthier riparian area although it does assist in improving soil porosity.

Life form	Botanical name (common synonym)	Common name (frequently used synonym)	Preferred planting form	Native (y=yes, n=no)	Notes
forb	*Achillea millefolium*	common yarrow	plug, seed	y	Can withstand highly disturbed areas; drought and salt tolerant; spreads readily vegetatively; often first to establish in harsh environments with poor soils
forb	*Achillea millefolium* 'Paprika'	paprika yarrow	1 gal, seed	n	Paprika yarrow is noted due to its bright colour and shorter compact growth habit; other coloured cultivars of yarrow would be appropriate as well; commonly sold as potted material although seeds are available
forb	*Androsace occidentalis*	western fairy candelabra	seed, plug	y	Moderately salt tolerant; annual; may be difficult to procure; adds floral biodiversity; could include in seed mix for early coverage
forb	*Artemisia ludoviciana*	prairie sagewort	plug, seed	y	Highly salt tolerant; often delineates peripheral low prairie zone/Class I wetlands with saline soils
forb	*Artemisia schmidtiana* 'Silver Mound'	silver mound artemisia	1 gal	n	Less hardy than native sages; may be used if native sages are not available for procurement
forb	*Asclepias speciosa*	showy milkweed	plug	y	Only genus of plant that monarch caterpillars feed on; can form large patches; somewhat tolerant to saline soils; drought tolerant
forb	*Campanula rotundifolia*	harebell	plug	y	Only plant that one native bee feeds on in Alberta; spreads readily; blooms throughout the growing season; very hardy plant
forb	*Centaurea cyanus*	cornflower (bachelor buttons)	seed	n	Annual; self-seeds; use care as may be invasive
forb	*Centaurea montana*	mountain star-thistle	seed, 1 gal	n	May be invasive; use caution with this plant

Life form	Botanical name (common synonym)	Common name (frequently used synonym)	Preferred planting form	Native (y=yes, n=no)	Notes
forb	*Cerastium tomentosum*	snow-in-summer	plug, 1 gal	n	Somewhat salt tolerant; very drought tolerant once established; caution advised as once established, this plant can spread into unwanted areas; recommend keeping it contained if not intended to spread and form dense ground cover
forb	*Chenopodium salinum*	oak-leaved (Rocky Mountain) goosefoot	plug, seed	y	Naturally colonizes open salty soils; not showy; appears weedy but is native; good candidate for use in areas where other species struggle
forb	*Cherianthus allionii*	Siberian wallflower	seed	n	Generally does not bloom the first growing season; does not volunteer often but may naturalize
forb	*Cosmos spp.*	Cosmos	seed	n	Annual; self-seeds if seed heads are left to mature; very drought tolerant; does well in poor soils; somewhat salt tolerant
forb	*Dalea purpurea*	purple prairie clover	plug, seed	y	Drought resistant; salt tolerant although research seems to be inconsistent regarding the degree of salt tolerance
forb	*Dracocephalum thymiflorum*	thyme-leaved dragonhead	seed, plug	n	Will colonize bare disturbed areas; not weedy in the Calgary-area; appears to be somewhat salt tolerant; highly drought tolerant; attracts pollinators
forb	*Echinops ritro*	globe thistle	1 gal	n	Salt and drought tolerant; will self-seed; may require deadheading to extend blooming time
forb	*Epilobium ciliatum*	northern willowherb	seed	y	Moderate salinity tolerance; drought tolerant; provides pollinator forage and winter interest; may be difficult to

Life form	Botanical name (common synonym)	Common name (frequently used synonym)	Preferred planting form	Native (y=yes, n=no)	Notes
					source; readily establishes from seed
forb	*Erigeron compositus*	cut-leaved fleabane	plug	y	Can function as somewhat of a ground cover; very drought tolerant; likely some salinity tolerance
forb	*Eryngium planum*	cross-thistle (sea holly)	1 gal	n	Be cautious when using this plant as it can volunteer in adjacent Natural Environment Parks
forb	*Eschscholzia californica*	California poppy	seed	n	Annual; somewhat saline tolerant; seed easily available
forb	*Gaillardia aristata*	gaillardia (blanket-flower)	plug, 1 gal, seed	y	Many different cultivars (e.g., variations on amount of red, orange and yellow) available at garden centres and nurseries; native species is salt tolerant; cultivars appear to be salt tolerant as well but would ensure that the salt tolerance of cultivars is investigated before purchasing; germinates well from seed but appears to take 1-2 years before flowering
forb	*Galium boreale*	northern bedstraw	plug, seed	y	Withstands shade, full sun and some disturbance; seems to be one of the last native plants to die out in urban parks; likely somewhat salt tolerant but research indicates inconsistent results regarding salinity tolerance
forb	*Geum triflorum*	three-flowered avens	plug	y	Prefers full sun; flowers after ~ 2 years or more of growth; distribution in saline grasslands indicates some salt tolerance; can act as a groundcover

Life form	Botanical name (common synonym)	Common name (frequently used synonym)	Preferred planting form	Native (y=yes, n=no)	Notes
forb	*Glycyrrhiza lepidota*	wild licorice	plug	y	Prefers well drained areas with periodic moisture such as edges of escarpments; somewhat salt tolerant
forb	*Grindelia squarrosa*	curly-cup gumweed	plug, seed	y	Very important resource for pollinators; very salt tolerant and thrives in alkaline flats; thrives in environments where other plants struggle
forb	*Gypsophila elegans*	annual baby's-breath	seed	n	Flowers early; readily self-seeds; ensure seed is the annual species as perennial baby's-breath is on the *Alberta Weed Control Act* and is much more aggressive than the annual species; comes in a variety of colours; may spread
forb	*Hedysarum boreale*	northern hedysarum	plug, seed	y	Requires ~4 years to grow and flower from collected seed due to hard seed coat; somewhat salt tolerant; more salt and drought tolerant than alpine hedysarum
forb	*Helianthus annuus*	common annual sunflower	seed, plug	y	Annual so needs to be able to self-seed; can be used as somewhat of an early succession cover crop; ensure genetic origin is known as most annual sunflowers are cultivars that have been bred extensively for the horticultural industry; can grow in very poor soils or substrates with little to no topsoil (e.g., road crush); very drought tolerant and moderately salt tolerant; have been unable to procure native annual sunflower seed in large quantity

Life form	Botanical name (common synonym)	Common name (frequently used synonym)	Preferred planting form	Native (y=yes, n=no)	Notes
forb	*Helianthus annuus* cultivar	annual sunflower	seed	n	Many annual sunflower cultivars exist; saline tolerance differs between cultivars
forb	*Helianthus maximilianii*	narrow-leaved sunflower	seed	n	Colonizes roadsides in southeast Alberta; recommended for areas such as these; seed available in United States
forb	*Helianthus pauciflorus ssp. subrhomboideus*	rhombic-leaved sunflower	plug, seed	y	Drought and disturbance tolerant; somewhat salt tolerant
forb	*Helianthus petiolaris*	prairie sunflower	plug, seed	y	Similar to common annual sunflower
forb	*Hemerocallis spp.*	daylily	1 gal	n	Prefer sunny areas with moist soil; ensure cultivar is appropriate for this climate; have observed abandoned gardens with very dry soil in which daylilies were thriving; do not seem affected by lily beetles like other lilies
forb	*Heterotheca villosa*	golden aster (hairy golden aster)	plug, seed		Low in stature and aids as a groundcover; very salt and drought tolerant; can grow in soils with very little organic content
forb	*Liatris punctata*	dotted blazingstar	plug, seed	y	Establishes from seed but takes multiple years to flower; can withstand taller adjacent vegetation once established; HCR grassland health indicator species; somewhat salt tolerant
forb	*Linum lewisii*	blue flax	seed	y	Provides excellent early coverage; aesthetically pleasing; good forage for native pollinators; germinates quickly
forb	*Lotus corniculatus*	bird's-foot trefoil	seed	n	Introduced as a drought and salt tolerant low-bloat cattle forage; provides significant floral resources to pollinators; not weedy in

Life form	Botanical name (common synonym)	Common name (frequently used synonym)	Preferred planting form	Native (y=yes, n=no)	Notes
					Calgary area but use with caution and away from healthy Natural Environment Parks; seed before July 1 to allow for adequate blooming time; functions somewhat as a ground cover due to its spreading growth habit; would be a good option in challenging areas
forb	*Lysimachia maritima* (*Glaux maritima*)	sea milkwort	plug	y	High salinity tolerance; sourcing may be difficult; attractive plants; provides floral resources to pollinators
forb	*Mentzelia decapetala*	sand-lily	plug, seed	y	Native to southeastern Alberta; naturally grows in alkaline soils; good restoration candidate for this habitat type
forb	*Nepeta spp.*	cat mint	plug, 1 gal	n	Somewhat salt tolerant and fairly drought tolerant; appears tolerant to salt spray and some soil salinity due to its ability to overwinter in median planters; different species and cultivars readily available at garden centres
forb	*Oenothera biennis*	yellow evening-primrose	seed, plug	y	Has colonized edges of regional pathways so appears to have some salt tolerance; very drought tolerant
forb	*Oenothera suffrutescens* (*Gaura coccinea*)	scarlet butterflyweed (scarlet gaura)	plug	y	Good candidate for restoration in this type of habitat
forb	*Onobrychis viciifolia*	sainfoin	seed	n	Introduced as a drought and salt tolerant low-bloat cattle forage; not weedy in Calgary area but use with caution and away from healthy Natural Environment

Life form	Botanical name (common synonym)	Common name (frequently used synonym)	Preferred planting form	Native (y=yes, n=no)	Notes
					Parks; seed before July 1 to allow for adequate blooming time; flower heads stick out above other vegetation; aesthetically pleasing
forb	*Oxytropis sericea*	early yellow locoweed	plug	y	Drought and salt tolerant; will tolerate occasional mowing; frequently comes up within turf grass on roadsides in the city's northwest where the seed bank has persisted
forb	*Oxytropis splendens*	showy locoweed	plug	y	Drought tolerant; likely somewhat salt tolerant; HCR grassland health indicator species
forb	*Perovskia atriplicifolia*	Russian sage	1 gal, seed	n	Moderately salt tolerant and tolerates dry to average moisture levels
forb	*Phlox hoodii*	moss phlox	plug	y	Functions well as a groundcover; is somewhat salt tolerant due to its ability to grow in saline prairie; one of first plants to flower in spring; provides early source of pollinator forage; requires full sun
forb	*Phlox subulata*	moss (creeping) phlox	plug, 1 gal	n	Some salt tolerance; drought tolerant; many cultivars available at garden centres/nurseries; most commonly has pink flowers; flowers in late spring/early summer; requires full sun to light shade
forb	*Potentilla anserina*	silverweed	plug	y	Forms ground cover; spreads by stolons; very salt tolerant; tolerates more disturbance than most other native plants; excellent fit for this habitat type
forb	*Sedum acre*	'Goldmoss' stonecrop	plug, 1 gal	n	Excellent ground cover; volunteers in areas along back alleys and anywhere

Life form	Botanical name (common synonym)	Common name (frequently used synonym)	Preferred planting form	Native (y=yes, n=no)	Notes
					where vegetation cannot compete due to thin poor soils; appears to be most salt tolerant of sedums; can be used in rock gardens and as a lawn replacement; often present in pre-grown sedum matts
forb	*Solidago canadensis*	Canada goldenrod	seed, plug	y	Salt and drought tolerant although low goldenrod is more tolerant of saline, poor dry soils
forb	*Solidago missouriensis*	low (Missouri) goldenrod	seed, plug	y	Naturally colonizes these types of habitats; very salt tolerant; tolerant of disturbance
forb	*Solidago rigida*	stiff goldenrod	plug	y	Grows in dry open areas; salt and drought tolerant; more difficult to procure than other more common goldenrods
forb	*Sphaeralcea coccinea*	scarlet mallow	plug	y	Good forage for pollinators; often forms somewhat of a ground cover
forb	*Stachys pectinata*	lamb's-ear	1 gal	n	Moderately salt tolerant and drought tolerant; fuzzy silver leaves provide texture to landscape design
forb	*Symphyotrichum ericoides*	tufted white prairie aster	seed, plug	y	Very salt and drought tolerant; dominant in dry saline soils; tolerates heavy disturbance
forb	*Symphyotrichum laeve*	smooth aster	plug, seed	y	Drought and salt tolerant; hardy and can withstand disturbance pressure
forb	*Thermopsis rhombifolia*	golden bean	plug	y	Can form somewhat of a ground cover; early pollinator forage
forb	*Thymus serpyllum*	creeping thyme	plug, seed	n	Prefers full sun; excellent ground cover; provides pollinator resources; tolerant of salt, drought and poor soils although can grow in

Life form	Botanical name (common synonym)	Common name (frequently used synonym)	Preferred planting form	Native (y=yes, n=no)	Notes
					more hospitable environments; very aromatic
forb	*Vicia villosa*	hairy vetch	seed	n	Low cost; moderate alkalinity tolerance; use carefully as it may be invasive although it has not been observed to volunteer in the Calgary area; good for erosion control and conditioning soil; may not persist due to Calgary's chinooks and the lack of consistent snow cover
grass	*Agrostis scabra*	rough hair grass (hair bentgrass)	seed	y	Excellent for use in this habitat type; seed is easily available
grass	*Bouteloua gracilis*	blue grama	seed	y	Warm season grass and therefore, must ensure that cool season grasses do not outcompete it in restoration activities; mid-successional; good for drier areas and slopes
grass	*Calamagrostis x acutiflora* Karl Foerster'	Karl Foerster Reed Grass	1 gal, 2 gal	n	Aesthetically pleasing feature plant in areas with drought and salt stress
grass	*Calamovilfa longifolia*	sand grass	seed	y	Excellent for sites with silty/sandy soils; very drought tolerant; some salinity tolerance
grass	*Deschampsia cespitosa*	tufted hair grass	seed	y	One of the best species for this habitat type; tolerates salt, inundation, sediment loading and water flow
grass	*Distichlis spicata* (*Distichlis spicata*)	saltgrass	plug	y	One of the most salt tolerant plant species; dominates saline wetlands; generally does not colonize areas well from seed as it is outcompeted; spreads easily from plug plantings
grass	*Elymus* hybrid	AC Saltlander	seed	n	Very salt and drought tolerant; aggressive; bred from a naturally occurring

Life form	Botanical name (common synonym)	Common name (frequently used synonym)	Preferred planting form	Native (y=yes, n=no)	Notes
		green wheatgrass			wheatgrass hybrid; use caution and assess adjacent land use before using this plant; tall stature
grass	*Elymus lanceolatus*	northern wheatgrass	seed	y	Very drought tolerant; some salinity tolerance
grass	*Elymus trachycaulus ssp. trachycaulus*	slender wheatgrass	seed	y	Cultivars available so ensure genetic origin is appropriate for the context; tall, robust and early successional; tall stature and may dominate, especially if seeded at a high rate
grass	*Festuca idahoensis*	bluebunch (Idaho) fescue	seed	y	Does well when seeded into this habitat type
grass	*Festuca ovina*	sheep fescue	seed	n	Salt and drought tolerant; more aggressive than Rocky Mountain fescue; 'Elijah blue' commonly used as decorative cultivar; may form monoculture
grass	*Festuca saximontana*	Rocky Mountain fescue	seed	y	Provides early successional cover when used in a seed mix; retains green colour until late in season, sometimes even under snow; moderate to high salinity tolerance; some initial moisture required for germination and persistence; very drought tolerant after establishment
grass	*Koeleria macrantha*	June grass	seed	y	Somewhat salt tolerant; more of a xeric prairie species but will do well with added moisture
grass	*Leymus arenarius*	blue lyme grass	seed	n	Some taxonomic confusion as often synonymous with smooth wild rye but this non-native species appears more robust and blue

Life form	Botanical name (common synonym)	Common name (frequently used synonym)	Preferred planting form	Native (y=yes, n=no)	Notes
grass	*Lolium multiflorum*	Italian (annual) ryegrass	seed	n	Establishes quickly; drought and salt tolerant but less so than some other species; will self-seed and persist; intense propagation has made this species more able to overwinter and act as a perennial; can substitute perennial ryegrass
grass	*Nasella viridula*	green needle grass	seed	y	Salt and drought tolerant; does well with added moisture; often colonizes these areas naturally
grass	*Pascopyrum smithii*	western wheatgrass	seed	y	Salt and drought tolerant; prefers more moisture than northern wheatgrass; tolerant of periodic short durations of inundation
grass	*Poa palustris*	fowl bluegrass	seed	y	Moderately saline tolerant; does well in this type of habitat
grass	*Puccinellia distans*	spreading alkali grass	seed	n	Native and introduced elements in the USA, northwest British Columbia and Alaska
grass	*Puccinellia distans* 'Fults'	'Fults' alkali grass	seed	n	Variety cultivated from specimen at a golf course in the USA; very salt tolerant
grass	*Puccinellia nuttalliana*	Nuttall's salt-meadow (alkali) grass	seed	y	Very salt and drought tolerant
grass	*Schizachyrium scoparium*	little bluestem	seed, plug, 1 gal	y	This species is provincially tracked on the Watch List (i.e., natural populations); forms a small portion of the plant community in saline ecosites; commercially available, usually as potted material; winter interest as it turns reddish-coloured in the fall; warm season grass

Life form	Botanical name (common synonym)	Common name (frequently used synonym)	Preferred planting form	Native (y=yes, n=no)	Notes
grass	*Spartina gracilis*	alkali cord grass	plug	y	Can assist in erosion control; best propagated vegetatively
grass	*Spartina pectinata*	prairie cord grass	plug, seed	y	It is currently on the provincial Tracking List; found to be more common in the province than originally thought and is supposed to be off the next edition of the Tracking List; very good for bank stabilization; not as easily outcompeted as other species due to its tall stature
shrub	*Artemisia cana*	silver sagebrush	1 gal	y	Low growing attractive shrub with silver foliage; does well in Calgary area although naturally found southeast of the city
shrub	*Artemisia tridentata*	big sagebrush	1 gal	y	Taller than silver sagebrush; rare and provincially tracked in Alberta; found naturally in the far southwest corner of the province; commercial propagation of this species has occurred and plantings do very well in the Calgary area in this habitat type
shrub	*Dasiphora fruticosa*	shrubby cinquefoil	1 gal	y	Does best in full sun
shrub	*Dasiphora fruticosa* 'Hachmann's Gigant'	Hachmann's Giant shrubby cinquefoil l	1 gal	n	Flowers fade in full sun; greenish-grey foliage turning to light green at maturity; large pale yellow flowers; one of the few cultivars of this species that is tolerant to salt
shrub	*Ericameria nauseosa*	rabbitbrush	plug, seed, 1 gal	y	Grows west and east of the Calgary area; it is early- to mid-seral/successional, salt and drought tolerant, grows rapidly, is deep-rooted and can tolerate poor saline soils; may be a candidate to

Life form	Botanical name (common synonym)	Common name (frequently used synonym)	Preferred planting form	Native (y=yes, n=no)	Notes
					try for restoration in this type of habitat; Chinook tolerance is unknown
shrub	*Hippophae rhamnoides* 'Indian Summer'	'Indian Summer' sea buckthorn	1 gal	n	Does not tolerate shady sites; cultivar is tolerant of drought and nutrient poor soils due to its ability to fix nitrogen; female plants produce fruit; provides early pollen source to pollinators and berries for birds in the winter; can be somewhat invasive; very similar in characteristics to thorny buffaloberry
shrub	*Pinus mugo var Mughus*	Mugo pine	3 gal	n	Requires watering for establishment but after establishment, drought tolerant; degree of salt tolerance inconsistent in literature; works well in parking lots and as such, appears to be tolerant of salt; may grow larger than anticipated
shrub	*Rhus trilobata*	skunkbush	1 gal, 2 gal	y	Naturally found in southern Alberta prairies; drought tolerant; salt tolerance not mentioned in literature but found in saline ephemeral wetlands
shrub	*Rosa woodsii*	common wild rose	1 gal	y	Moderately salt tolerant; often dominates habitats similar to these; comes in on its own
shrub	*Salix bebbiana*	beaked (Bebb's) willow	plug, 1 gal	y	More drought tolerant than other willows
shrub	*Salix brachycarpa 'Blue Fox'*	blue fox willow	1 gal	n	Drought tolerant; tolerates poor soils, full sun to part shade; some salinity tolerance; provides early season forage for pollinators

Life form	Botanical name (common synonym)	Common name (frequently used synonym)	Preferred planting form	Native (y=yes, n=no)	Notes
shrub	*Salix exigua*	narrow-leaf willow	plug, 1 gal	y	Tolerant of saturation; fairly drought tolerant once established; moderate salinity tolerance
shrub	*Salix interior*	sandbar willow	plug, 1 gal	y	Tolerant of saturation; fairly drought tolerant once established; moderate salinity tolerance
shrub	*Salix pentandra*	laurel willow	plug, 1 gal+	n	Will volunteer; prefers moist ground but drought tolerant once established; very large and tree-like
shrub	*Shepherdia argentea*	thorny buffaloberry	1 gal	y	Very salt and drought tolerant; tolerates inundation and occurs sporadically in different wetlands zones throughout the prairies
shrub	*Symphoricarpos occidentalis*	buckbrush	1 gal	y	Moderate salinity tolerance; dominant and often delineates peripheral low prairie zone of wetlands with varying alkalinity; cultivars available but cultivars not likely to be as hardy
shrub	*Syringa villosa*	villosa (Japanese) (late) lilac	1 gal+	n	Most salt tolerant lilac; does not volunteer as commonly common lilac; slower growing than common lilac
shrub (dwarf)	*Atriplex canescens*	four-wing (Nuttall's) salt bush	plug	y	Now on provincial Watch List; common in southeast Alberta; not very attractive but may be a potential groundcover for saline areas
shrub (dwarf)	*Juniperus horizontalis*	creeping juniper	plug, 1 gal	y	Salt and salt spray tolerant; native species tends to be lower growing than various salt and drought tolerant cultivars
shrub (dwarf)	*Juniperus horizontalis* 'Wiltoni' or 'Blue Rug'	'Wintoni' or 'Blue Rug' creeping juniper	1 gal	y	Salt and salt spray tolerant; native species tends to be lower growing than various salt and drought tolerant cultivars

Life form	Botanical name (common synonym)	Common name (frequently used synonym)	Preferred planting form	Native (y=yes, n=no)	Notes
vine	*Humulus lupulus*	common hop	1 gal	n	Fair salt tolerance; very drought tolerant; can be used to add vertical interest; requires something to grow on
vine	*Parthenocissus quinquefolia*	Virginia creeper	1 gal	n	Native to eastern and central USA; grow in full sun to part shade; can use as ground cover for erosion; do not grow in areas where other vegetation may be choked out as it is aggressive; adds vertical interest; moderate salt tolerance; plant in permanent location; does not require staking as adheres to substrates