Living Collections Strategy
Approved by Gardens and Conservation Committee on October 6, 2021

Executive Summary

Denver Botanic Gardens (DBG) is a museum of botanical species recognized as one of the top botanical gardens in the United States with more than 50,000 plants from such far-away places as Australia, Africa and the Himalayas. Located in the heart of Denver on 23 acres of well-maintained gardens, Denver Botanic Gardens demonstrates an array of landscape designs and plant collections, ranging from traditional to contemporary, native to exotic and simple to grandiose. Additional sites at Denver Botanic Gardens at Chatfield Farms, a 750-acre wildlife and native plant refuge and agriculturally focused farms and gardens in Littleton and Mount Goliath, a high-altitude trail and interpretive garden on the Mount Evans Scenic Byway extend this experience throughout the Front Range. The eastern plains of Colorado is characterized by a semi-arid climate with low humidity. Adapting to these natural climatic conditions, all the gardens at DBG exemplify best management practices in water conservation.

Deviating from the past standard of having a separate collections policy and plan, we are following standards established by Royal Botanic Gardens, Kew, Cambridge University Botanic Garden and others and merging both documents to create one Living Collections Strategy. The purpose of this Strategy is to provide uniform direction to assist in the acquisition, maintenance, documentation, expansion and development of various living collections. This document will be useful in identifying collection priorities within the framework of the institution's mission and vision and within available resources.

The Strategy is spread out over seven sections:

Section 1 – Introduction

This section provides an overview of the Gardens' mission, geographic and climatic features of the site, the various DBG locations that house our living collections, the scope of our collections, the seven major collections and nationally accredited collections, and finally where the collections are displayed within the various locations.

Section 2 – Monitoring Collections: Quality Metrics

This new section outlines the 10 key metrics that we will be using to monitor the growth and improvement of our living collections. This will be evaluated periodically to see if these metrics are valid in growing and improving our collections and based on that they will be modified in future years as needed.

Section 3 - Collections Status, Strengths and Priorities

For each of our seven major living collections, the following information is provided:

- Collection description
- Collection content
- Collection status and priorities

Section 4 – Management of Collections

In this section, we discuss how we manage and develop our collections and provide guidelines for staff to follow with regards to acquisition, accessioning, deaccessioning, disposal, documentation, care and maintenance, inventories, photographic documentation of collections, distribution to Plant Select®, our plant introduction program in collaboration with Colorado State University and the Green Industries of Colorado, gifts, and exchanges, loans and exhibitions.

Section 5 – Governance of Collections

In order to ensure that we are following best practices to ensure that proper ethics are followed, this section provides information about who has authority over our collections, ethics regarding collections stewardship and management, access, regional, national and international laws pertaining to wild collection, risk management and emergency planning and invasive species policies.

Section 6 – Future Forecasting and Preparedness

As we experience change in climatic patterns, the living collections will be the ones most impacted by this. Hence in anticipation of future changes in weather patterns, we need to prepare for climate change impact. This section identifies what we will be doing over the course of the next 10 years in preparation for climate change and other disasters.

Section 7 – Appendix

This section has several documents that will provide more information about topics identified in the text.

Section 1 – Introduction

a. Mission

The mission of Denver Botanic Gardens (DBG) is to *connect people with plants, especially plants from the Rocky Mountain Region and similar regions around the world, providing delight and enlightenment to everyone.* The acquisition and care of the collections is guided by the Gardens' four core values:

- Diversity
- Relevance
- Sustainability
- Transformation

b. Geography & Climate

Denver Botanic Gardens is located in a steppe region with a semi-arid climate, meaning that the Gardens experiences hot, dry summers and cold, dry winters. Winter moisture comes in the form of snow, which often sublimates, providing little moisture to the soil, and although there is a summer monsoon season, it is not uncommon to experience several weeks at a time with no precipitation

According to usclimatedata.com, the average temperatures are 64˚F (18˚C) high and 35˚F(2˚C) low. Records are 105˚F (34.5˚C) and -30˚F (-34.4˚C) Average annual precipitation is currently 15.58 inches (396mm), which includes 55 inches (144cm) of snowfall. May is the month with the highest average precipitation and January and February are typically the driest.

The soils in and around Denver are largely pedocal with low organic matter and high mineral content. Garden soils often vary from heavy clay to deep sand. The pH of soils is typically alkaline, and it is not uncommon for soils to be pH 8 or higher.

c. DBG Locations

Living collections are located in three DBG locations: 1) the York Street campus, 2) Mt. Goliath, a site managed in collaboration with the United States Department of Agriculture Forest Service in the Arapaho National Forest, and 3) Chatfield Farms.

d. **Scope of Collections**

The purpose of this Collections Strategy is to ensure that the Living Collections are well managed, now and into the future. The Living Collections (including the seed herbarium) at Denver Botanic Gardens are principally composed of plant species, subspecies, varieties and formae (and their later derivatives and cultivars) that support Denver Botanic Gardens' mission of *connecting people with plants, especially plants from the Rocky Mountain Region and similar regions around the world*. Collections showcase the use of right plants in the right place, educating the public about horticulture in the semi-arid, steppe climate of the Rocky Mountain and Plains regions. The diverse collections ranging from alpine to tropical plants fulfill the mission through education and conservation messages, and by "providing delight and enlightenment to everyone." Viable seeds and propagules of plant species,

subspecies, varieties and formae (and their later derivatives and cultivars) are stored for trials and future propagation.

e. Living Collections

The living collections are comprised of seven major collections:

i. Alpine
ii. Amenity
iii. Aquatic
iv. Cactus & Succulents
v. Native
vi. Steppe
vii. Tropical

To support and conserve our living collections, the Gardens also maintains a seed collection. Seeds are collected from within the current living collections for the purposes of supplementing the gardens through propagation, preserving germplasm of short-lived species as well as important accessions, sharing to Index Seminum or Plant Select® partners, or to grow for plant sales. Purchased seeds from prior years are also stored for future use. Restrictions placed on the parent accession are followed for subsequent progeny. The collection to date is comprised of 7,738 collections having been made and recorded. These collections are stored in our facilities that are meant for short-term seed storage; it is intended to store seed 5-10 years before seed loses viability. We are currently refining our facilities to facilitate longer-term storage that will aid in preserving Rocky Mountain biodiversity and support *in situ* conservation. The Gardens' also supports a small, seed herbarium, a catalogued collection of representative seeds used as research references and aids in documentation of our wild collection trips.

In addition, the Gardens collects seed of rare native plants throughout the United States for conservation purposes. Seed are collected only under written permission from the relevant authorities. Denver Botanic Gardens holds a US Fish and Wildlife Permit which authorizes named individuals to collect seed and herbarium vouchers of named federally listed plant species. The permit is renewed as needed and the list of authorized individuals is kept current with the agency. Additional collection permits are obtained from relevant landowners on an annual basis (US Bureau of Land Management, US Forest Service). All permits are held on file in the Research & Conservation department. Seed is stored in freezers within the Ecology Lab in the Freyer – Newman Center with back up material sent to the US National Laboratory of Genetic Resources Preservation in Fort Collins, CO.

f. Nationally Accredited Collections

Among our living collections reside two national collections registered with the National Plant Collections Network (PCN): Oaks (*Quercus*) and Alpines of the World. Since 2016, the Dwarf Conifer Collection has served as an American Conifer Society Reference Garden, a

program where the American Conifer Society partners with public gardens throughout the United States to recognize noteworthy conifer collections.

g. Display of Collections

Living collections are displayed in themed gardens at all DBG locations. Detailed descriptions of all the gardens at York Street campus are listed in Appendix A.

Section 2 - Monitoring Collections – Quality Metrics

The quality metrics described below will provide a comprehensive quantitative analysis of each of our seven collections, which will help us identify strengths and weaknesses of our collections. This will help us prioritize areas for improvement over the next decade. Since this is a newly initiated process, information for some of the metrics for some of the collections are not readily available at this time. We will continue researching information and update this strategy as new information is gathered.

1. **Rarity**: Number of accessions (percentage) that are held in fewer than 10 gardens world-wide.
2. **Diversity**: Diversity of living collections will be measured by total number of taxa, families, genera, and species.
3. **Wild Origin**: Number of accessions (percentage) of wild origin and derived from wild collected species.
4. **Extinction Risk**: Total number of IUCN Red List taxa which will include the following categories: Extinct in the Wild (EW), Critically Endangered (CR), Endangered (EN), and Vulnerable (VU).
5. **Seed Banking**: Number of accessions (percentage) preserved in long-term seed storage.
6. **Duplication**: Number of species with multiple accessions held in different locations within the Gardens and number of accessions distributed to other regional gardens.
7. **Longevity & Sustainability**:
   Age of collections:
   Number of accessions <10 years old
   Number of accessions 10 – 25 years old
   Number of accessions 26 – 50 years old
   Number of accessions >50 years old
8. **Exceptional Interest**: This is more of a qualitative aspect that determines value of our collections with representation of plants with special interests such as species with interesting narratives, biological interests, etc. E.g., *Amorphophallus titanum*, Wollemi pine.
9. **Crop Wild Relatives**: Crop wild relatives (CWR) are the wild 'cousins' of our cultivated crops. They are related to our food plants and contain useful diversity, for adapting crops to climate change. As *ex situ* repositories of plant collections, botanic gardens harbor an immense wealth of genetic resources, including CWR that are valuable for research and conservation of our crop plants. By identifying the CWRs in our collections, we make them accessible to researchers. The study of crop-wild relatives is an evolving field and current lists are incomplete for most of the collections. Over time, we will be documenting CWRs across all collections.
10. **Herbarium Vouchering**: Number of accessions vouchered at the Gardens' Kathryn Kalmbach Herbarium (KHD) and number of accessions preserved as genomic quality plant tissues as part of the Global Genome Initiative.

Section 3 - Collections Status, Strengths and Priorities

Alpine

a. Collection Description

Denver Botanic Gardens' Alpine Collection is one of the largest in the country with regards to the number of species. The Gardens' Alpine Collection includes both true alpine plants (species found natively above tree line but not necessarily obligate alpines) and plants that grow in pseudo-alpine habitats, such as rock crevices (chasmophytes) or exposed locations (facultative alpines).

Definitions:

- Alpine: The standard definition of an alpine habitat is the area above tree line (tree line is the particular elevation above which trees are not able to grow). This definition, however, is misleading as many of the world's mountain ranges do not have a defined tree line. Another definition of alpine is given in *The Biology of Alpine Habitats* by Laszlo Nagy and Georg Grabher, which is the definition the Gardens' uses: "...Alpine environments are found where, along an altitude gradient, natural woody vegetation changes from various lowland and montane forest formations and gives way to dwarf shrubs, various grass-heath, sedge-heath and moss-heath formations and finally to open frozen ground."
- Chasmophyte: a plant that dwells mainly in rock crevices.
- Facultative alpine: a plant that grows below the tree line in alpine-like habitats and mimics alpine plants in growth habit. An example is a cushion plant growing on exposed rock at Pawnee Buttes in northeastern Colorado.
- Pseudo-alpine: The collective term used in this report when referring to both chasmophyte and facultative alpines.

b. Collection Content

Globally there are 4,000-5,000 species of true alpine (TA) plants. Of these the Gardens has 565 species, an increase of 170 species since 2017. Alpine and pseudo-alpine plants are used widely throughout the gardens. For example, Native, Steppe and Amenity all have some overlap with this collection. Alpines native to western North America overlap with those in the Native Collection and chasmophyte and facultative alpines from steppe regions cross over with the Steppe Collection; however, because these species need a rocky environment to survive, they are displayed in the Rock Alpine Garden or in a traditional setting for cultivating alpines, such as troughs. In 2016 a new Steppe Garden was added with these microclimates in mind. Alpines of cultivated origin, including the various *Primula* and *Saxifraga* cultivars, overlap with the Amenity Collection, but are best displayed in the Alpine Collection.

Below are the gardens with high numbers of alpine taxa, listed in order of total number of species:

- Rock Alpine Garden
- Mordecai Children's Garden
- Mount Goliath (germplasm native to Mount Evans Wilderness area only)

- Chatfield Rock Garden
- Western Panoramas
- Steppe Garden

In 2012 Denver Botanic Gardens' Alpine Collection was registered with the American Public Gardens Association Plant Collection Network (PCN) and granted national accreditation as "Alpines of the World Collection." At the time, the Gardens was the only institution in North America recognized for a worldwide collection of alpines.

The collection in the Rock Alpine Garden (RAG) is especially rich in species of certain genera. Many of the same genera are found in steppe environments and continental alpine environments -- an example of the similar floristic evolutionary roots shared by these two environments.

Genus	**# Taxa**	**# True Alpine**
Acantholimon	28	0
Aethionema	10	0
Allium	75	9
Androsace	31	15
Campanula	55	14
Crocus	65	2
Cyclamen	10	1
Daphne	47	3
Dianthus	64	17
Draba	28	20
Ephedra	13	2
Erigeron	28	20
Gentiana	39	9
Geranium	38	4
Helleborus	30	0
Iris	131	2
Penstemon	46	23
Phlox	48	6
Pinus	54	13
Plantago	10	4
Primula	55	16
Salix	59	18
Salvia	46	1
Saxifraga	68	24
Sempervivum	71	5
Stipa	8	1
Veronica	48	5
	Total Genera	**Total Taxa**
Colorado Alpine	**166**	**359**

Genus	# Taxa	# True Alpine
Rocky Mountain Alpine	**149**	**312**
North American Alpine	**219**	**468**

Denver Botanic Gardens probably holds the largest collections of *Ephedra*, Turkish *Salvia*, *Acantholimon* and *Penstemon* of any public institution in the United States. The Gardens also holds collections of *Aethionema*, *Stipa*, *Cyclamen*, *Helleborus*, *Veronica*, and *Daphne.* Since 2005, these collections have been augmented, making them some of the largest in the country. Sizable collections of *Androsace*, *Draba*, *Erigeron*, *Primula*, and *Salix* have also been added since 2005.

c. Collection Status and Priorities

Quality Metric	Current Status	Future Target
1. Rarity	Not assessed	TBD
2. Diversity • # Taxa • # Families • # Genera • # Species	 • 3655 RAG (610 TA) • 135 RAG (55 TA) • 715 RAG (236 TA) • 2869 RAG (567 TA)	 • 3,800 RAG • 136 RAG (60 TA) • 720 RAG (240 TA) • 3000 RAG (600 TA)
3.Wild Origin • # accessions of wild origin • # accessions of wild origin derivative	 • RAG 764 / TA 955 • RAG 159 / TA 120	 • RAG 1000 • TA 1000
4. Extinction Risk • EW • CR • EN • VU • Colorado Alpine Endemics	 • 0 • 0 • 1 • 0 • 10 taxa	5 Southern Rocky Mountain Endangered Alpines
5. Seed Banking	TA – 206 taxa/197 spp./114 genera/35 families	250 spp. TA
6. Duplication • Species with multiple accessions • Accessions distributed to regional gardens		Increase wild collected accessions across regional gardens
7. Longevity and Sustainability • # accessions <10 years old (2011 – 2021)	 • RAG – 2470 • TA - 2195	

Quality Metric	Current Status	Future Target
• # accessions 10 – 25 years old (1996 – 2010) • # accessions 26 – 50 years old (1973 – 1995) • # accessions >50 years old	• RAG – 1388 • TA – 639 • RAG – 879 • TA -226 There are no accessions older than 50 years in the collection	
8. Exceptional Interest	N/A	N/A
9. Crop Wild Relatives	RAG- 27 taxa; TA – 14 taxa (Khoury & Alvarez)	
10. Herbarium Vouchering and Genomic Collections • # accessions w/herbarium vouchers • # accessions preserved as genomic tissue with GGI	• RAG: 622 vouchers in KHD representing 400 accessions • TA: 113 vouchers in KHD representing 95 accessions	• RAG 700 • TA 200

Priorities:

North American Alpines:

Following the North American Botanic Garden Strategy for Alpine Plant Conservation, the Gardens will continue to grow and display more North American alpines for public education and awareness. Our unique site at Mount Goliath allows us the opportunity for *in situ* conservation with species native to the Mount Evans Massif. The Gardens will continue to grow the living collection on Mount Goliath with germplasm collected only on the Mount Evans Massif. Additionally, we will continue our herbarium vouchering, and Global Genome Initiative (GGI) work on Mount Goliath.

True Alpines (TA):

Since 2005 the true alpine collection has grown substantially. In 2015 there were 391 true alpine taxa in the living collections. As of January 2021 there were 565 taxa. The goal for the Alpines of the World Collection was 500. The priority is to add more Rocky Mountain species of known wild origin as available and continue to maintain and distribute the additional true alpine species to regional botanic gardens.

Wild Collection:

The number of wild collected accessions has grown substantially. In 2005 there were 78 true alpine accessions with wild collection data. In January 2021 there were 910 true alpine accessions with wild collection data. In the Rock Alpine Garden there were 668

accessions with wild collected data in 2016 and in January 2021 there were 1531 accessions. The priority will be placed on obtaining more wild collected material from the Rockies and western North America and to back up our existing and new wild collected material at other regional gardens.

Seed Conservation:
Following the North American Botanic Garden Strategy for Alpine Plant Conservation, the Gardens will do its part in ensuring that 60 percent of all North American alpine plant species are conserved by 2030. At this time, the Gardens is working with Betty Ford Alpine Gardens to assess what is reasonably attainable. Likewise, the Gardens will work to help reach the goal of ensuring at least 75 percent of all identified threatened North American alpine plant species are held in *ex situ* collections and 10 percent are in recovery and/or restoration programs by 2030.

Support for the North American Botanic Garden Strategy for Alpine Plant Conservation by working regionally and nationally:
Denver Botanic Gardens will work in concert with Betty Ford Alpine Gardens and other regional and North American botanic gardens to help achieve the goals of the Alpine Strategy. The Gardens will focus on Southern Rockies alpines and western North American alpines.

Duplicating living collections and continuing herbarium work:
As mentioned above, additional goals for the collection are to continue backing up the living collections at additional sites prioritizing true alpines especially those of known wild origin and collecting herbarium specimens.

Amenity

a. Collection description

The Amenity Collection exists as the nexus point for all other DBG Collections, encompassing woody and herbaceous plants of various lifecycles that are not specific to any one biome, life zone, or growing region. The gardens of the Amenity Collection feature new and heritage cultivars, hybrids, selections available through the nursery trade and wild collections of traditional garden plants in dynamic displays, presenting climatic resilience and regional relevance for a direct and lasting influence on the public.

b. Collection Content

The Amenity Collection is broken into two main divisions, Woody and Herbaceous, with thirteen featured subcollections which span thematic gardens and Nationally Accredited Plant Collections. The Herbaceous division is further broken down into Seasonal (annuals, vegetables and select tender plants) and Permanent collection designations.

Amenity Collection Organizational Chart

- Woody Collections
    - Bonsai
    - Dwarf Conifer – American Conifer Society Reference Garden
    - *Quercus* - Plant Collections Network Nationally Accredited Plant Collection
    - *Rosa*
    - *Syringa*
    - *Viburnum*
- Herbaceous Collections
    - Seasonal Collections
        - Annuals
        - Vegetables
    - Permanent Collections
        - *Hemerocallis*
        - *Iris*
        - *Lavandula*
        - *Paeonia*

Subcollections:

Annuals

The Annuals Collection exhibits ornamental plants ranging from summer annuals and cool season annuals. The ever-changing displays include many All-America Selection Winners and feature numerous “Best in Show” from Colorado State University’s Annuals Trial Garden and Welby Garden’s Annuals Trials yearly evaluations.

Bonsai

The Bonsai Collection showcases bonsai created from native plant material of the Rocky Mountain region, in addition to traditional bonsai (Asian species), tropical bonsai, subtropical bonsai and succulent bonsai.

Dwarf Conifer
The dwarf conifer collection is primarily concerned with dwarf selections of gymnosperms from the Rocky Mountains and Intermountain West, and as such the collection is dominated by the following species: *Picea pungens, Pinus ponderosa, Pinus flexilis, Pinus edulis, Pinus monophylla, Pinus aristata* and *Pseudotsuga menziesii.*

Hemerocallis
The *Hemerocallis* collection in the Ann Montague Iris and Daylily Garden features historic cultivars that have persisted since the Gardens founding.

Iris
The historic *Iris* collection at Chatfield Farms contains over 400 different varieties of iris with the oldest variety dating back to 1597. These plants were donated from a private collection built by iris enthusiasts Carla and George Lankow from Washington state. Over 400 accessions of mostly historic cultivars, hybrids and species iris are growing within this collection. The central collection of *Iris* at York Street is displayed in the Ann Montague Iris and Daylily Garden. The garden features Colorado bred iris, award-winning iris selected for prestigious American Dykes Memorial Medal and the John C. Wister Memorial Medal and historic iris from the Lankow Collections.

Lavandula
The *Lavandula* collection contains hardy species of *Lavandula* x *intermedia* and *Lavandula angustifolia* with 30 different cultivated varieties within these two species. The collection continues to evolve by testing new varieties of these species for hardiness along the Front Range of Colorado.

Paeonia
The peony collection thrives throughout Denver Botanic Gardens and highlights herbaceous peonies, Itoh (intersectional) peonies and tree peonies. Many individual plants have been in the collection since the 1950s, when Denver Botanic Gardens was founded. These historic and contemporary cultivars perform beautifully in Denver's climate.

Quercus
The oak collection contains species, hybrids and cultivars. The species collections include many shrub forms from the Western United States with a focus on known wild provenance while the hybrid collection is primarily from the Cottam collection from the University of Utah. Newer introductions represent many of the cultivars in the oak collection. The collection is one of 21 collections that are part of the Plant Collection Network Oak Multisite Collection accredited by the American Public Gardens Association.

Rosa

The rose collection features historic species roses, hybrids and cultivars that highlight the history of rose cultivation. The collection constantly introduces and evaluates new cultivars which perform well and are adapted to a steppe climate.

Syringa

The lilac collection includes unique and showy cultivars of *Syringa*, as well as rare and unusual species. Additionally, based on developments in *Syringa* phylogenetics, the former genera of *Ligustrum* has been added to this collection.

Vegetables

The vegetable display of York Street displays both heirloom vegetables and new cultivars adapted to Denver's short growing season. The display is rotated three-times per year, in spring (cool season crops), main growing season (warm season crop), and fall crops (cool season crops).

Viburnum

A well-adapted genus of shrubs to our region, the *Viburnum* Collection includes 55 taxa and over 100 accessions. This group is best known for the variation found between the different species and cultivars in their leaf shape, flower scent, fruit color, fall coloration and mature size.

Diversity of Subcollections

Genus	Number of Species	Number of Hybrids, Selections and Cultivars in Collection	Number of Taxa	Number of Plants	Number of Accessions	Number of Accessions of known Wild Origin
Bonsai	56 (25 Families, 36 genera)	11	58	123	88	16
Dwarf Conifers	30 (4 families, 10 genera)	92	108	176	184	45
Hemerocallis	11	304	228	302	245	0
Iris	101	1054	1023	1857	1485	25
Lavandula	12	102	74	209	126	3
Paeonia	22	165	163	242	208	6
Quercus	87	34	109	265	397	64
Rosa	28	209	236	399	291	12
Syringa	25	93	103	193	143	0
Viburnum	29	55	55	161	104	3

Housing & Display of Collections

Although the Amenity Collection can be found throughout most DBG locations and gardens, primary locations include:

- Ann Montague Iris and Daylily Garden
- Annuals Garden and Pavilion (All-America Selections Garden)
- Bill Hosokawa Bonsai Pavilion and Tea Garden
- Birds and Bees Garden
- Cut Flower Garden (Chatfield)
- Dwarf Conifer Collection
- The Ellipse in honor of Nancy Schotters
- Fountain Beds
- Fragrance Garden
- Gloria Falkenberg Herb Garden
- Herb Garden (Chatfield)
- Home Harvest Garden at Mordecai Children's Garden
- Iris Garden (Chatfield)
- Janice Ford Memorial Dye Garden (Chatfield)
- Kim Sterne Survival Garden (Chatfield)
- Lainie's Cutting Garden
- Le Potager: A gift from the Ladd Family
- Lavender Garden (Chatfield)
- Lilac Garden
- Mary Washburne Orchard (Chatfield)
- Oak Grove
- Ornamental Grasses Garden
- Romantic Gardens
- Shady Lane
- Shofu-en Japanese Garden
- Victorian Secret Garden
- Welcome Gardens

c. Collection Status and Priorities

Quality Metric	Current Status	Future Target
1. Rarity	• *Iris revoluta* • *Quercus look* • *Quercus havardii* • *Prunus webbii*	• *Quercus depressipes*
2. Diversity • # Taxa • # Families	 • 2,157 • 37	 • 2,270 • 39

Quality Metric	Current Status	Future Target
• # Genera • # Species	• 54 • 401	• 56 • 422
3.Wild Origin • # accessions of wild origin • # accessions of wild origin derivative	 • 127 • 33	 • 133 • 34
4. Extinction Risk • EW • CR • EN • VU	 • 0 • 3 • 18 • 4	 • 1 • 4 • 19 • 5
5. Seed Banking	• Off Site Seed Storage – 0 • Internal Seed Lab - 0	• Off Site Seed Storage – 1 • Internal Seed Lab - 1
6. Duplication • Species with multiple accession • Accessions distributed to regional gardens	 • 563 • 0	 • 592 • 5
7. Longevity and Sustainability • # accessions <10 years old • # accessions 10 – 25 years old • # accessions 26 – 50 years old • # accessions >50 years old	 • 2045 • 1014 • 682 • 0 (excluding estimated ages of Bonsai)	
8. Exceptional Interest	The Amenity Collection features classic plants with deep emotional and ethnobotanical connections of use by humans.	
9. Crop Wild Relatives	N/A	N/A
10. Herbarium Vouchering and Genomic Collections • # accessions w/ herbarium vouchers	 • 79	 • 83

Quality Metric	Current Status	Future Target
• # accessions preserved as genomic tissue with GGI	• 35	• 36

Priorities:
In addition to developing and stewarding beautiful, innovative, and compelling gardens to inspire and educate the public, the caretakers of the Amenity Collection are charged with pursuing diverse strategies to ensure Collection longevity, including but not limited to – propagation and duplicate plantings at the Gardens, working with partner gardens, plant societies, nurseries and individuals to propagate and distribute rare and unusual plant material and collecting and cataloging seed.

Any newly introduced cultivars and selections should be monitored, and their performance recorded in BG-BASE. Any plants that seem like outstanding candidates for continued cultivation in the Front Range and Intermountain West will be recommended for the Plant Select® program.

Also, over the next 5 to 10 years, we plan to develop and establish the Ethnobotanical Collection as a Core Collection. The current accessions which would make up the Ethnobotanical Collection are mostly concentrated within the Amenity Collection, including herb gardens, medicinal plant gardens and the Sacred Earth Garden.

Future targets of collection numbers as represented in the Quality Metrics table are highly subject to the effects of climate change on the Intermountain West. While we will do our best to expand the collection, we may not be able to predict attrition rates or best adapted species, selections or cultivars using the same methods that we did in the past.

Subcollection Priorities:
Annuals: The annuals collection will continue as an All-America Display Garden, promoting and exhibiting annual plants that thrive in our region.

Bonsai: Priorities of the bonsai collection center on continued maintenance of specimens and enhancement of the quality and diversity of the collection. The steward of the collection will also continue biennial specimen photography to record the progress and changes in the collection.

Dwarf Conifer: Expansion of collection to include more hardy dwarf mutations of southwestern, western and Great Basin conifers.

Hemerocallis: The daylily collection at DBG will undergo a revitalization in the coming years by infusing the collection with new cultivars, types, color combinations and patterns.

Iris: The *Iris* collection continues to be diversified annually, a wide variety of new and historic species and cultivars continue to be researched and will be added, enhancing the existing collections.

Lavandula: The collection continues to expand to test new varieties that exhibit cold hardiness in our climate. Documentation is collected each year to evaluate performance.

Paeonia: The collection requires research regarding missing information, especially several unknown tree peony cultivars. Expansion of the peony collection is slow and needs stronger commitment.

Quercus: Expand and showcase the Oak Savanna Garden located at Denver Botanic Gardens Chatfield Farms.

Rosa: Continued pursuit of new cultivars which are adapted to a steppe climate.

Syringa: Continued pursuit of species lilacs, germplasm of wild collected lilacs and inclusion of *Ligustrum* species.

Vegetables: Continue to develop wide range of vegetable display.

Viburnum: Continue adding hybrids and exploring species well-suited to the Front Range.

Aquatic

a. Collection Description

Since the summer of 1973, visitors to Denver Botanic Gardens have enjoyed an extensive waterway that runs throughout the Gardens' property. The world's first water gardening society was founded on February 13, 1983, when the Colorado Water Gardening Society (CWGS) was created in a Denver Botanic Gardens' classroom. Soon after, the International Waterlily and Water Gardening Society (IWGS) was created. Water gardening has grown at a rapid pace ever since, gaining an enthusiastic following worldwide. The summer displays at the Gardens focus attention on the enduring power of water gardens, especially in a steppe climate.

b. Collection Content

The Aquatic collection consists of the following sub-collections:

- Hardy waterlily species and hybrids
- Tropical waterlily species and hybrids
- Intersubgeneric waterlily hybrids
- Wiersema acquisition species waterlilies
- Historical waterlilies (Denver Botanic Gardens' Rocky Mountain Legacy Collection)
- Victoria waterlilies
- Tropical marginal plants
- Hardy marginal plants
- Lotus
- Floating plants
- Aquatic plants native to Colorado
- Carnivorous plants

Diversity of Subcollections

Sub-collection	# Families	# Genera	# Species	# Taxa	# Accessions
Hardy Waterlilies	1	1	4	117	215
Tropical Waterlilies	1	1	7	43	86
Intersubgeneric Waterlilies	1	1	1	20	31
Historical Waterlilies (RMLC)	1	1	1	10	36
Lotus	1	1	1	49	58
Victoria*	1	1	1	2	2
Tropical Marginals	10	13	20	63	103

Sub-collection	# Families	# Genera	# Species	# Taxa	# Accessions
Hardy Marginals	18	21	33	62	110
Floating Plants	3	3	3	4	4
Floating-Leaved Plants	5	7	10	11	11
Weirsema acquisition	1	1	4	4	7
Aquatics Native to Colorado	9	11	11	11	21
Carnivorous Plants	4	7	55	88	126

*Victoria - accessions vary each year, plants composted at end of each summer

The Aquatic collections are housed in water features located throughout the grounds of the gardens' York Street location as well as in a dedicated aquatics greenhouse and a storage fridge for tropical waterlily tubers.

c. Collection Status and Priorities

Quality Metric	Current Status	Future Target
1. Rarity	Unknown - some past IWGS contest entries could be included as well as older waterlily varieties that are no longer easily found on the market.	Research existing collections to identify rarity. Expand opportunities for adding rare plants to collection.
2. Diversity 1. # Taxa 2. # Families 3. # Genera 4. # Species	Taxa: 498 Families: 42 Genera: 69 Species: 169	Expand collection of waterlily species.
3.Wild Origin • # accessions of wild origin • # accessions of wild origin derivative	WO - 10 WOD - 9	Given difficulty of acquiring wild collected taxa, will find all opportunities

Quality Metric	Current Status	Future Target
		to add plants of wild origin.
4. Extinction Risk • EW • CR • EN • VU	EW: 0 CR: 1 EN: 1 VU: 3	Will do more research and look into the possibility of adding more taxa at risk.
5. Seed Banking	None	None
6. Duplication • Species with multiple accession • Accessions distributed to regional gardens	• 146 • 11 (to MBOT)	Continue distributing to regional and other botanic gardens
7. Longevity and Sustainability • # accessions <10 years old • # accessions 10 – 25 years old • # accessions 26 – 50 years old • # accessions >50 years old	<10 years - 583 10-25 years – 183 26-50 years – 31 >50 - 0	
8. Exceptional Interest	Victoria, Intersubgeneric Hardy x Tropical waterlilies	
9. Crop Wild Relatives	The study of crop-wild relatives is an evolving field and current lists are incomplete.	Will explore all databases to identify CWRs in this collection
10. Herbarium Vouchering and Genomic Collections • # accessions w/ herbarium vouchers • # accessions preserved as genomic tissue with GGI	Vouchers - 9 GGI - 0	Over the next 10 years, have 30% of accessions vouchered.

Cactus and Succulent

a. Collection Description

The cactus and succulent collection encompass plants in the family *Cactaceae* as well as succulent plants that store water in fleshy leaves, stems, or roots. Our collection has broad horticultural importance and because of the enduring popularity of cacti and succulents with the general public, this collection is a valuable tool to fulfill our mission of connecting people with plants.

b. Collection Content

The Cactus and Succulent Collection is divided into two sub-collections: the outdoor cactus and succulent collection and the indoor (non-hardy) cactus and succulent collection.

Outdoor Cactus and Succulent Collection

A plant falls within the Outdoor Cactus and Succulent Collection if it is permanently housed outdoors, and therefore most accessions in this collection are fully or partially cold hardy. Within this sub-collection, there is significant overlap with the Gardens' Native, Steppe, and Alpine living collections.

Cacti and succulents provide year-round structure, texture and color to a large percentage of the outdoor gardens especially when mixed with other non-succulent plant material that has similar cultural requirements. These displays effectively showcase cactus and succulents in garden contexts that are attractive and interesting to the general public. The outdoor cactus and succulent collection has a key role in sustainable garden-making, as the unique physiology and adaptations of cacti and succulents mean they are among the most xeric landscape plants available. As consumers and institutions become increasingly committed to resource-conscious approaches to landscape management, cacti and succulents will become even more pertinent.

The Outdoor Cactus and Succulent Collection includes a representative balance between wild-type species, hybrids, and cultivars. Among native cacti and succulents, the outdoor collection contains a nearly complete representation of cacti and succulents found in Colorado. Represented families primarily include: *Asparagaceae, Aizoaceae, Cactaceae,* and *Crassulaceae*, with fewer representatives from *Portulacaceae, Euphorbiaceae* and *Fouquieriaceae*. Collections of *Asparagaceae, Aizoaceae, Cactaceae* (especially *Opuntia, Cylindropuntia*, and *Echinocereus*), *Crassulaceae* (particularly *Sempervivum* and *Sedum*) are exceptionally strong.

The outdoor cactus and succulent collection has widespread distribution throughout DBG garden locations, however specimens are most prevalent in the following locations:

- Dryland Mesa
- Crossroads Garden
- Nexus Garden
- Roads Water-Smart Garden
- Rock Alpine Garden

- Steppe Garden

Non-Hardy Cactus and Succulent Collection
The aim of this collection is to represent a good cross section of the many varieties of succulents from all over the world, and a variety of families for display in the Cactus and Succulent House and seasonal outdoor displays.

The Non-Hardy Cactus and Succulent Collection has representatives from 20 families. Though some families, such as *Cactaceae*, have many more representatives than a family such as *Welwitschiaceae* for the indoor collection, they cannot be considered more important. This is partly because the aim of the indoor collection is to show as wide a variety of succulents as possible. *Welwitschia* are plants that most people would rarely get an opportunity to see. Also, in the case of *Welwitschiaceae*, *Welwitschia mirabilis* is monotypic. Similarly, many of the other families represented only have a few succulent members; in many of these cases, visitors are surprised to find that their common garden plants have succulent relatives.

The Non-Hardy Collection is displayed in the Cactus and Succulent House, as well as in seasonal displays in Marnie's Plaza and the Steppe Garden with the backup collection in Greenhouse 8. The Succulent House has year-round interest, with many plants being winter-blooming. Space is limited and this, in turn, limits the number of plants in the collection, in particular large specimens used in outdoor displays. The epiphytic cacti are housed in the Tropical Collection greenhouses, as the conditions are more suitable for them here, and they are used for display with the other tropical plants.

This collection is very diverse, with plants from many areas of the world and many plant families. It shows the variety that exists in succulents. There is a good balance between the more common plants that can be bought and grown by the typical visitor, and the more unusual that can only be seen at botanic gardens by most visitors. In recent years, the collection has improved markedly, especially the genera *Aloe*, *Haworthia* and *Crassula*.

c. Collection Status and Priorities

Quality Metric	Current Status	Future Target
1. Rarity	• *Aloinopsis acuta* • *Maihueniopsis minuta* • *Melocactus schatzlii* • *Sclerocactus brevispinus*	• 5 taxa
2. Diversity • # Taxa	• 1,804	• 1,894

Quality Metric	Current Status	Future Target
• # Families • # Genera • # Species	• 17 • 209 • 1,133	• 18 • 219 • 1,189
3.Wild origin • # accessions of wild origin • # accessions of wild origin derivative	 • 394 • 166	 • 413 • 174
4. Extinction Risk • EW • CR • EN • VU	 • 0 • 2 • 15 • 3	 • 0 • 3 • 17 • 4
5. Seed Banking	• Offsite Seed Storage – 31 accessions • Seed Lab - 6	• Offsite Seed Storage – 33 • Seed Lab - 10
6. Duplication 5. Species with multiple accession • Accessions distributed to regional gardens	 • 376 • 0	 • 394
7. Longevity and Sustainability • # accessions <10 years old • # accessions 10 – 25 years old • # accessions 26 – 50 years old • # accessions >50 years old	 • 1,492 • 1,064 • 137 • 8	
8. Exceptional Interest	• *Kumara haemanthifoli* • *Aloe polyphylla* • *Bulbine torta* • Arboresecent *Yucca spp.*	
9. Crop Wild Relatives	N/A	N/A
10. Herbarium Vouchering and Genomic Collections · # accessions w/ herbarium vouchers · # accessions preserved as genomic tissue with GGI	 • 38 • 6	 • 40 • 7

Priorities - Outdoor Cactus and Succulent Collection
We will continue to acquire plant material suitable for outdoor cultivation including cacti hybrids and cultivars with high display value as well as accessions of rare, biologically threatened species with a focus on wild-collected material. Specific priorities include:

*Wild Collection Efforts***:** The outdoor cactus and succulent collection should be bolstered by wild-collected plant material, especially for regionally native taxa, to increase knowledge of plant provenance and provide substantive genetic resources for research purposes. Collection priorities in the future include the trans-Pecos region of Texas, Great Basin ranges of Nevada, and high elevation areas of the Sonoran desert with particular interest in cacti suitable for outdoor cultivation. Specific emphasis should be placed on species that are rare or threatened in the wild.

*Hardiness Documentation***:** Newly accessioned species, hybrids, and selections will be evaluated for hardiness through systematic documentation of performance and relevant cultural conditions. The outdoor cactus and succulent collection contains a number of marginally hardy species which require further testing to determine their viability for long-term outdoor cultivation. The Gardens will continue to develop and implement a formal procedure for hardiness testing. Photographic documentation will accompany other accession recordkeeping to ensure collection accuracy and integrity.

*Collections Duplication***:** Many taxa in the outdoor cactus and succulent collection are represented by a single accession and are therefore vulnerable to loss. To further secure these taxa in our collection we will pursue diverse strategies including propagation and housing of unique accessions in multiple locations, distribution to regional botanic gardens and growers, and when applicable, seed banking.

Priorities - Indoor Cactus and Succulent Collection
- *Development of Aridarium on West Terrace*:
  - The West Terrace of the Greenhouse Complex is a possible site for an immersive display of non-hardy cacti and succulents.
  - Design with themes in mind such as: Madagascar Bed; African Bed; Australian Bed; Galapagos Bed; *Welwitschia* in-ground display.
  - Can include other desert plants to accent the display and educate on arid ecosystems and environs.
  - Develop impactful interpretive content related to cultivating cacti and succulents both indoors and out.
- *Taxonomy:*
  - Plant names are constantly changing and it is not possible to determine which names or sources should be used forever; however, attempts are being made to choose the most accepted names for plants we currently have and to update these regularly.
  - Start by finding out which names similar institutions are using, particularly Albuquerque Botanic Gardens, Huntington Botanic Gardens and Arizona Sonora Desert Museum. Through conversations with the Desert Botanic Gardens and the

Arizona Sonora Desert Museum, we've decided to use CITES as the authority for taxonomic changes.

Native

a. Collection Description

The Native Plant Collection has significant overlap with several other collections, primarily the Steppe, Alpine and Cactus and Succulent collections. This collection consists of two sub-collections which are defined as follows:

Colorado Native Collection:
Defined as those species that are known to occur naturally (pre-European settlement) within the borders of Colorado, but not necessarily exclusive to Colorado.

Western North American Native Collection:
Defined as those species native (pre-European settlement) to other regions of western North America, but not found naturally within the borders of Colorado.

b. Collection Content

The Colorado Native Plant Collection: Colorado has an estimated 3,430 native taxa found within its borders (Source: Ron Hartman, B.E. Nelson, A Checklist of Vascular Plants of Colorado, Rocky Mt. Herbarium, University of Wyoming, Laramie.) Of these, Denver Botanic Gardens grows 776 species (≈ 6% increase from the 2017 document). Most of this collection exists within gardens that have great aesthetic appeal and strongly evoke images of our natural Colorado landscapes. This is one of Denver Botanic Gardens' great strengths, and its diversity is unparalleled in other public gardens of the region.

The Western North America Native Plant Collection can be characterized as a strong representative collection including great diversity, but seldom including a complete collection of any specific families or genera, rather focusing on species that are well adapted to our local conditions. Many have unrealized potential simply because of limited availability or limited trial outside of their original habitats.

Wild collected germplasm is especially valuable to our collection, as it usually represents pure species without genetic material from far-off sources. These are plants that have evolved under, and adapted to, regional conditions and are potentially better suited for use in regional horticulture. At this time nearly 32% (previously 26%) of our native Colorado collections and 26% (previously 14%) of other Western Native collections are wild-collected or of known wild origin. These are strong numbers, showing a measurable increase in wild provenance and adding to the integrity of the collection.

Authorities often differ on exact nomenclature, which can alter numbers significantly, particularly in difficult families such as *Cactacea*e or *Poaceae*. The following families have especially strong regional representation:

- *Asteraceae*
- *Asparagaceae (Agave, Yucca)*
- *Cactaceae (*cold tolerant species and cultivars, especially *Opuntia)*
- *Fagaceae (Quercus)*
- *Poaceae*

- *Polygonaceae (Eriogonum)*
- *Plantaginaceae (Penstemon)*
- *Rosaceae*

This collection is displayed primarily in large naturalistic gardens, though many species are also grown throughout our outdoor displays. While propagation usually occurs in the greenhouses and nursery, only a select few plants (mainly cactus and succulent species) might be kept indoors under glass for any extended period of time.

Primary locations, in approximate order of prevalence, include:
- Two off-site locations: Chatfield Farms and Mount Goliath Nature Center
- Laura Smith Porter Plains Garden
- Western Panoramas
- Gates Montane Garden
- Dryland Mesa
- Sacred Earth
- Steppe Garden Intermountain Section
- Dwarf Conifer Garden
- Rock Alpine Garden
- Roads Water-Smart Garden
- Nexus Berm
- Japanese Garden
- Crossroads

c. Collection Status and Priorities

Quality Metric	**Current Status CO Natives**	**Current Status Other Western Natives (not in CO)**	**Future Target**
1. Rarity	• 9 species, (all of least concern) • Also 8 species of native cactus, (7 of least concern, 1 endangered)		8 additional poorly represented species from the BGCI Redlist could potentially be added to our collection.
2. Diversity • # Taxa • # Families • # Genera • # Species	• 856 • 86 • 336 • 776	• 884 • 97 • 329 • 805	Current species count of CO natives shows a 6% increase over 2017 assessment, and a 57% increase in other western natives not in CO. (Some of the latter increase can be attributed to updated provenance data on existing accessions.) Target: To add under-represented CO

Quality Metric	Current Status CO Natives	Current Status Other Western Natives (not in CO)	Future Target
			species, including orchids, ferns and fern allies, and aquatics.
3.Wild Origin • # accessions of wild origin • # accessions of wild origin derivative	• 1,408 • 207	• 559 • 82	Many accessions are duplicate species. Create priority list for future wild collections of species that are currently lacking.
4. Extinction Risk • EW • CR • EN • VU • CO State level (Critically Imperiled, Imperiled, or Vulnerable rating)	• 0 • 2 • 5 • 0 • 58	• 0 • 2 • 1 • 0	Acquisition of such plants requires special permitting and collaboration with our Research Department. Desired species will be carefully evaluated before priorities are set. State rankings are especially relevant for the Native Collection. Representation of *Penstemon* and *Physaria* is quite strong. Setting targets for new accessions will be done in conjunction with the Research Department.
5. Seed Banking	Specific data not available		
6. Duplication • Species with multiple accession • Accessions distributed to regional gardens	• 768 (90%)	• 678 (76%)	Species that lack duplicates will be evaluated and prioritized, with a preference for adding wild collected germplasm when possible.
7. Longevity and Sustainability • # accessions <10 years old • # accessions 10 – 25 years old • # accessions 26 – 50 years old	• 3,403 • 1,548 • 153	• 481 • 360 • 56	Assess oldest collections and develop plan for continued preservation when possible.

Quality Metric	**Current Status CO Natives**	**Current Status Other Western Natives (not in CO)**	**Future Target**
• # accessions >50 years old	• 0	• 2	
8. Exceptional Interest	The character pines in the Japanese Garden are all *Pinus ponderosa* that were collected in the wild in the late 1970's. These trees are confirmed to be as much as 700 years old, possibly more.	The large conifers in the gates Montane Garden are among our oldest trees, as are the bristlecone pines in the Bristlecone Border. Hardy forms of *Yucca, Dasylirion, Nolina, Agave, Chilopsis,* and *Arbutus xalapensis* are unique specimens in our region.	Continue to maintain these in good health.
9. Crop Wild Relatives	≈ 55 Western native species are considered crop wild relatives, although this does not account for the many additional species that had historical and present-day use in their wild forms by		The study of crop-wild relatives is an evolving field and current lists are incomplete. In the case of Native Plants, we will continue to obtain and display those which have known ethnobotanical uses by Native Americans.

Quality Metric	Current Status CO Natives	Current Status Other Western Natives (not in CO)	Future Target
	Native Americans, whether for fiber, medicine, shelter, or food.		
10. Herbarium Vouchering and Genomic Collections • # accessions w/ herbarium vouchers # accessions preserved as genomic tissue with GGI	155 vouchers (just 3% of all accessions received)	72 vouchers (just 3% of all accessions received)	Main families represented include *Asteraceae*, *Poaceae*, and *Fagaceae*. There is ample room for improving these numbers, with a priority placed on accessions that are wild-collected and of known wild origin.

Priorities:

Wild-Collection Opportunities: Several western regions will always have exceptional interest and potential as sources of plants suitable for horticulture in Colorado. These include, but are not limited to the following:

- Big Bend area—West Texas
- Edwards Plateau—Texas
- High elevations within Sonoran Desert—Arizona, Mexico
- High Elevations within Chihuahuan Desert—New Mexico, Mexico
- Eastern slope Sierra Nevada—California, Nevada
- Great Basin ranges—Southern/Central Nevada
- Eastern slope Cascade Range, Blue Mts. and Wallowa Mts.—Oregon
- Colorado Plateau and Mogollon Rim—Arizona, Utah
- All of Colorado, especially:
    - Uncompahgre Plateau—SW Colorado
    - High Plains—E Colorado and bordering states

*Endemics***:** Of the 135 accepted plants considered endemic to Colorado, 38 species have been grown and maintained by Denver Botanic Gardens. The Gardens has significant potential to act as a repository for more endemic and threatened or endangered plants.

Under-represented Taxa: The majority of our native collections have been assembled based on ease of culture, availability and suitability for horticultural use by the gardening public. Aggressive plants, or those that require highly specialized conditions or specific plant or microbial associations are less likely to be included. At this time, several

families, genera, and groups of plants are very poorly represented, and continue to provide a challenge. Examples include:

- *Orchidaceae*
- Ferns and fern allies
- Native aquatics

In the case of *Orchidaceae*, these present some level of difficulty in culture and procurement and are illegal to acquire from public lands due to rarity and CITES status. These are valuable in their own right, interesting to taxonomists, and important to conservationists and researchers. Still, most have little practical application in horticulture and are not considered high priorities for collections at Denver Botanic Gardens. However, ongoing collaboration with the Research Department and governmental agencies continues to make more species available to us. Future efforts via tissue culture may result in more of these otherwise unavailable species in our collection.

Hybrids and Cultivars of Native Species: The viability of native plants for use in horticulture is a continuing aspect of our research. While we list 278 hybrids and named cultivars as derived from species that are native to Colorado, most of these have been selected from other regions where they also occur, especially the Midwest. There is great opportunity to select and name cultivars from our indigenous germplasm, thereby bringing better adapted plants into the market. Plant exploration, breeding and trials are the only way to acquire and introduce such unique material.

The Chatfield Trial Garden provides the space and opportunity to test uncommon plants, to make improved selections, and to make side-by-side comparisons to plants existing in the trade. This is vital to our relevance in the world of horticulture and contributes to the continued success of the Plant Select® program.

Seed Conservation: Renewed efforts to conserve native plant seeds in cold storage has become a current focus. Seed storage continues to be a priority when we are wild-collecting seeds for our garden collections.

Steppe

a. Collection Description

The steppe biome is dominated by grasslands and shrublands that are found on all continents except Antarctica and occurs most abundantly in North America, South America, Central Asia and Southern Africa. Steppe regions have a continental climate and are most often in the rain shadow of larger mountain complexes. Climatically, the extreme cold of winter and conversely, the extreme heat of summer differentiate steppe from other grassland biomes.

In Steppe regions, where moisture and temperature can fluctuate extremely within a single growing season as well as over longer periods of time, geophytes store the moisture and other resources needed to survive in bulbs, or similar structures, such as corms and tubers. Moisture, usually most prevalent in spring, brings on early season growth and bloom. Then, in the dry heat of summer and through fall and winter, many of these same plants go dormant and preserve their resources.

b. Collection Content

Due to the great geographic ranges represented in steppe bioregions, not all plants from steppe regions can survive winters in Colorado. The Steppe collection includes both cold hardy and non-cold hardy plants to represent the greatest possible diversity of plants from each steppe region. Annual plants, manmade hybrids and plants that come from more temperate areas within the steppe regions are used to enhance the display. The collection also includes many plants from steppe regions that have been used, cultivated, and moved by Indigenous persons. These plants cannot always be traced back to exact native occurrences and distributions but are important in the ethnobotanical interpretation of how humans interact with the steppes.

Geophytes are a significant feature of each of the Steppe sub-collections, as well as those crucial to the horticulture industry. Both wild and cultivated forms are displayed within these subsections of the Steppe Garden:

- Central Asian Steppe: The birthplace of the tulip. Collection includes tulips, iris, crocus, *Colchicum, Fritillaria, Corydalis* and *Eremurus*.
- South African Steppe: Possessing one of the highest concentrations of bulb species on Earth, the collection includes: *Agapanthus, Albuca, Crocosmia, Gladiolus, Nerine, Ornithogalum, Oxalis* and *Zantedeschia*.
- South American Steppe: Includes but not limited to: *Alstroemeria, Leucocoryne, Tecophilaea, Rhodophiala* and *Oxalis.*
- North American Steppe: Includes *Camassia, Fritillaria, Calochortus*, lilies, *Triteleia, Sysirinchium* and more.

Much of the Steppe collections can be found centrally in the Steppe Garden. However, the plants of the steppe regions of the world have been integral to the work and collections of Denver Botanic Gardens from its earliest endeavors with native and climatically adapted plants. Steppe collection plants can also be found in:

- Crossroads

- The Diane Radichel Plant Select Garden
- Dryland Mesa
- The Josephine Streetscape
- Laura Smith Porter Plains Garden
- Mordecai Children's Garden
- Nexus Berm
- Plant Asia
- Roads Water-Smart Garden
- Rock Alpine Garden
- Western Panoramas

Quantitative strengths: Given the number of species represented in the collection, there are a high number of families represented. In total, there are 89 families within three garden spaces. Although many of species listed were originally planted in the Rock Alpine Garden in the late eighties and nineties, the number of accessions has risen. This is due to the construction of PlantAsia and the increase in diversity in the Water-Smart Garden as well as plantings and expansions of Crossroads Garden, the Mordeacai Children's Garden, the green roof, the Diane Radichel Plant Select® Garden, and the Steppe Garden.

Adaptability: Since steppe plants have evolved to thrive in climates similar to Denver's, steppe plants often exhibit a propensity to thrive in our gardens. A majority of steppe plants are tolerant of extended dry seasons, sun, and wind, and expand the plant palette for dryland garden design. They are often easy to care for and need little supplemental water. Many of these plants also thrive in mineral rich organic poor soils that are indicative of the Colorado Front Range. Because of this, plants are carefully monitored to avoid excessive potential for invasiveness.

Aesthetic appeal: This may be the greatest strength of Denver Botanic Gardens' Steppe Collection. The Gardens derive a great aesthetic benefit from plants such as *Eremurus*, *Veronica*, *Acantholimon* and *Tulipa*. These have become signature plants, adding color and, in some cases, winter interest. Many of the plants introduced to the local trade through the Plant Select® program find their origins in steppe regions around the world. *Delosperma, Diascia,* and *Gazania* from South Africa and many United States steppe natives, such as *Ericameria*, *Bouteloua, Penstemon,* and *Scuttelaria* have been included in Plant Select.

Interpretive message: Similarities between the Asian steppe and Colorado's high plains offer another way to educate the public about other countries as they relate to Colorado. Perhaps it even lends an exotic feel to the steppe of Colorado, Wyoming and New Mexico. Conservation and collaboration with partners in other steppe regions is critical to understanding our sense of place. Until the last few decades, there has been little exploration of plants from steppe climates. With ever-growing pressures to conserve water, finding plants that thrive in our low-water steppe habitat will be increasingly more important.

Unique with a wide range of potential: This collection is most likely the only one of its kind in North America. This fact, coupled with our Native Plant Collection, sets us apart from other botanic gardens. Given the vast number of untested plants in the Rocky Mountain Region, the Asian Steppe subcollection has incredible potential for growth and research. For example, the Soviet-Armenian botanist Armen Takhtajan outlines the Central Anatolian Province as having a species endemism of 30 percent. The Armeno-Iranian province contains unique genera, such as *Acanthophylum* and *Onobrychis,* and many unique species of *Quercus*. This gives us the option of expanding our collection in many different directions.

Succulents and their importance in the Steppe Collection: The Steppe Garden, completed in 2016, will allow for a significant expansion in the development of the cacti and succulent collection. Constructed of concrete, large sandstone slabs and a fast-draining soil substrate, the Steppe Garden offers augmented planting space and multiple microclimates for appropriate succulents.

c. Collection Status and Priorities

Quality Metric	Current Status	Future Target
1. Rarity	While there are rare plants in the collection, there is so much crossover of native and steppe plants many of the rare plants are under the purview of the Native plant collections. The focus of the greater Steppe collection is to create a representative collection of plants from each of the identified Steppe regions. This collection looks for horticulturally relevant and interesting species.	Identify plants of horticultural relevance and importance. Review collection lists and identify plants listed as rare in their native ranges.
2. Diversity • # Taxa • # Families • # Genera • # Species	 • 2,019 • 101 • 781 • 2,019	Continue working to define steppe taxa. Begin working on subcategories of steppe and identify species shared with

Quality Metric	Current Status	Future Target
		other living collections.
3.Wild Origin • # accessions of wild origin • # accessions of wild origin derivative	• 915 • 220	Continue to work on steppe specific collections in all of the steppe regions.
4. Extinction Risk • EW • CR • EN • VU	• 0 • 0 • 1 • 2	Add more plants of risk status as opportunities arise
5. Seed Banking	Seeds are collected from the gardens annually. The seed collected changes yearly based on multiple factors. Plants with wild known origins are a priority. Plants of horticultural interest are also collected for propagations	Continue seed collections and document collections and target wild known origin species
6. Duplication • Species with multiple accession • Accessions distributed to regional gardens	• We have received 83 accessions from other PCC members that are part of the Steppe collection • PCC distributions from KG/KZ trip (97 taxa to 6 institutions)	Will continue to reach out to regional gardens to share wild known origin plants of significance. All distributions will be recorded with Plant Records department.
7. Longevity and Sustainability • # accessions <10 years old • # accessions 10 – 25 years old • # accessions 26 – 50 years old • # accessions >50 years old	At this time the steppe collection is being tagged in the database. As this information becomes complete more specific data can be extracted and sorted.	The oldest accessions are from the native plant collections. In the years 2009 and 2010 collection efforts began specifically for the steppe collection. As

Quality Metric	Current Status	Future Target
		the collection was growing and trips to Southern Africa, Central Asia, and partnerships in Argentina developed the number of steppe specific accessions really began to grow.
8. Exceptional Interest	This diverse collection has many wonderful plants that are relevant to garden spaces. Of particular note are the bulbs. Species and cultivars alike are planted in the Central Asian and the Southern African sections of the Steppe Garden.	The goal is to continue adding species as we can find them on the open market or grow them from wild collected sources.
9. Crop Wild Relatives	The study of crop-wild relatives is an evolving field and current lists are incomplete.	Will explore all databases to identify CWRs in this collection
11. Herbarium Vouchering and Genomic Collections • # accessions w/ herbarium vouchers • # accessions preserved as genomic tissue with GGI	• 1,266 in KHD • 34 from Steppe Garden	The future goal is to process specimens from collections trips as they begin to flower. This will be focused mainly on plants in the Steppe Garden

Tropical

a. Collection description

Tropical plants are particularly interesting and appealing to the general public and can readily serve as an important vehicle for introducing the plant world to a wider audience. The world's tropical ecosystems have great importance far beyond their geographical boundaries, and the Denver Botanic Gardens Tropical Collection can help people in our semi-arid region, most of whom will never be able to visit a tropical ecosystem, learn about tropical ecosystems and the importance of their conservation.

Plantings within Boettcher Memorial Conservatory and the associated collections are designed to showcase plant species found in tropical rainforests around the world, as well as cultivated varieties chosen for their exceptional form or color.

b. Collection Content

The tropical collections are housed in the Boettcher Memorial Tropical Conservatory, Marnie's Pavilion, and non-public collection greenhouses (primarily greenhouses 1-5 and 7).

Broadly speaking, the Tropical Plant Collection can be characterized as a strong representative collection including great diversity, but seldom including a complete collection of any specific family or genera. Currently, Denver Botanic Gardens' Tropical Collection contains nearly 3,228 taxa (+51), representing more than 2,424 species (+50) from 672 genera (-34) and 124 families (-13). Over the years several families have obtained prominence in our collection. These families include:

- *Orchidaceae*
- *Bromeliaceae*
- *Arecaceae*
- *Gesneriaceae*
- *Acanthaceae*

Several individual accessions in the tropical collection should also be recognized as heritage plants, having been grown at the Gardens since the inception of the Tropical Collection (circa 1965). These plants include: *Callisia fragrans, Eucharis* x *grandiflora, Dichorisandra thyrsiflora, Cecropia peltata, Cycas circinalis, Calliandra haematocephala, Hibiscus rosa-sinensis '*Scarlet Giant', *Ficus aspera, Rondeletia leucophylla, Dombeya elegans, Pilea cadierei, Pilea involucrata* and *Eletarria cardamomum*.

c. Collection Status and Priorities

Quality Metric	**Current Status**	**Future Target**
1. Rarity 2.	24	Maintain
2. Diversity • # Taxa • # Families • # Genera	 3,228 111 672	Improve representation of tropical ferns. Reinvigorate *Bromeliaceae* and

Quality Metric	Current Status	Future Target
• # Species	2,425	Begoniaceae collections.
3.Wild Origin • # accessions of wild origin • # accessions of wild origin derivative	 147 35	Maintain
4. Extinction Risk • EW • CR • EN • VU	 1 22 31 31	Maintain
5. Seed Banking	0	Not a collection priority but look for opportunities.
6. Duplication • Species with multiple accession • Accessions distributed to regional gardens	 • 703 = 16% • 9 local – 19 worldwide	 • Increase 2% • Identify opportunities
7. Longevity and Sustainability • # accessions <10 years old • # accessions 10 – 25 years old • # accessions 26 – 50 years old • # accessions >50 years old	 1,160 2,036 591 48	Maintain
8. Exceptional Interest	• *Amorphophallus titanum* • *Wollemi nobilis* • *Eligmocarpus cynometroides*	
9. Crop Wild Relatives	8	Maintain
10. Herbarium Vouchering and Genomic Collections • # accessions w/ herbarium vouchers • # accessions preserved as genomic tissue with GGI	 • 705 = 17% • 0	 • + 25 vouchers/year

Priorities:

- Increased number of vouchered accessions
- Photo-documentation of collection for Garden's Navigator
- Develop display opportunity for cool-growing orchid specimens
- Cull less desirable/poor-quality cultivars
- Continue to diversify collection
- Staff enrichment through networking and travel

Section 4 - Management of Collections

a. Acquisition

In compliance with the Convention on Biological Diversity (CBD), plants may be acquired for permanent or temporary display through exchange, loan, purchase from private or commercial sources, responsible collection from the wild, gifts or *Index Seminum*. Any illegally collected or obtained plants will not knowingly be accepted.
Plants obtained for horticultural research and evaluation, or restoration work, will be acquired according to the standards set by the evaluator/researcher as long as they meet the purpose of the evaluation/research and abide by the invasive plants policy (Appendix B). These plants will be accessioned even though they may be for temporary use.

b. Accessioning

All plants acquired for permanent collection, conservation or research/evaluation shall be accessioned. Plants acquired for plant sales will not be accessioned. Plants or collections on short-term loan to DBG (less than 6 months) will not be accessioned but should have proper documentation from the loaner. Annuals will be accessioned upon receipt at the Gardens (as seed or plants) and will be deaccessioned upon their removal at the end of the growing season.

All plants will be accessioned upon delivery, even if the final location is not determined and the plant will temporarily reside in the greenhouse or nursery. When moved and planted, the Horticulture staff will immediately inform Plant Records.

c. Deaccessioning

Deaccessioning of plants may occur for several reasons:

- Death of the plant in the gardens or greenhouses
- Deterioration of plant in gardens or greenhouses that could lead to either harm to people or to other plants or infrastructure
- Plant is determined to no longer meet goals/needs of collection
- Plant is duplicated elsewhere
- Change in garden design or mission statement
- Taxa with invasive potential

Potential major deaccessions that include large specimens, large numbers of plants, or entire collections will be submitted by the Director of Horticulture to the Gardens & Conservation Committee for recommendation to the Board of Trustees. Other recommended deaccessions when plant health is not the issue should be approved by the collection's curator and Director of Horticulture. Changes in plant status should be submitted to Plant Records in writing within 24 hours of removal.

d. Disposal

Plants that have been de-accessioned and divisions of accessioned plant material may be held on premises for use in Denver Botanic Gardens' annual plant sale. Funds acquired through sale will be used for the betterment of the collections. At regular intervals, surplus plants will be assessed by the Production team and Director of Horticulture and excess may be dispersed to other botanic gardens and/or to staff and volunteers or other appropriate parties. However,

plant material received by employees, volunteers or other appropriate parties is for personal use only and is not for resale. Plants acquired through *Index Seminum* may only be dispersed based upon requirements of the distributing organization and with a signed Material Transfer Agreement. Plants acquired through special agreements or collecting permits will not be dispersed without the consent of the Director of Horticulture in consultation with Plant Records to verify that agreement and permit conditions are met.

e. Documentation

When a taxon is acquired by Denver Botanic Gardens, accurate information will be provided for plant records, including the plant's full plant name and cultivar (hereafter referred to as scientific name), plant source (nursery, donation or wild collected data), date of receipt, type of germplasm, size, and quantity of plants or propagules, and intended planting location. Accession records of plants propagated at the Gardens to be used in restoration will be entered and stored in a computerized database. Living, permanent collections are surveyed and added into a computerized mapping system. Entered data will be backed up nightly by the computer network and stored at onsite and offsite locations. The living collections database is continuously updated with details such as plant characteristics, phenological observations, ecology, evaluation notes, collection, propagation and herbarium information (as applicable). Records of plants used in conservation research are the responsibility of the Director of Research and Conservation. Seed collections stored at Denver Botanic Gardens or collected by Gardens' staff and stored at offsite locations, such as the USDA National Laboratory for Genetic Resource Preservation, are also documented in the database. Wild collected germplasm documentation shall also require copies of permits to be shared with Plant Records.

Labeling is an important component of record keeping and the educational aspect of the Gardens. All permanent plants, upon accessioning will have an embossed aluminum accession tag and/or a barcode label (specifically for the orchid collection) created for each individual or grouping and that tag shall be either attached to a branch or staked into the ground near the base of the plant or plant grouping. The accession tag will contain the accession number and full scientific name. At least one instance of each taxon in the permanent collection on display will have a display label, where practical. Display labels will contain the scientific name, common name if applicable, family name, and nativity information. Special collections may also be noted on the display labels, such as Plant Select or State Champion Trees. Hybridizer information is shared on display labels for select cultivar collections such as *Iris* and *Hemerocallis*.

f. Care & Maintenance

The living collections are cared for on a daily basis by following sound horticultural plant care practices as prescribed in the Horticulture Procedures Manual.

g. Inventories

Inventory of the Gardens' permanent collections is an ongoing task of horticulture and plant records staff and should focus on the continued fulfillment of the purpose of the collection, accuracy of nomenclature, recommendations for de-accessioning, growing existing collections, or acquisition of new collections.

h. Photographic Documentation of Collections and Access

As part of the plant documentation process, the Gardens strives to maintain a digital image collection of accessions, both current and no longer living. Photos to be added to the database should include the following metadata: scientific name, accession number plus qualifier when known, location of plant (specific garden or in habitat), date image taken, photographer name, plant parts visible in image (flower, fruit, leaf, bark). Multiple images can be maintained through the database system to represent the species and individual plants at different points in life and phenology. Specific groups of plants, such as bonsai and character pines should have data tracked to the individual plant (Accession # + qualifier). Images may be contributed by either staff, volunteers or members of the public with their permission. Images, once entered in the database, become property of Denver Botanic Gardens and may be displayed online or used for marketing purposes by the Gardens.

Access to images: Staff are encouraged to make use of this image collection for professional purposes such as presentations and publications. Images may also be used by other nonprofits or horticultural institutions with permission. Permission may be granted by the Director of Horticulture or Associate Director of Horticulture who oversees Plant Records. Photos should be credited as ©Denver Botanic Gardens.

i. Distribution to Plant Select

Seeds, cuttings and/or tissue culture propagules from our collections will be distributed to Plant Select members for the purpose of research and evaluation for future introduction. The Seed Distribution Policy is described in Appendix C. All recipients of germplasm material will sign the License Agreement for Research, Cultivar Development & Evaluation (Appendix D).

j. Gifts

Plants and/or collections will be accepted as gifts only if they meet the purpose of the collection and are in compliance with the Convention on Biological Diversity. Donated plants should have provenance and a properly identified name including cultivar name if appropriate. Any illegally collected or obtained plants will not knowingly be accepted. The donor may place no restrictions on gifts of plant material. An in-kind donation form will be given to the donor, and a copy will be submitted to the Development Department. Denver Botanic Gardens encourages significant gifts of plants to be accompanied by sufficient endowment to provide long-term maintenance. As much as possible, donated plants will be used in displays, however, Denver Botanic Gardens has the right to sell or de-accession any gifts. Under IRS regulations Denver Botanic Gardens will not make monetary appraisal of gifts.

k. Exchange, Loans, and Exhibitions

Living plants, including seeds, obtained via exchanges with other gardens and institutions must meet the purpose of the collection and shall be accepted with the approval of the Director of Horticulture. Loans and temporary exhibits of plants shall meet the requirements of this policy and will be accepted or granted by the Director of Horticulture.

Section 5 - Governance of Collections

a. Authority

The living collections fall under the purview of the Gardens and Conservation Committee, consisting of appointed Board members, the Gardens' CEO and Director of Horticulture. The overall implementation and evaluation of the living collections strategy is overseen by the Director of Horticulture, Associate Directors of Horticulture and the Curators of specific collections.

b. Ethics Regarding Collections Stewardship and Management

Activities related to the development, management, and use of the living collections must comply with all relevant local, state, federal and international laws. A few such laws are listed as examples under the section Laws below. Individuals acquiring plant material are responsible for researching current access laws and quarantines governing the collection, movement, and distribution of plants within and outside the US and acquiring pertinent permits. Acquired taxa will fall under the ownership of Denver Botanic Gardens, held in public trust for the benefit of present and future generations. All acquired taxa are evaluated for their potential invasiveness. In the event invasive or potentially invasive plants are retained for their scientific value, they will be appropriately labelled, and additional management procedures are put into place for containment purposes. No such plants will be distributed for horticultural use but may be distributed to researchers investigating invasion biology.

Under the International Plant Exchange Network (IPEN), plants acquired through *Index Seminum* are transferred solely to Denver Botanic Gardens and not to the individual making the request. Under no circumstances are they to be distributed to employees, volunteers or board members without consent from the collection's original institution and the Director of Horticulture. Employees, volunteers and Trustees are not allowed to keep or store personal plant material at the Gardens. This would create a conflict of interest in staff time, space and resources. Plant material, preserved specimens or any portion of the collections are to be used solely for education, research or horticulture display and are not for personal use.

The Gardens acknowledges ownership of accessions acquired without official permits. These may have been acquired either before the Convention on Biological Diversity (CBD) which went into effect in 1992 or post-CBD until 2010. Since 2011, all wild collected accessions have been acquired with official permits. Even though the United States has not ratified the CBD, as an accredited botanic garden, Denver Botanic Gardens chooses to follow all the stipulations identified in the CDB and other local, regional, national and international laws. All wild collected accessions acquired without a permit have been tagged in BG-Base as "do not distribute" and will serve as back up collection in the event any of these taxa were to become endangered or go extinct.

c. Access

Collecting plant material from displays and living collections including seeds, cuttings, scion wood or seedlings by staff, educators, nurseries and researchers must be approved in advance with the execution of the Material Transfer Agreement: Living Collections Access and

Distribution Form (Appendix E). Collection of plant material from living collections for any reason is to be approved by the Director of Horticulture and carried out only under the direction of appropriate staff member. Approved distributions through the Material Transfer Agreement process will be entered into the living collections database as permanent record.

d. Laws

Policies and regulations that staff embarking on plant exploration and wild collection should familiarize themselves with include:

- USDA Animal and Plant Health Service (APHIS) permits such as PPQ Form 587 (permit to import plant or plant products) others as relevant to the work being conducted.
- Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) – Provisions under the CITES provide a legal framework regulating the trade of endangered plant and animal species that are commercially exploited (https://www.cites.org/eng/disc/what.php).
- Convention on Biological Diversity (CBD) - The objectives of this Convention, to be pursued in accordance with its relevant provisions, are the conservation of biological diversity, the sustainable use of its components and the fair and equitable sharing of the benefits arising out of the utilization of genetic resources, including by appropriate access to genetic resources and by appropriate transfer of relevant technologies, taking into account all rights over those resources and to technologies, and by appropriate funding (https://www.cbd.int/).
- The Nagoya Protocol on Access and Benefit Sharing of the CBD - The Nagoya Protocol on Access to Genetic Resources and the Fair and Equitable Sharing of Benefits Arising from their Utilization to the Convention on Biological Diversity is an international agreement which aims at sharing the benefits arising from the utilization of genetic resources in a fair and equitable way, including by appropriate access to genetic resources and by appropriate transfer of relevant technologies, taking into account all rights over those resources and to technologies, and by appropriate funding, thereby contributing to the conservation of biological diversity and the sustainable use of its components (https://www.cbd.int/abs/).

In addition to these international rules and regulations, staff need to also familiarize themselves with the importation and exportation laws of the countries involved and proper permits acquired before embarking on plant exploration. For local collecting, permits from local landowners (such as BLM, USDA Forest Service, etc.) should be acquired and rules pertaining to the land adhered to. Collecting should be done only of those species that are listed on the permit.

e. Risk Management and Emergency Planning

Due to the nature of living collections, weather-related damage to plants is sometimes unavoidable. But, wherever possible horticultural best management practices (e.g. brushing off snow from tree limbs during early fall snow storm), will be followed. Off-site backups of electronic collections databases will be maintained to ensure data is preserved in the event on-site information is destroyed or lost. A detailed disaster plan for living collections is provided in Appendix F.

f. Invasive Species Policy

Denver Botanic Gardens is dedicated to the prevention of introduction of new invasive species (plants, insect pests and diseases) as well as the understanding and management of existing plant pests. Our detailed invasive species policy is given in Appendix B.

Section 6 - Future Forecasting & Preparedness

a. Climate Change Impact

The climate in Colorado is increasingly becoming unpredictable. Situated in a semi-arid climate, fluctuating temperatures and low rainfall have always been a reality and adapting to these conditions has always been a priority with our living collections. As impacts of climate change become more exacerbated, we need to be prepared with a plan so that we can respond immediately instead of being reactive. Two initiatives we are currently engaged in are:

- The North American Botanic Garden Strategy for Alpine Plant Conservation
- The Climate Change Alliance of Botanic Gardens

Through participation in both initiatives, we will be identifying strategies to cope with and mitigate negative impacts of climate change.

b. Climate Disaster Preparedness

One of the strategies we will be considering over the next few years to address climate disaster preparedness is the development of a landscape succession strategy similar to what has been done by Royal Botanic Gardens Victoria, Melbourne. The Climate Risk Assessment Tool currently in development by the Climate Change Alliance of Botanic Gardens, University of Tasmania, Royal Botanic Gardens Victoria and Botanic Gardens Conservation International, when available, will provide us an important tool to assess our collections in relation to future climate forecast and help develop our landscape succession strategy.

Section 7 – Appendix

A. Garden Descriptions
B. Invasive Species Policy
C. Plant Select Seed Distribution for Research & Trialing Policy
D. Plant Select License Agreement for Research, Cultivar Development & Evaluation
E. Material Transfer Agreement: Living Collections Access & Distribution Form
F. Living Collections Disaster Plan
G. Maps

Appendix A – Garden Descriptions

Ann Montague Iris and Daylily Garden
This garden features more than 200 cultivars of iris and 150 cultivars of daylilies interspersed with other spring-blooming bulbs and perennials to create a tapestry of color from early spring through mid-summer.

Annuals Garden
This display garden of annuals (formerly the All-America Selections Garden) bursts into view with bold, brilliant color. New blooms continually replace old ones as the finest plant introductions in North America demonstrate their vigor. Over 15,000 bulbs are planted in the fall for a dramatic display in the spring.

Birds and Bees Walk
This is a pollinator garden showcasing plant reproduction and pollination. As visitors walk a woodland path, they observe bees, butterflies and hummingbirds flitting among flowers, and learn about plant pollination and reproduction. Each plant was chosen for its ability to attract birds, pollinators and other fauna.

Boettcher Memorial Tropical Conservatory
Dedicated in 1966 and awarded Denver Landmark Status in 1973, the Tropical Conservatory is one of the world's most unique displays of exotic plants from tropical and subtropical regions. Midway on a circular path is a fabricated two-story banyan tree that offers a multi-layered view of the indoor tropical forest.

Cactus and Succulent House
Tender cacti and succulents representing 20 families are displayed in this quaint glass house. Unusual, desert-adapted Old-World exotics lead into native species of North America, Central America and South America.

Colorado Garden Show Promenade Garden
This street-side garden features hardy, low-water plants that thrive on steep slopes. The plants are fast-growing and low-maintenance, and they have tightly intertwining roots that help prevent rainwater from washing away soil.

Community Garden at Congress Park
The Community Garden provides urban garden space for residents of the Denver community. Gardeners come together to share their knowledge of organic gardening while creating community and beautifying their neighborhood. Creating compost, attending garden workdays, donating vegetables and hosting community social events are just a few of the gardeners' efforts.

Crossroads Garden
A low-water garden, Crossroads showcases yuccas and other members of the asparagus family. These woody relatives of asparagus are excellent specimens for water-smart landscaping, as they conserve water in their roots and stems.

Darlene Radichel Plant Select Garden
This garden displays low-water plants introduced by Plant Select®, a collaborative program among the Gardens, Colorado State University and Colorado's Green Industry. Each plant has undergone a rigorous process to determine its suitability for the High Plains-Intermountain Region.

Dryland Mesa
Receiving no supplemental irrigation, except during extreme drought, the Dryland Mesa is a showcase for arid-adapted plants. The garden features cacti, agave, yuccas, trees and shrubs that are suitable for our region. Peak bloom is from mid-May to mid-June. Dryland Mesa serves as a test site for many uncommon southwestern plants.

Dwarf Conifer Collection
This western-themed garden highlights the subtle variations in color and texture of dwarf conifers, a category of cultivars well-suited for small spaces. These slow-growing evergreens, perhaps best viewed in winter, gain only 1-6 inches of height annually.

The Ellipse in Honor of Nancy Schotters
The Ellipse is designed to complement the historic Waring House while connecting with the adjacent Romantic Garden. The elliptical design of the garden, set off-center from the house creates a dramatic focal point from the Crossroads. The view is maintained through the O'Fallon Perennial Walk continuing on to Schlessman Plaza, drawing one to the entry of the Ellipse. The sunken bed and the water feature surrounded by sandstone walls add a sense of place to this garden, complementing the historic house and holds the Chihuly sculpture, "Colorado." The garden features roses from the May-Bonfils Stanton rose collection. The various types of roses featured in this garden include floribunda, hybrid tea, hybrid musk, grandiflora, polyantha, shrub and climbing roses. These are complemented by companion plants such as hydrangeas, peonies, delphiniums, daylilies, hostas, irises, phloxes and spring-blooming bulbs.

El Pomar Waterway
This elegant garden features a stucco wall, brick walkway and long reflecting pool, culminating in a waterfall. The bottlebrush-like flowers of Oriental fountain grass line the pool, while vertical beech trees and blue oat grass soften the border along the wall.

Gates Montane Garden
The first garden built at the York Street location, Gates Montane brings Colorado's high-altitude forests down to the plains. Here, you'll see ponderosa pine, quaking aspens and other trees and shrubs common to altitudes of 8,000-10,000 feet.

Gloria Falkenberg Herb Garden
Designed in a traditional European style, with circular, narrow beds at the center, Denver Botanic Gardens Guild helps maintain the herb garden. It features culinary and medicinal herbs from the Middle Ages that are still common today, as well as a sandstone sundial. Herbs in over 150 varieties grow in this intimate garden.

Green Roof
This living roof is a testing ground for growing plants atop buildings in a semi-arid environment, and includes more than 100 species of native, drought-tolerant plants. Installed in the fall of 2007, it was the first publicly accessible green roof in the city of Denver. Data is collected annually on plant survival and precipitation from nature and irrigation.

Greenhouse Complex
Funded by the citizens of Denver through the Better Denver Bond Campaign, the 50,000 square-foot Greenhouse Complex, which opened in 2010, consists of 16,000 sq. ft. of new state-of-the-art greenhouses with flexibility for 12 climate control options, a renovated Marnie's Pavilion which showcases our epiphytic (orchids, bromeliads and ferns) collections, an Orangery with seasonal year-round displays reminiscent of traditional European Renaissance garden displays, and horticulture department offices. The greenhouses house our diverse tropical, orchid and bromeliad, cactus & succulent, and aquatic collections as well as production and propagation spaces.

Japanese Garden
The Japanese Garden is an authentic traditional Japanese garden reflecting the unique environment of its Colorado setting. The garden is named *Shofu-en*, meaning "garden of the pines and wind," both of which are typical of the natural environment of Colorado. The main feature of this garden is the abundant use of beautifully aged character pines, *Pinus ponderosa*, collected from Roosevelt National Forest and installed by members of the Rocky Mountain Bonsai Club. The garden was designed by Koichi Kawana and built in 1979. The Bill Hosokawa Bonsai Pavilion & Tea Garden is an extension of the Japanese Garden that opened in 2012. The pavilion displays majestic trees on a miniature scale. Bonsai from Rocky Mountain tree species seasonally appear on outdoor pedestals, while tropical specimens fill a glass house. Within the glass house, a water table provides humidity for these tender bonsai. Also on display are viewing stones suggestive of landscapes. The garden surrounding the existing Tea House is the focus of the activities of *Shofu-Kai*, Denver Botanic Gardens' Tea Ceremony Society. The society includes members who have studied the rituals from Tea Ceremony Masters in Japan ensuring an authentic experience for visitors who attend their events and classes. The authentic Ella Mullen Weckbaugh Tea House was shipped across the Pacific from Japan and reassembled by skilled Japanese artisans and is the focus of *Shofu-Kai.*

June's Plant Asia
This intimate garden features eastern Asian plants, including peonies, bamboos and wild-collected species from the steppe regions of Kazakhstan and Pakistan. A lush woodland area displays Himalayan and lacebark pines, and more than a dozen varieties of Asian maple. Future plans include the renovation of the steppe area of this garden to a Himalayan garden.

Lainie's Cutting Garden
The Cutting Garden is designed in concentric circles with annuals planted in the inner circles and perennials in the outer circles, with a focal urn planter in the center. Each bed within the garden is planted in specific color themes for ease of floral harvesting.

Laura Smith Porter Plains Garden

Extending east from a backdrop of cottonwoods, this lowland garden features grasses and wildflowers of the Great Plains. Every plant within this garden is native to different types of prairie found within Colorado. This garden thrives with no supplemental irrigation, and is burned every 2-4 years to replicate natural fire cycles. The landscape design intentionally tricks the visitor's eye, making this garden seem to extend farther than it really does, just as the horizon line on the open prairie is often deceiving.

Le Potager: A gift from the Ladd Family
French-style design combines with agriculture in this culinary garden of vegetables, herbs and edible flowers. Lined with a mixture of boxwoods, basils, chives and stone walls, the garden boasts multi-colored vegetables and espaliered apple trees.

Lilac Garden
The Lilac Garden features over two-dozen species and nearly 80 selections of lilacs (genus *Syringa*), prized for their late-spring displays of showy and fragrant clusters of flowers, nestled in a diverse display of bulbs and perennials.

Marnie's Pavilion
This two-story indoor garden is a rotating display of the tropical greenhouse collections. Recesses within the walls allow staff to easily change out orchids, bromeliads and other tropical plants as they come into bloom.

Mordecai Children's Garden
The Mordecai Children's Garden is a place for children and families to explore plants and the natural world, through hands-on experiences and play. A variety of authentic natural materials in this garden allow kids to use their imagination and sense of wonder to create their own connections with plants. This magical, 3-acre oasis provides a unique opportunity for kids to experience the plant life and natural environment of the diverse ecosystems in Colorado. These ecosystems continually change throughout the spring, summer and fall, so no two visits are the same. The ecosystems represented in the Children's Garden are: Alpine Tundra, Subalpine Habitat, Montane Forest, Pinon Juniper Woodlands, Foothills, Grasslands, and Wetlands Riparian Zone. The Home Harvest Garden educates children about where food comes from.

Nexus Garden
The steep berm west of the Orangery features a collection of WALK IN BEAUTY™ *Opuntia* (prickly pears). Additional cacti and succulents, as well as many drought-tolerant perennials, are also planted on this slanted slope.

O'Fallon Perennial Walk
O'Fallon Perennial Walk is a superb place to begin a leisurely stroll through the Gardens. Modeled after European perennial borders, it weaves together a rich variety of perennials of varying colors, heights, shapes and textures. This garden will be renovated in 2022 with an inspiring new design showcasing new and adapted perennial cultivars.

Oak Grove

For many people, the oak is the quintessential tree. Oak trees are large, long-lived, disease-resistant and beautiful. In this naturalistic woodland setting, you'll find many species and hybrid oaks. Though oaks are uncommon in Colorado, these varieties grow well in our climate and are good choices for gardeners in this region. Denver Botanic Gardens has made a commitment to conserving the germplasm of this very large and important genus by joining the multi-institutional *Quercus* (Oak) Collection Consortium of the North American Plant Collections Network (PCN).

Orangery
In keeping with traditional French orangeries, this glass walkway showcases exotic tropicals, Italian cypress and seasonal plantings in custom, Versailles-style planters. It also displays a variety of potted citrus that are moved to the outside terrace during warm months. The horticultural displays in this space rotate on a regular basis, allowing visitors to experience a variety of plants and themes throughout the year. Visitors can also view the Greenhouse Complex from the Orangery and observe the diversity of the tropical collections and the beginnings of plant life in the two production greenhouses.

Ornamental Grasses Garden
This garden provides a bridge to Colorado's historic prairie lands, and highlights the graceful structure and diversity of ornamental grasses, as well as their usefulness in providing year-round texture, color and sound to any bed. It also is home to one of our permanent art pieces, a sculpture 'So Proud of my Children' from the Chapungu art movement in Zimbabwe. Another feature of the grass garden is that it is packed with spring flowering bulbs, most notably the bold *Eremurus* or foxtail lilies, which makes it a beautiful garden in spring before the grasses have grown to their mature size for the season. Over 50 varieties of ornamental grasses are featured in this garden.

Parking Garage and Streetscapes
The Streetscape along York Street from 11th Avenue creates an entryway that informs the visitor that they have reached their destination. Street trees lining York Street were selected to create a procession through ornamental groupings. Fence structures trained with vines provide vertical interest. Ornamental planter beds and containers add color through plantings of annuals, bulbs and perennials.

The Josephine Streetscape uses planting and seeding to replace the traditional turf grass used on a parkway strip with drought tolerant grasses, shrubs and flowering plants, creating a resilient landscape.

Roads Water-Smart Garden
Set along the main western path into the Gardens, this area shows off the flower power of drought-tolerant plants and demonstrates ways to group plants with similar watering requirements. It brings together plants from Colorado and other semi-arid regions of North and South America, the Mediterranean, South Africa and Central Asia.

Rock Alpine Garden

Home to more than 2,300 species of plants, this internationally acclaimed garden exemplifies the art of rock gardening. It simulates more than 20 habitats of varying slopes, soil types, moisture needs and exposures. The plant collections in this garden are part of the North American Plant Collections Network's (PCN) Alpines of the World Collection.

Romantic Gardens
Comprising of two garden spaces, the Fragrance Garden and Schlessman Plaza, the Romantic Gardens evoke a sense of sentiment and privacy and were the first gardens at York Street to host outdoor weddings. They combine fragrant, lush flowers with graceful walkways, arches, gazebos and columns.

Sacred Earth
This educational display garden focuses on plants important to Native Americans from the Four Corners Region. A prominent feature of Sacred Earth is the use of Native American gardening techniques, including waffle beds and the planting of the Three Sisters crops. This garden receives little to no supplemental irrigation during the growing season.

Scripture Garden
A contemplative space, the Scripture Garden brings together plants originating in the Fertile Crescent, the ancient region of the Middle East associated with Jewish, Christian and Muslim faiths. The plants were selected to symbolize various religious stories and interpretations.

Sensory Garden
This unique garden utilizes architectural features and sensory plantings to enable people of all ages and abilities to interact with plants. Specialized gardening techniques and structures help to minimize barriers and maximize people's abilities. This relaxing therapeutic garden appeals to all five senses. You will find colorful displays of flowers throughout the growing season, along with plants that please your nose, rustle in the breeze, or tickle your skin with interesting textures. Fruits and vegetables will bring you back to memories of biting into the first tomato of the season, or gardening with your grandma or grandpa.

Shady Lane
In the spring, Shady Lane comes alive with the blooms of crabapples, bulbs and spring ephemerals. As the season progresses, it settles into a restful shade garden. Here, visitors can take refuge from the heat or find inspiration for low-light gardens. In the beds beneath the trees a variety of shade plants offer inspiration to homeowners looking for ideas for their shady spots where competitive tree roots create challenging growing conditions.

Steppe Garden
The Steppe Garden is an ambitiously diverse collection of tough and unique plants from steppe biomes, some of the most rugged habitats on Earth. This quarter-acre garden brings together the North American, South American, Central Asian and Southern African steppes to explore the diversity and similarities of their cold, dry grasslands and shrublands.

Victorian Secret Garden

This garden pays homage to Europe's golden age of plant exploration in the late 1800s, when it was fashionable to create opulent tropical gardens to show off personal wealth and exotic plant collections. Since Colorado's climate is arid, this garden uses hardy plants that capture the look of tropicals.

Water Gardens
The water gardens are home to the aquatic plant collection, which includes waterlilies, water platters, lotus and canna. A system of pools meanders through the Gardens and provides backdrops for many other gardens. The Four Towers Pool adjacent to the Science Pyramid displays a changing array of aquatic plants including papyrus, swamp hibiscus and cannas along with hardy and tropical waterlilies. The tower fountains in this pool are the entry point for water recirculated throughout all of our waterways running west to the Gates Montane pond. The Monet Pool is our largest water garden and features a stunning collection of aquatic plants including hardy and tropical waterlilies, Victoria waterlilies, pickerel plants, cannas, iris and more. Peak bloom occurs from June through September each year. An annual Water Blossom Festival is held in early August.

Welcome Garden
The Welcome Garden serves as a gateway to the Gardens, offering year-round interest while hinting at what is possible in your yard. Among its features are flowing water, a gathering space and native plants intermingling with ornamental cultivars. Planter beds sprinkled throughout the garden add color featuring annuals and perennials.

Western Panoramas
Western Panoramas consists of three distinct gardens that display dominant tree species from three of our Colorado life zones: plains, foothills and subalpine. The gardens are Bristlecone Border, Cottonwood Border and Ponderosa Border.

- **Bristlecone Border** is a demonstration of Colorado's subalpine ecosystem from 10,000 feet to 11,500 feet. Gnarled bristlecone pines are accentuated by a variety of native grasses, flowers and shrubs.
- **The Grant Family Cottonwood Border** offers a glimpse into the Colorado plains ecosystem between 3,500 feet and 6,000 feet in elevation. It features lowland grasses, trees, and shrubs, and serves as a demonstration of native, wild gardening.
- **Ponderosa Border** spotlights ponderosa pines living in the foothills at 6,000-8,000 feet. Known for their cinnamon-colored bark, the pines are displayed among drifts of native grasses and wildflowers.

Woodland Mosaic
Woodland Mosaic demonstrates the use of low-light plants in a wooded environment, while highlighting the ecological importance of forests. A patinaed solarium is used for social gatherings and events throughout the year.

Appendix B – Invasive Species Policy

The living collections at Denver Botanic Gardens are some of the most diverse in North America. To further the goal of diversity in collections, Denver Botanic Gardens engages in seed collecting expeditions to other regions of the world with similar climates and collaborates with other gardens through the Plant Collecting Collaborative (PCC) for the acquisition of seed. As a member of International Plant Exchange Network (IPEN), Denver Botanic Gardens also participates in the exchange of plant genetic resources including seed through *Index Seminum*. Another collaboration with Instituto Nacional de Tecnología Agropecuaria (INTA) allows Denver Botanic Gardens to obtain seeds of Argentinian species.

As a member of Plant Select®, Denver Botanic Gardens furthers its mission of connecting people with plants by increasing the availability of regionally appropriate ornamental plants in the nursery trade. These taxa, many of which are species native to other regions of the world with similar climates, undergo rigorous selection and evaluation before being introduced. Since its inception in 1997, Plant Select® has increased the palette of plants designed to thrive in gardens across the high plains and intermountain regions.

The aforementioned collaborations have allowed Denver Botanic Gardens to build plant collections that include taxa from around the world and to share some of these taxa with the nursery industry and the public. Over the years, the Gardens has become increasingly concerned with invasive species, which are defined as species that are not native to the location being considered and whose presence and spread negatively impact ecological, economic, or human health, or are likely to. Some of these invasive species are unintentionally introduced through contaminated crop seed, nursery stock, or ship ballast, while others are intentionally introduced for agriculture, forestry, or the ornamental plant industry.

Denver Botanic Gardens acknowledges the magnitude of the invasive species problem and is dedicated to the conservation of native plant diversity through the understanding and management of existing invasive plant species and preventing the introduction of new invasive species.

Invasive Plants Policy

a. Plant Records staff accession all plant material entering the Gardens and ensure that no plants listed as invasive weeds by the Colorado Department of Agriculture (CDA) Plant Industry Division will be acquired for collections or sold at plant sales. Plant Records shares the Weed List – CWMA with horticulture staff annually and any species additions are highlighted.
b. As per the Colorado Noxious Weed Act, any List A species detected on Gardens' property will be destroyed, properly disposed of, and eradicated. The Gardens actively manages species on Lists B and C through the Known Weed Action Plan (see Invasive Plant Action Plan below).

c. Cultivars of federal and state listed species are presumed to have the same invasive status as the straight species, unless exempted (proven to be sterile, male cultivar of dioecious species).
d. Staff members are actively engaged in the community for the most current information on invasive plant species, species on the state watchlist, their potential threats, and best management practices.
e. Denver Botanic Gardens is committed to early detection and rapid response (EDRR) of potentially invasive ornamental species and will maintain a watch list and a list of potentially invasive horticultural species. This list will be reviewed annually by the invasive plants committee. Species on the watch list will not be promoted through plant sales or shared through *Index Seminum* (see Potentially Invasive Plant Action Plan below).
f. All laws on importation and quarantine of plant materials across political boundaries and rules pertaining to the Colorado Noxious Weed Act (35-5.5-101 through 119, CRS 2003) will be followed. USDA Animal and Plant Health Service (APHIS) permits such as Plant Protection Quarantine (PPQ) Form 587 (permit to import plant or plant products) will be followed.
g. As a participant of *Index Seminum*, Denver Botanic Gardens does not distribute known invasive plants except for bona-fide research purposes. Before seeds are made available to other institutions, a staff member from the Research and Conservation department reviews the *Index Seminum* list for potentially invasive plants. Additionally, Denver Botanic Gardens requests any data pertaining to invasiveness of these species in other regions.
h. Prior to distributing plant material from its living collections, Denver Botanic Gardens requires recipients to complete a Material Transfer Agreement. The information requested in this form allows the Gardens to track with whom plant material is shared as well as the taxa distributed. If any taxa become problematic, the Gardens can notify the recipient scientists or organizations of any concerns.
i. Denver Botanic Gardens serves as an educational resource to the public and nursery industry about preventing the introduction and spread of invasive species.

Invasive Plant Pests and Diseases Policy

Plant pests and diseases are an environmental and economic threat in both urban and natural areas, costing billions of dollars in management costs and lost revenue (http://www.sentinelplantnetwork.org/). According to Sentinel Plant Network, plant pests and diseases decimate millions of trees, have a negative impact on ecosystem services such as clean air and water, and negatively impact agriculture, landscape, and garden plants. Examples include insects such as the emerald ash borer and Japanese beetle, as well as pathogens such as Sudden Oak Death and various rusts. Denver Botanic Gardens is committed to detecting and responding to serious plant pests and diseases and will:

a. Maintain membership with the Sentinel Plant Network and send staff to regional trainings; Partner with CSU Extension, diagnostic agencies, and USDA ports-of-entry to ensure the Gardens has the most current information on plant diagnostics, significant pests and diseases in the region, potential threats, and best practices for monitoring the living collections.

b. Plant collections will be monitored regularly for invasive plant pests and diseases, potentially significant finds will be documented, and the National Plant Diagnostic Network (NPDN) or the state's diagnostician will be contacted for help with identification.
c. After a positive identification, all early detections of potential significance will be reported to the program director of the Sentinel Plant Network and the CSU extension agent.
d. Denver Botanic Gardens will maintain a list of pests and diseases that are currently being managed and best practices on their management.
e. Gardens' staff will refer the public to CSU Extension's resources on high consequence pests and diseases, their threat and impact, steps to help prevent spread, and importance of early detection, rapid response, and regulatory action.
f. The Gardens will follow all rules and regulations set forth by the Colorado Nursery Act regarding importing/exporting plants and quarantining to prevent the introduction and spread of pests.

Animal Pests Policy

a. Squirrels: Denver Botanic Gardens is currently evaluating altering garbage cans to prevent squirrels from having direct access to visitor food waste.
b. Rabbits: Denver Botanic Gardens has surrounded the property with fencing and continues to protect certain plant specimens with cages to mitigate rabbit damage.

Invasive Plant Action Plan

a. Denver Botanic Gardens maintains a list of known invasive species and naturalized species of concern found at the Gardens or in the immediate region. This list, which serves as an educational resource to staff, outlines best management practices to prevent, eradicate, or stop the spread of these species.
b. Denver Botanic Gardens employs the tenets of Integrative Pest Management (IPM) when managing invasive species and strives to employ methods resulting in the least amount of harm while maintaining the highest level of control. As such, we attempt to use cultural, mechanical, and biocontrol methods before resorting to herbicides. However, individual species and their potential impact are evaluated on a case-by-case basis, and this ultimately determines management.
c. Annually, Denver Botanic Gardens provides a chemical training to horticulture staff.
d. Denver Botanic Gardens follows Colorado State University (CSU) Extension's recommendations on invasive species management and refers the public to this resource.

Potentially Invasive Plant Action Plan

As a public garden with plant collections that include taxa from around the world, along with resources and expertise, Denver Botanic Gardens is uniquely positioned to play a proactive role in the early detection of introduced ornamental species that are demonstrating warning signs of becoming invasive. Many of these taxa were recently introduced and/or not yet widely known or available in the horticulture trade of North America. Thus, Denver Botanic Gardens will:

a. Observe which nonnative taxa, or native taxa from another region of the country, exhibit early warning signs of becoming invasive prior to their becoming invasive.
b. Document plant taxa escaping from cultivation by creating and maintaining a watch list.
c. Use this list to inform and document internal decision-making related to taxa that escape cultivation and to guide management and outreach messaging.
d. Avoid promoting taxa showing greater invasive potential at plant sales and not include these taxa in seed exchanges.

Definitions of Terms

Denver Botanic Gardens acknowledges that terminology used in the field of invasion biology is sometimes criticized as being value-laden, with too much emphasis placed on species' global origins, and not enough emphasis on measurable impacts. When taken out of context or used inappropriately, this terminology can contribute to xenophobic sentiments. In developing this policy, the Gardens has endeavored to define terms appropriately and use non-value-laden language.

For the purposes of the invasive plant policy, the following definitions are used:

- **Invasive plant**: a plant species that is non-native to the location being considered and whose presence and spread negatively impacts (or is likely to impact) ecological, economic, or human health.
- **Native plant**: a plant species that is indigenous to a bioregion or has arrived through means unrelated to human activity.
- **Naturalized**: a non-native species, or a native species from another region of the country, that has become established in disturbed areas and/or native communities.
- **Nonnative (introduced/adventive)**: a species that was brought to a new bioregion by humans, either deliberately or accidentally.

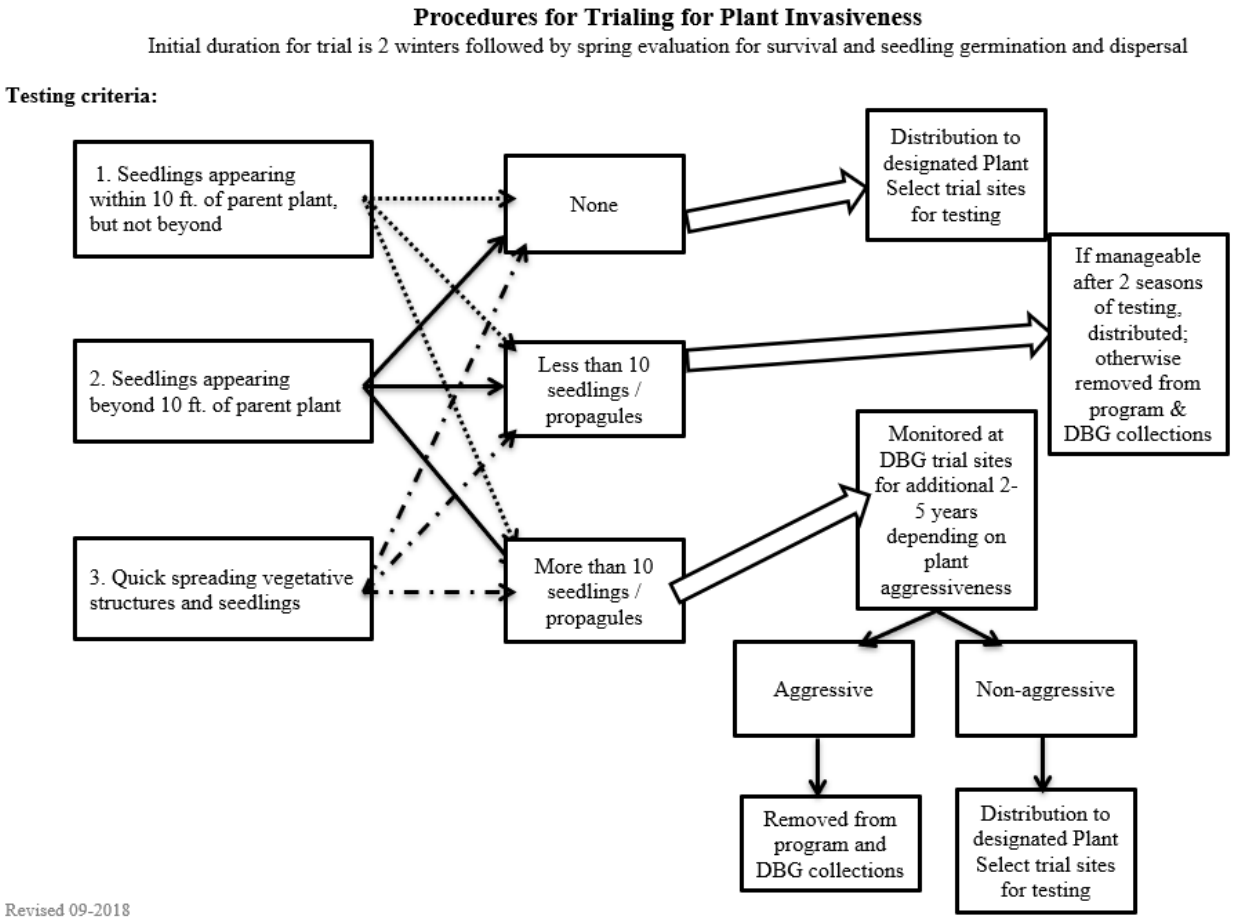
Voluntary Codes of Conduct for Botanic Gardens and Arboreta

St. Louis Declaration Codes of Conduct http://www.centerforplantconservation.org/invasives/; adopted by Denver Botanic Gardens 2005

- Conduct an institution-wide review examining all departments and activities that provide opportunities to stem the proliferation of invasive species and inform visitors. For example, review or write a collections policy that addresses this issue; examine such activities as seed sales, plant sales, bookstore offerings, wreath-making workshops, etc.
- Avoid introducing invasive plants by establishing an invasive plant assessment procedure. Predictive risk assessments are desirable and should also include responsible monitoring on the garden site or through partnerships with other institutions. Institutions should be aware of both direct and indirect effects of plant introduction, such as biological interference in gene flow, disruption of pollinator relationships.

- Consider removing invasive species from plant collections. If a decision is made to retain an invasive plant, ensure its control and provide strong interpretation to the public explaining the risk and its function in the garden.
- Seek to control harmful invasive species in natural areas managed by the garden and assist others in controlling them on their property, when possible.
- Promote non-invasive alternative plants or, when possible, help develop non-invasive alternatives through plant selection or breeding.
- If your institution participates in seed or plant distribution, including through *Index Seminum*, do not distribute known invasive plants except for bona-fide research purposes, and consider the consequences of distribution outside your biogeographic region. Consider a statement of caution attached to species that appear to be potentially invasive but have not been fully evaluated.
- Increase public awareness about invasive plants. Inform why they are a problem, including the origin, mechanisms of harm, and need for prevention and control. Work with the local nursery and seed industries to assist the public in environmentally safe gardening and sales. Horticulture education programs, such as those at universities, should also be included in education and outreach efforts. Encourage the public to evaluate what they do in their own practices and gardens.
- Participate in developing, implementing, or supporting national, regional, or local early warning systems for immediate reporting and control. Participate also in the creation of regional lists of concern.
- Botanical gardens should try to become informed about invasiveness of their species in other biogeographic regions, and this information should be compiled and shared in a manner accessible to all.
- Become partners with other organizations in the management of harmful invasive species.
- Follow all laws on importation, exportation, quarantine and distribution of plant materials across political boundaries, including foreign countries. Be sensitive to conventions and treaties that deal with this issue, and encourage affiliated organizations (plant societies, garden clubs, etc.) to do the same.

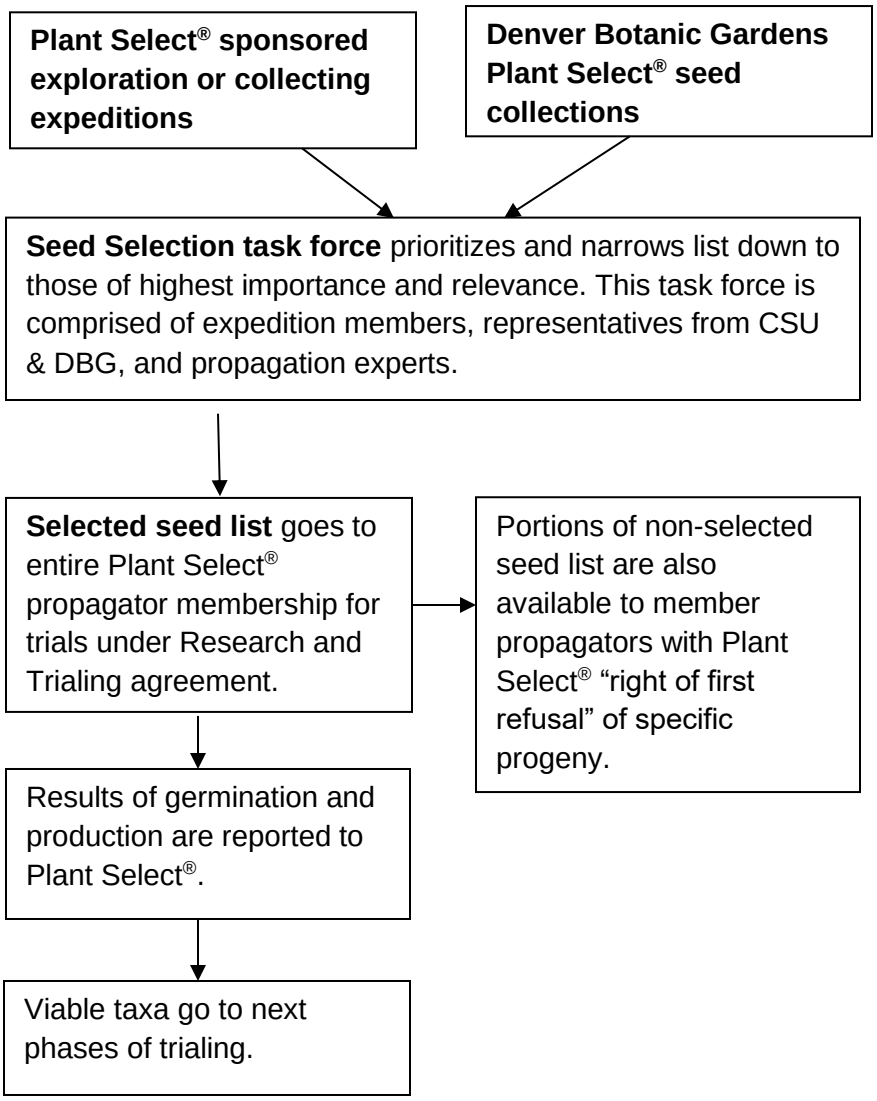
Procedures for Trialing for Plant Invasiveness



Appendix C

Plant Select Seed Distribution for Research and Trialing Policy

Proposed policy: A sub-committee of Plant Select® will review each seed list and narrow it down to a "selected" list containing a "reasonable" number of taxa for member propagators to test. Other seeds collected that do not make the "selected" list will also be available to propagator members with no obligation to report results. If, however, something superior develops from these seeds, Plant Select® will have the "right of first refusal." If Plant Select® is not interested in pursuing for the program, then those plants may be sold by the grower with no further obligation to Plant Select®.



Appendix D
Plant Select License Agreement: Living Collections Access and Distribution Form

License Agreement for Research, Cultivar Development & Evaluation

This License Agreement is made between Plant Select®, a Colorado non-profit corporation, and

Contact Person _____
Organization _____
Address _____
City, State, Zip Code _____
Telephone _____
FAX _____
Email _____
hereinafter called "Licensee."

1. Licensee is____ a member in good standing with Plant Select®, or____ a research or educational facility (the membership requirement will be waived for a research or educational facility). [Check as applicable.]

2. Plant Select® grants Licensee the non-exclusive, non-divisible, non-transferable and non-assignable license (A) to Plant Select® plants and/or propagules listed in Exhibit I (including cuttings, seeds, spores, grafts, budding, tissue cultures, etc.), herein called the "Licensed Plants," solely and only for garden use, as a basic research subject, for field/greenhouse testing, or for product evaluation and (B) to intellectual property rights of Plant Select®, including trademarks, copyrights and patents, related to the Licensed Plants to the extent necessary for Licensee to conduct its activities pursuant to the license granted under the preceding (A). Licensee agrees that the Licensed Plants shall be used only for the purposes described in the preceding (A). With respect to the intellectual property rights of Plant Select®,
Licensee acknowledges Plant Select® proprietary rights and agrees not to do, or to suffer to be done, any act or thing which would impair the rights of Plant Select®. It is understood that Licensee, including any parent or subsidiary of Licensee, shall not acquire, nor shall claim, any title or right adverse to the proprietary rights of Plant Select® by reason of the license granted to the Licensee hereunder.

Additionally, Licensee agrees that all selections conducted upon the licensed plants are and shall be the sole property of Plant Select®.

Licensee shall have no right to sublicense or otherwise use or transfer any rights of Licensee to any Licensed Plant unless specific arrangements are made in writing with Plant Select®.

3. Licensee agrees that all results from any manipulation of Licensed Plants listed in Exhibit I, including mutagenic, tissue culture, molecular or cellular techniques, conducted during the terms of this Agreement must be reported to Plant Select® in writing and shall be owned exclusively without question by Plant Select®. All results from such manipulations shall be maintained by the Licensee until instructions for handling are received from Plant Select®.

4. Licensee agrees that all selections conducted upon the Licensed Plants are and shall be the sole property of Plant Select®.

5. Licensee agrees no seeds, or plant parts of the Licensed Plants, will be distributed to a third party without the prior written authorization of Plant Select®.

6. This Agreement constitutes the entire agreement between the parties with respect to the subject matter of this Agreement and supersedes any prior agreement, written or oral, between Plant Select® and Licensee with respect to the subject matter of this Agreement. No amendment or modification of this Agreement shall be made except in writing signed by both parties.

7. Unless sooner terminated by one party upon giving 90 days prior written notice to the other party, the term of this Agreement is for five (5) years following the effective date of the Agreement and shall be effective as to each plant and/or propagule licensed to Licensee under this Agreement. This Agreement may be renewed for an additional period upon written agreement by Plant Select® and Licensee. Licensee will destroy or return plant(s) and propagules licensed under this Agreement when this Agreement terminates.

8. Any unused or unwanted plants and propagules are to be either returned to Plant Select® or to be destroyed.

9. This Agreement has been entered into in the State of Colorado and shall be governed by and construed in accordance with the laws of the State of Colorado.

10. Any notice required or permitted to be given by either party to the other is given in accordance with this Agreement if it is in writing and mailed to either Plant Select® or Licensee by certified mail addressed to the intended recipient at its address contained in this Agreement or to such other address as the recipient may furnish to the other party for purposes of receiving notices under this Agreement.

11. This Agreement may not be assigned by Licensee without the prior written consent of Plant Select®, which may withhold its consent for any or no reason. This Agreement shall be binding upon the respective parties, their successors and permitted assigns.

ATTACHMENTS: Exhibit I: List of plants and/or propagules requested attached.

IN SIGNING OF THIS AGREEMENT, the parties have hereunto executed this agreement effective on this day for the attached plants and/or propagules.

AGREED

LICENSEE	**PLANT SELECT®**
Organization: _____	By: _____
By: _____ (signature)	Ross Shrigley, Executive Director
	c/o Colorado State University 1173 Campus Delivery Fort Collins, CO 80523-1173 email: director@plantselect.org

Appendix E

Material Transfer Agreement

Living Collections Access and Distribution Form

User Information (To be filled out by or on behalf of primary user)

Today's Date: _____ Proposed Date of Collection: _____

Name: _____ Telephone #: _____

Position: _____ Email Address: _____

Organization: _____

Mailing or shipping address: _____

_____ City _____ State/Country _____ Zip

_____ _____ _____

FedEx Account # (if applicable) _____

Collection use:

Project Description (please attach an addendum if needed)

Please note any additional requirements/requests for collection or shipping:

Use/Project Type (check one or more box)

☐ Breeding/Hybridization
☐ Conservation Research
☐ Horticultural Display
☐ Horticultural Research
☐ Molecular Research
☐ Propagation
☐ Research (other) _____
☐ Teaching
☐ Other _____

Is there an intent to commercialize? ☐ No ☐ Yes (if yes, this will serve as a conditional agreement, with a new agreement drawn up for commercial use)

Plant Records Staff Use Only

Source Number: **Shipment Number(s):**

Date entered: **Staff Contact:**

Species Requested: (To be filled out by or on behalf of primary user. Add extra sheets if more species requested.)

Scientific Name	**Accession Number(s)***	**Material needed** (seeds, stem cutting, leaves, etc.)	**Quantity Requested**

*Please refer to Gardens Navigator to find accession numbers of plants in the living collections. Please note that plants listed as non-public are usually growing in our greenhouse collections. Some plants listed may be growing at our Chatfield Farms or Mt. Goliath sites. http://navigate.botanicgardens.org/ecmweb/FindPlant.html

Terms:

Samples are distributed under the following conditions:

1. Samples will be used only for the purposes stated in the Project Description.
2. Samples will not be further distributed to others without prior consent of Denver Botanic Gardens' (DBG) Horticulture Department.
3. Recipient will provide a report to DBG at the end of the project as well as copies of any publications arising from use of DBG samples.
4. Samples are generally distributed for research, display or education. Post-research, if there is intention to commercialize specific plants, a new agreement will be instituted between DBG and the Primary User.

Signatures

Requester: _____ **Approved by:** _____
Director of Horticulture

Date Submitted: _____ **Date Approved**: _____

Submit completed forms to: Horticulture@botanicgardens.org

Appendix F: Living Collections Disaster Plan

Setting priorities for salvaging collections, institutional records, and other important materials is one of the most difficult but also one of the most important aspects of disaster planning. If an emergency occurs, there may be very little time for salvage. Materials could be lost while valuable time is wasted deciding what to save. A listing of priority materials and equipment allows the institution to concentrate on the most important items that are accessible for salvage. Living collections, planted in ground, pose an additional challenge where they cannot be easily uprooted and moved.

In this section, we offer strategies to rescue living collections in the event a disaster was to strike. Most of the strategies are planned activities ahead of a disaster rather than responsive actions at time of disaster. All general procedures and protocols will be addressed in the institutional disaster plan.

Indoor collections

In the event of a disaster, the following collections will be salvaged and moved to a more secure location:

- Wild collected tropical accessions from Greenhouses 1, 2, 3, 4, 5 and 7. Plants to be rescued are marked with red tags.
- Wild collected and Wiersema waterlilies from Greenhouse 6. Plants to be rescued are marked with red tags.
- Wild collected cactus and succulent accessions from Greenhouse 8. Plants to be rescued are marked with red tags.
- Wild collected seed housed in Greenhouse area Room 229.
- All other seed held as backup for plants on the ground.

Outdoor collections

Since the outdoor collections cannot be moved easily, our strategy is to back them up as seed as well as duplicate them by distributing material to regional botanic gardens and other gardens. This has been identified as metrics for evaluation for each of the major collections and will be accelerated over the next few years to ensure representation of all our important taxa as seed backup or at other gardens. Regional gardens that we collaborate with include Betty Ford Alpine Gardens in Vail, Gardens on Spring Creek in Fort Collins, Cheyenne Botanic Garden in Wyoming, Yampa River Botanic Park in Steamboat Springs, Montrose Botanic Garden, Santa Fe Botanical Gardens, High Plains Environmental Center, Idaho Botanical Gardens, Durango Botanic Gardens, Teton Botanical Garden in Jackson, WY, Red Butte Garden & Arboretum in Salt Lake City, UT, Western Colorado Botanic Gardens, Grand Junction, and others. This regional botanic garden network meets twice a year and will serve as locations for duplicating our collections since many of them have climatic conditions very similar to ours.

Accessions acquired though expeditions of the Plant Collecting Collaborative are distributed to other botanic gardens nationally and serve as back-up sites.

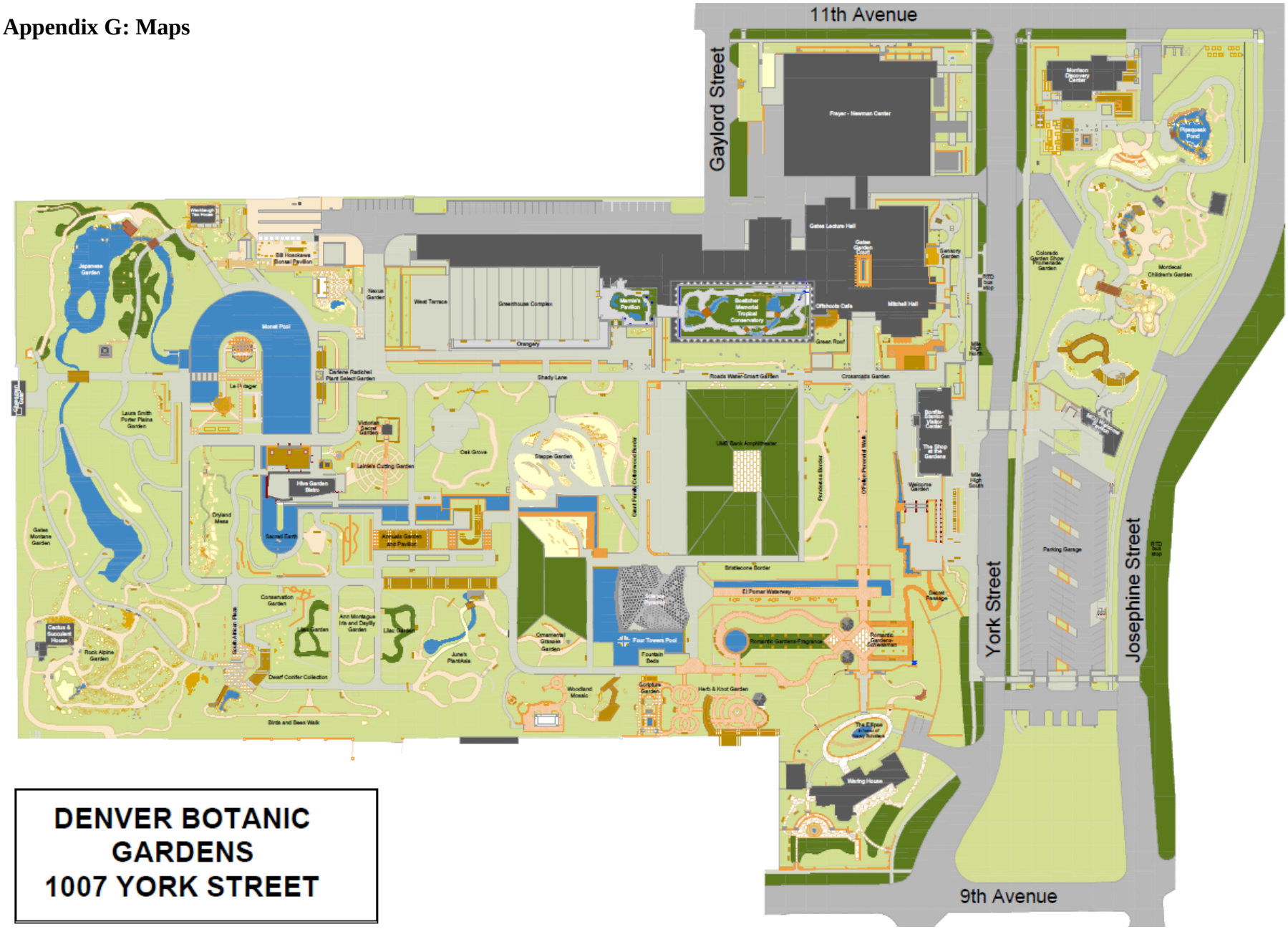
Climate Control Systems for Tropical Collections and Production Greenhouses
Greenhouse environments are managed by Wadsworth Control System panels located in each greenhouse compartment. Conservatory and Orangery environments are managed by Johnson Control systems located in the greenhouse mechanical room. Staff should be familiar with our control systems and take actions to ensure smooth operations of systems in preparation for a disaster.

- **Heating System**
  Steam or hot water heat is generated by three natural gas boilers and distributed throughout the complex. In the event of an interruption in natural gas availability, the fuel source for the boilers can be switched to fuel oil stored on site.
- **Cooling Systems**
  Greenhouse and conservatory cooling is largely achieved by a combination of mechanical roof vents (passive cooling) and a combination of exhaust fans and evaporative cool cells (active cooling). These systems rely on an electric power source. In the event of a power outage, systems automatically switch to electricity provided by an onsite gas-powered generator.

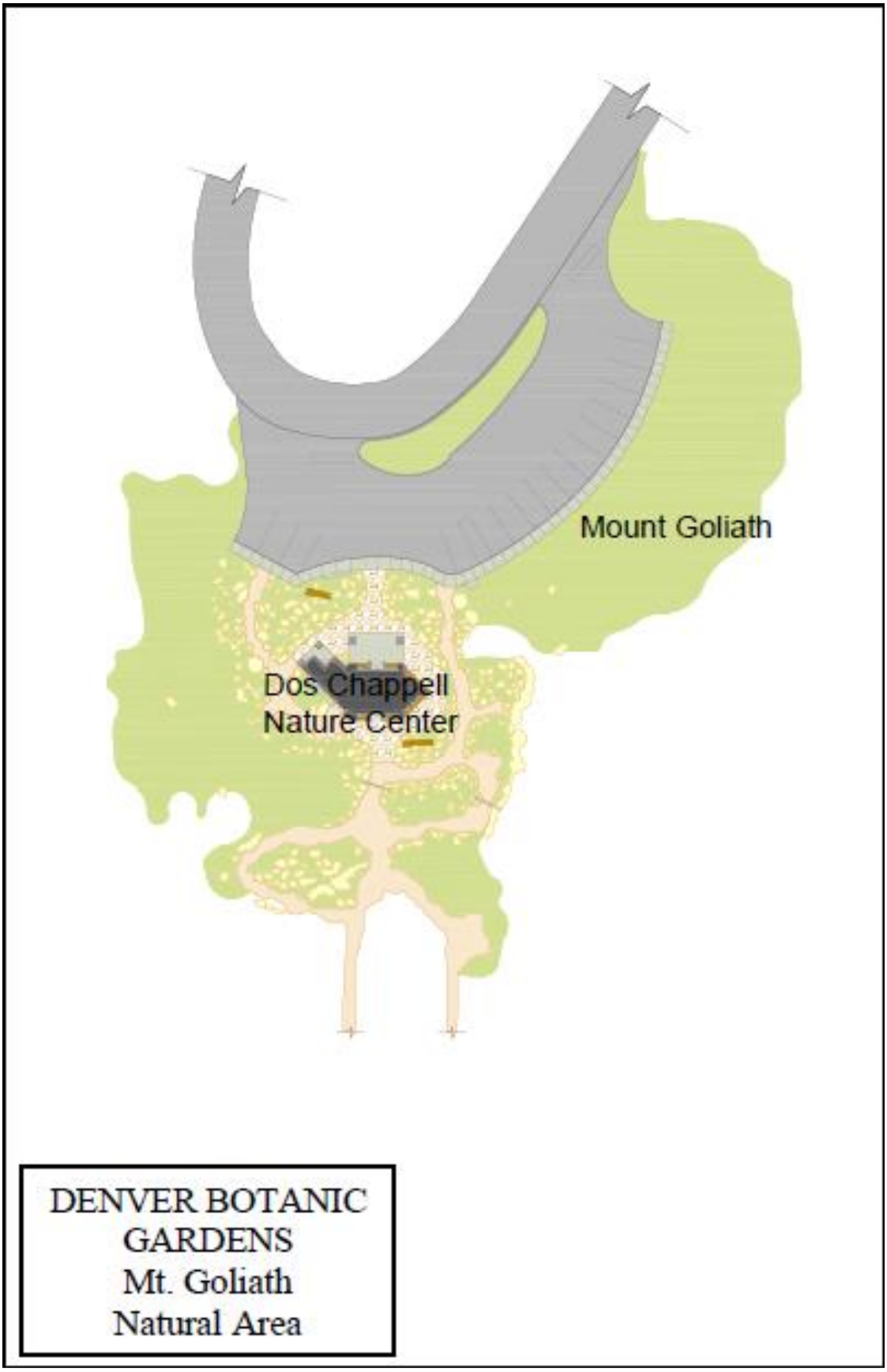
Oversight

- Director of Horticulture
- Associate Directors
- Curators
- All other staff responsible for specific collection

Appendix G: Maps




Chatfield Farms
8500 W Deer Creek
Canyon Road


Mount Goliath
Dos Chappell
Nature Center
DENVER BOTANIC
GARDENS
Mt. Goliath
Natural Area