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1998 25 2023 YEARS

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Roadside Vegetation Naturalization Pilot Project in Calgary, Alberta

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www.Earthmaster.ca

Earthmaster Environmental Strategies Inc.

A Canadian environmental technologies company:

- Founded in 1998 and based in Calgary, Alberta, Canada.
- Specializes in providing environmental services (remediation & reclamation) to the commercial/industrial and upstream oil and gas industry in Western Canada.
- In-house lab facilities for microbiological research and a growth facility for plant testing.
- Co-developed commercial phytoremediation systems (PEPSystems®) to treat contaminated soil in an eco-friendly and responsible manner.
- Provides urban/roadside naturalization services.

Pilot Project Site Location

16th Ave NE in Calgary, AB (Trans-Canada Highway)

Project site is 5 hectares in size

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Control Area Location

16th Ave NE in Calgary, AB (Trans-Canada Highway)

Unmowed turfgrass control

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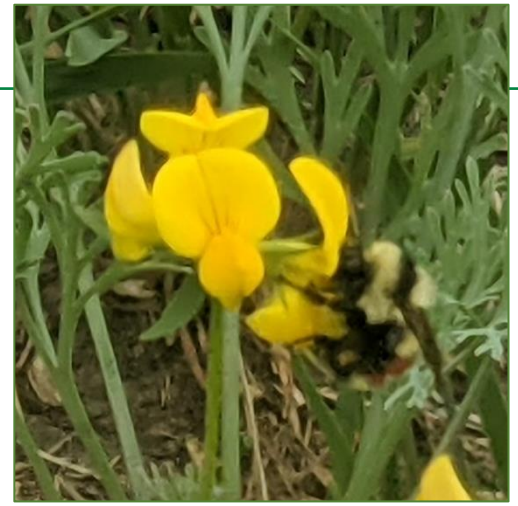
Pilot Project Goals

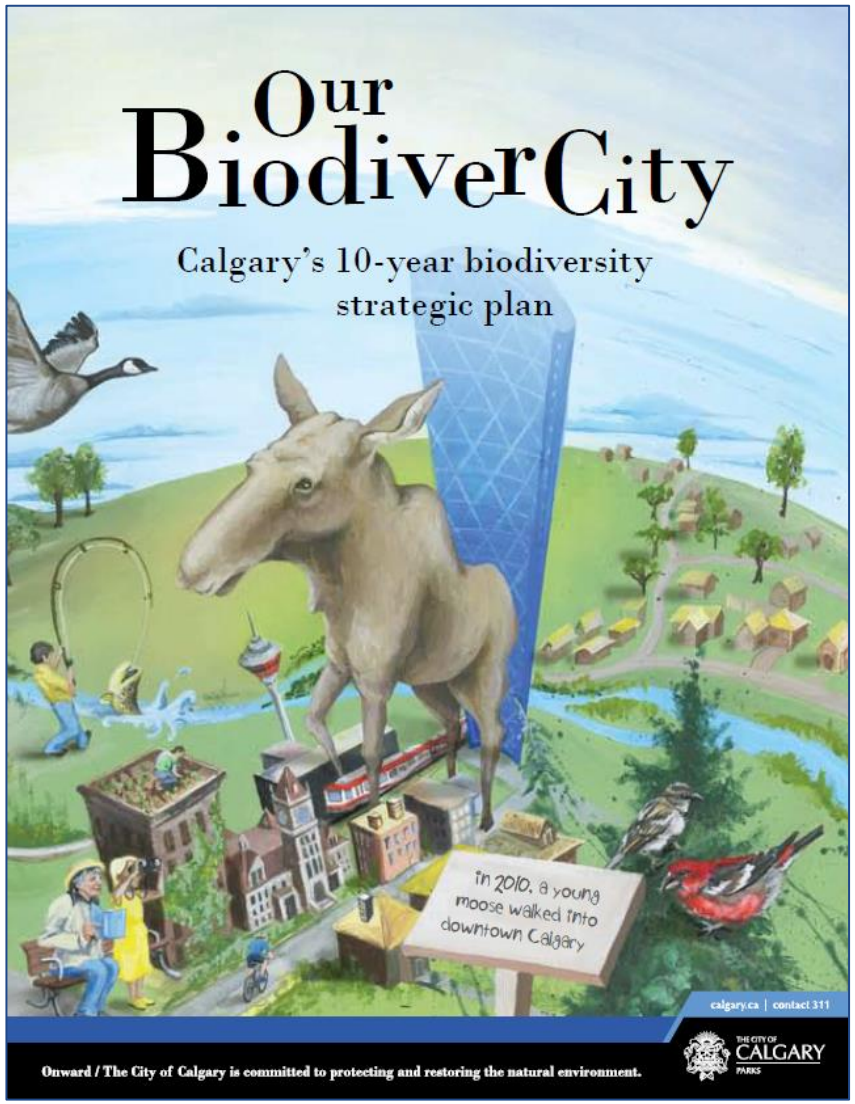


Demonstrate roadside naturalization on a large scale.

- Replace non-native manicured turfgrass with:
  - Plants that are adaptable and can withstand extremes
    - Native grasses
    - Wildflowers
- Achieve environmental benefits including:
  - Increasing diversity
  - Reducing maintenance
    - Mowing
    - Weed control
  - Increasing resilience to changing climate
  - Enhancing the pollinator population

This is a 3-year pilot project demonstrating proof of concept.

Pilot Project Goals



Naturalize 20% of Calgary's municipal open spaces by 2025

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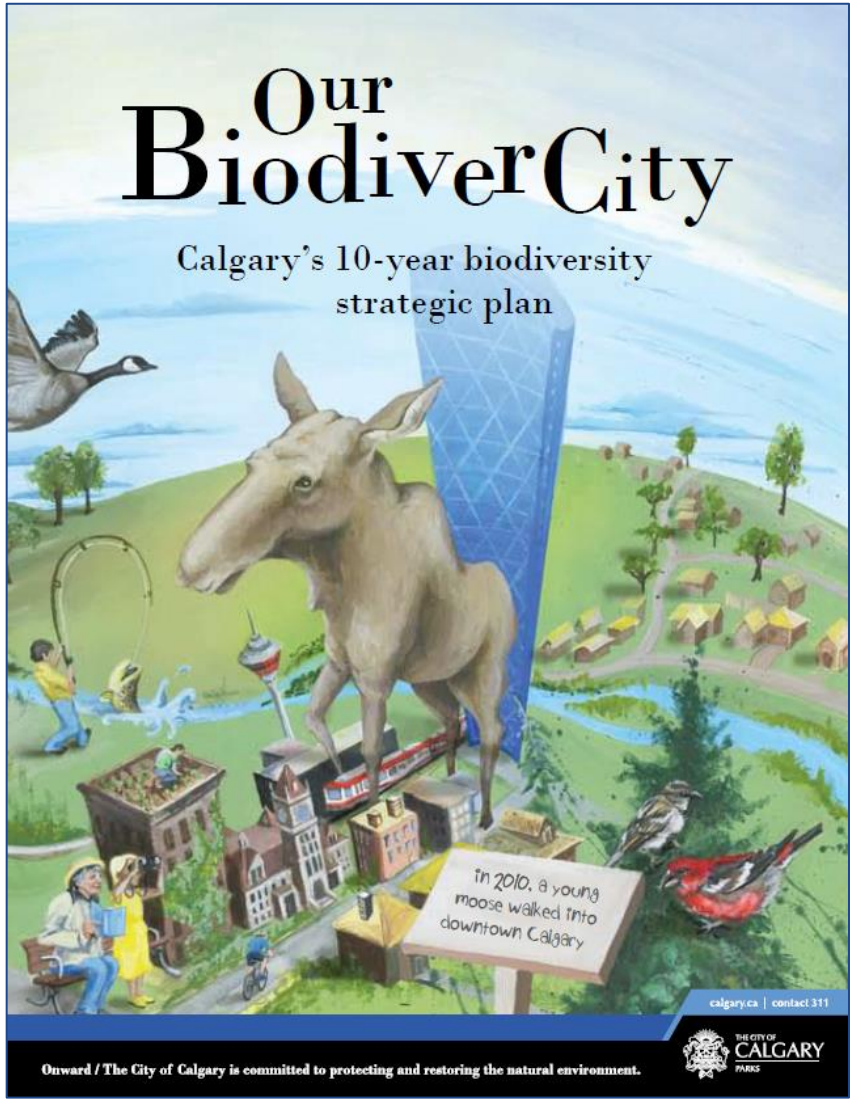
Yukon
Northwest Territories
Nunavut
British Columbia
Alberta
Manitoba
Saskatchewan
Ontario
Quebec
Newfoundland and Labrador
Prince Edward Island
New Brunswick
Nova Scotia

Pilot Project Goals

Bee City CANADA

Connecting People, Pollinators and Places

Naturalize 20% of Calgary's municipal open spaces by 2025



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Earthmaster's Role in Pilot Project

Work with the project team to source and select seed:

- The City of Calgary
- University of Calgary
- ISL Engineering

Procure seed, make mixes, and install:

- No till seed drill

*Build and install social and solitary bee boxes:

- Register with the AB Native Bee Council

*Monitor and assess vegetation throughout the growing season.

Conduct weed and litter control.

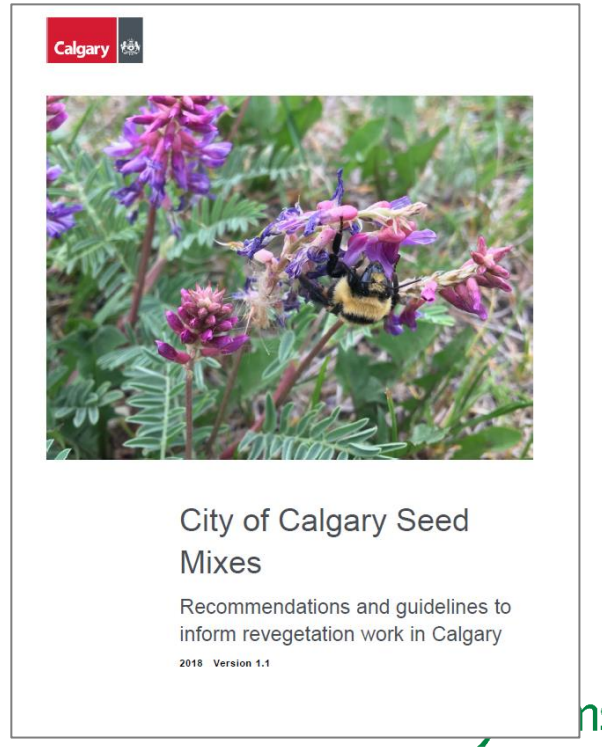
Seed Mixes

Mix A
Upper slopes

Latin Name	Common Name
GRASSES	
Agrostris scabra	Rough Hairgrass
Deschampsia caespitosa	Tufted Hairgrass
Elymus glaucus	Blue Wild Rye
Elymus lanceolatus	Northern Wheatgrass
Elymus trachycaulus	Slender Wheatgrass
Festuca saximontana	Rocky Mountain Fescue
Nassella viridula	Green Needlegrass
Pascopyrum smithii	Western Wheatgrass
Poa palustris	Fowl Bluegrass
Puccinellia nuttalliana	Nuttall's Saltgrass
PERENNIALS	
Achillea millefolium	Common Yarrow
Gaillardia aristata	Common Gaillardia
Linum lewisii	Blue Flax
Ratibida columnifera	Prairie Coneflower
ANNUALS	
Clarkia elegans	Elegant Clarkia
Coreopsis tinctoria	Plains Coreopsis
Cleome serrulata	Bee-plant
Eschscholzia californica	California Poppy
Gaillardia pulchella	Annual Gaillardia
Helianthus annuus	Annual Sunflower

Mix B
Adjacent to roads
On the median

Latin Name	Common Name
GRASSES	
Agrostris scabra	Rough Hairgrass
Deschampsia caespitosa	Tufted Hairgrass
Poa palustris	Fowl Bluegrass
Puccinellia nuttalliana	Nuttall's Saltgrass
PERENNIALS	
Linum lewisii	Blue Flax
Artemisia ludoviciana	Prairie Sagewort
Dalea purpurea	Purple Prairie Clover
Lotus corniculatus	Bird's-foot Trefoil
Onobrychis viciifolia	Sainfoin
ANNUALS	



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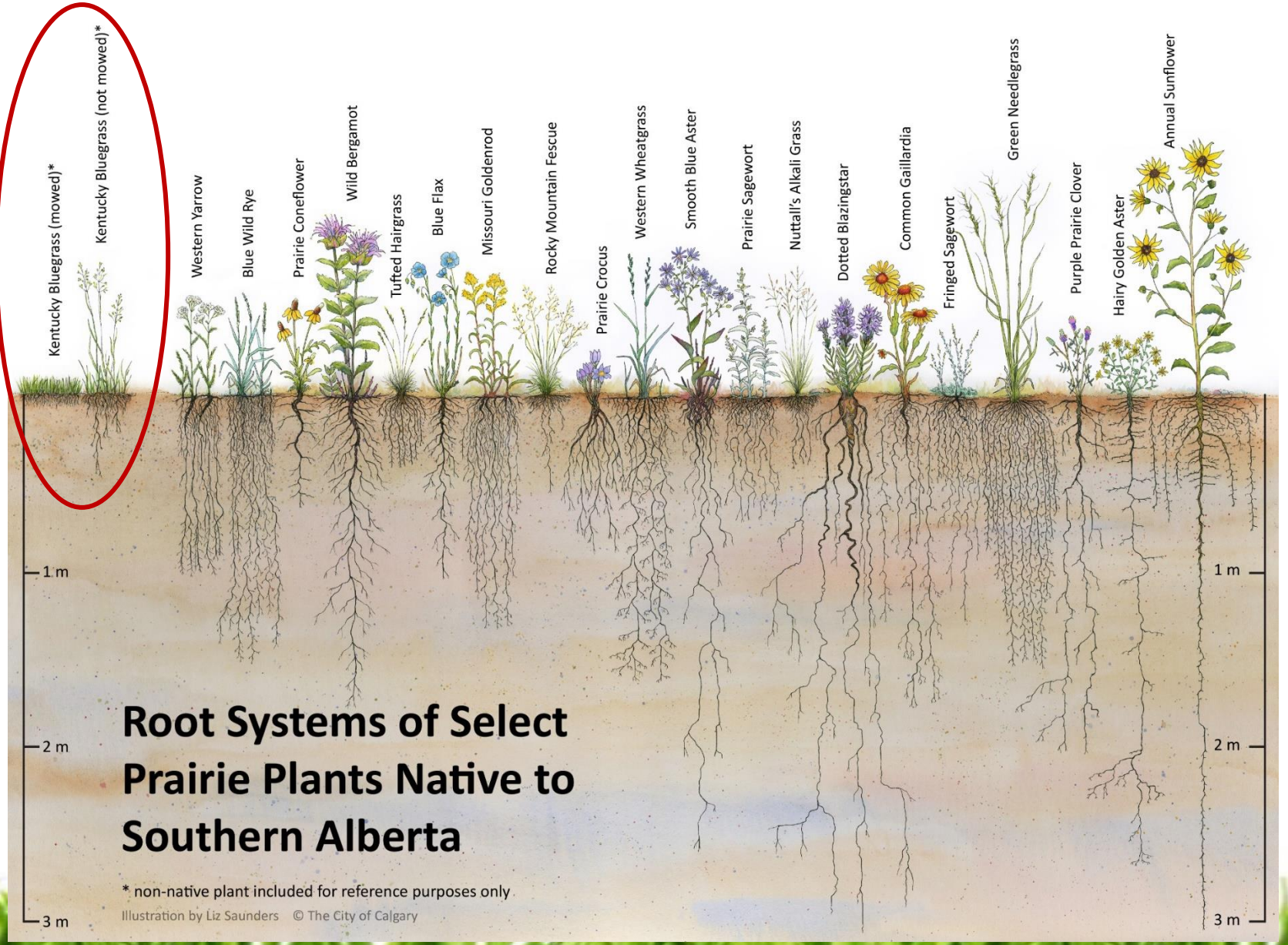
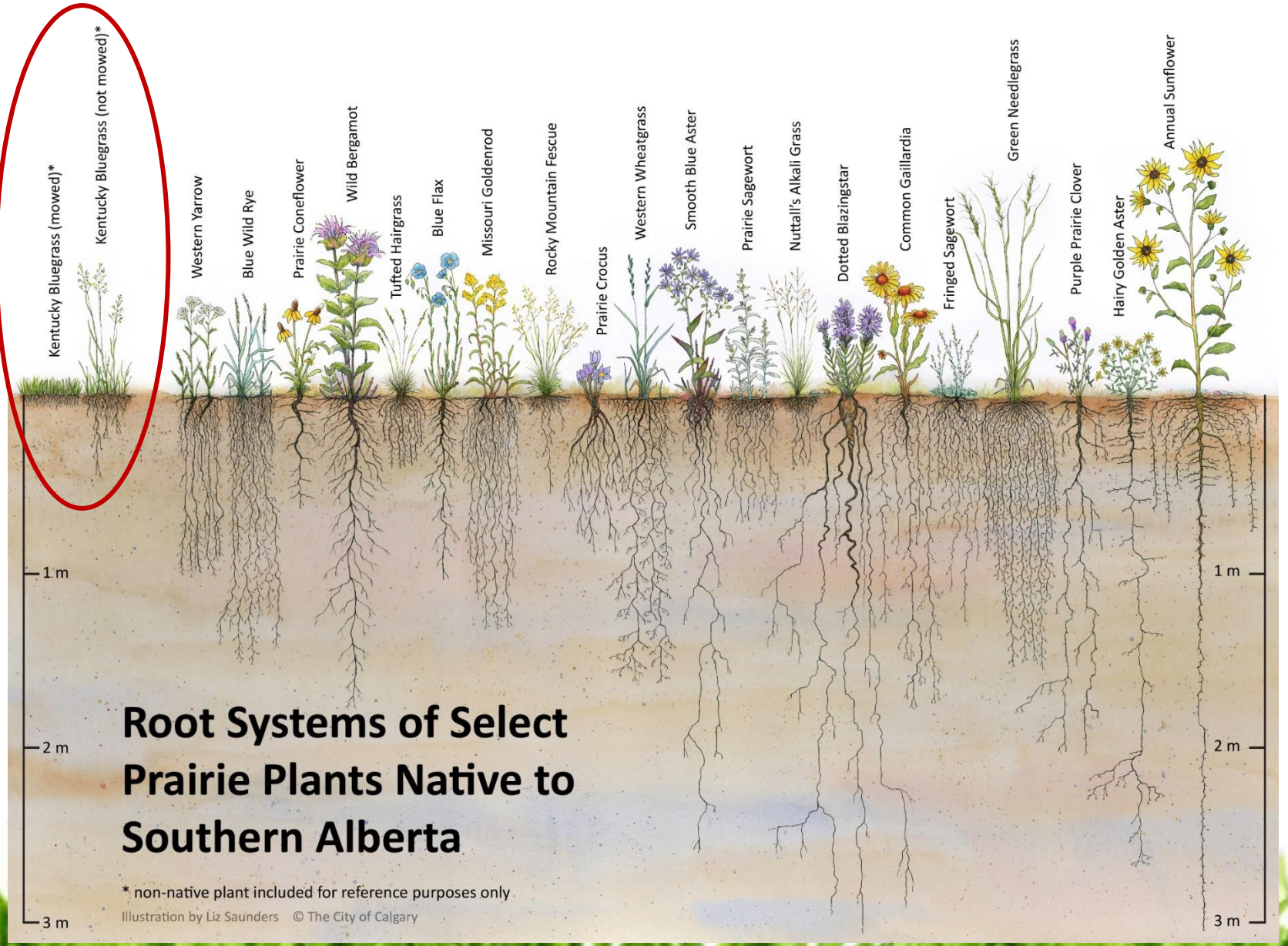
The Native Plant Advantage



The Native Plant Advantage



- Deeper roots
  - Soil structure
  - Runoff
  - Stabilization
- More resilient to heat
- More resilient to drought
- Can have some salt tolerance
- Improve ecological diversity

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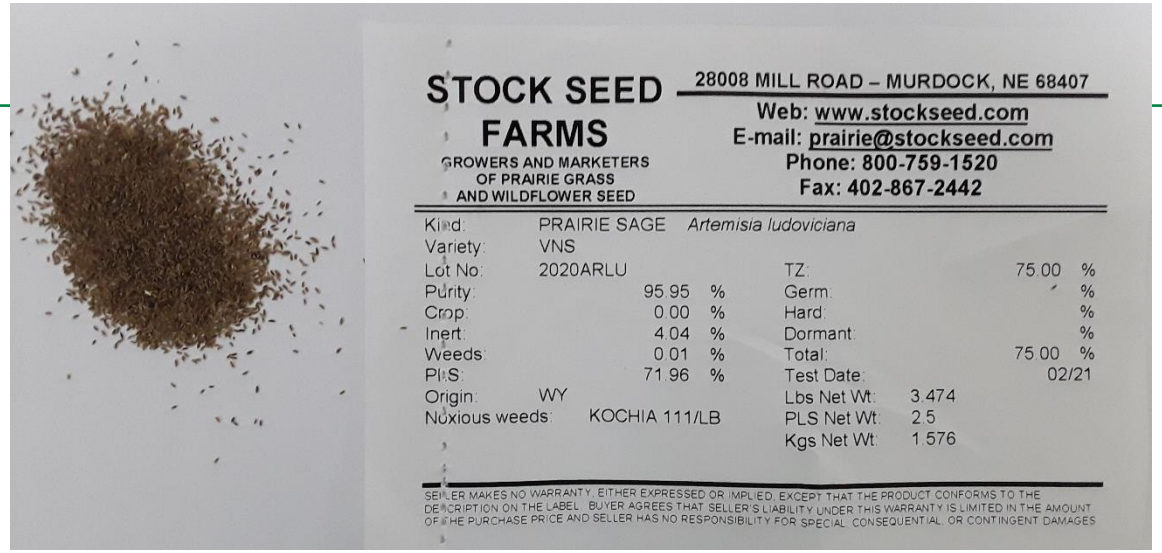
Seed Mixes

Considerations:

- Source and volume
  - Canada and USA
- Cost (Prairie sage)
- Salinity tolerance
  - Medians vs. adjacent to roadway vs. upper slopes
- Mostly native but some horticultural species
- Annuals for cover crop
- Bulking agent
  - Wheat bran (1:1)



Site Conditions

May 5, 2021

Site Conditions

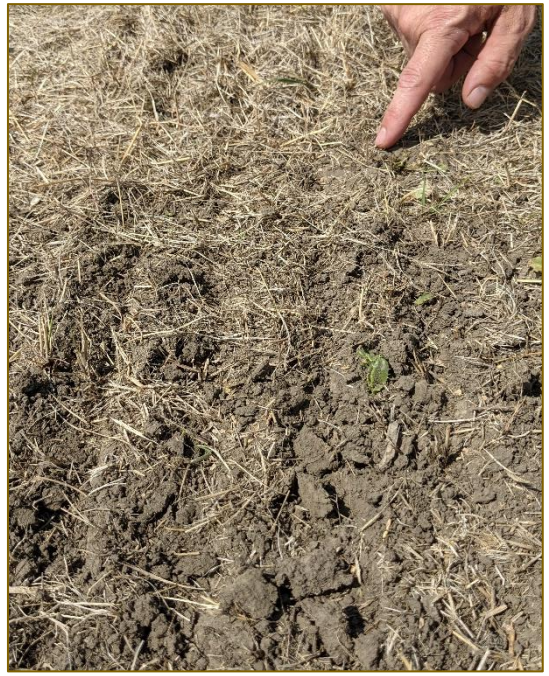
Site was to have had:

- Herbicide applied to eradicate cultivated turfgrass (fall 2020 and spring 2021)
- Mowing and dethatching to leave short stubble (challenge)
- Site required additional preparation (including herbicide) in early June 2021 – delayed seeding

Seeder and Harrows

Seeder: Land Pride no till seed drill.

- Pulled by a skid steer – tractor not suitable for steep slopes
- Seeded in one direction - safety
- Followed by harrowing
- Seeding rate ~45 kg/ha



Side Project – Plant Development Guide


Common Gaillardia - *Gaillardia aristata*. Mix A. Similar to Annual Gaillardia but with more elongated leaves, no stalk. Fuzzy leaves.

seed

Day 5

Day 9

Day 13

Day 20

Day 27

Property of Earthmaster Environmental Strategies Inc. 4


Day 34

Day 41

Day 49

Day 55

Day 65

Day 108

Property of Earthmaster Environmental Strategies Inc. 5

How can seedlings be identified when just a few days old?

- Develop a guide for every annual, perennial, and grass used in the project.
- Ideal growing conditions in an environmental growth chamber planted in ProMix.

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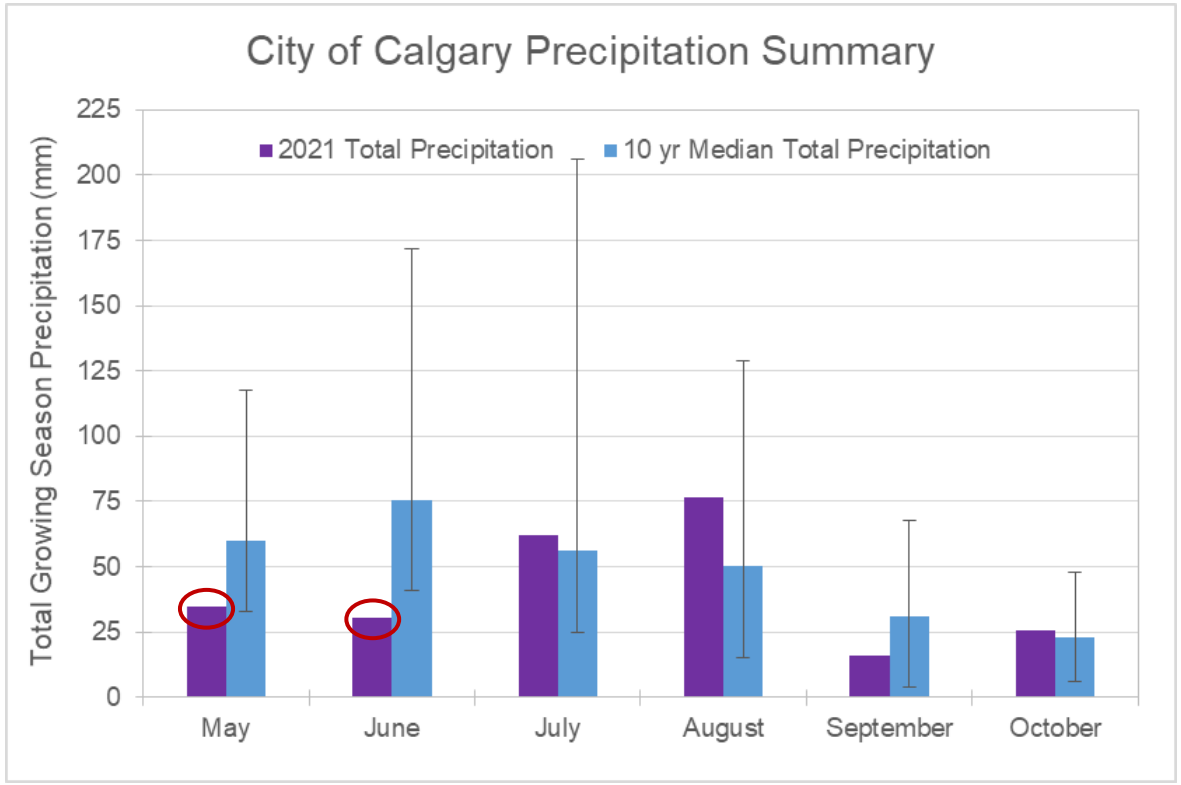
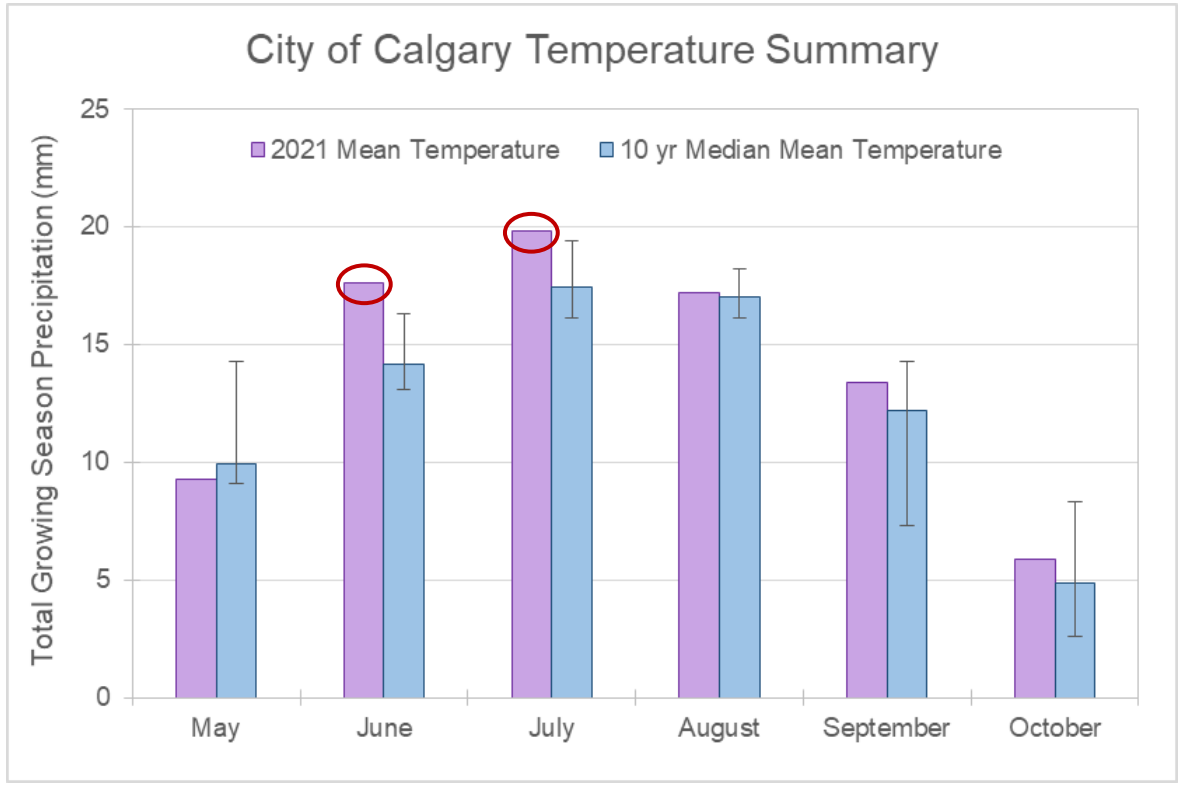
Results & Learnings Year 1

Results – Late Planting and Challenging Weather

Goal – seed the site by mid-May 2021

Reality – planting was on June 14th (hot and dry)





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Results Year 1 – Flowers

Sep 16, 2021


Year 1 (2021)
Please Bee Patient


Year 1 (2021)

Learnings Year 1

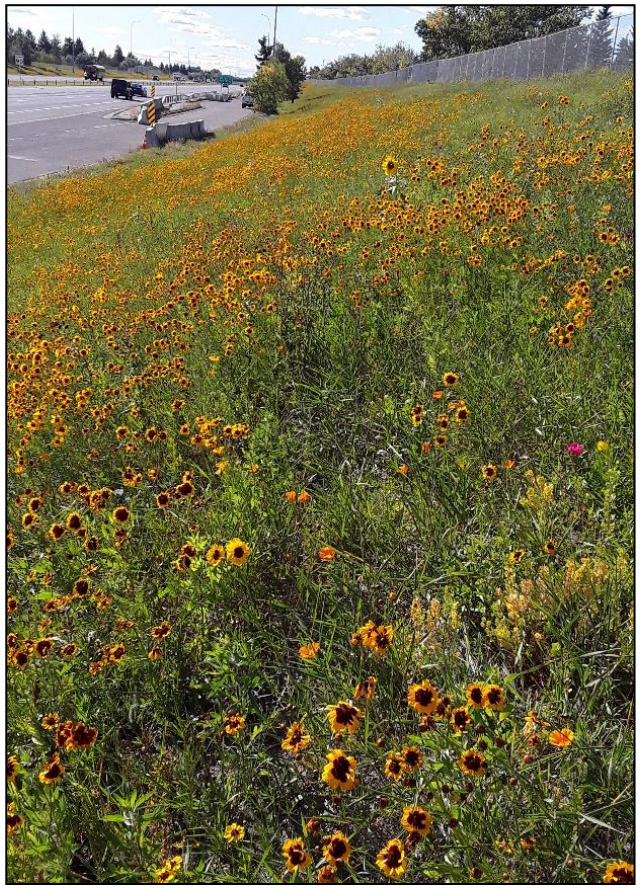
Despite the late planting, limited precipitation and exceedingly hot temperatures – things grew!

Stubble is a bonus:

- Prevents movement of seed in heavy rain
- Shelters and protects

North side and south side are not the same.

- Seed produced on north side plants
- They will not progress the same



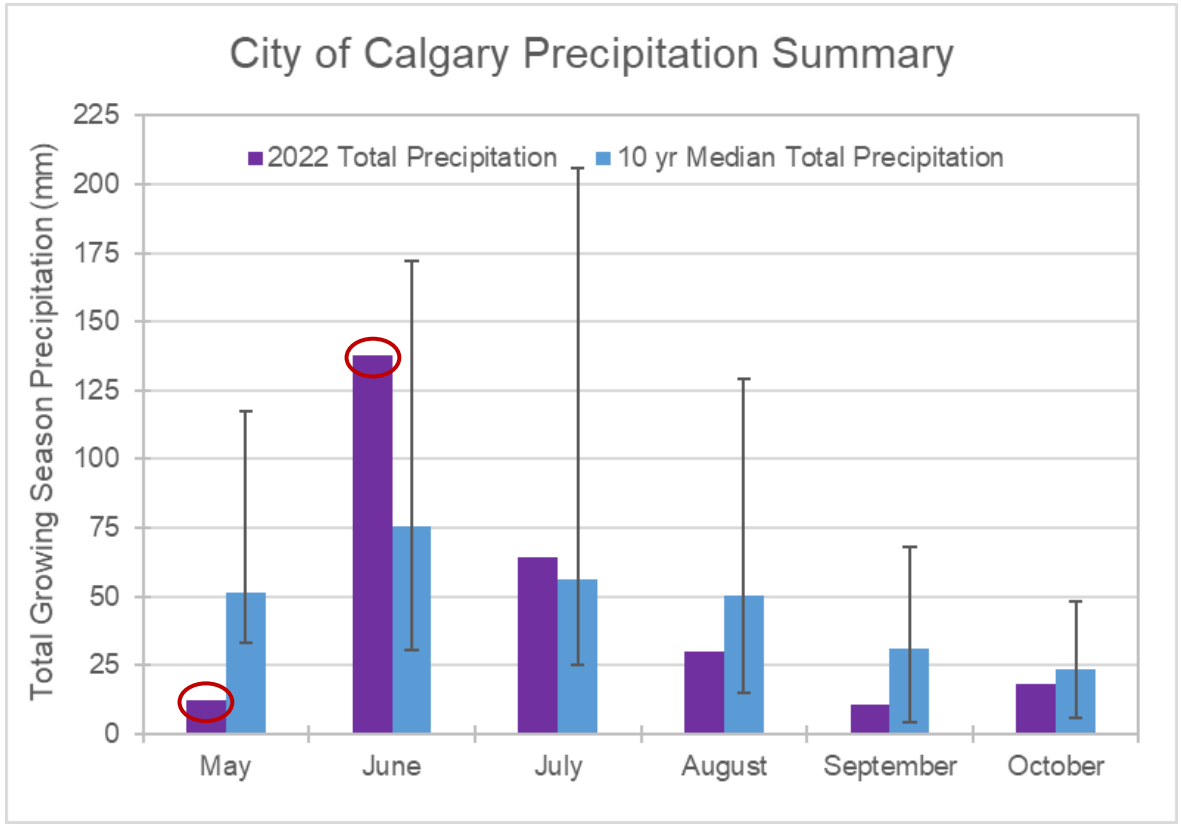
north

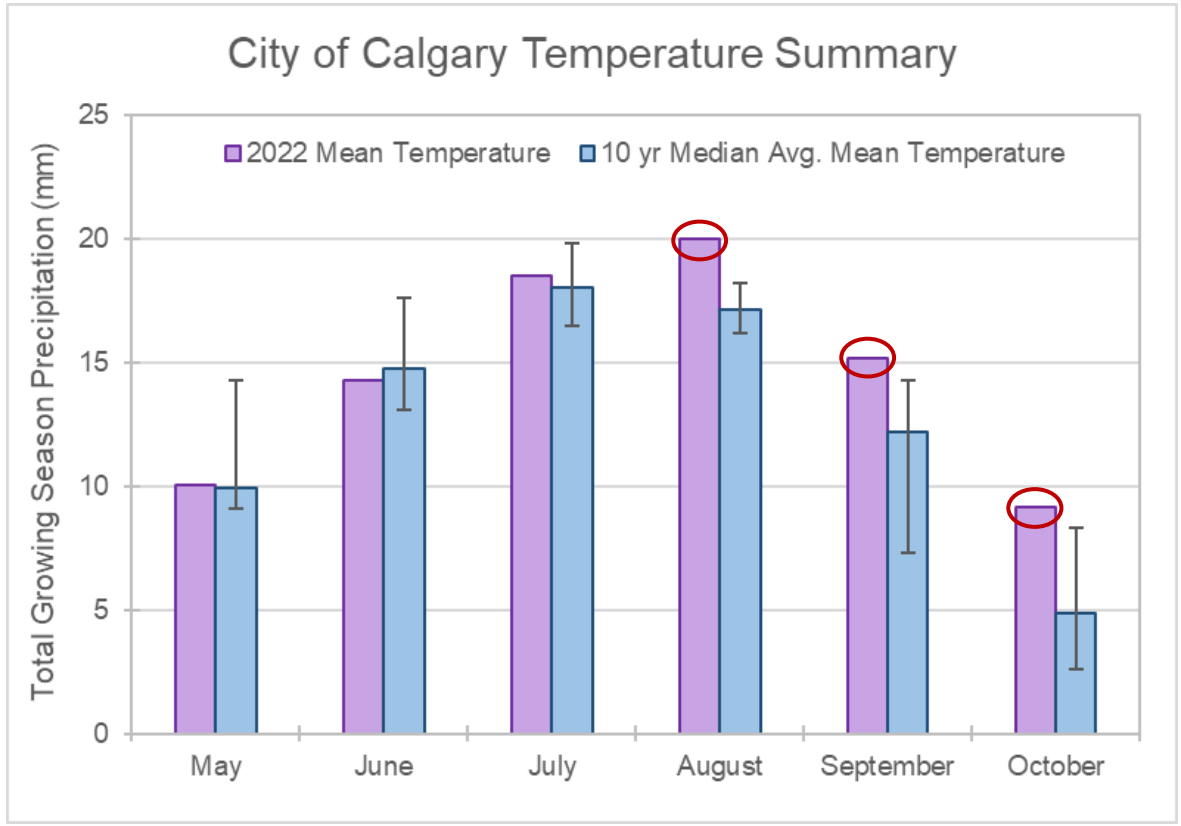
south

Weather Challenges - 2022

Moisture – May was exceptionally dry, June was wet

Temperature – August to October were exceptionally warm





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Year 2 (Summer 2022)

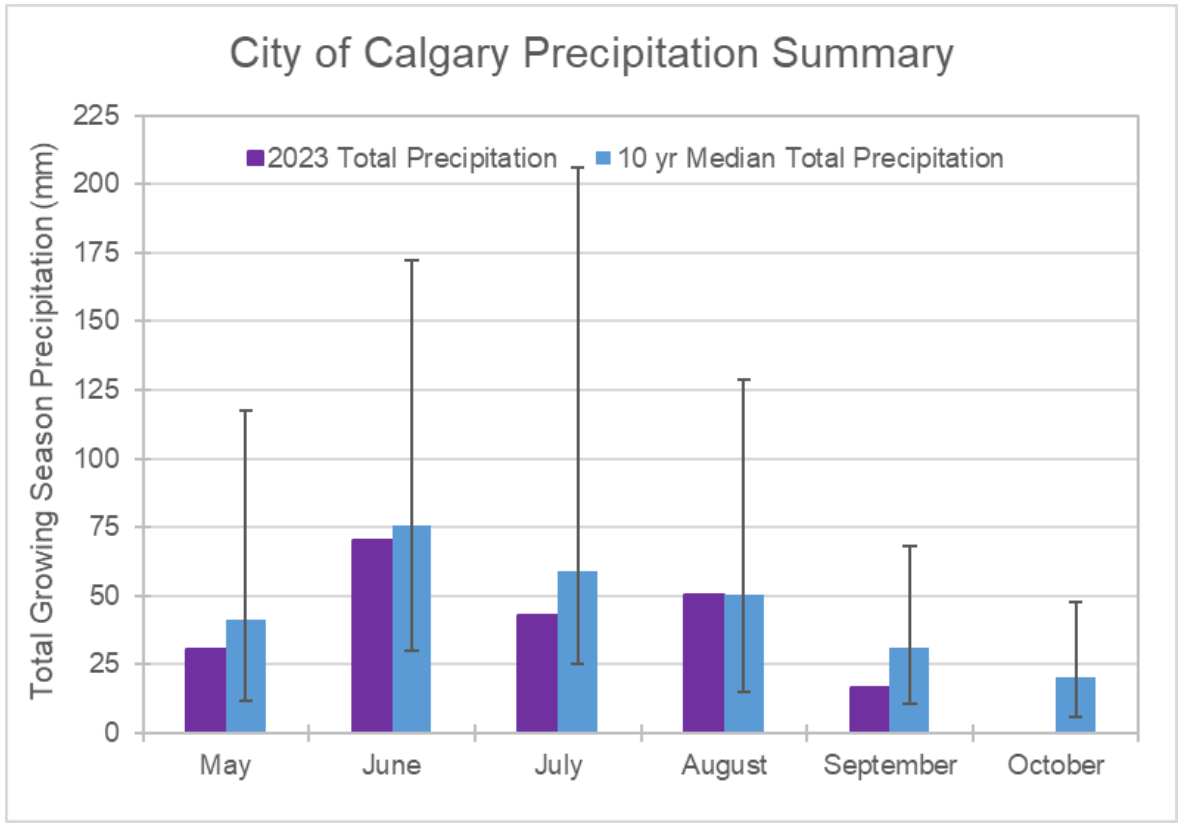
Year 2 (Fall 2022)

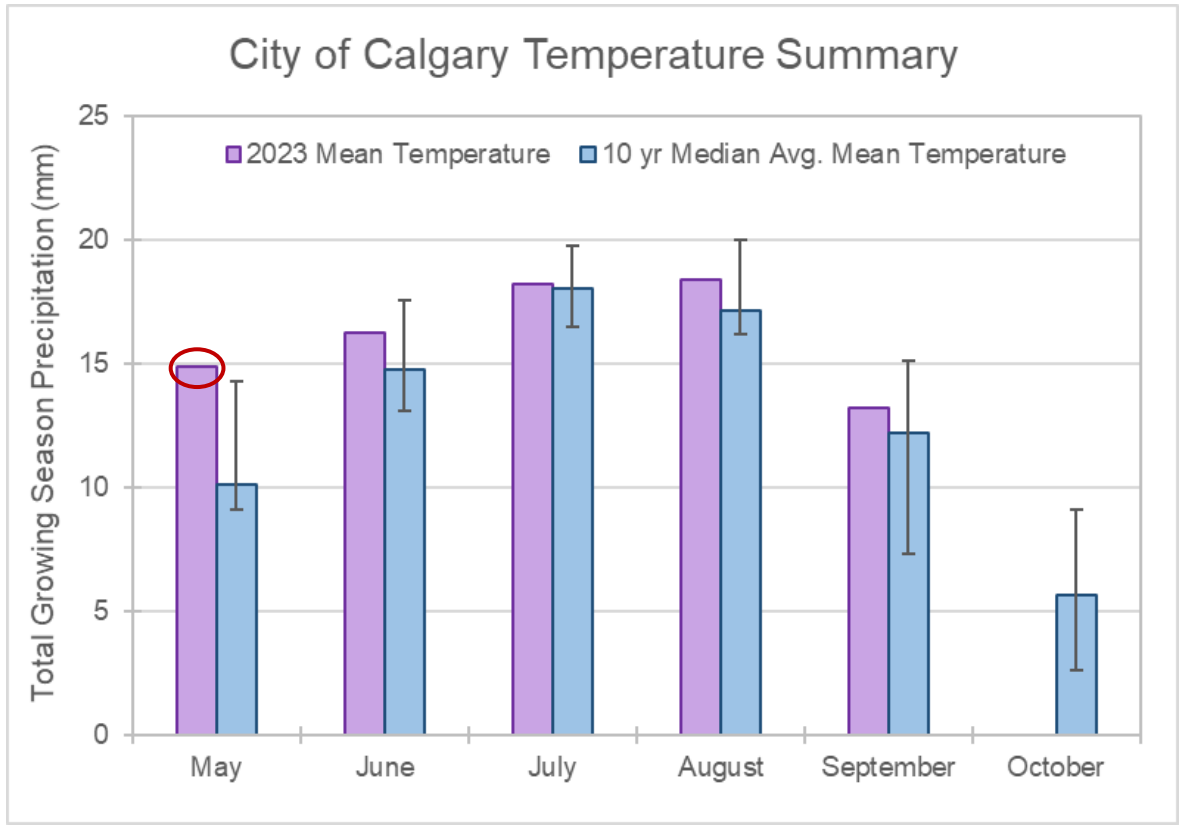
Year 2 – Biomass Management

Weather Challenges - 2023

Moisture – May only had 2 rain days early

Temperature – End of May was exceptionally warm





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Year 3 (Summer 2023)

Year 3 (Fall 2023)

Results – Bee Boxes

Box occupancy following July 2021 installation:

- One of the 15 social bee boxes was occupied
- Occupation in 7 of 15 solitary bee boxes
  - holes plugged

Bees on site:

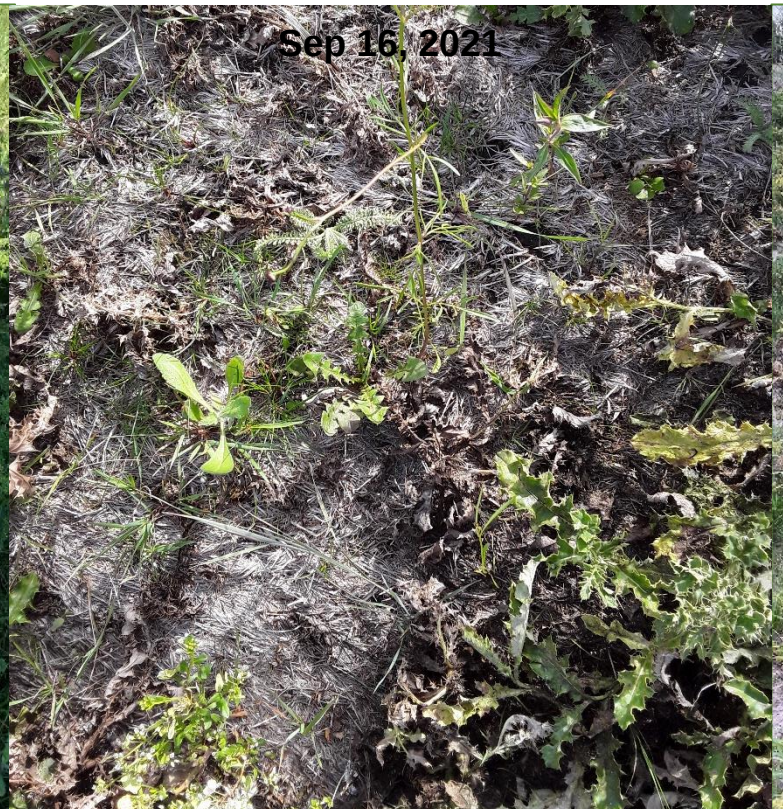
- Prior to the project: no flowers, very few bees
- After flower establishment: ~3,000/ha

Collection Date	Genus	Species	Common Name	Number of Specimens
Sep-16-21	*Bombus*	*ternarius*	Orange-belted bumblebee	1
		rufocinctus	Red-belted bumblebee	2
		insularis	Indiscriminate cuckoo bumblebee	1
		huntii	Hunt bumblebee	2

Results – Weeds

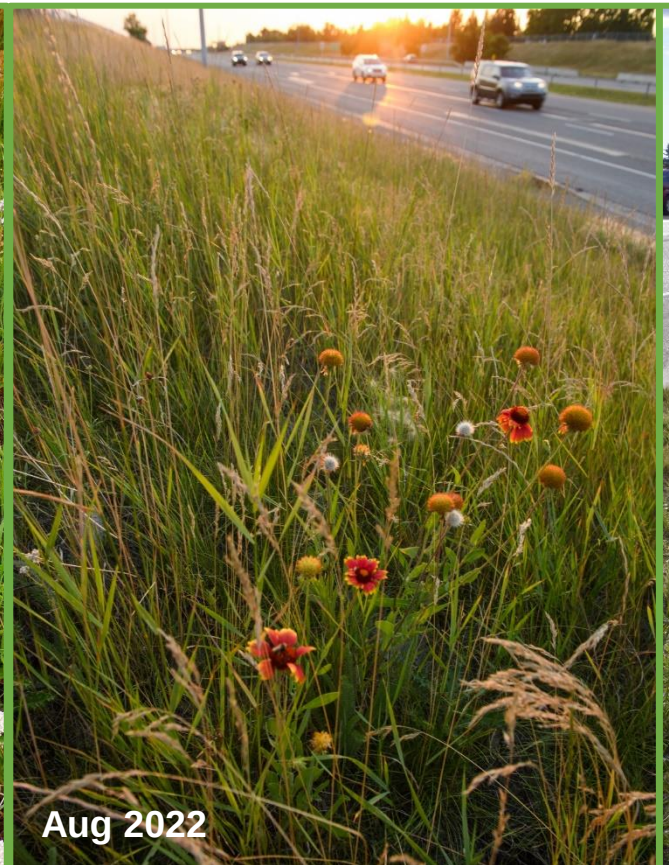
Canada thistle and kochia were spot sprayed Year 1, 2, and 3

- Wild oats, Goatsbeard, and Bindweed were pulled by hand.
- Thistle was less of a problem in Year 2 (allelopathic).
- Returned in Year 3.



Learnings – Grass

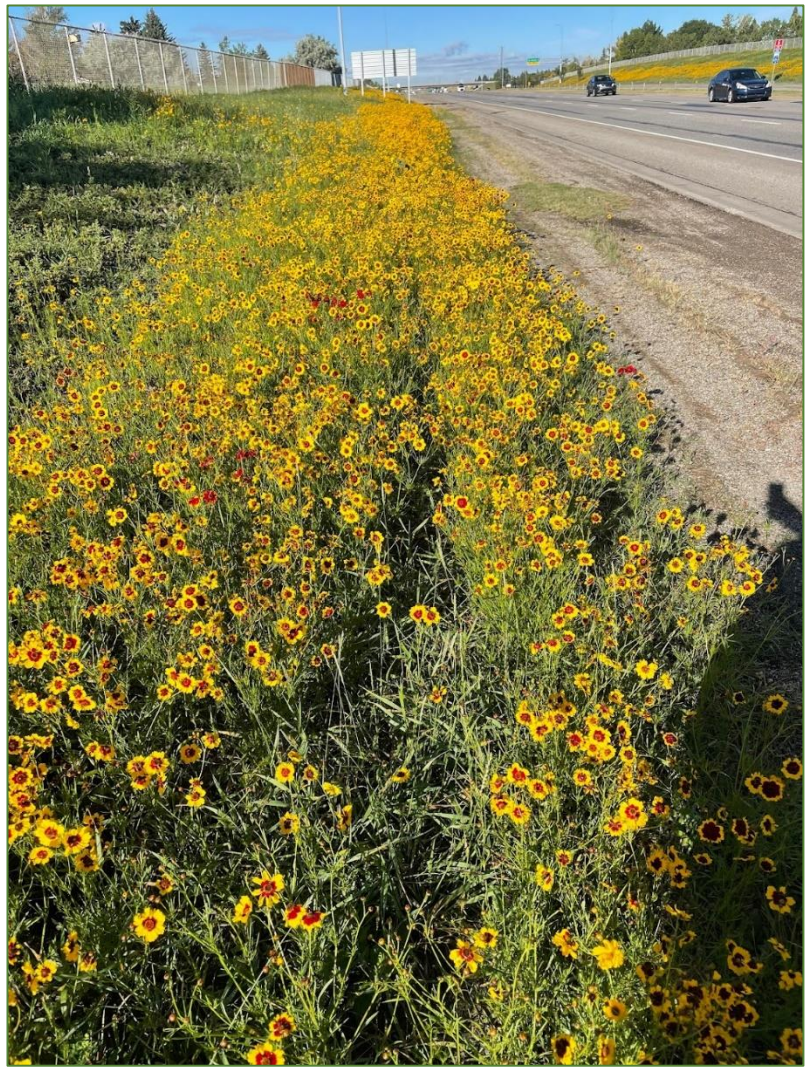
There was lots of fescue and Nuttall’s alkali grass.
The tall grasses dominated the site in Year 2, less so in Year 3.
There was some breakthrough Kentucky blue grass and quackgrass.



Immediate Roadside

The areas adjacent to the roadway will be difficult

- Regular vehicle traffic
- Lots of amendment accumulation
- Elevated salinity



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Median

Learnings

Annuals were replaced by perennials:

- Tall grass in Year 2 choked out the annuals so little self-seeding was evident

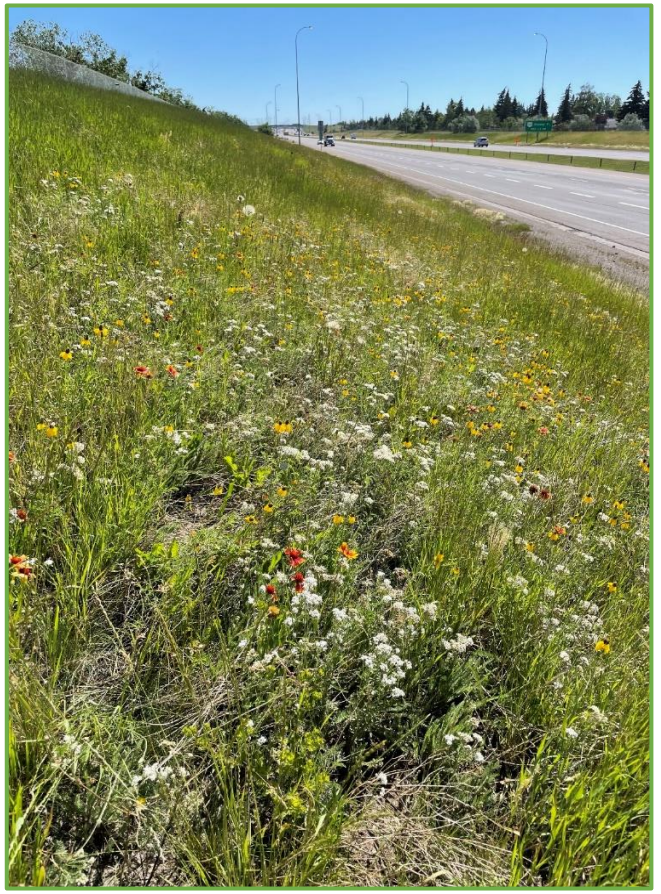
Yarrow, Prairie Coneflower, Sage, Blue Flax, Sainfoin, and Gaillardia are prevalent in Years 2 and 3.

The north and south side have progressed differently

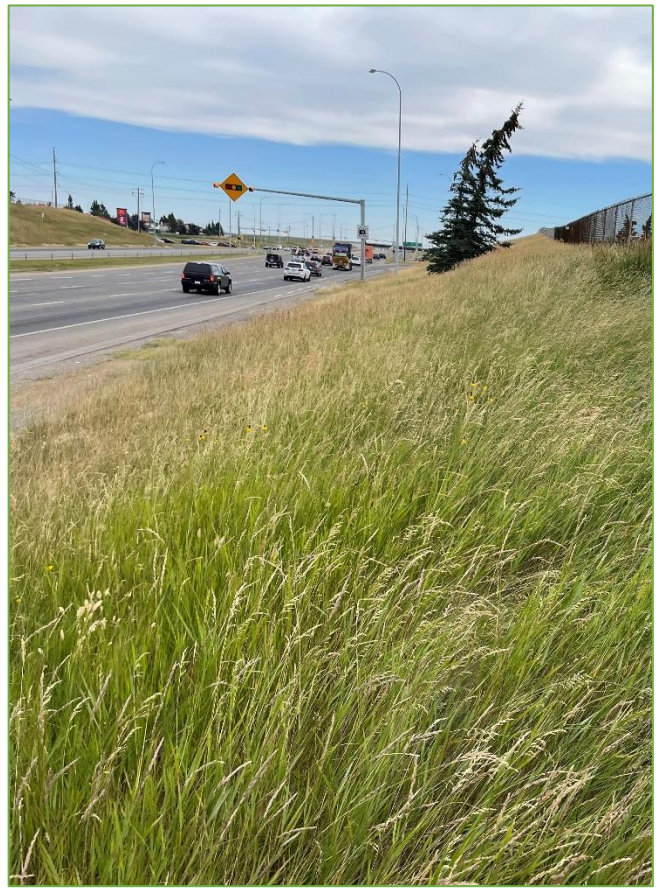
- North side is about 2 weeks ahead of the south side
- South side has less flowers

Mowing is not a good thing!

- Avoid it if possible



north



south

Comparisons – Other Areas in Calgary

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West control area:

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West control area (C1-C3): Pilot Project Area (P1-P3)

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Nose Hill Park:

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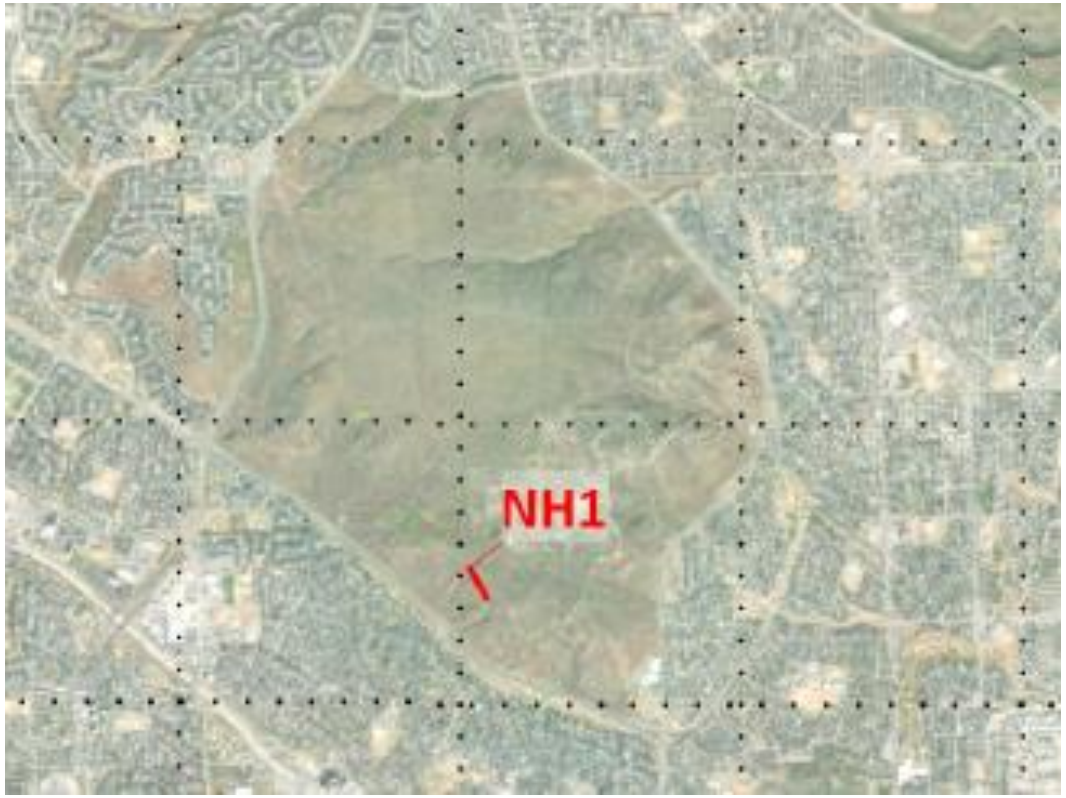
Nose Hill Park: undisturbed natural area



Comparisons – Other Areas in Calgary

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Line transect comparison: 300 m x 20 m

West control area: allowed to grow

- Mowing matched pilot project area
- Not seeded

Site		% Native Cover	% Non-native Cover	Plant Diversity
West Control	C1 north	3.5	96.5	24
	C2 median	0	100	16
	C3 south	2.1	97.9	29

Most are grasses:
Green Needlegrass
Rocky Mtn Fescue
Inland Saltgrass
Foxtail Barley

species

Pilot project area: allowed to grow

- Mowing matched control area
- Seeded

Site		% Native Cover	% Non-native Cover	Plant Diversity
West Control	C1 north	3.5	96.5	24
	C2 median	0	100	16
	C3 south	2.1	97.9	29
Pilot Project	P1 north	70	30	38
	P2 median	65	35	17
	P3 south	41	59	29

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Comparisons – Other Areas in Calgary

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Nose Hill Park: represents realistic goal for naturalization

- In an urban area

Site		% Native Cover	% Non-native Cover	Plant Diversity
West Control	C1 north	3.5	96.5	24
	C2 median	0	100	16
	C3 south	2.1	97.9	29
Pilot Project	P1 north	70	30	38
	P2 median	65	35	17
	P3 south	41	59	29
Nose Hill	NH1	80	20	58

Agronomic grass:
Quack Grass
KBG
Smooth Brome
Intermediate Oatgrass
Crested Wheatgrass

Eurasian forbs:
Canada Thistle
Common Dandelion
Yellow Sweetclover
Sow Thistle
Yellow Salsify

Agronomic grass:
Quack Grass
KBG
Smooth Brome
Crested Wheatgrass

Eurasian forbs:
Canada Thistle
Kochia
Common Dandelion
Yellow Sweetclover
Sow Thistle
Yellow Salsify

Agronomic grass:
KBG
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Crested Wheatgrass

Eurasian forbs:
Canada Thistle
Common Dandelion
Yellow Toadflax
Sow Thistle
Yellow Salsify

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Conclusions? Did the Project Succeed?

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Nose Hill Park: represents realistic goal for naturalization

- In an urban area.

Site		% Native Cover	% Non-native Cover	Plant Diversity	% Native Forbs	% Native Grasses	% Agronomic Grasses	% Eurasian Forbs
West Control	C1 north	3.5	96.5	24	0	3.5	81.5	15
	C2 median	0	100	16	0	0	90	10
	C3 south	2.1	97.9	29	0.1	2.0	75	22.9
Pilot Project	P1 north	70	30	38	21	49	23.75	6.25
	P2 median	65	35	17	1	64	17	18
	P3 south	41	59	29	15	26	47	12
Nose Hill	NH1	80	20	58	30	50	12	8

Comparisons – Other Areas in Calgary

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Nose Hill Park: represents realistic goal for naturalization

- In an urban area

Site		% Native Cover	% Non-native Cover	Plant Diversity
West Control	C1 north	3.5	96.5	24
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	C3 south	2.1	97.9	29
Pilot Project	P1 north	70	30	38
	P2 median	65	35	17
	P3 south	41	59	29
Nose Hill	NH1	80	20	58

What's missing?

- Some categories of plants
  - Early spring bloomers
    - Crocus
    - Golden Bean
  - Legumes
  - Fall bloomers
    - Aster
    - Goldenrod

This was a seed supply issue.

Conclusions and Next Steps

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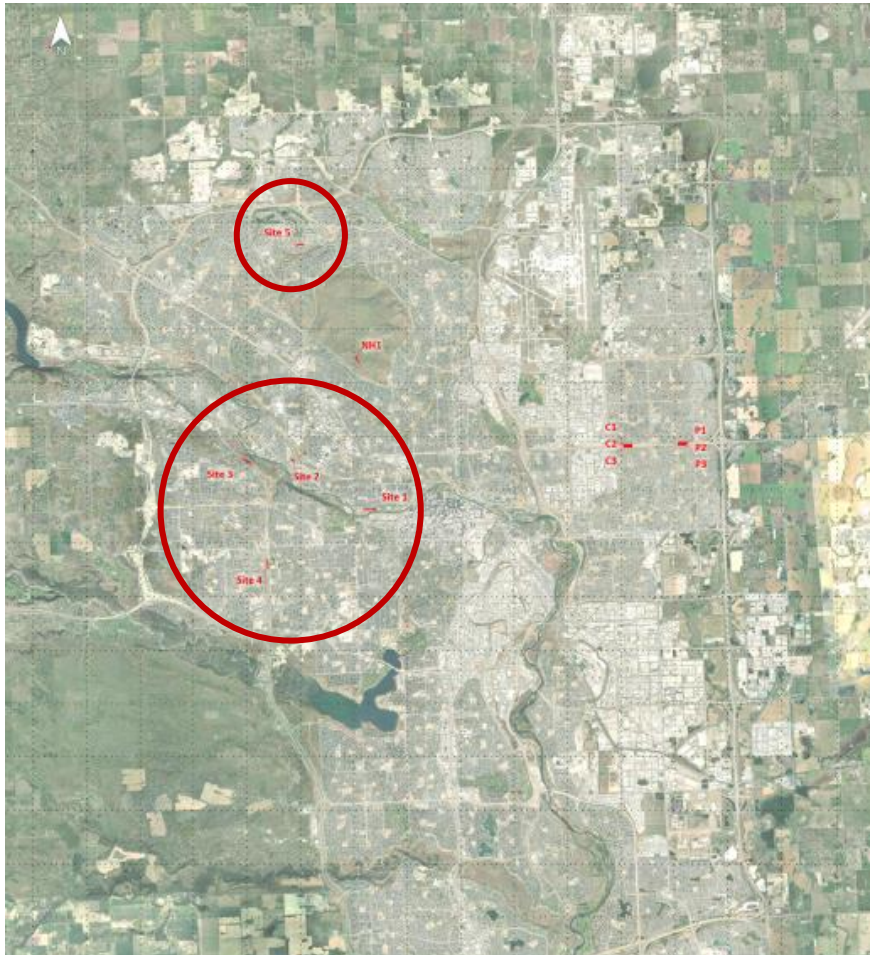
100% native plants is not realistic: 50-80% is a success!

Letting turfgrass areas grow out won't return diversity.

- 5 additional study transects
- 10-20 year grow out
- Surveyed in July 2021

Site	% Native Cover	% Non-native Cover	Plant Diversity
Site 1	0.5	99.5	21
Site 2	1.5	98.5	13
Site 3	26	74	25
Site 4	7.75	92.25	26
Site 5	38	62	17



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Conclusions and Next Steps

100% native plants is not realistic: 50-80% is a success!

Letting turfgrass areas grow out won't return diversity.

Naturalization needs to be proactive.

Seed availability is a problem for large volumes.

Next steps:

- This is going to city council to ask for changes within administration regarding how vegetation in open spaces is handled.
  - Disturbed vs. undisturbed areas

The Team

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Mike Quesnel
Adam Dunn
Liz Murray

Mathis Natvik

Gavin Wyman

Subcontractors:

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THANK YOU

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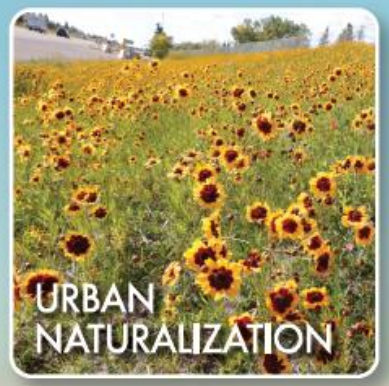

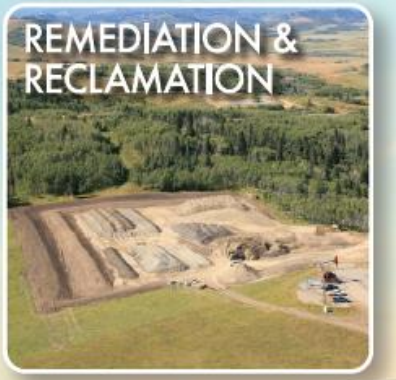

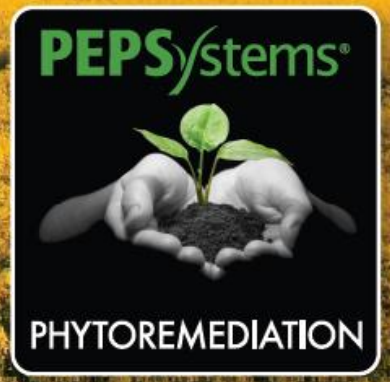

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