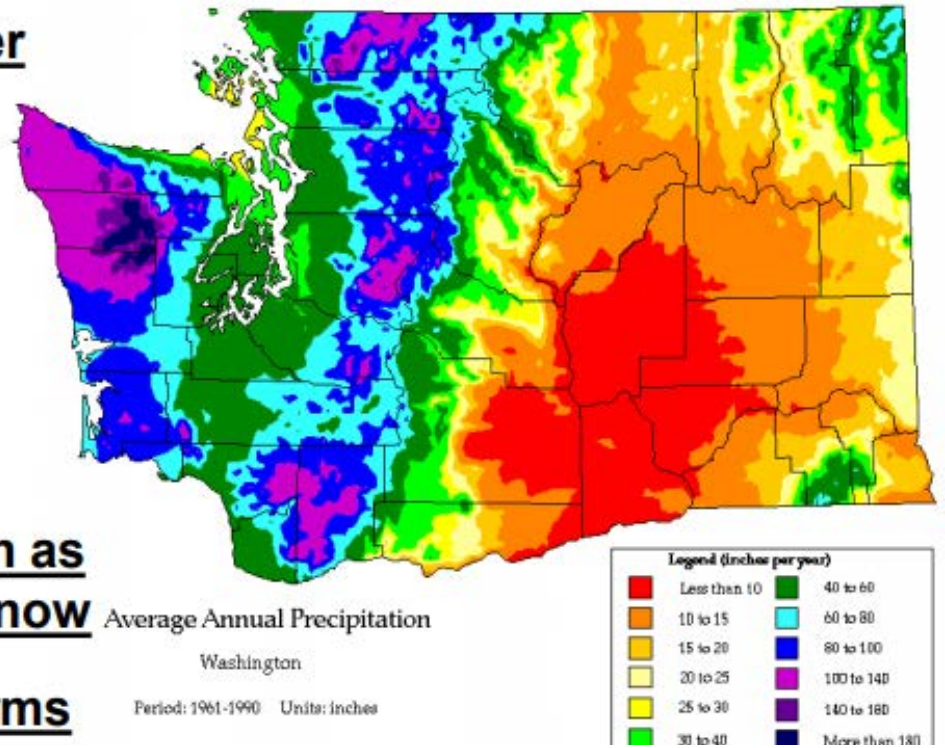
Adapting Seattle Park Landscapes to Protect Trees and People

How design and maintenance is evolving to be a climate solution

PREDICTED CLIMATE CHANGE IN THE PACIFIC NORTHWEST

- Increased summer temperature
- Increased winter temperature
- Drier summers
- Wetter winters
- More precipitation as rain rather than snow
- More intense storms



Average Annual Precipitation

Washington

Period: 1961-1990 Units: inches

Prepare for larger winter storm events, flooding, and CSO's, and summer heatwaves and drought

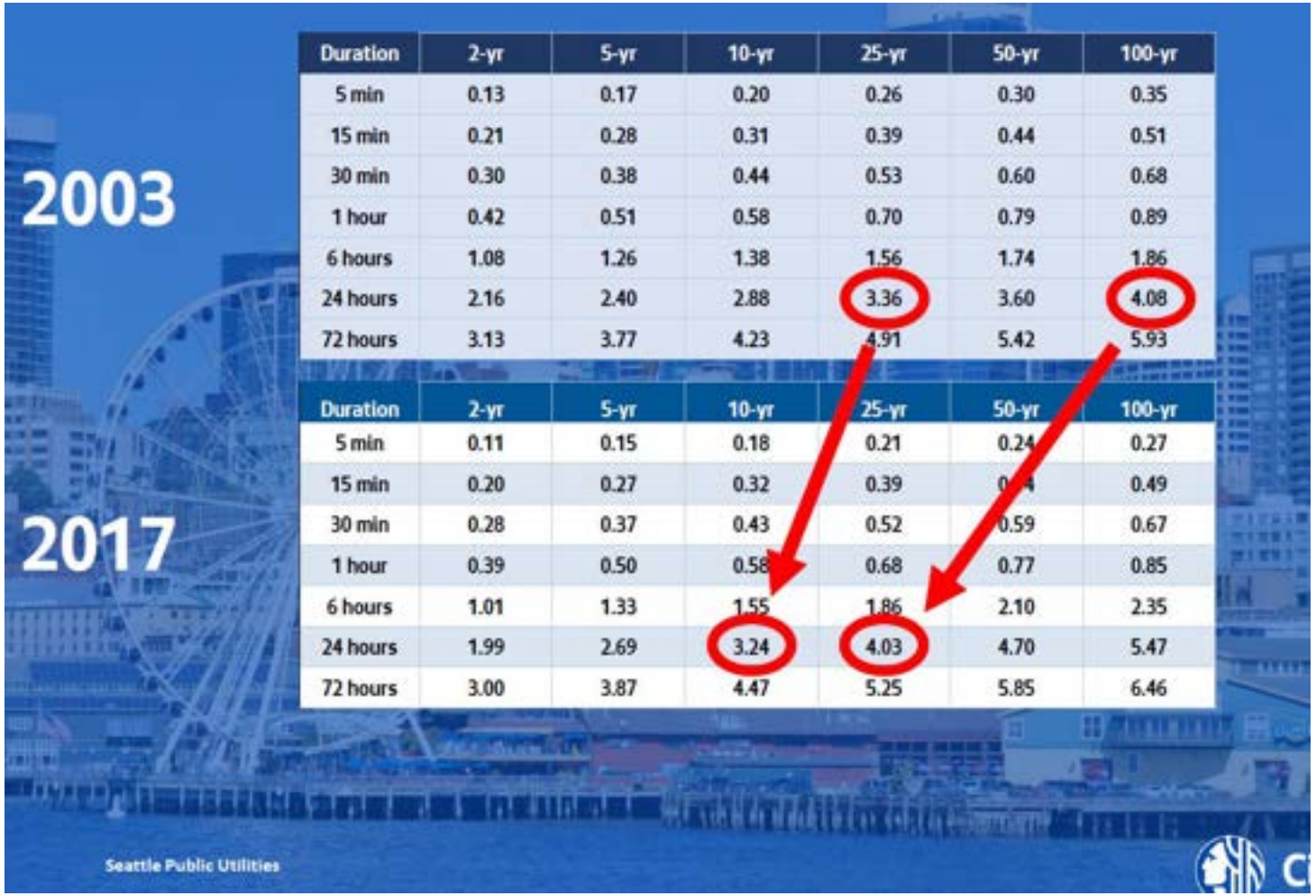
Seattle.gov

Office of the Mayor

Mayor Jenny A. Durkan

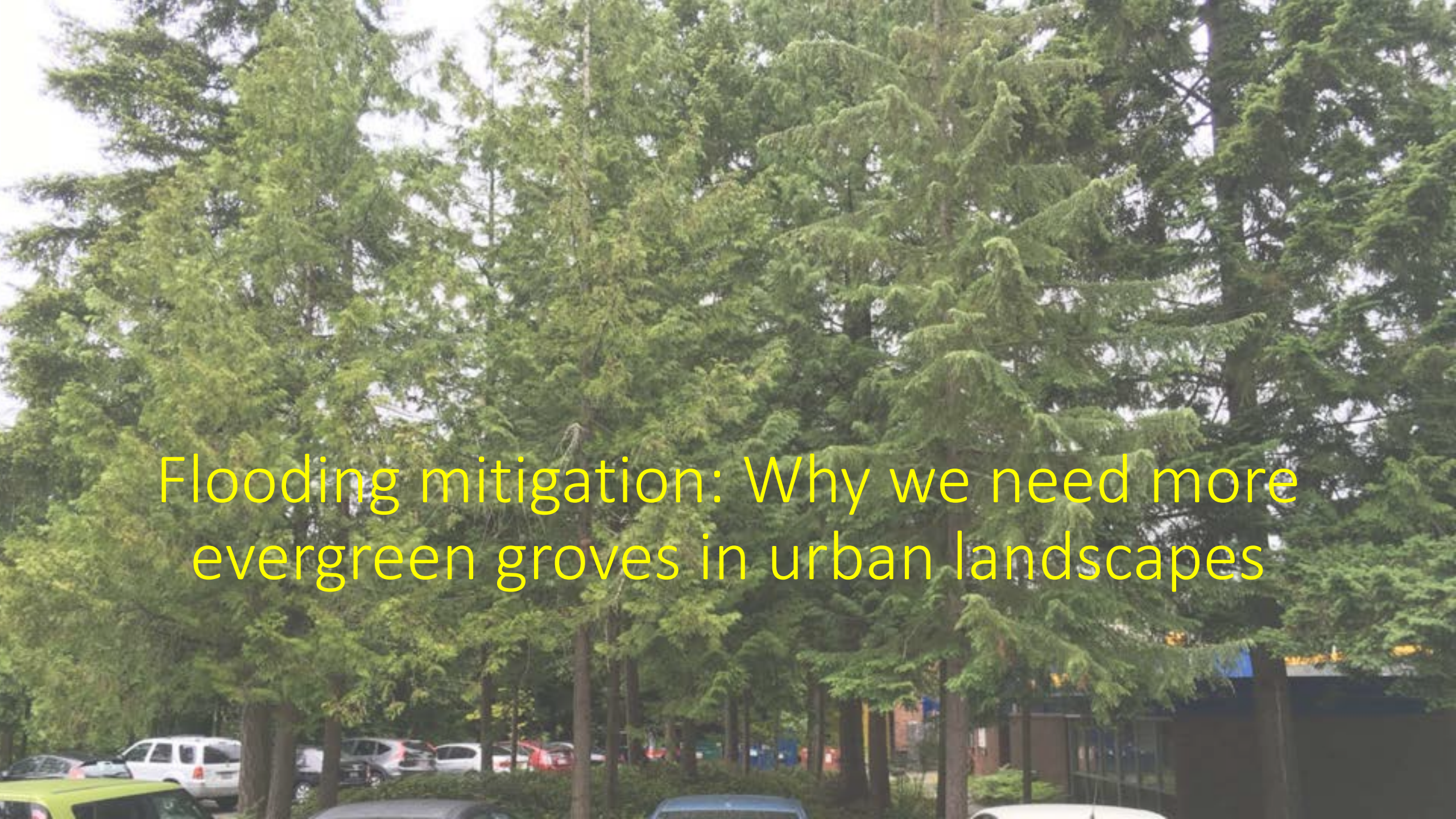
With New Study Showing Extreme Rainstorms in Seattle Area Grew by 30 Percent Since 2003, Mayor Durkan Will Highlight Innovative City Initiatives to Combat Climate Change

January 29, 2018 by Kamaria Hightower

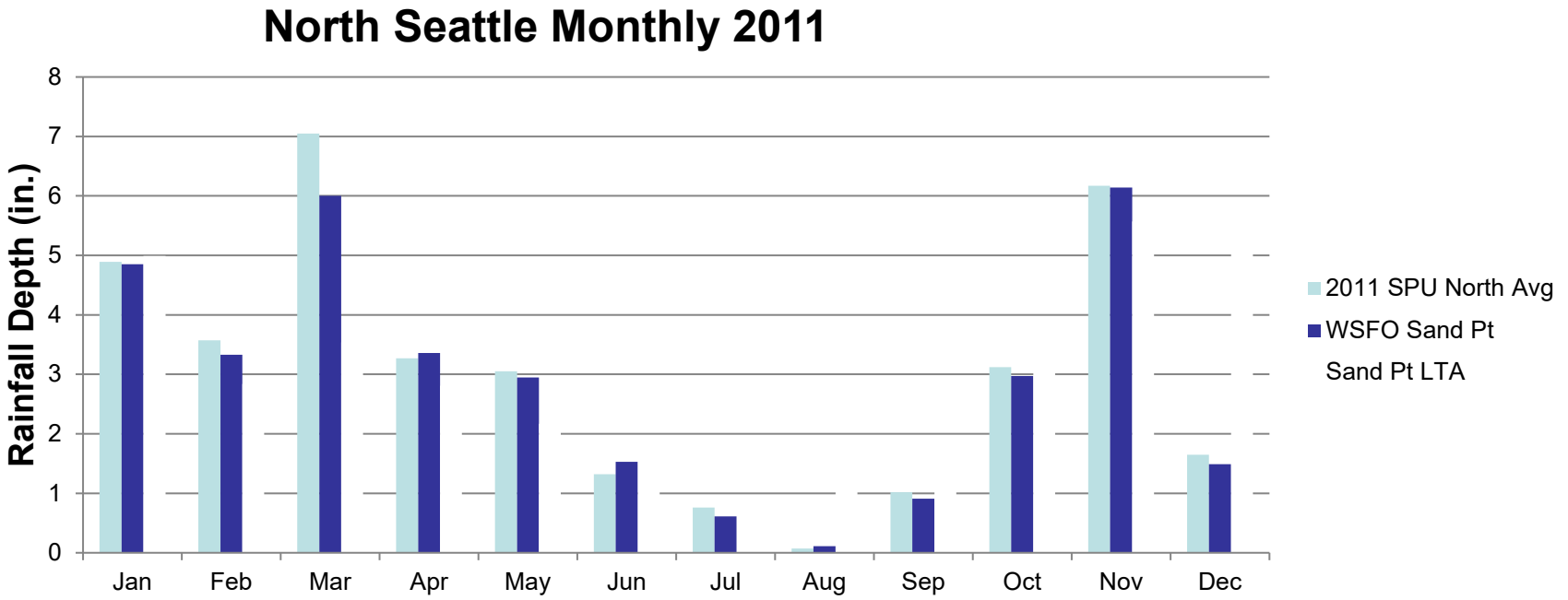


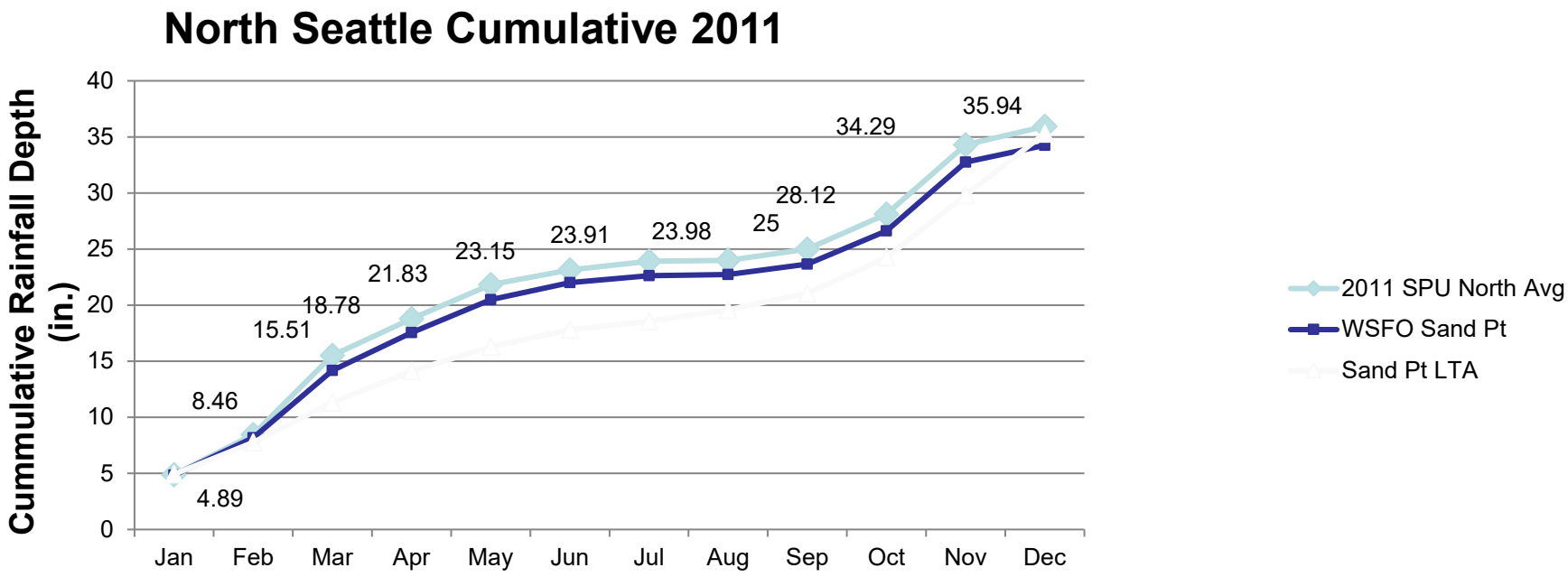
Duration	2-yr	5-yr	10-yr	25-yr	50-yr	100-yr
5 min	0.13	0.17	0.20	0.26	0.30	0.35
15 min	0.21	0.28	0.31	0.39	0.44	0.51
30 min	0.30	0.38	0.44	0.53	0.60	0.68
1 hour	0.42	0.51	0.58	0.70	0.79	0.89
6 hours	1.08	1.26	1.38	1.56	1.74	1.86
24 hours	2.16	2.40	2.88	3.36	3.60	4.08
72 hours	3.13	3.77	4.23	4.91	5.42	5.93

Duration	2-yr	5-yr	10-yr	25-yr	50-yr	100-yr
5 min	0.11	0.15	0.18	0.21	0.24	0.27
15 min	0.20	0.27	0.32	0.39	0.44	0.49
30 min	0.28	0.37	0.43	0.52	0.59	0.67
1 hour	0.39	0.50	0.58	0.68	0.77	0.85
6 hours	1.01	1.33	1.55	1.86	2.10	2.35
24 hours	1.99	2.69	3.24	4.03	4.70	5.47
72 hours	3.00	3.87	4.47	5.25	5.85	6.46

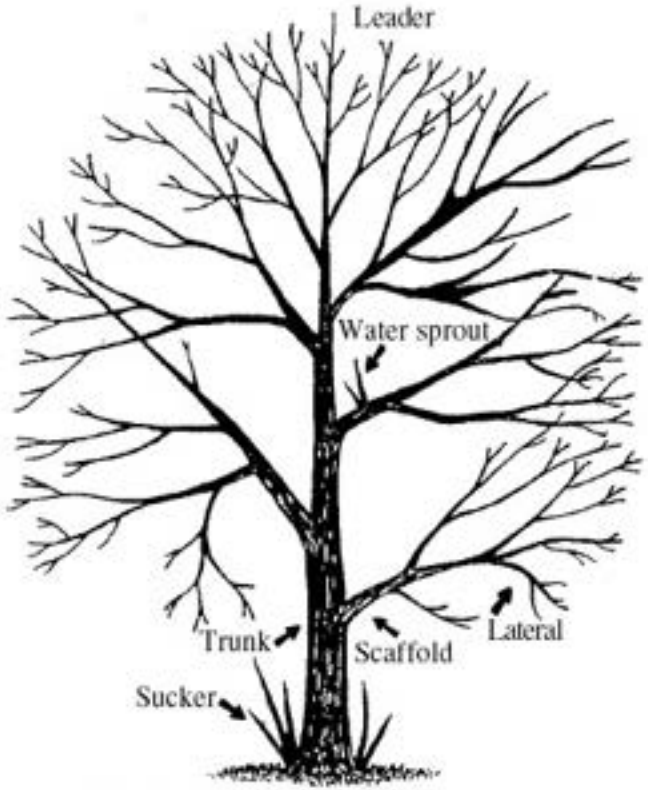


Flooding mitigation: Why we need more evergreen groves in urban landscapes


North Seattle Monthly 2011
Rainfall Depth (in.)
0
1
2
3
4
5
6
7
8
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
2011 SPU North Avg
WSFO Sand Pt
Sand Pt LTA

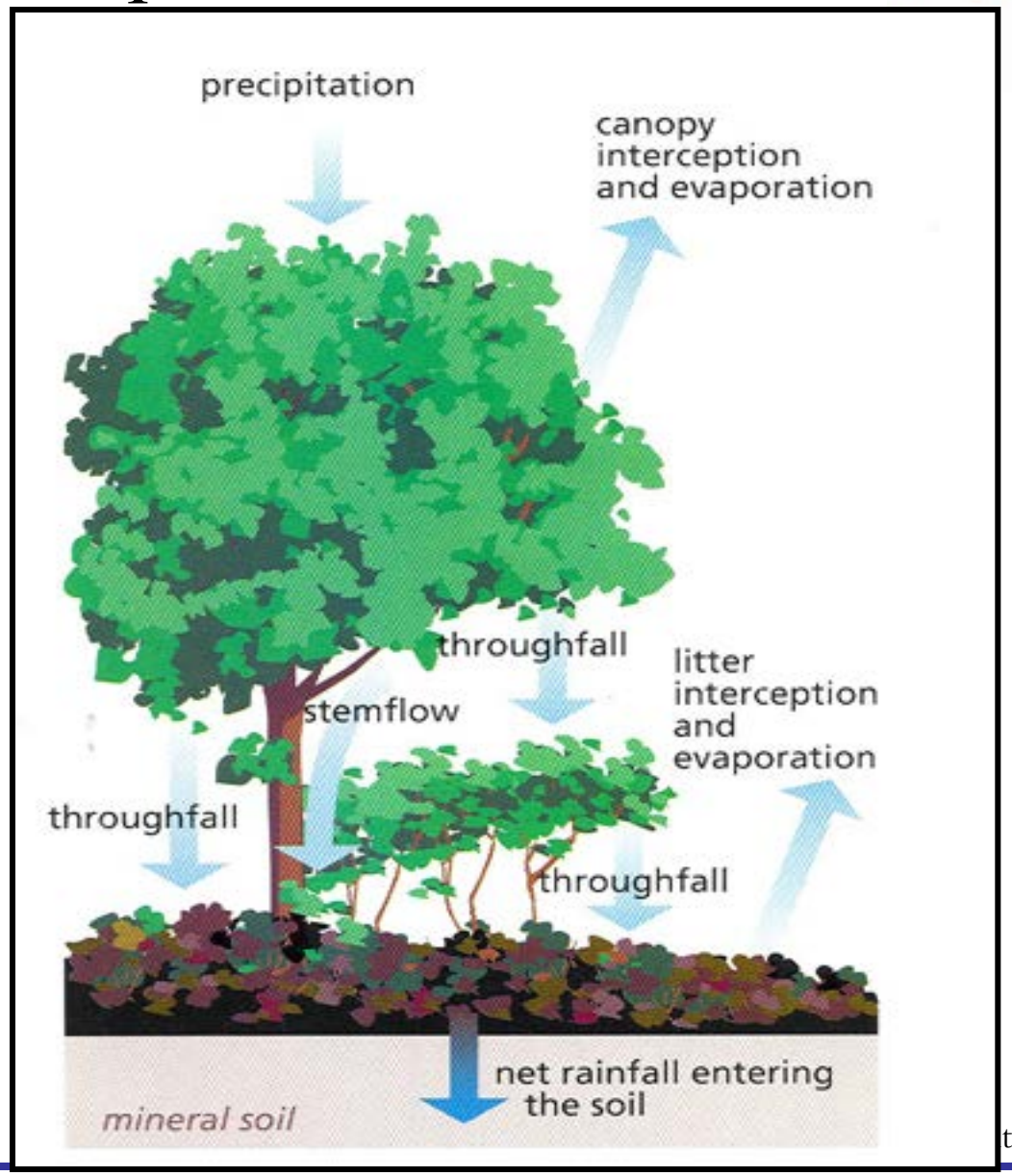

North Seattle Cumulative 2011
Cummulative Rainfall Depth (in.)
0
5
10
15
20
25
30
35
40
4.89
8.46
15.51
18.78
21.83
23.15
23.91
23.98
25
28.12
34.29
35.94
Jan
Feb
Mar
Apr
May
Jun
Jul
Aug
Sep
Oct
Nov
Dec
2011 SPU North Avg
WSFO Sand Pt
Sand Pt LTA

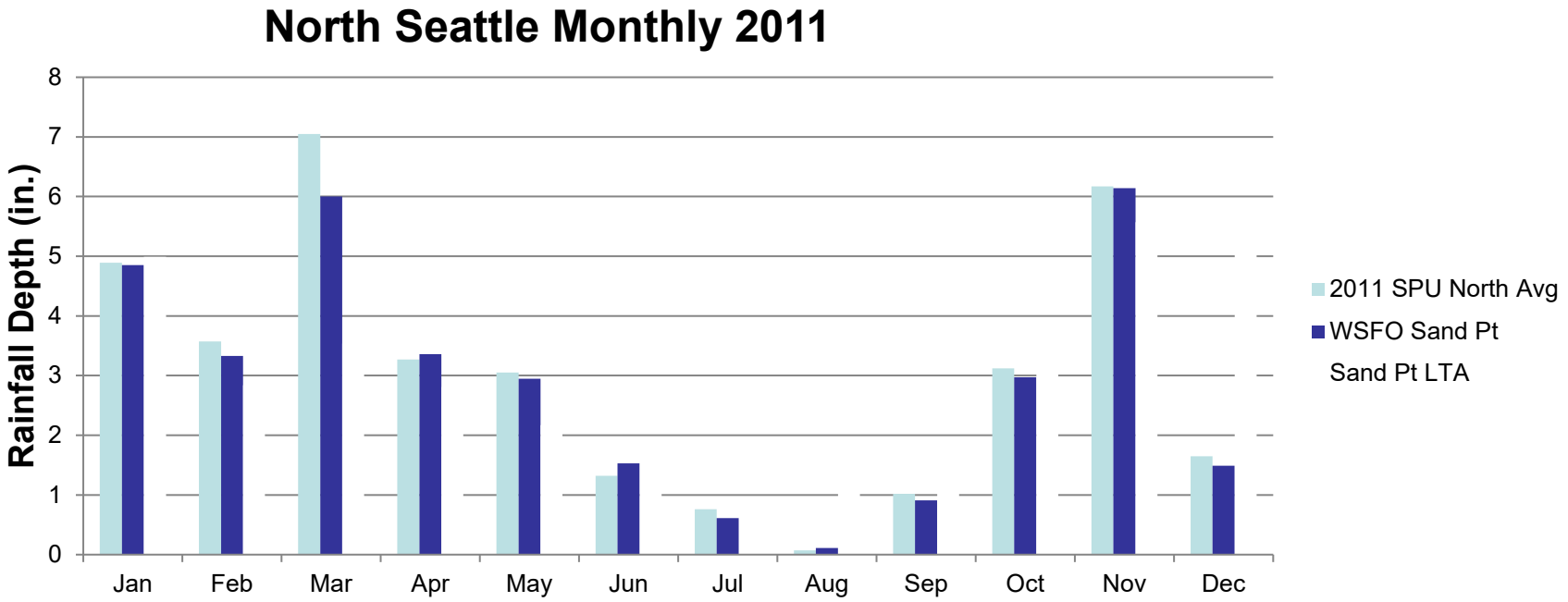
March



Typical above-ground tree framework

April

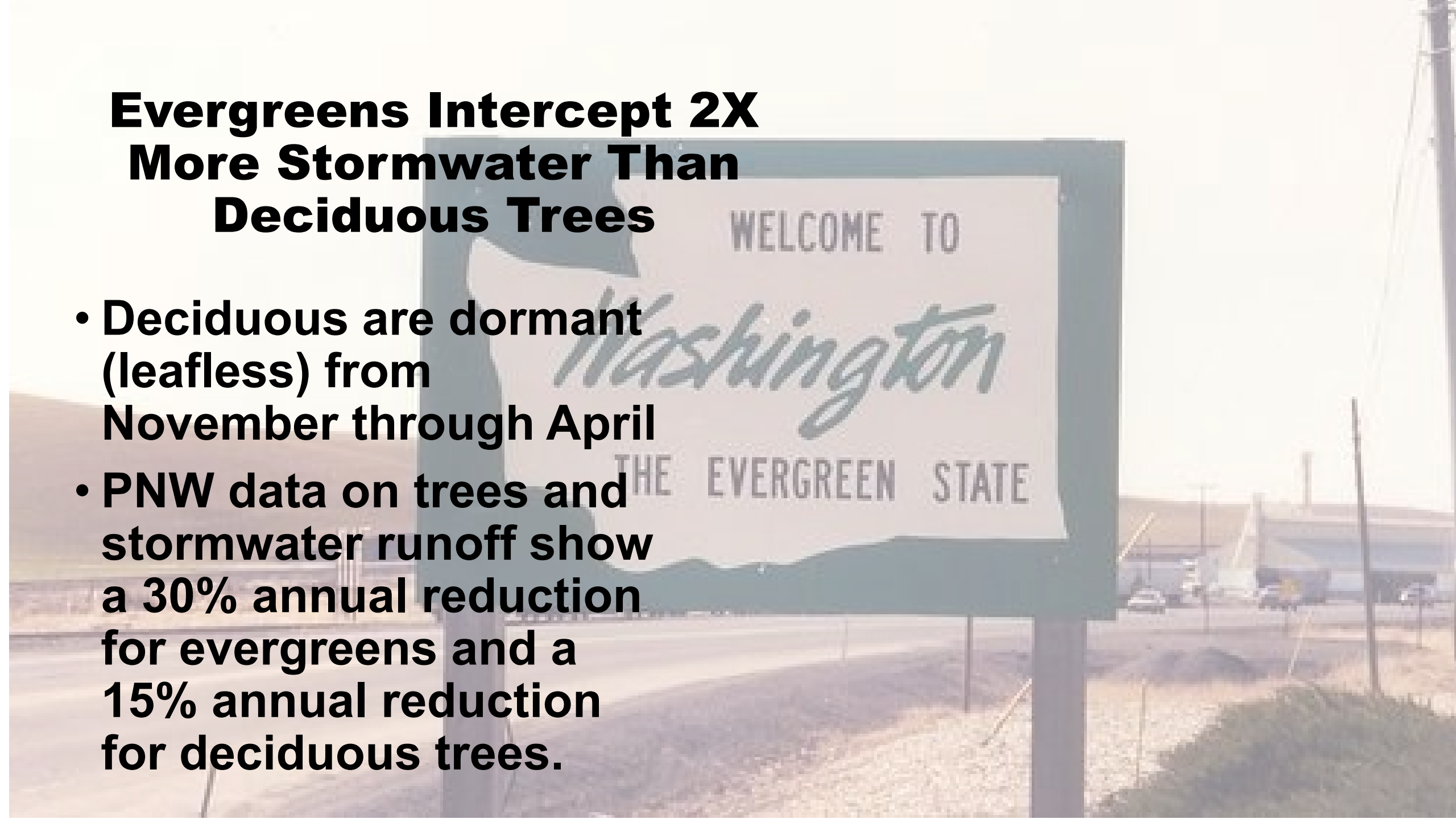




Seattle's Canopy is 72% Deciduous 28% Evergreen

Pre-European settlement the Puget Sound lowlands were dominated by mixed evergreen forests

Evergreens Intercept 2X More Stormwater Than Deciduous Trees



- Deciduous are dormant (leafless) from November through April
- PNW data on trees and stormwater runoff show a 30% annual reduction for evergreens and a 15% annual reduction for deciduous trees.


Why landscape maintenance professionals ask for more evergreen vegetation?

Leaf Blower Bans are on the Rise

Evergreens retain leaves or needle for 3-5 years

Like tree, like needle: Bristlecone needles may survive for as long as three or four decades.

- Evergreen's shed 66%-80% less annual leaf debris, even less depending on species.

Seattle's Master Tree List Perpetuates The Fetish For Deciduous Trees

Seattle's Master Tree List	
Evergreen	19
Deciduous	166
Total	185

City of Seattle – Master Tree List

Large Columnar Trees

Scientific & Common Name	Mature Height	Spread	Under Wires?	Min Strip Width	Flower Color	Fall Color
Acer nigrum 'Green Column' Green Column Black Sugar Maple	50	10	No	6	N/A	
Fraxinus americana 'Empire' Empire Ash	50	25	No	6	N/A	
Ginko biloba 'Princeton Sentry' Princeton Sentry Ginkgo	40	15	No	6	N/A	
Nyssa sylvatica Tupelo	60	20	No	6	N/A	
Quercus 'Crimschmidt' Crimson Spire Oak	45	15	No	6	N/A	
Quercus frainetto Italian Oak	50	30	No	6	N/A	
Quercus robur 'fastigiata' Skyrocket Oak	40	15	No	6	N/A	
Taxodium distichum 'Mickelson' Shawnee Brave Bald Cypress	55	20	No	6	N/A	

Help the public make more adult decisions

Do this……

City of Seattle – Master Tree List

Large Columnar Trees

Scientific & Common Name	Mature Height	Spread	Under Wires?	Reduces Flooding Year round	Filters Air Pollutants Year round	Supports Native Wildlife
Acer nigrum 'Green Column' Green Column Black Sugar Maple	50	10	No	No	No	No
Fraxinus americana 'Empire' Empire Ash	50	25	No	No	No	No
Ginko biloba 'Princeton Sentry' Princeton Sentry Ginkgo	40	15	No	No	No	No
Nyssa sylvatica Tupelo	60	20	No	No	No	No
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Not this…..

City of Seattle – Master Tree List

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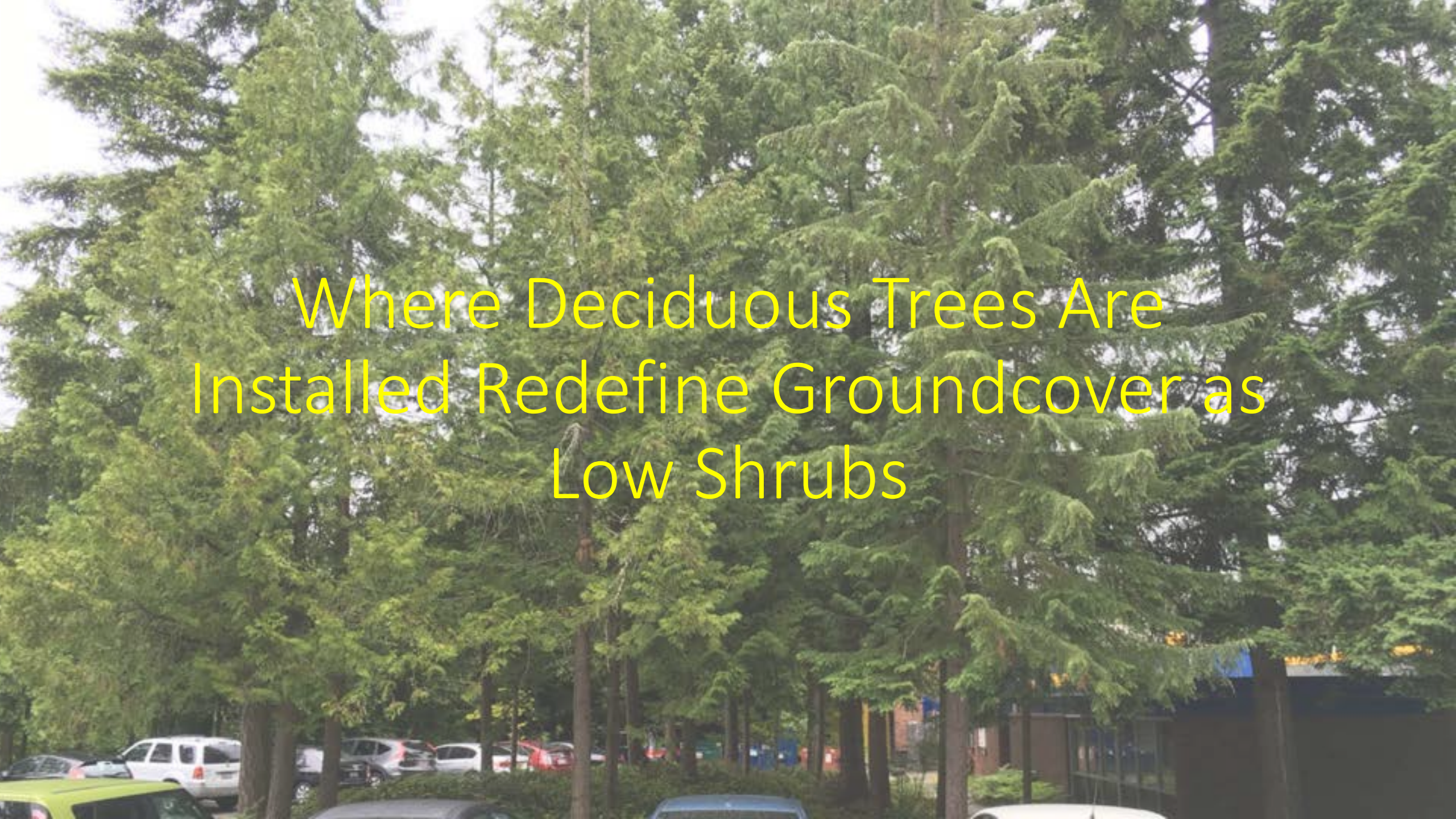
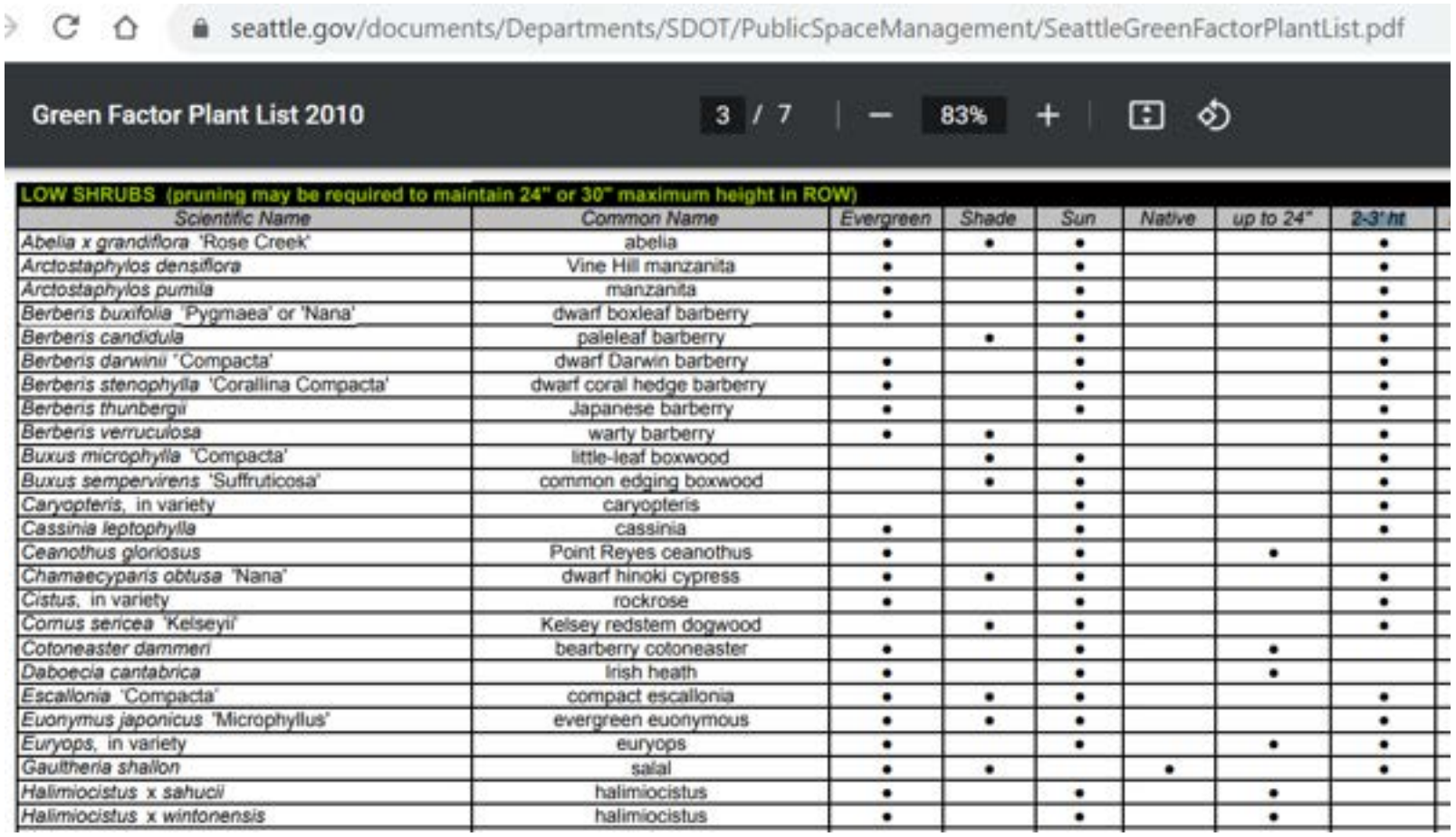

Where Deciduous Trees Are
Installed Redefine Groundcover as
Low Shrubs

If deciduous trees are installed groundcover = low shrubs (2’-3’ ht)

- Understory must survive an unnatural accumulation of fall leaves.
- Prefer evergreen shrubs to provide year-round weed suppression.
- Request adding logs as leaf dams



LOW SHRUBS (pruning may be required to maintain 24" or 30" maximum height in ROW)

Scientific Name	Common Name	Evergreen	Shade	Sun	Native	up to 24"	2-3' ht
Abelia x grandiflora 'Rose Creek'	abelia	•	•	•			•
Arctostaphylos densiflora	Vine Hill manzanita	•		•			•
Arctostaphylos pumila	manzanita	•		•			•
Berberis buxifolia 'Pygmaea' or 'Nana'	dwarf boxleaf barberry	•		•			•
Berberis candidula	paleleaf barberry		•	•			•
Berberis darwinii 'Compacta'	dwarf Darwin barberry	•		•			•
Berberis stenophylla 'Corallina Compacta'	dwarf coral hedge barberry	•		•			•
Berberis thunbergii	Japanese barberry	•		•			•
Berberis verruculosa	warty barberry	•	•				•
Buxus microphylla 'Compacta'	little-leaf boxwood		•	•			•
Buxus sempervirens 'Suffruticosa'	common edging boxwood		•	•			•
Caryopteris, in variety	caryopteris			•			•
Cassinia leptophylla	cassinia	•		•			•
Ceanothus gloriosus	Point Reyes ceanothus	•		•		•	
Chamaecyparis obtusa 'Nana'	dwarf hinoki cypress	•	•	•			•
Cistus, in variety	rockrose	•		•			•
Cornus sericea 'Kelseyii'	Kelsey redstem dogwood		•	•			•
Cotoneaster dammeri	bearberry cotoneaster	•		•		•	
Daboecia cantabrica	Irish heath	•		•		•	
Escallonia 'Compacta'	compact escallonia	•	•	•			•
Euonymus japonicus 'Microphyllus'	evergreen euonymous	•	•	•			•
Euryops, in variety	euryops	•		•		•	•
Gaultheria shallon	salal	•	•		•		•
Halimiocistus x sahucii	halimiocistus	•		•		•	
Halimiocistus x wintonensis	halimiocistus	•		•		•	

Staging logs as leaf debris dams

- Functions as casual seating opportunity
- Returns nurse log habitat to urban parks
- Returns nutrients to soil for decades
- Stores carbon in soil
- Feeds beneficial soil microbes
- Helps reduce offsite hauling
- Helps suppress weeds

Importing logs adds habitat for cavity nesting pollinators & retains stormwater

Habitat fire breaks

Water squeezed out of log pulp

Pros and Cons of adding Large Woody Debris:

Pros

1. Reduces area to mulch
2. Reduces area to weed
3. Reduces waste hauling costs
4. Blocks unwanted social paths
5. **Creates casual seating opportunity**
6. Returns nutrients to soil
7. Stores carbon in soil
8. Creates beneficial insect habitat
9. Creates beneficial fungus habitat
10. Enhances drought tolerance
11. Acts as fire break
12. Adds barrier to retain fall leaves
13. Protects trees from staff damage
14. **Adds naturalistic aesthetic**

Cons

1. Some privileged bully might complain
2. Adds something new to a familiar maintenance routine
3. Beneficial Yellow Jackets could also benefit from the habitat


Top Priority: Protect And Preserve
The Trees We Have


End Staff Equipment Damage With...

Stop mowing under tree driplines

- Prevents tree root and trunk damage
- Retains more leaf litter,
  reduces mulching needs
- Simplifies mowing
- Reduced mower damage

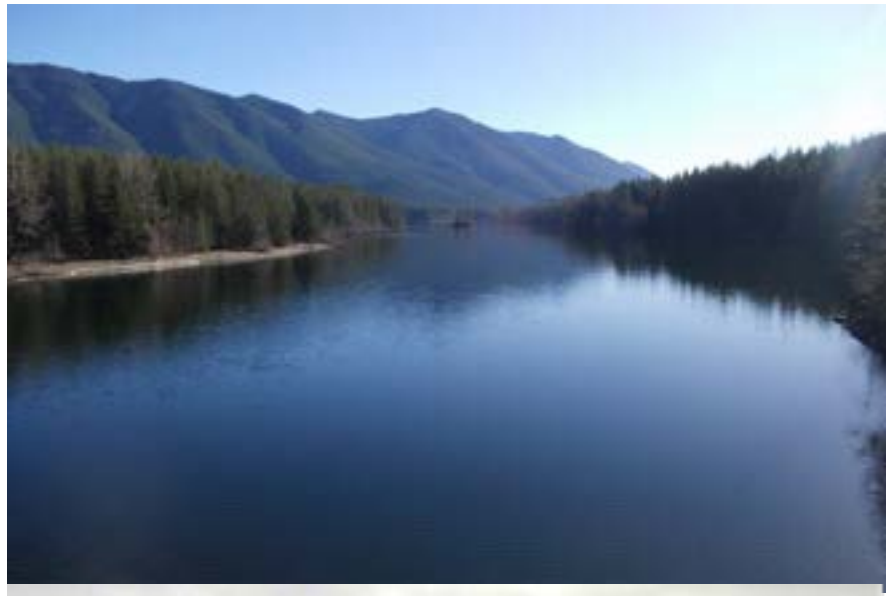
Protect trees with Eco-turf lawns requiring little to no mowing

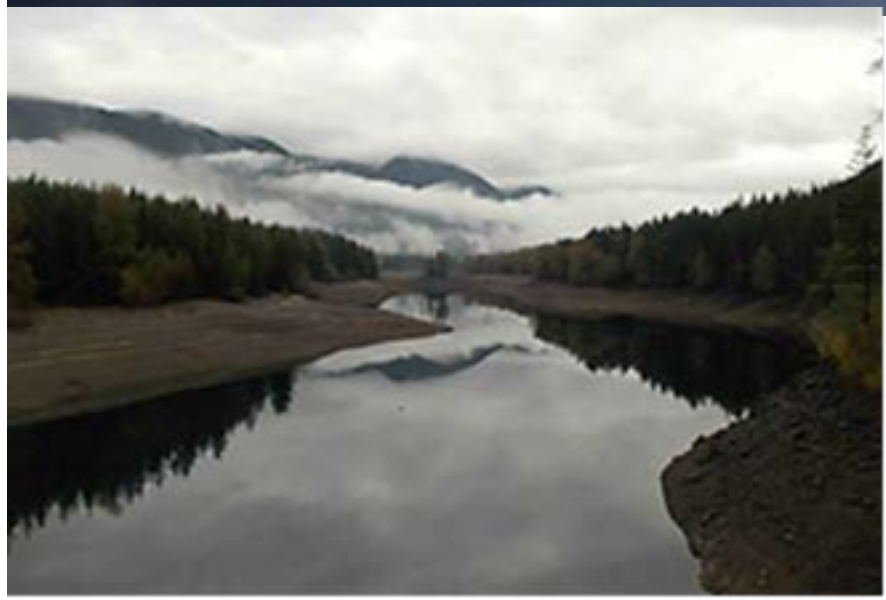

Limit the Need for Artificial Life Support, Install Future Climate Tolerant Vegetation

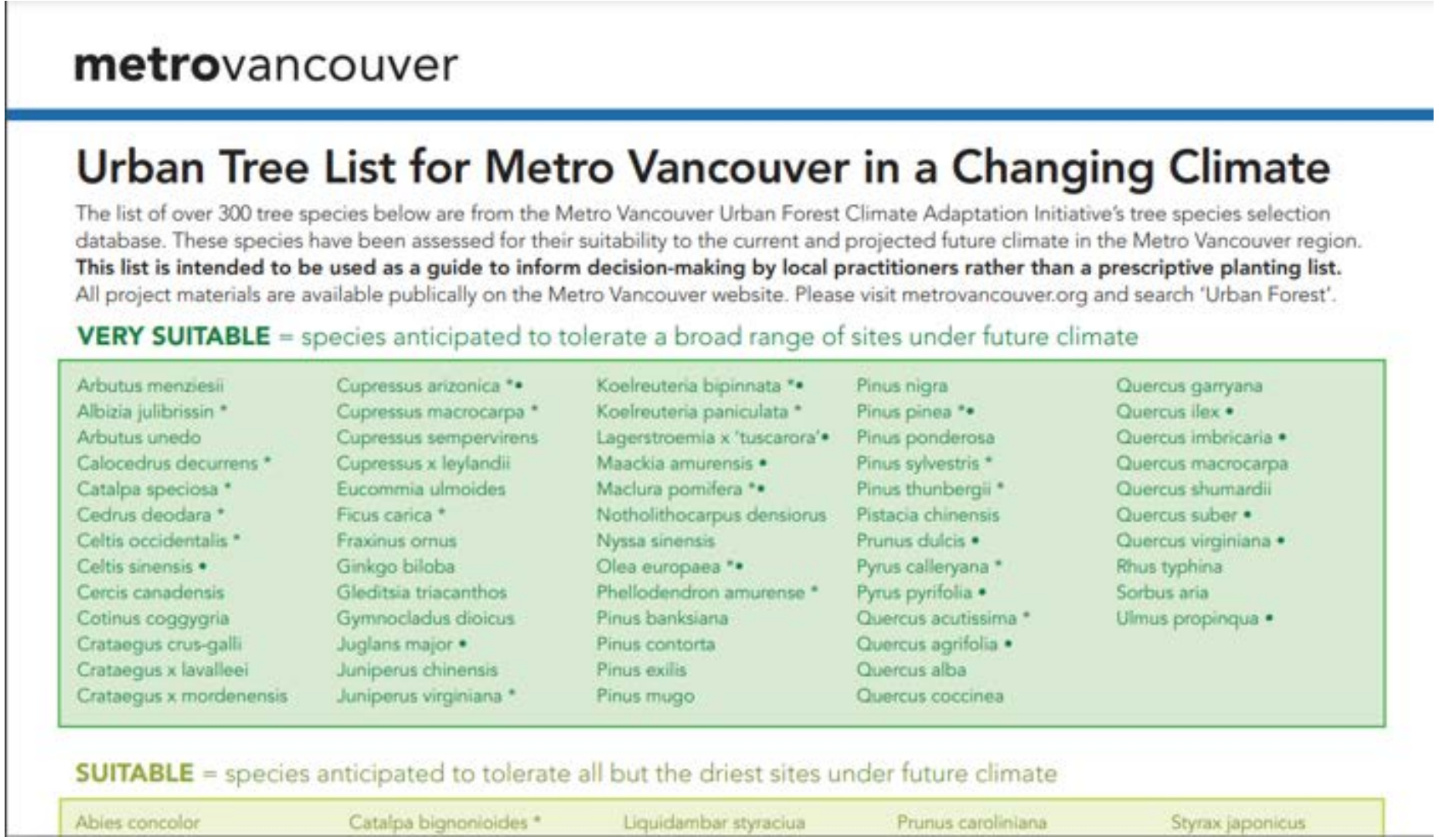
We expect increased water needs & costs

SPU 2019 Water System Plan

- Update the analysis of the adaptation options to include considerations of cost, environmental impacts, policy implications, in addition to gains in water supply.
- Continue tests to monitor and assess environmental and dam safety considerations associated with routinely refilling Chester Morse Lake to 1566 feet.
- Identify and plan for additional adaptation and new supply options with an emphasis on building system resilience under a range of potential scenarios.
- Identify indicators that can be tracked and used to help determine when to pursue more complex and expensive adaptation or new supply options.







metrovancouver

Urban Tree List for Metro Vancouver in a Changing Climate

The list of over 300 tree species below are from the Metro Vancouver Urban Forest Climate Adaptation Initiative's tree species selection database. These species have been assessed for their suitability to the current and projected future climate in the Metro Vancouver region. **This list is intended to be used as a guide to inform decision-making by local practitioners rather than a prescriptive planting list.** All project materials are available publically on the Metro Vancouver website. Please visit metrovancouver.org and search 'Urban Forest'.

VERY SUITABLE = species anticipated to tolerate a broad range of sites under future climate

Arbutus menziesii	Cupressus arizonica *•	Koelreuteria bipinnata *•	Pinus nigra	Quercus garryana
Albizia julibrissin *	Cupressus macrocarpa *	Koelreuteria paniculata *	Pinus pinea *•	Quercus ilex •
Arbutus unedo	Cupressus sempervirens	Lagerstroemia x 'tuscarora'•	Pinus ponderosa	Quercus imbricaria •
Calocedrus decurrens *	Cupressus x leylandii	Maackia amurensis •	Pinus sylvestris *	Quercus macrocarpa
Catalpa speciosa *	Eucommia ulmoides	Maclura pomifera *•	Pinus thunbergii *	Quercus shumardii
Cedrus deodara *	Ficus carica *	Notholithocarpus densiorus	Pistacia chinensis	Quercus suber •
Celtis occidentalis *	Fraxinus ornus	Nyssa sinensis	Prunus dulcis •	Quercus virginiana •
Celtis sinensis •	Ginkgo biloba	Olea europaea *•	Pyrus calleryana *	Rhus typhina
Cercis canadensis	Gleditsia triacanthos	Phellodendron amurense *	Pyrus pyrifolia •	Sorbus aria
Cotinus coggygria	Gymnocladus dioicus	Pinus banksiana	Quercus acutissima *	Ulmus propinqua •
Crataegus crus-galli	Juglans major •	Pinus contorta	Quercus agrifolia •	
Crataegus x lavalleei	Juniperus chinensis	Pinus exilis	Quercus alba	
Crataegus x mordenensis	Juniperus virginiana *	Pinus mugo	Quercus coccinea	

SUITABLE = species anticipated to tolerate all but the driest sites under future climate

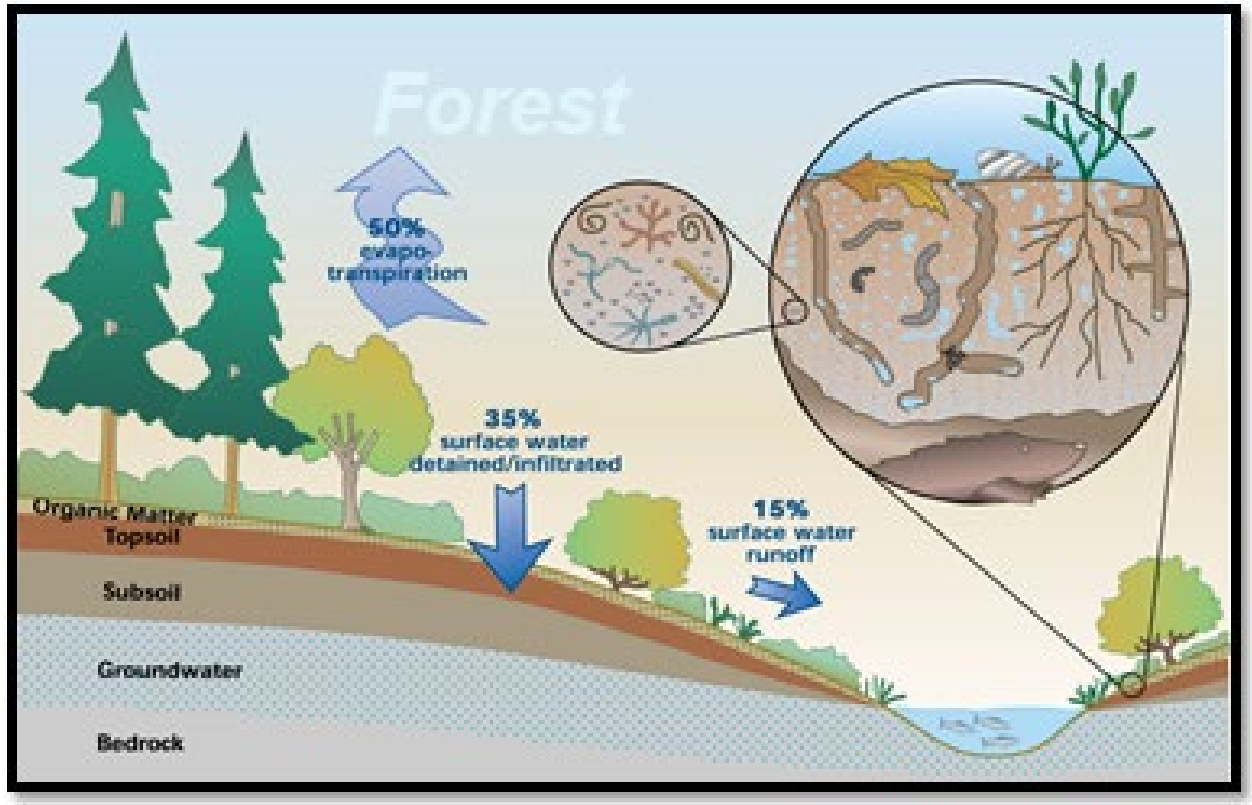
Abies concolor	Catalpa bignonioides *	Liquidambar styraciua	Prunus caroliniana	Styrax japonicus

Take inspiration from our innovative Canadian neighbors

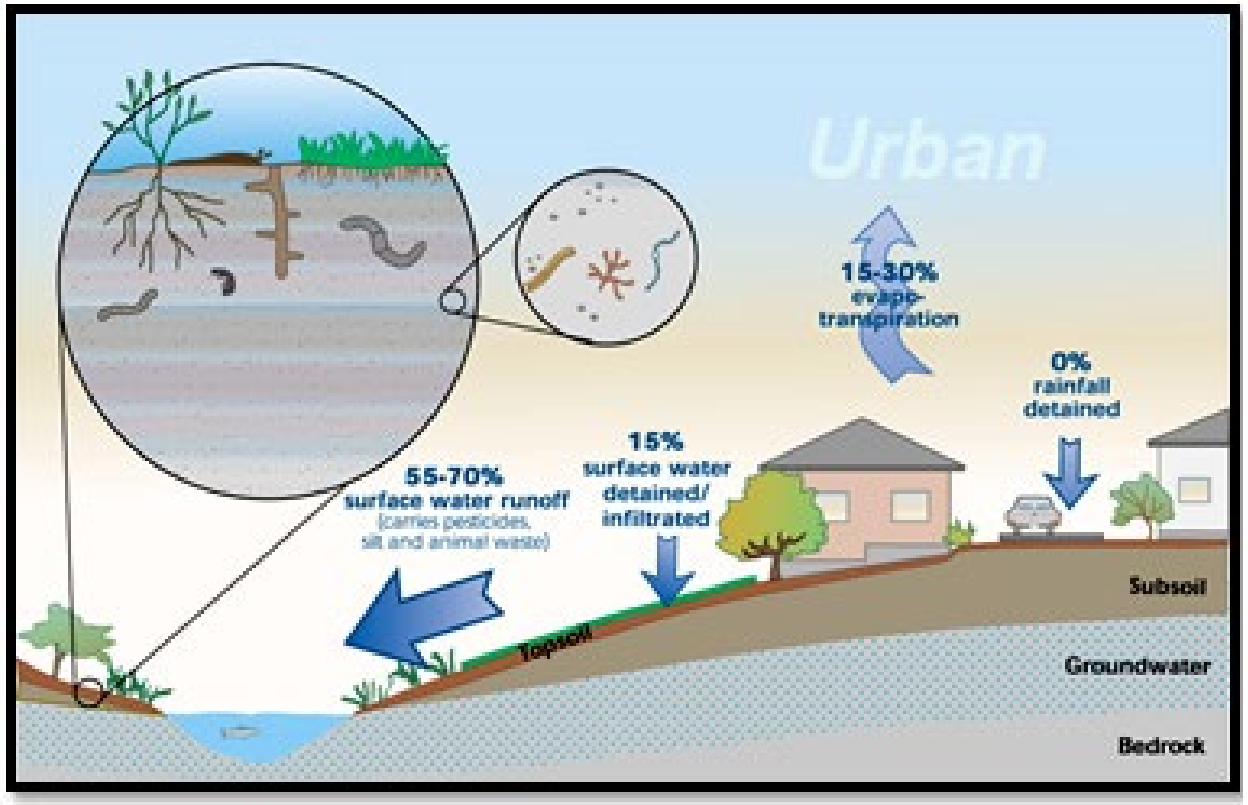

Replace Extractive Landscape Practices with Regenerative Practices

Urban park's soil needs to function like forest soil

Soils Like This.....

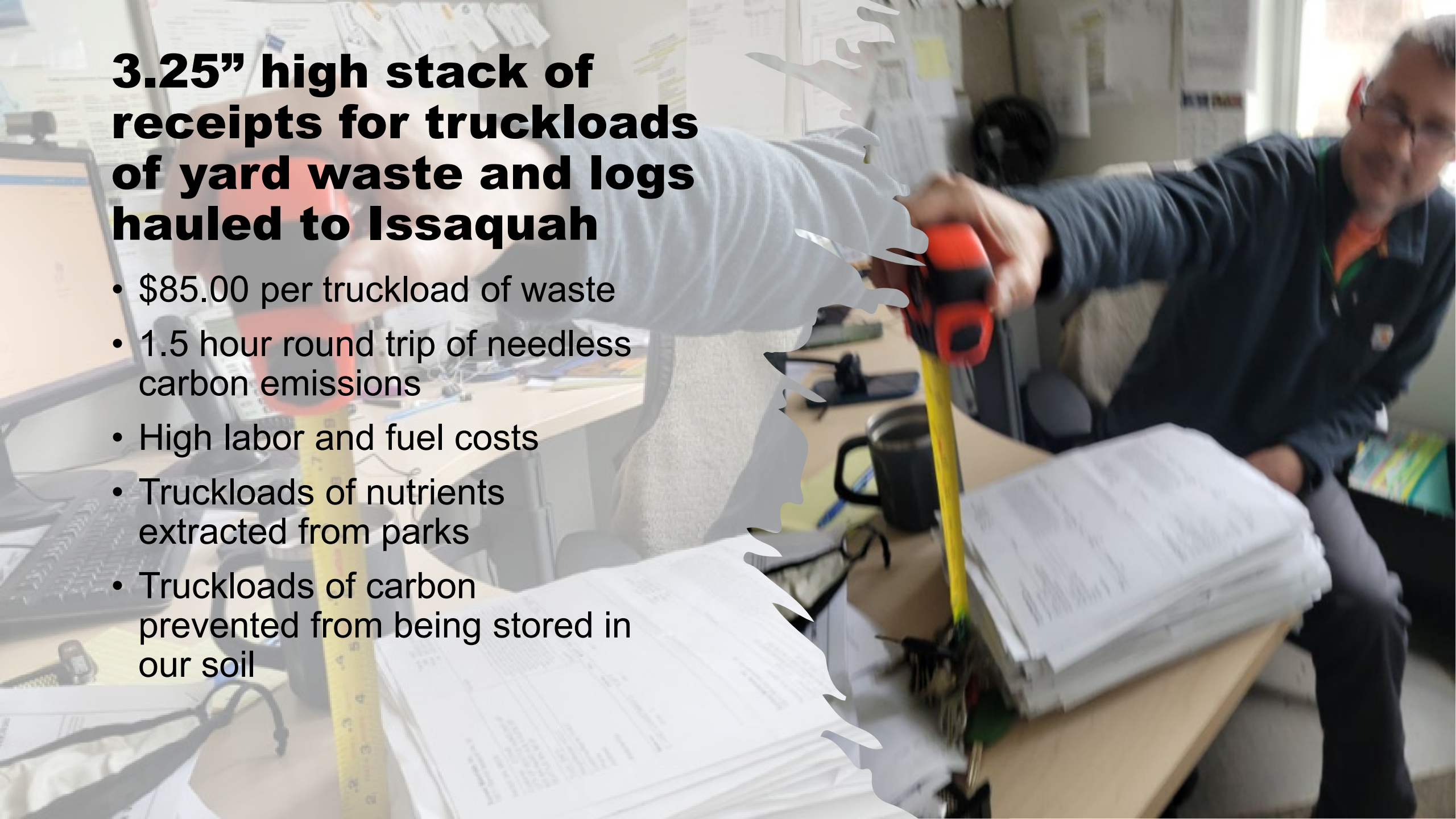


Not this.....



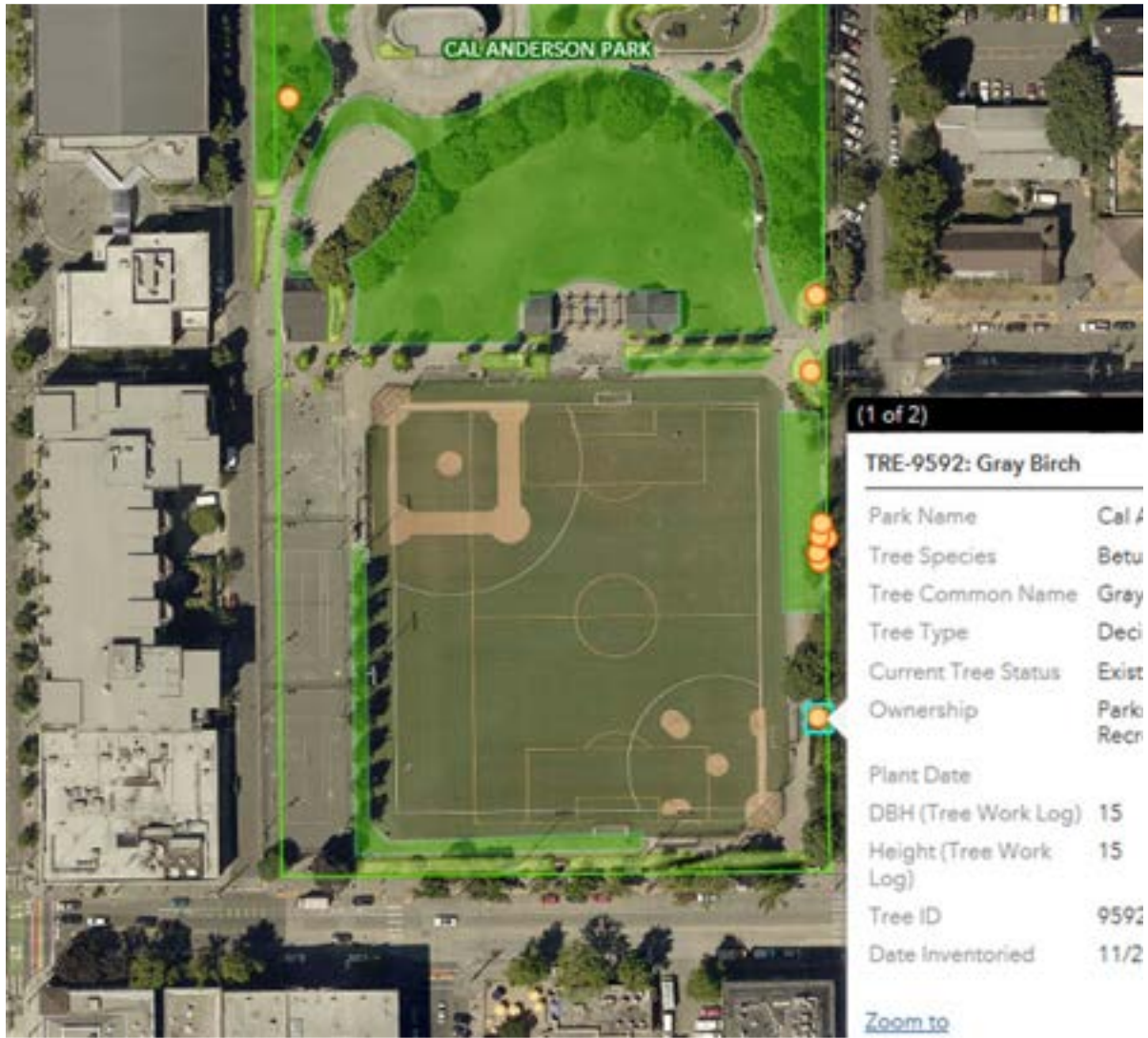
3.25” high stack of receipts for truckloads of yard waste and logs hauled to Issaquah

- $85.00 per truckload of waste
- 1.5 hour round trip of needless carbon emissions
- High labor and fuel costs
- Truckloads of nutrients extracted from parks
- Truckloads of carbon prevented from being stored in our soil



We mapped drought vulnerable trees in parks

- **Use Drought Vulnerable Tree Map to identify trees that need support**
- Prioritize zones to irrigate based on vulnerable trees
- Shift leaves where they're needed most
- https://seattlecitygis.maps.arcgis.com/apps/webappviewer/index.html?id=84790190c19842cca73e6419c2d33f1d&extent=-13618572.0832%2C6044114.0736%2C-13613985.8615%2C6046256.699%2C102100

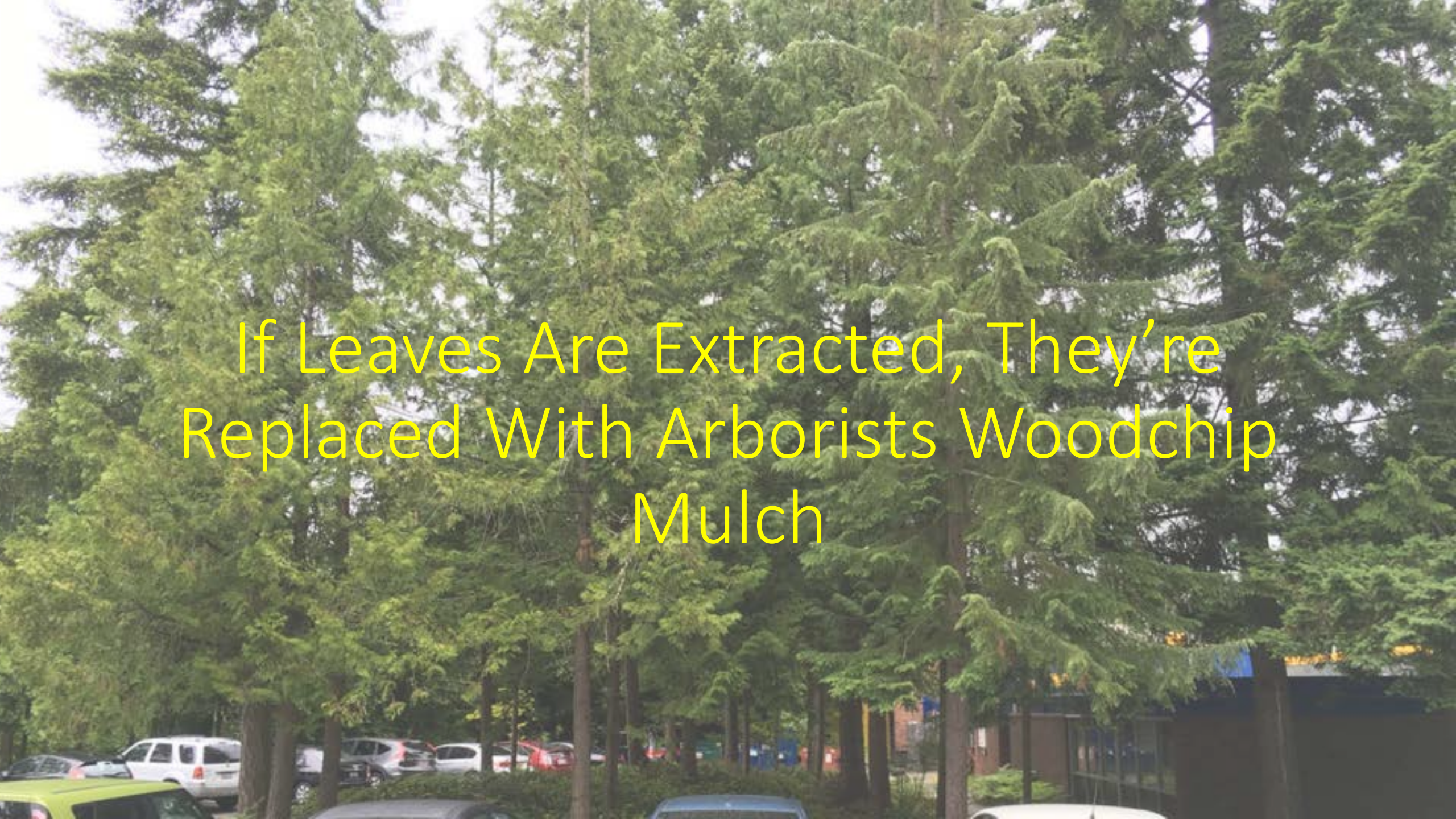


Save your lower back: Let nature do the work

Keep leaves and branches where they belong - on the ground!


Top with arborist woodchips to retain leaves

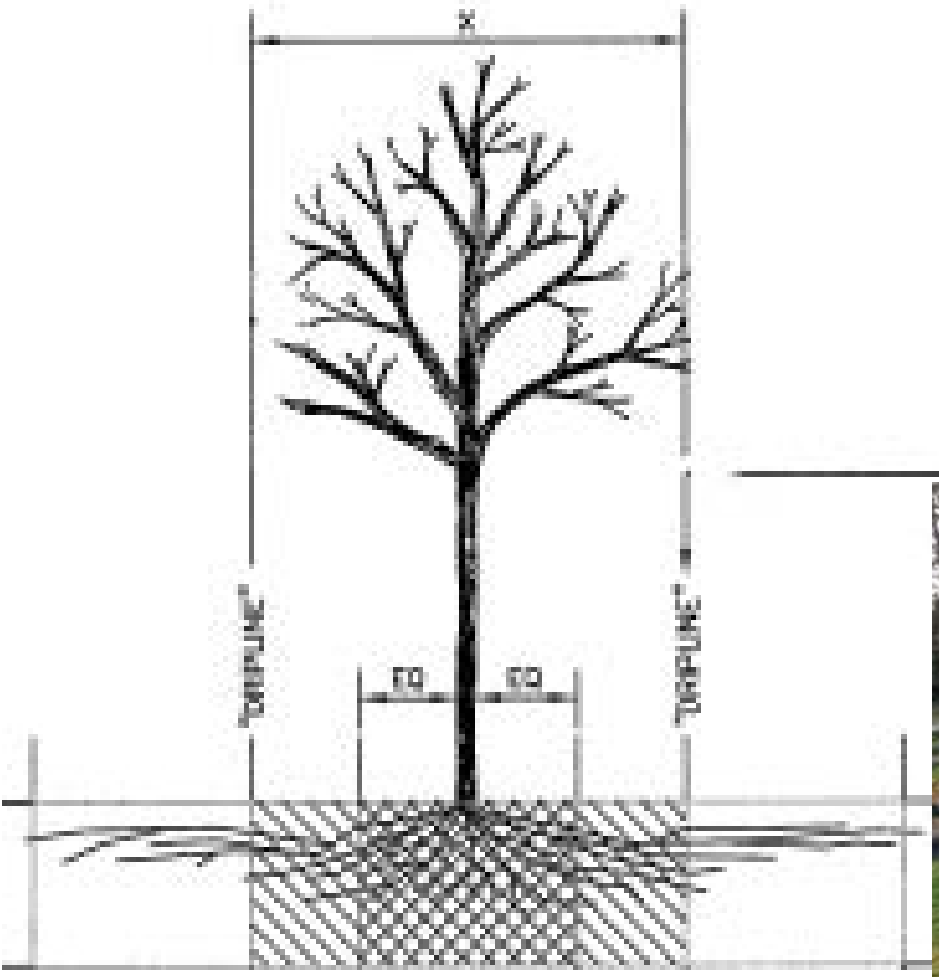
Preserve Trees with Less Work

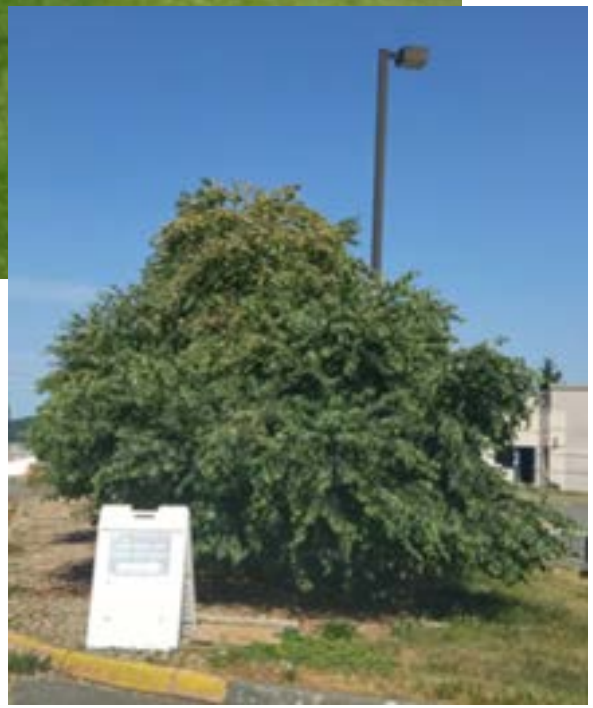

If Leaves Are Extracted, They’re Replaced With Arborists Woodchip Mulch

“Each 1 percent increase in soil organic matter helps soil hold 20,000 gallons more water per acre."

Source: Kansas State Extension Agronomy e-Updates, Number 357, July 6, 2012

Mulch to the dripline radius





Install safer, more efficient tree wells

This……

Not this……

Make tree preservation the priority

Do this….

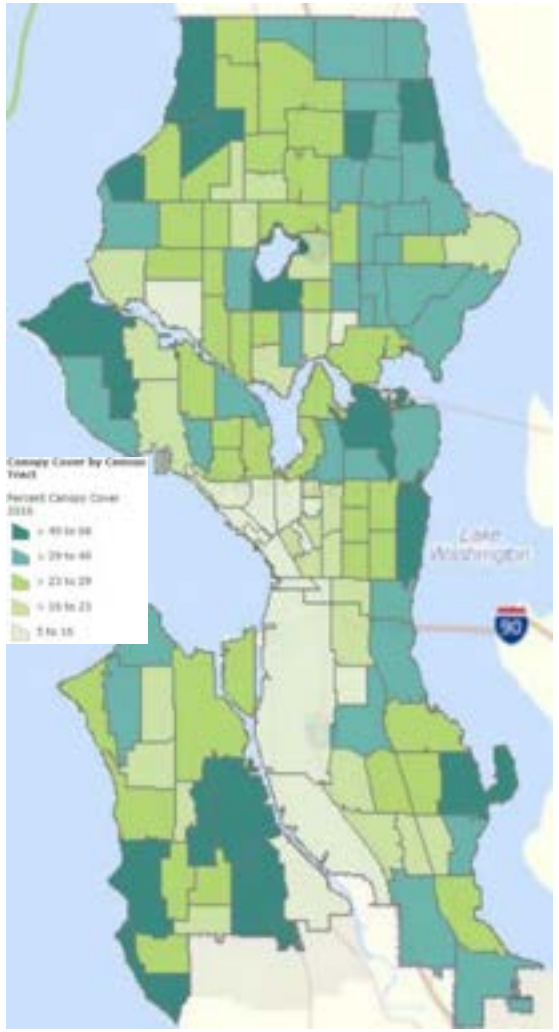
Not this….

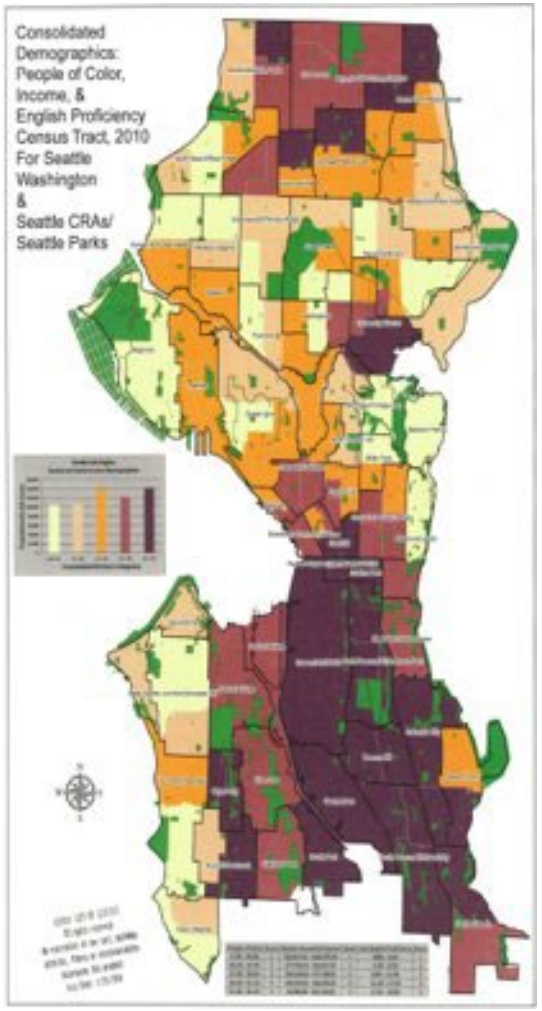
Mulching Do’s and Don'ts

- Don’t exceed 6” mulch depth
- **Don’t use bark-based mulch**
- Don’t use gravel mulch
- **Don’t use weed fabric**
- Don’t bury the root crown
- **Do** keep trunk free of mulch
- **Do** mulch to the dripline radius
- **Do** use arborist woodchip mulch
- **Do use burlap & cardboard**
- 3” depth minimum, **4”-6” is best**

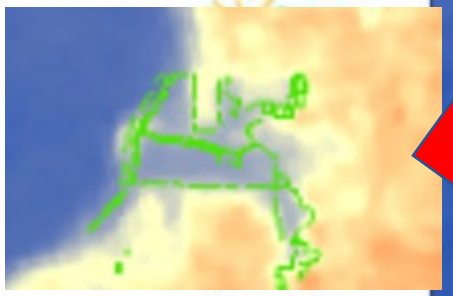
Future Plans for More Equitable Access to Cooling Shade

Seattle's Unintended History of Shade Removal & Social Injustice

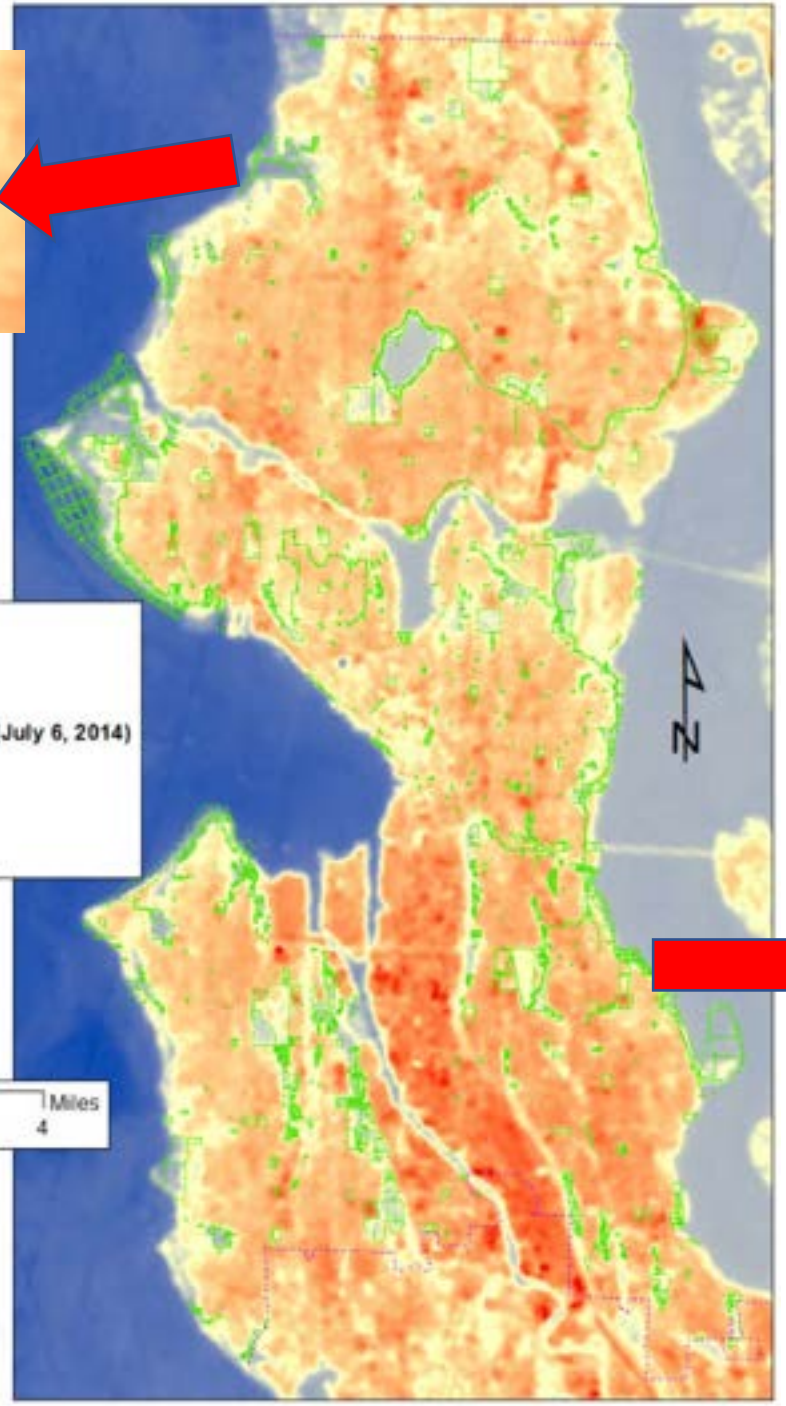


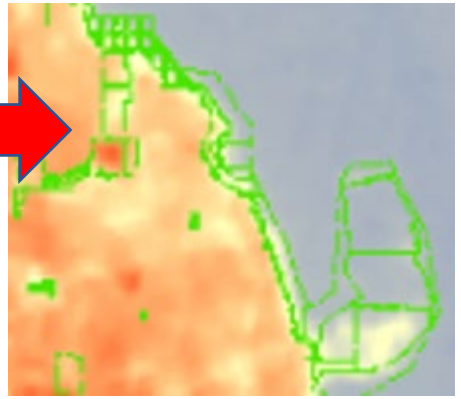


"We always have to be evaluating our climate goals against our equity goals to make sure that we further our climate goals and advance equity." Mayor Jenny A. Durkan



Heat &
Seattle Parks





Thermal imagery was taken by Landsat 8 satellite and provided by the U.S. Geological Survey.

Map Date: 7/10/2015

People want more shade in our parks

Hopeful Future Innovations

- Predeath tree replacement
- Dense tree groves, rather than vulnerable lone specimens
- Miyawaki Forests
- **Evergreen street tree requirement, special permission to plant deciduous**
- 50% canopy coverage over parking lots within 15 years
- Future climate tolerant
- Native to Cascade Bioregion
- Mowed turf less than 20% of urban landscapes


Thank you!

4 evergreens work as hard as 11’x12’ rain garden

City of Seattle Pre-Sized Flow Control Calculator (11-25-09)

Project Type →	Parcel-based Project
Flow Control Standard(s) →	Peak Flow Control Standard
New plus Replaced Impervious Area →	3,000 sf
Area Requiring Mitigation if Only GSI Used (70% Impervious area) →	2,100 sf
Area Requiring Mitigation if Traditional Facilities Used (100% Impervious Area) →	3,000 sf
Flow Control Standard Achieved? →	**FAIL**

GSI Runoff Reduction Methods			Facility Size				Credit		Area Mitigated
Retained Trees									
Existing Evergreen	# Trees	4	Total Canopy Area of Trees		sf	x	20% (or min 100 sf/tree)	=	400 sf
Existing Deciduous	# Trees	8	Total Canopy Area of Trees		sf	x	10% (or min 50 sf/tree)	=	400 sf
New Trees							Note: Maximum tree credit is 25% area requiring mitigation		
New Evergreen			# Trees	8		x	50 sf	=	400 sf
New Deciduous			# Trees	20		x	20 sf	=	400 sf
Dispersion									
Downspout or Sheet Flow Dispersion			Dispersed Impervious Area		sf	x	100.0%	=	sf

GSI Infiltration and Reuse Facilities			Facility Size			Sizing Factor		Area Mitigated
Infiltrating Facilities								
Bioretention Cell (without underdrain)								
Ponding Depth	6	in	Bioretention Bottom Area	135	sf	÷	0.331	= 408 sf
Design Infiltration Rate	0.25	ir						

Seattle's Master Tree List is Skewed Toward Continuation of a Deciduous Dominated City

Seattle's Master Tree List	
Evergreen	19
Deciduous	166
Total	185

SDOT Full tree list	
Alien Evergreen	12
Native evergreen	7
Alien Deciduous	153
Native Deciduous	13
Edible	3
Total Species	185