



# Urban Ecosystem Analysis Bellevue, Washington

Dan DeWald

Cheryl Kollin

Kevin LeClair

Elissa Ostergaard



# Historical Perspective

- Studies in the 1980s focused on street tree condition
- Cities losing 4 trees for every 1 planted (1986)
- No way to quantify whole urban forest
- GIS to show extent, composition, and benefits of entire tree canopy

# 2007 Land Cover

**37% trees**

**44% impervious**

**16% open space**

**<3% other**

**2 ft. pixel resolution,  
imagery**



**High Resolution  
Land Cover Classification**

Legend

Deciduous Trees	Paved Surfaces
Evergreen Trees	Buildings & Structures
Shrub	Trees over impervious
Open Space	Other Impervious
Bare	Water





Land cover analysis (in acres)

Category	Acres	Percentage
Impervious Surfaces	2,131.0	10.0%
Impervious Surfaces: Buildings/structures	3,947.7	16.9%
Impervious Surfaces: Paved	4,884.4	21.0%
Open Space - Grass/Scattered Trees	3,185.8	15.8%
Shrub	538.6	1.6%
Trees	7,708.3	34.1%
Trees: Impervious canopy	408.1	1.9%
Urban: Bare	105.2	0.5%
Water Area	120.3	0.6%
<b>Total</b>	<b>71,377.4</b>	<b>100.0%</b>

Total Tree Canopy: 7,708.3 acres (36.1%)

**Air Pollution Removal**

Nearest Air Quality Reference City: Seattle

	Lbs. Removed/yr	Dollar Value
Carbon Monoxide	41,728	\$17,594
Ozone	226,733	\$896,634
Volatile Organic	101,000	\$316,637
Particulate Matter	313,010	\$436,930
Sulfur Dioxide	103,000	\$77,350
<b>Totals:</b>	<b>685,471</b>	<b>\$1,845,145</b>

**Carbon Storage and Sequestration**

Total Tons Stored:	331,701.48
Total Tons Sequestered (Annually):	2,582.38

**Stormwater**

**Water Quantity (Runoff)**

Typ. 24-hr Rainfall: 2.50 in.

Curve Number reflecting existing conditions: 81  
Curve Number using default replacement landcover: 93

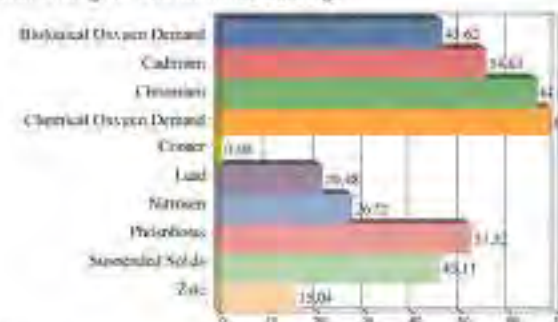
Additional Storage volume needed: 61,344,489 cu. ft.  
Construction cost per cu. ft.: \$2.00

Total Stormwater Savings: \$123,288,978

Annual costs based on payments over 20 years at 6% interest: \$10,748,895 per year

**Water Quality (Contaminant Loading)**

Percent Change in Contaminant Loadings



# Analysis Report

▪ Landcover

▪ Air Pollution Removal

▪ Stormwater runoff and Water Quality

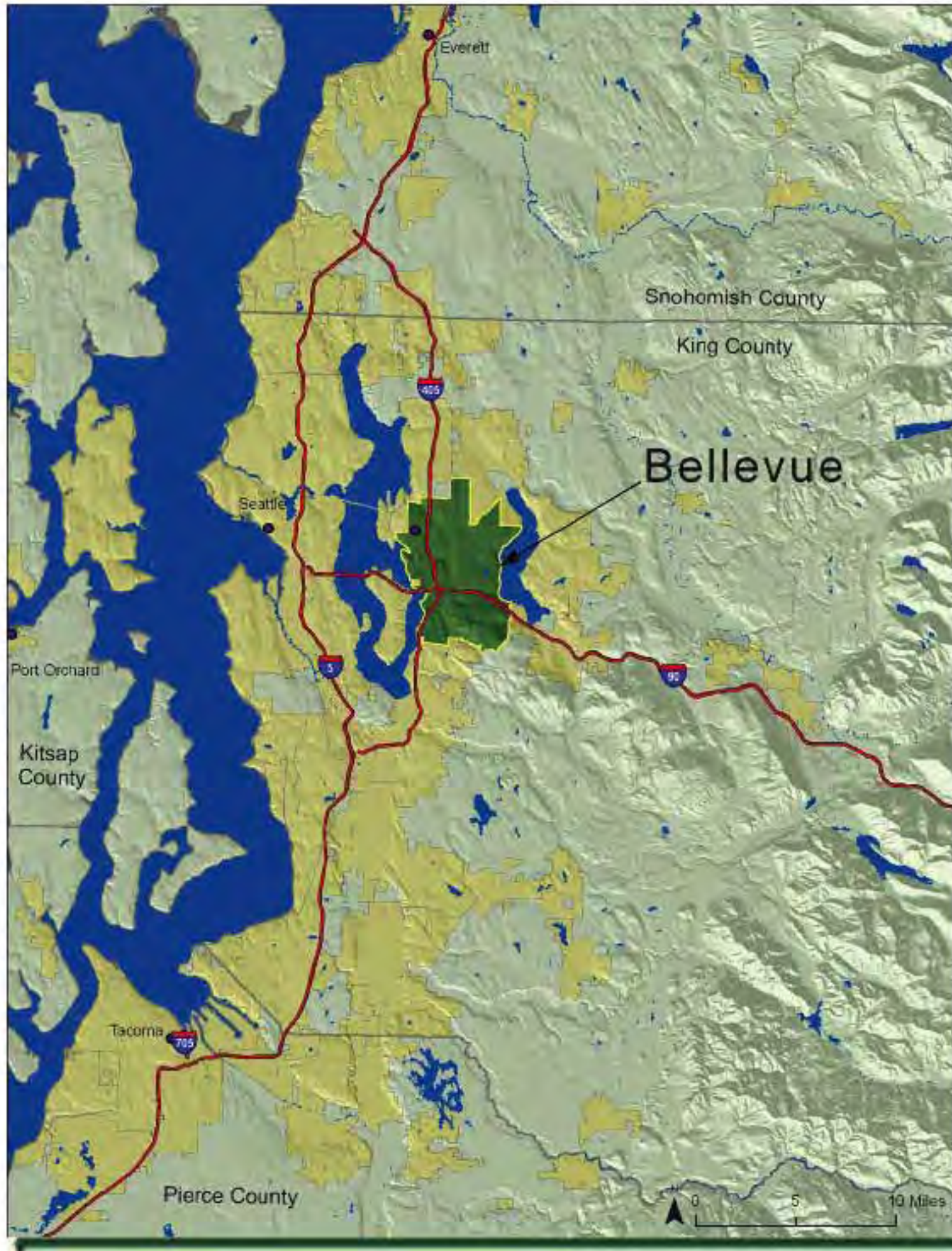
▪ Carbon

# Why Set Canopy Goals?

- Canopy has declined 30% ; urban areas increased 20%
- Can't see the forest for the trees
- Canopy related to environmental quality
- Quantify canopy cover and how it affects air and water quality, infrastructure costs.

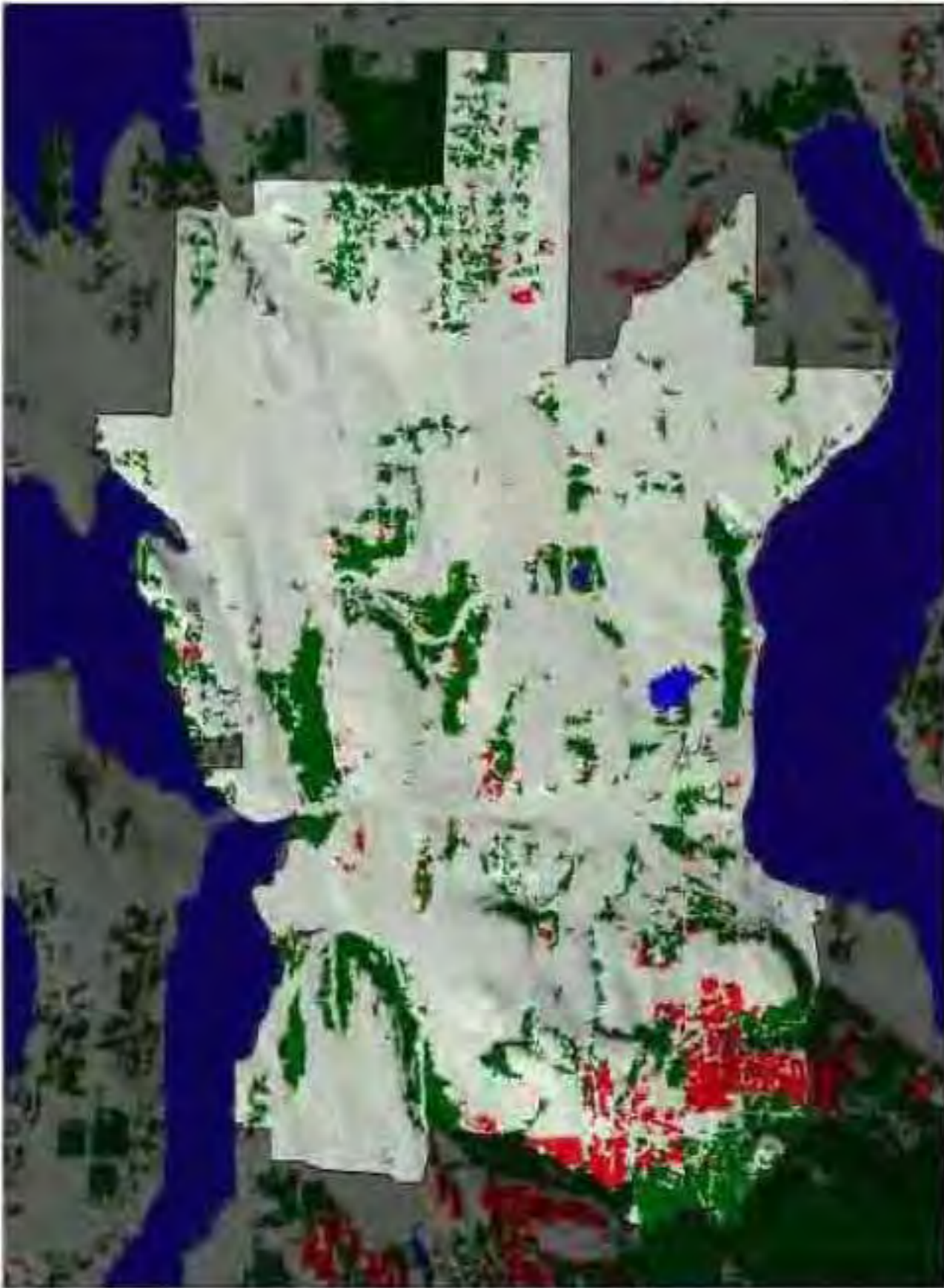
# Starting Point Canopy Goals

- **For metropolitan areas east of the Mississippi and in the Pacific Northwest:**
  - Average 40%
  - Suburban residential 50%
  - Urban residential 25%
  - Central business districts 15%
- **For metropolitan areas in the Southwest and dry West:**
  - Average 25%
  - Suburban residential 35%
  - Urban residential 18%
  - Central business districts 9%

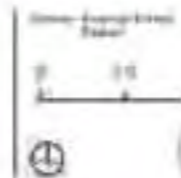


# Bellevue, WA Project Goals

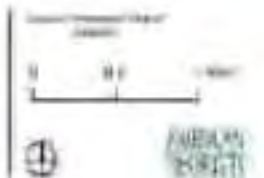
- **Landcover Analysis**
- **Ecosystem Benefits**
- **Landuse**
- **Recommended  
Tree Canopy Goals**



**Tree Loss 1985 - 1996  
Landsat Analysis**



**Tree Loss 1996 - 2006  
Landsat Analysis**



# Bellevue's Landuse

## Three Ownership Categories

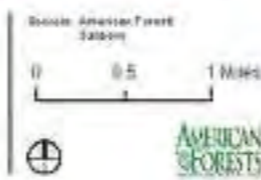
- Private Property: 69%
    - Central business district, commercial and mixed use, residential, and industrial
  
  - City Owned 12%
    - Parks and open space
  
  - Public Right-of-Way 19%
-



**Commercial and Mixed Use Zoning**

**Legend**

- |   |  |
|---|--|
|  Deciduous Trees |  Paved Surfaces         |
|  Evergreen Trees |  Buildings & Structures |
|  Shrub           |  Trees over Impervious  |
|  Open Space      |  Other Impervious       |
|  Bare            |  Water                  |



## Commercial and Mixed Use

- 2,340 acres tree canopy
- Air Pollution Removal
  - 45,000 lbs valued at \$101,000/yr
- Stormwater Value
  - 4.1 million cubic ft. valued at \$8.4 million
- Carbon
  - Stored: 22,000 lb.
  - Sequestered 169 lbs./yr.

# Recommended Landcover

Landuse	Canopy %	Recommended	Difference
Citywide	37%	40%	-3%
Urban Res.	30%	35%	-5%
Suburban Res.	35%	50%	-15%
CBD	7%	15%	-8%
Mixed Use	21%	25%	-4%
Industrial	20%	25%	-6%



Right-of-Way Zoning

Legend

- |   |   |
|---|---|
| <span style="color: green;">■</span> Deciduous Trees      | <span style="color: grey;">■</span> Paved Outcrop             |
| <span style="color: lightgreen;">■</span> Evergreen Trees | <span style="color: black;">■</span> Buildings & Structures   |
| <span style="color: yellow;">■</span> Street              | <span style="color: lightgrey;">■</span> Trees and Impervious |
| <span style="color: white;">■</span> Open Space           | <span style="color: darkgrey;">■</span> Other Impervious      |
| <span style="color: brown;">■</span> Base                 | <span style="color: blue;">■</span> Water                     |



# Public ROW

**Current: 20% tree canopy**

**Tree Canopy Increased 5%**

- **Additional Air Pollution Removal**
  - 18,800 lbs valued at \$42,000/yr.
- **Stormwater Value**
  - 1.86 million cubic ft. valued at \$3.7 million
- **Carbon**
  - Stored: 9,000 lb.
  - Sequestered 70 lbs./yr.

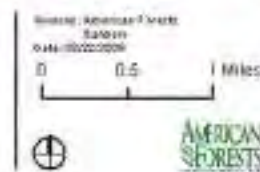
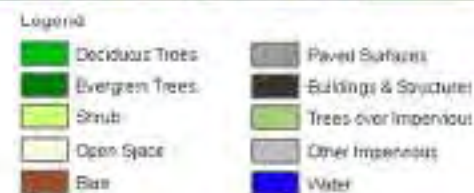
# Central Business District

If 15.5 acres of trees with impervious understory were changed to pervious surface...

...it would provide an additional 269,000 cu. ft. stormwater management, valued at \$537,000



Central Business District Zoning



# City of Bellevue Environmental Stewardship Initiative

## Green Infrastructure Master Plan

- Comprehensive Tree Plan
  - Natural Drainage Practices
  - Green Buildings
  - Climate & Energy
-

## Urban Ecosystem Analysis

Bellevue, Washington

October, 2018



AMERICAN  
FORESTS  
A WORLD OF FORESTS

<http://www.bellevuewa.gov/environmental.htm>

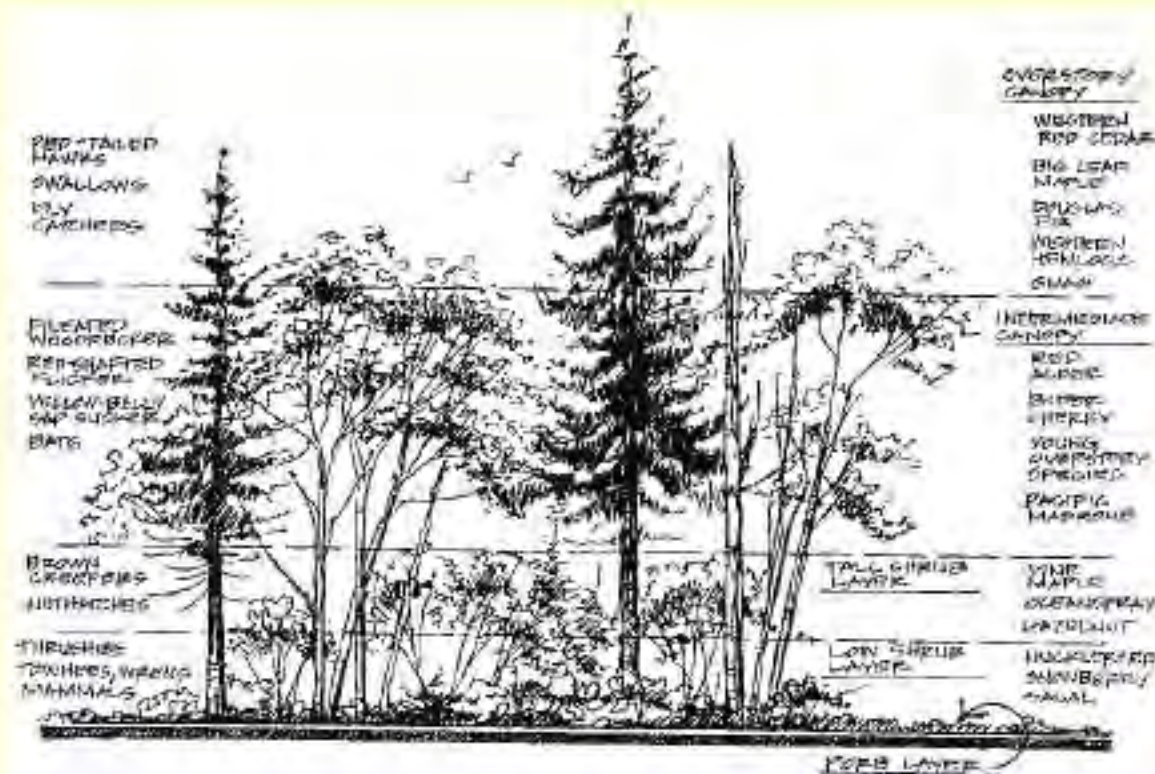
# Three-Pronged Approach

## 1. City Parks and Open Space

- Improve the health of existing urban forest
  - For all classes of tree canopy
  - To a healthy and sustainable state
- Share data with other city departments
  - Stream buffers
  - Planning: development scenarios

# Environmental Stewardship Initiative

## Enhanced Forest Management - \$50,000



# FOREST CONDITION ASSESSMENT STUDY

1900 Acres - Forest and Natural Area

100 – 1/10th Acre Plots

- **Class 1 – Healthy and sustainable.** Primarily coniferous overstory, native tree regeneration present – multiple age classes, healthy shrub and forb layer, invasive species not present to minimal.
  - **Class 2 – Mixed Forest with Invasive.** Mixed coniferous - deciduous forest, successional stage moving from pioneering to mid-successional, some native tree regeneration present, native shrub and understory present, invasive species present and competing.
  - **Class 3 – Deciduous Forest with Invasive.** Primarily deciduous overstory and a single age class, overstory declining in condition, native tree regeneration not present to minimal, native shrub and understory competing with invasive species.
  - **Class 4 – Deciduous to Non Forested.** Deciduous tree overstory dead and/or in decline and site is dominated by high levels of invasive species
-

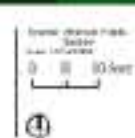
# Forest Enhancement



**Class 1**  
High Resolution  
Land Cover Classification



**Class 4**  
High Resolution  
Land Cover Classification



Class 1 – stormwater = \$65,000 acre

Class 4 – stormwater = \$26,000 acre

# Environmental Stewardship Initiative

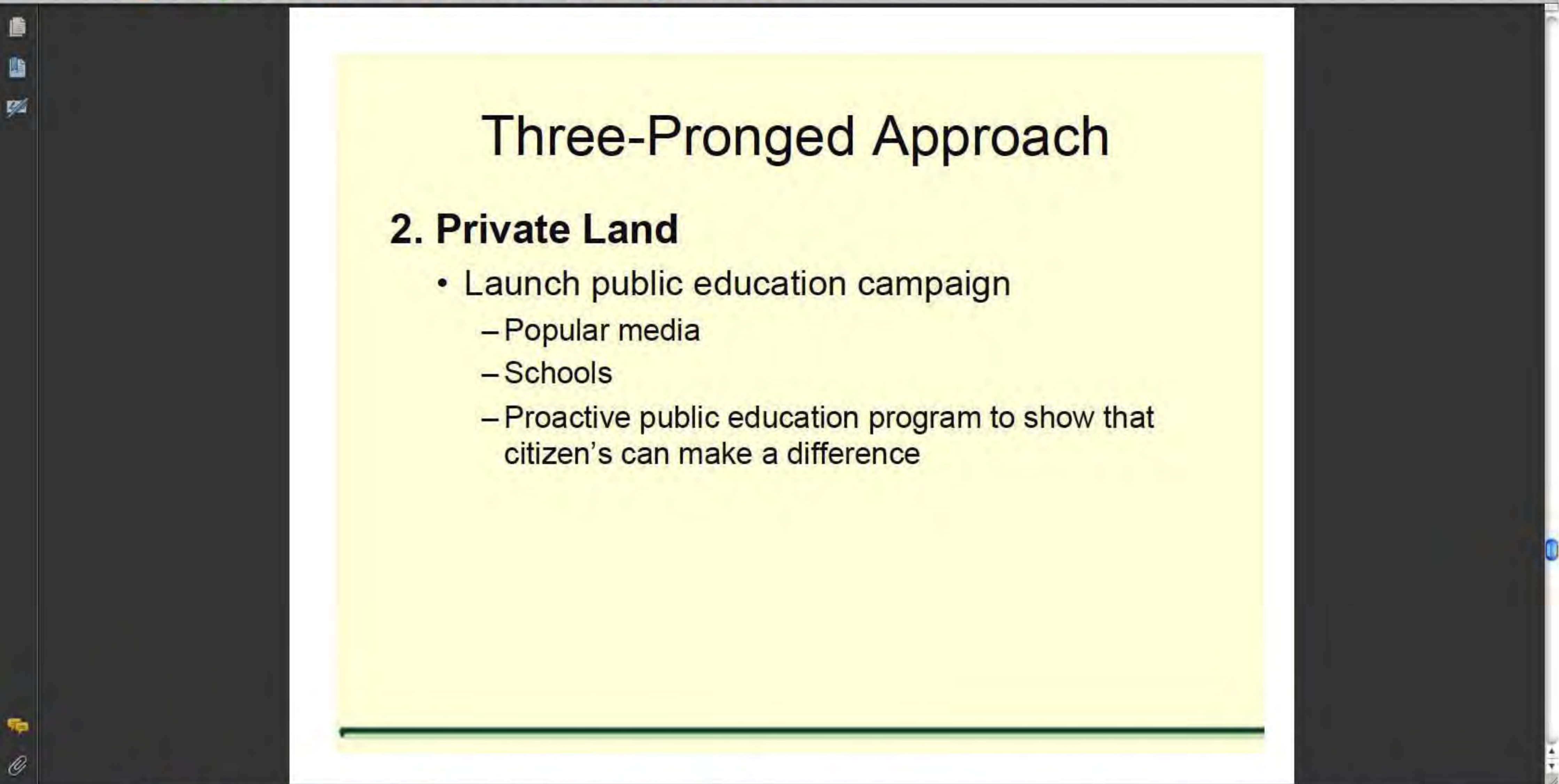
## Enhanced Forest Management - \$50,000



# Three-Pronged Approach

## 2. Private Land

- Launch public education campaign
  - Popular media
  - Schools
  - Proactive public education program to show that citizen's can make a difference





## NEWS RELEASE

FOR IMMEDIATE RELEASE: Friday, December 5, 2008

CONTACT: Sheida Sahandy, Assistant to the City Manager  
Eus: (425) 452-6168

### City Council endorses environmental measures

**BELLEVUE** – The Bellevue City Council has endorsed additional steps in a comprehensive Environmental Stewardship Initiative.

The steps, designed to expand existing efforts, will focus on the city's tree canopy, the expansion of recycling efforts at parks and ball fields, natural drainage practices and "green" buildings.

"Our community has a proud tradition of being a strong steward of the environment," said Mayor Grant Degginger. "This initiative will help us build on that tradition in significant ways."

Over the years, Bellevue's ongoing environmental programs have helped earn the city the nickname "City in a Park." Last year, Council members asked staff to review those programs as part of a broader, citywide strategic initiative.

Earlier this year, the Council, as part of that initiative, approved a Bellevue Climate Action resolution to reduce the city's greenhouse gas emissions.

Under the steps approved last week, Council members agreed to immediately fund an updated study of the city's tree canopy with the goal of enhancing the city's urban forest. The city last commissioned a tree canopy study in 1999. Information from the study will be used to determine future canopy targets and prioritize activities such as tree planting.

Staff will also explore specific activities such as expanded tree planting and restoration activities in city rights of way, and tree education and assistance programs for private property owners.

In other steps approved by the Council, the city will:

- Significantly expand its existing recycling program at community and beach parks and school ball fields maintained by the city. At present, recycling containers are located at

- Neighborhood Character Phases I & II

- Critical Areas Training and Information Handouts

- Tree Pruning Guidelines

- Updated Tree Protection Standards

- Expanded Neighborhood Tree Retention

# Three-Pronged Approach

## 3. Public Right-of Way

- Provide more pervious paving as canopy understory
- A 5% change = 137,000 cu. ft. stormwater managed valued at \$274,000
- Initiate active public tree planting program to meet increased tree goals within the ROW
- A 5% increase in canopy = 1 million cu. ft. stormwater managed valued at \$2 million

# Natural Drainage Practices

- New Storm and Surface Water Engineering Standard to include NDPs – Update January 1, 2010
- 46% of the City land base is impervious surface
- [http://www.bellevuewa.gov/utilities\\_codes\\_standards\\_intro.htm](http://www.bellevuewa.gov/utilities_codes_standards_intro.htm)



City of Bellevue – SE 8<sup>th</sup> Street

**From:** Deep Root Partners, L.P. [Deep\_Root\_Partners\_LP@mail.vresp.com]  
**Sent:** Monday, December 07, 2009 8:02 AM  
**To:** Dewald, Dan  
**Subject:** Silva Cell earns "General Use Designation" by WA DOE

**DeepRoot**



Washington Department of Ecology identifies the Silva Cell system as "functionally equivalent to a rain garden."

DECEMBER 2009

SILVA CELL



CITY OF BELLEVUE  
UTILITIES DEPARTMENT

# ENGINEERING STANDARDS

Chapter D9  
Natural Drainage Practices



[http://www.bellevuewa.gov/utilities\\_codes\\_standards\\_intro.htm](http://www.bellevuewa.gov/utilities_codes_standards_intro.htm)

# Environmental Stewardship Initiative

## Enhanced Right-of-Way - \$50,000





**American Forests**  
**Urban Ecosystem Center**  
[www.americanforests.org](http://www.americanforests.org)

**City of Bellevue**  
**Resource Management & Natural Resources**  
[http://www.ci.bellevue.wa.us/natural\\_resources.htm](http://www.ci.bellevue.wa.us/natural_resources.htm)