PLANTING THE SEEDS OF SUCCESS.

One Million Trees in SLC: New Research and Technologies You Can Use

Greg McPherson
USDA Forest Service,
PSW Research Station

Utah Green Annual Conference

Center for Urban Forest Research

Vision

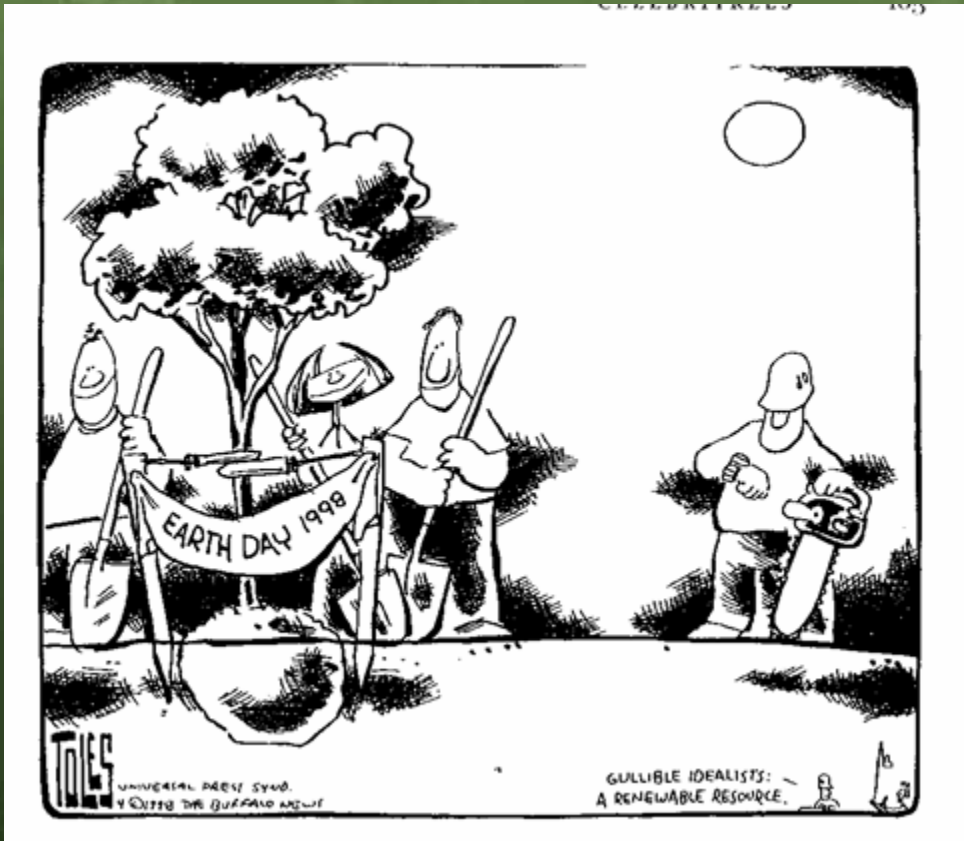
Agenda Today

- Tree Planting Initiatives
- Tree Canopy Cover and Benefits
- Implementing Tree Planting Programs

Tree Planting Initiatives

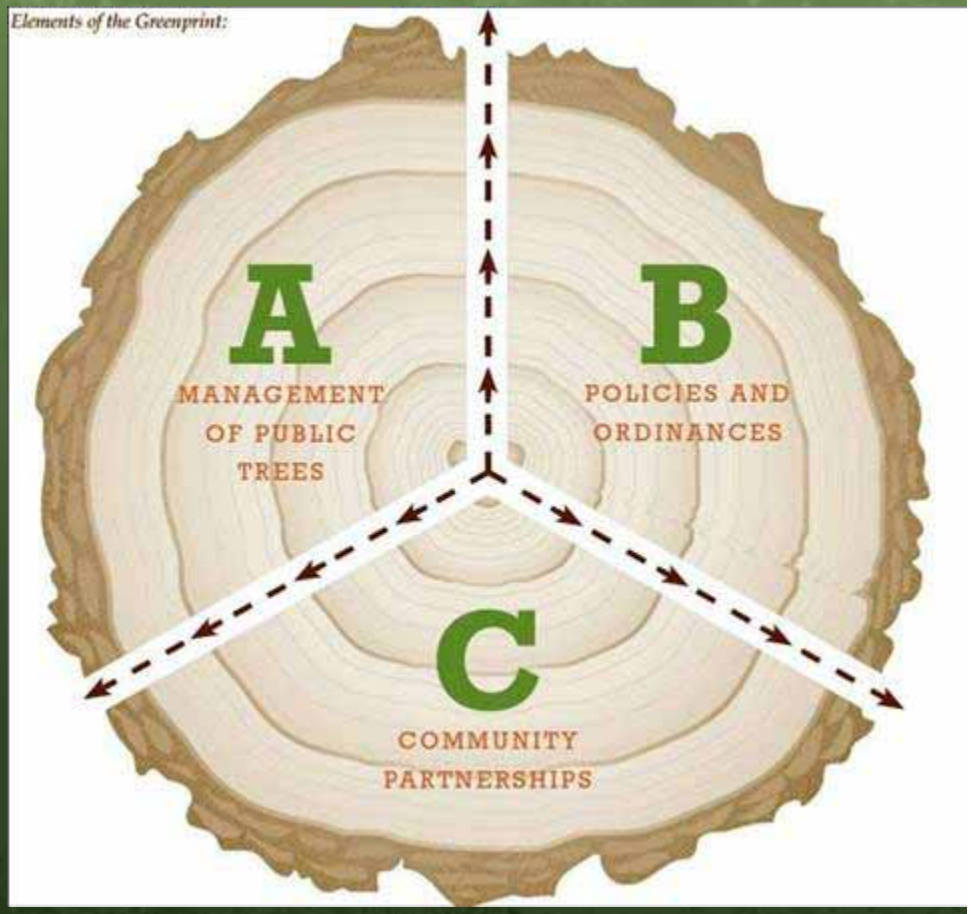
Rhetoric or Reality?

- Leadership
  - Invested
  - Beyond tree planting
- Management
  - Capacity, quality
  - Unifying
- Program
  - Planning
  - Partnerships
  - Decision-making
  - Outcomes/Monitoring
  - Accountability/Reporting



Building the Best Urban Forest

- Veg Resource
  - Canopy cover
  - Diversity
  - Native veg
- Veg Mgmt
  - City-wide plan
  - Funding
  - Staffing
  - Assessment tools
  - Protect existing trees
  - Species and site selection
- Community Framework
  - Public agency coop
  - Involve large landholders
  - Green industry coop
  - Neighborhood action
  - City-govt-business interaction
  - Regional cooperation



AIR
AIR HERE
IS FREE
The Least You
Can Do Is Roll
The Damn Hose.

Why Tree Canopy Cover?

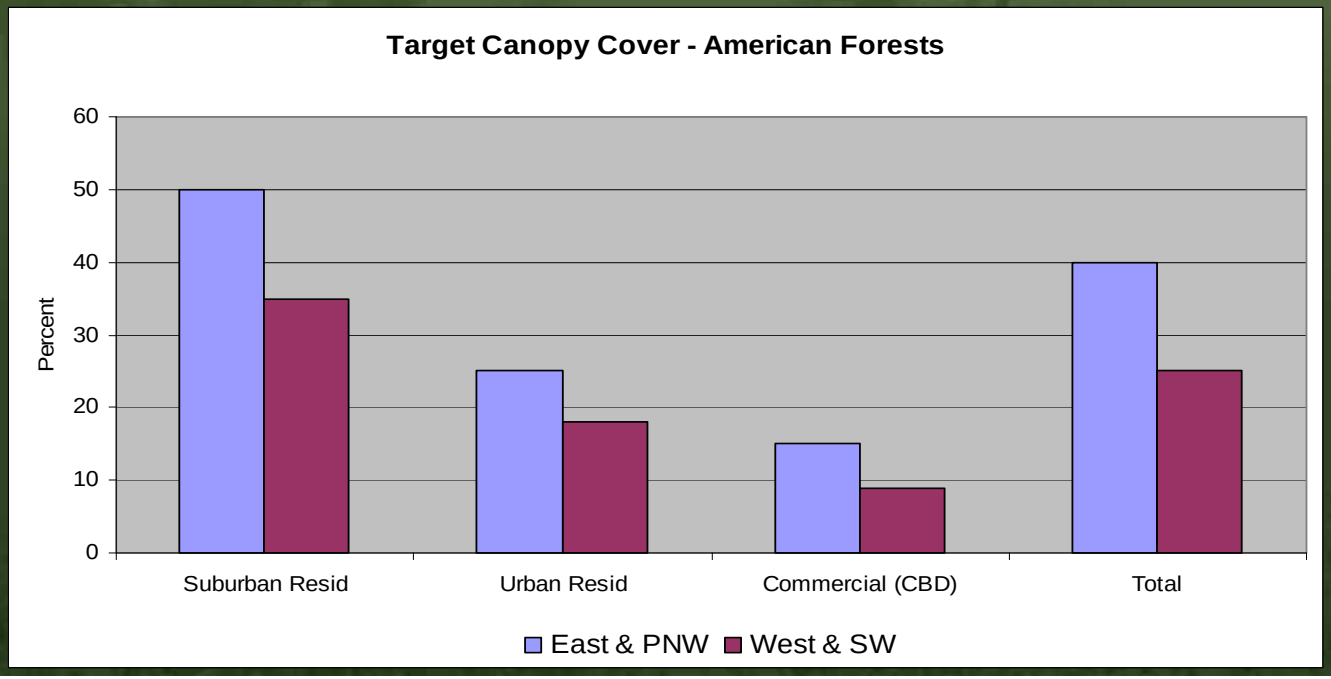
- Percentage of area on ground covered by tree crowns
  - Easy number to obtain
  - Standard number – size of area does not matter
  - Good performance measure
    - Across time and space
  - Easy to understand

Terms

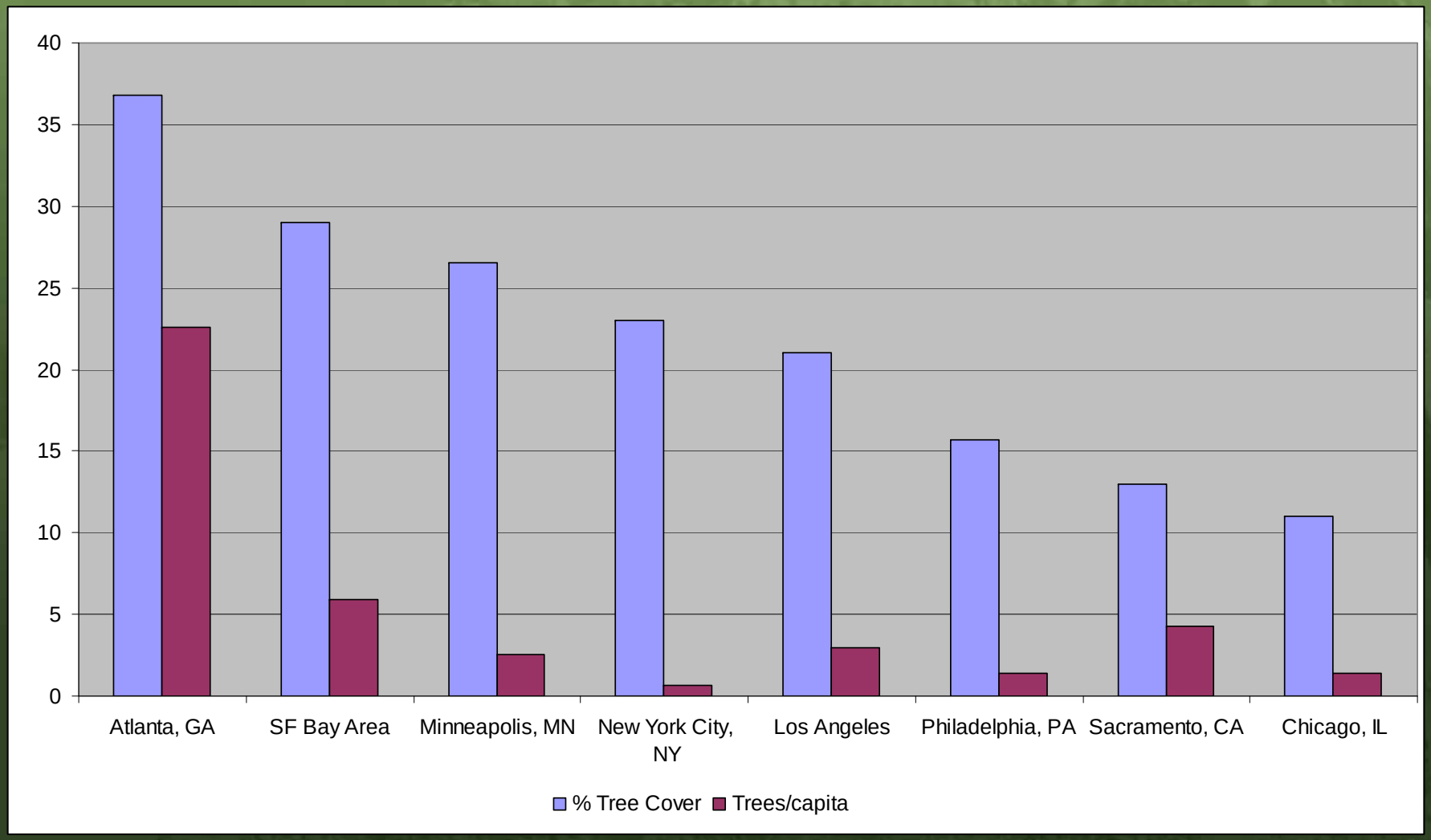
- Existing TCC
  - Classification accuracy
- Potential TCC
  - All potential sites
    - Excludes tree planting in paved areas
    - Assumes all potential sites plantable
- Market Potential
  - Accounts for sites that are not plantable
  - SMUD survey: 25% said don't want trees
- Target TCC – Between Existing and Market Potential

Canopy Cover Targets

- No widely adopted targets
- Local climate
- Land use and historic development patterns
- Future development patterns
- High but realistic to maximize potential benefits



TCC Comparison



Remote Sensing and GIS Data

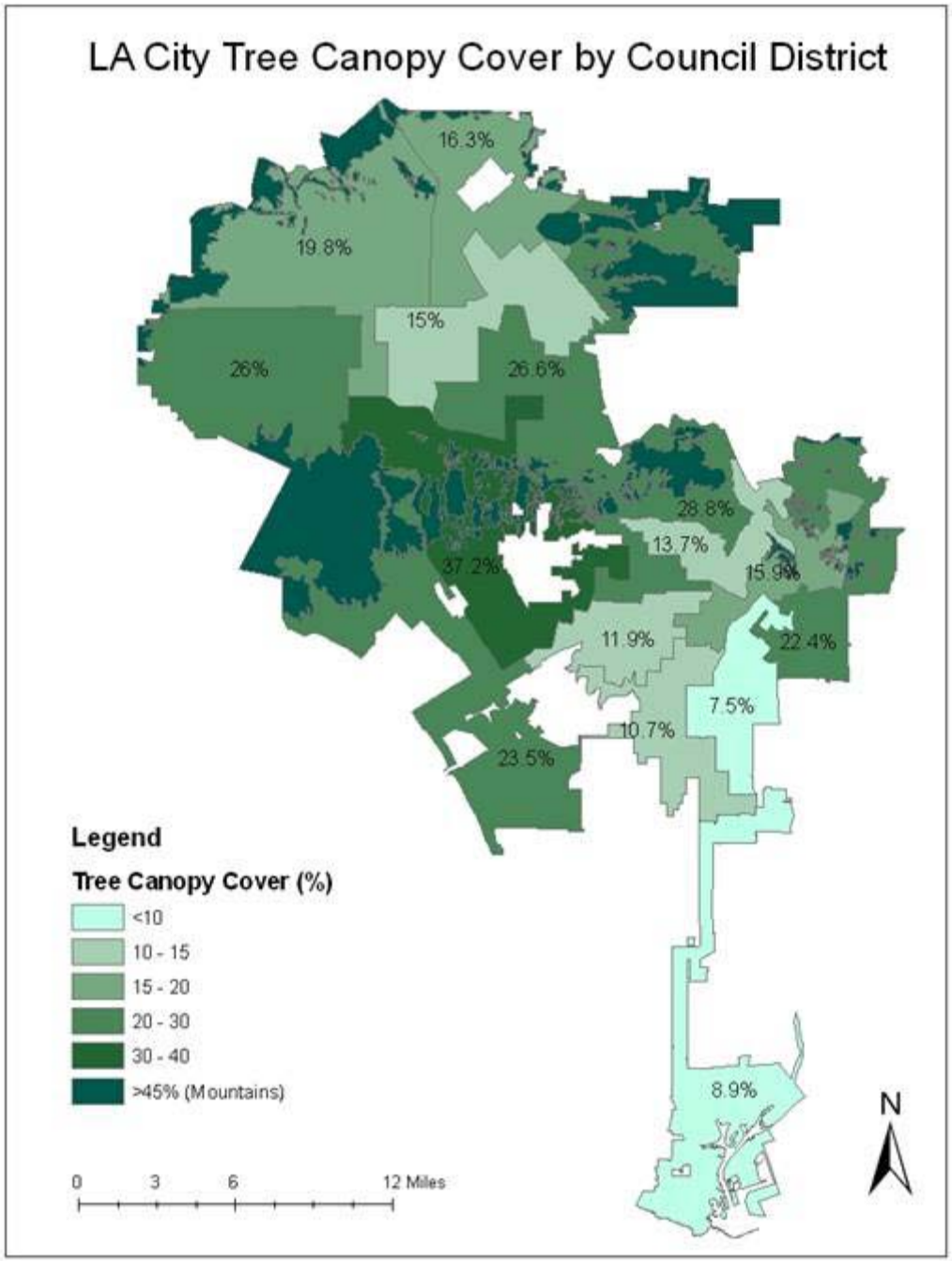
- Satellite Imagery
  - LandSat Thematic Mapper (30 m)
  - Quickbird (2002-2005) (60 cm, 2.4 m)
- Digital Aerial Imagery (1 ft)
- Digital Land Use Maps
- Other Base Maps
  - Council districts & Neighborhoods
  - Census data
  - Highways, major streets

Los Angeles Million Tree Canopy Cover Assessment

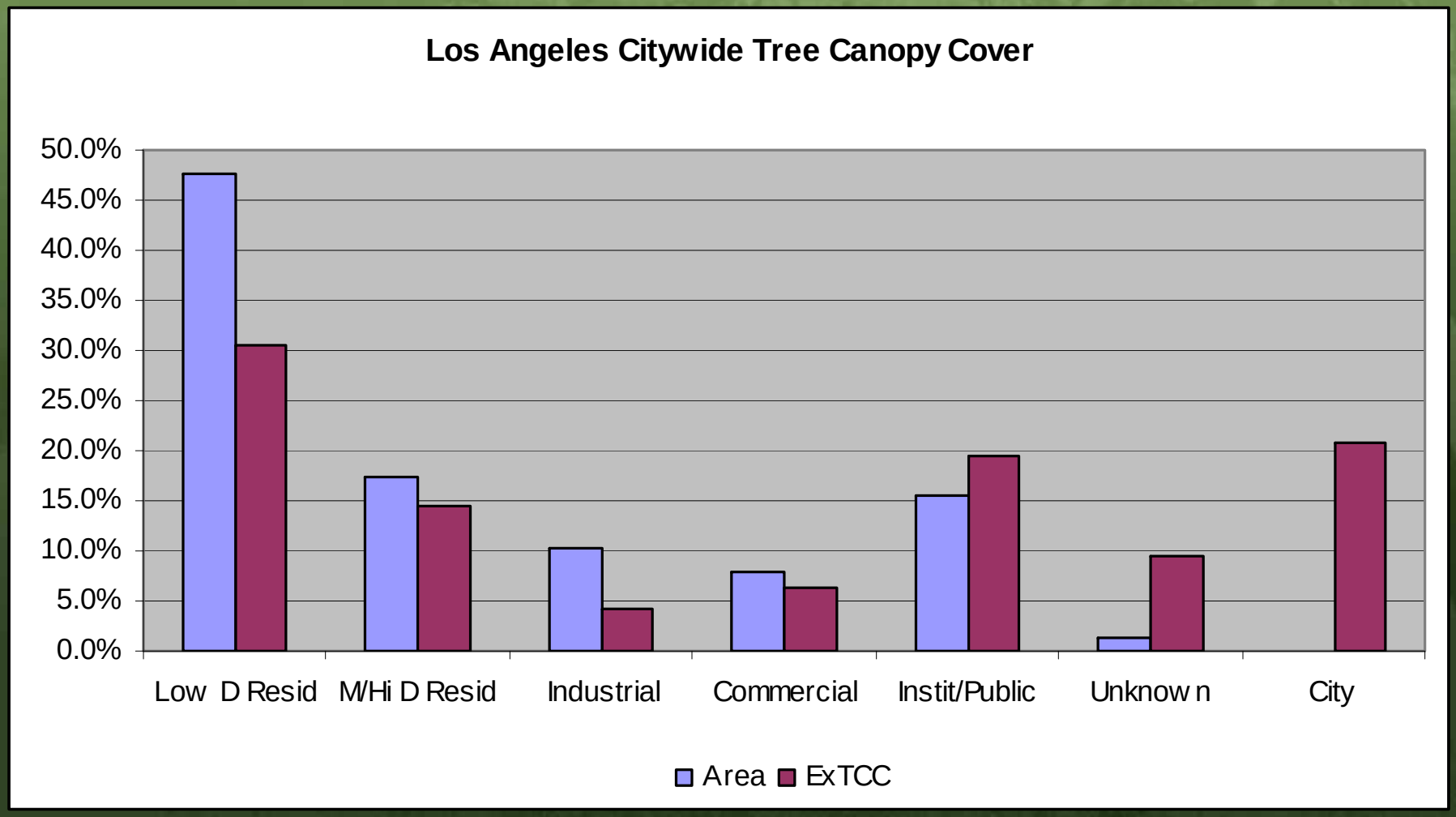
- Study Goals
  - Current tree canopy cover
  - Number and type of potential tree planting sites
  - Value of ecosystem services for 40 yrs

Results – Existing Canopy

- 21%
- 10.7 mil1ion trees
- 8%-37%



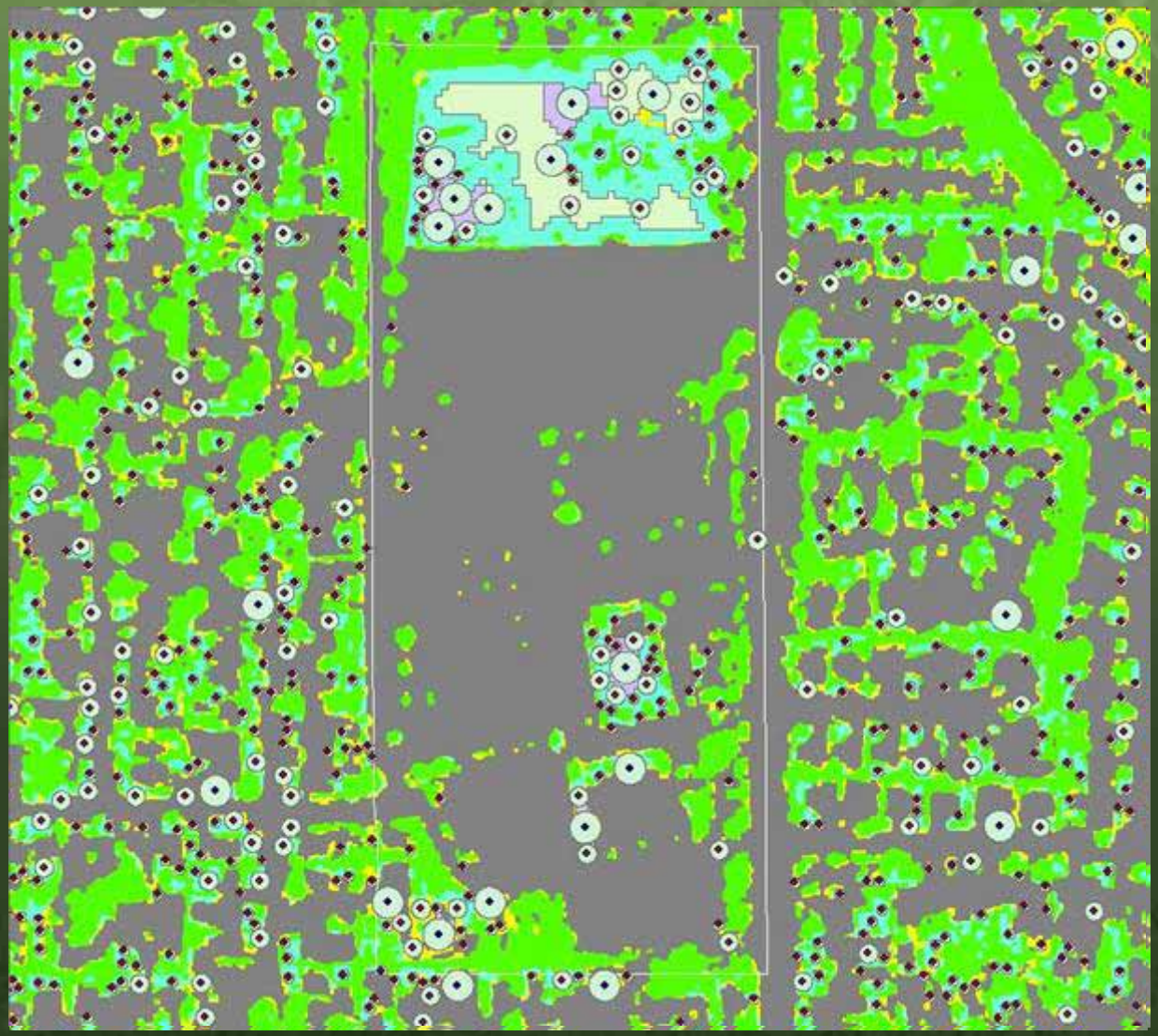
Results – Existing Canopy



Method for Potential TCC

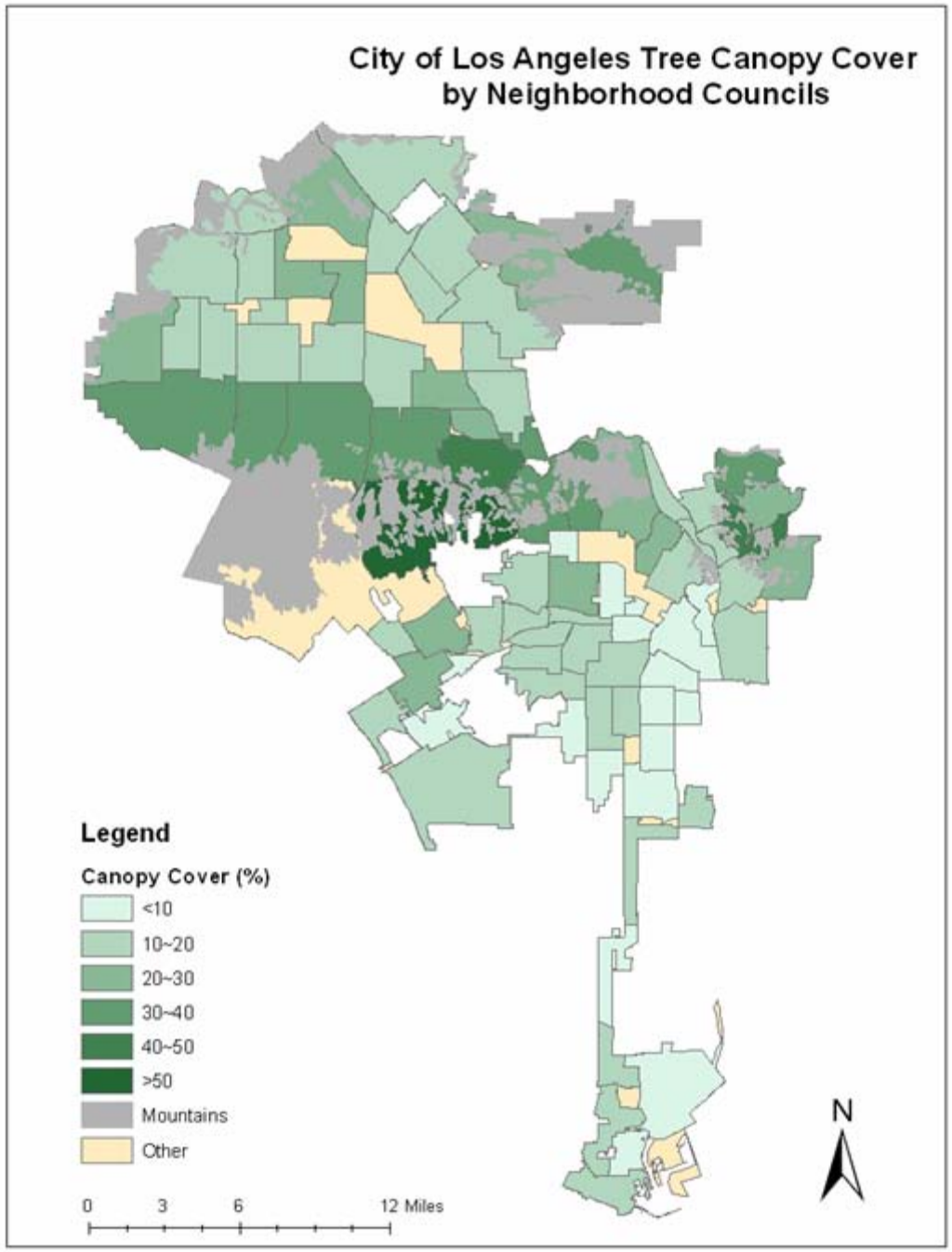
- Potential Tree Canopy Cover
  - Grass area without tree canopy
  - Tree trunk 2-ft min from paving & building
  - Tree crowns don't overlap
  - Largest stature trees first
  - Reiterate for each tree type
- Mature Tree Crown Diameters
  - 50 ft, 30 ft, 15 ft
- Accuracy Assessment
  - 50 sample plots
  - Ground Truthing

Method for Potential TCC

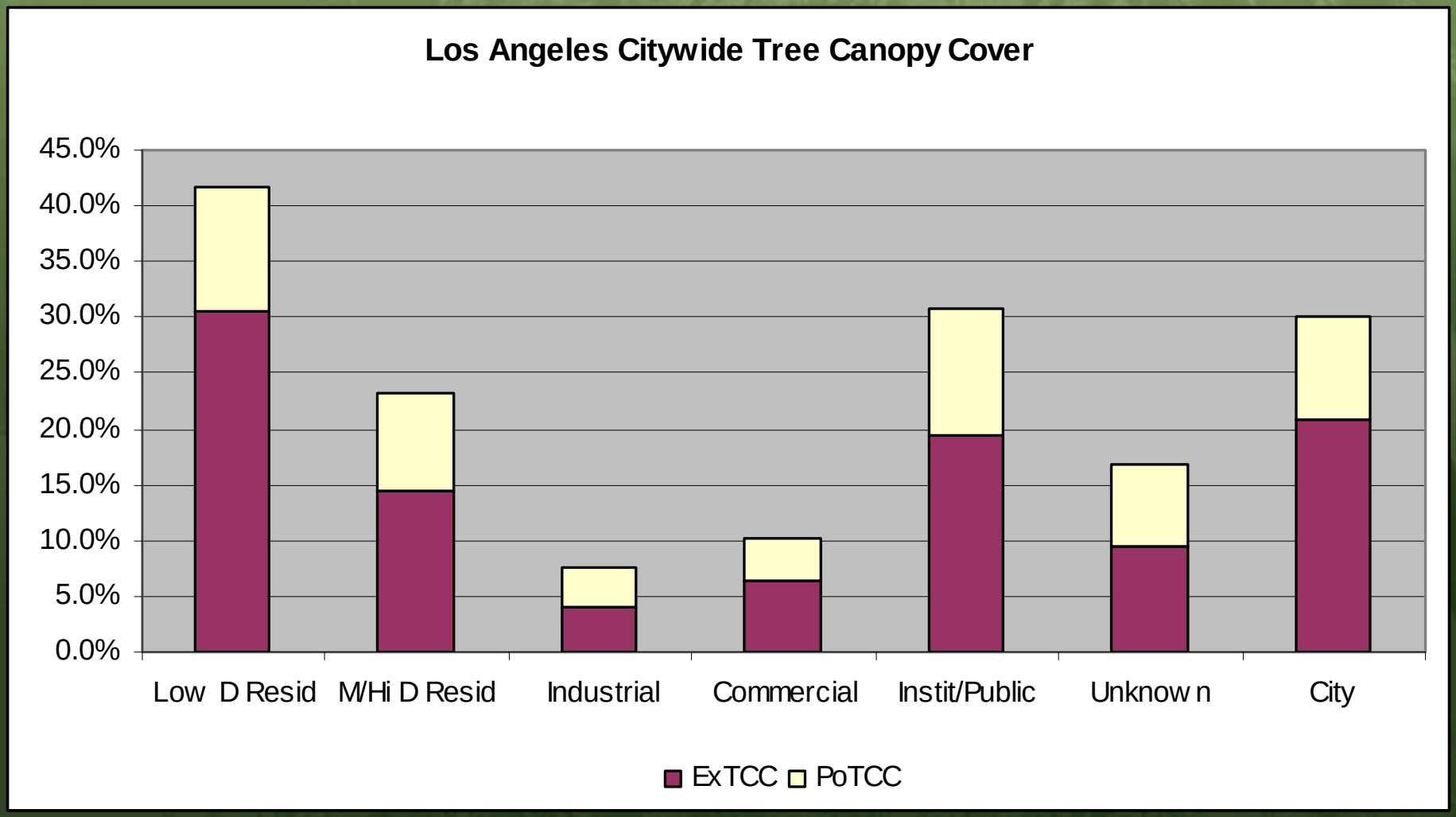


Results – Potential Canopy

- 9.2% Citywide
  - 23,244 ac
- 2.7 million trees
  - 73% small
  - 20% medium
  - 7% large



Results – Potential Canopy

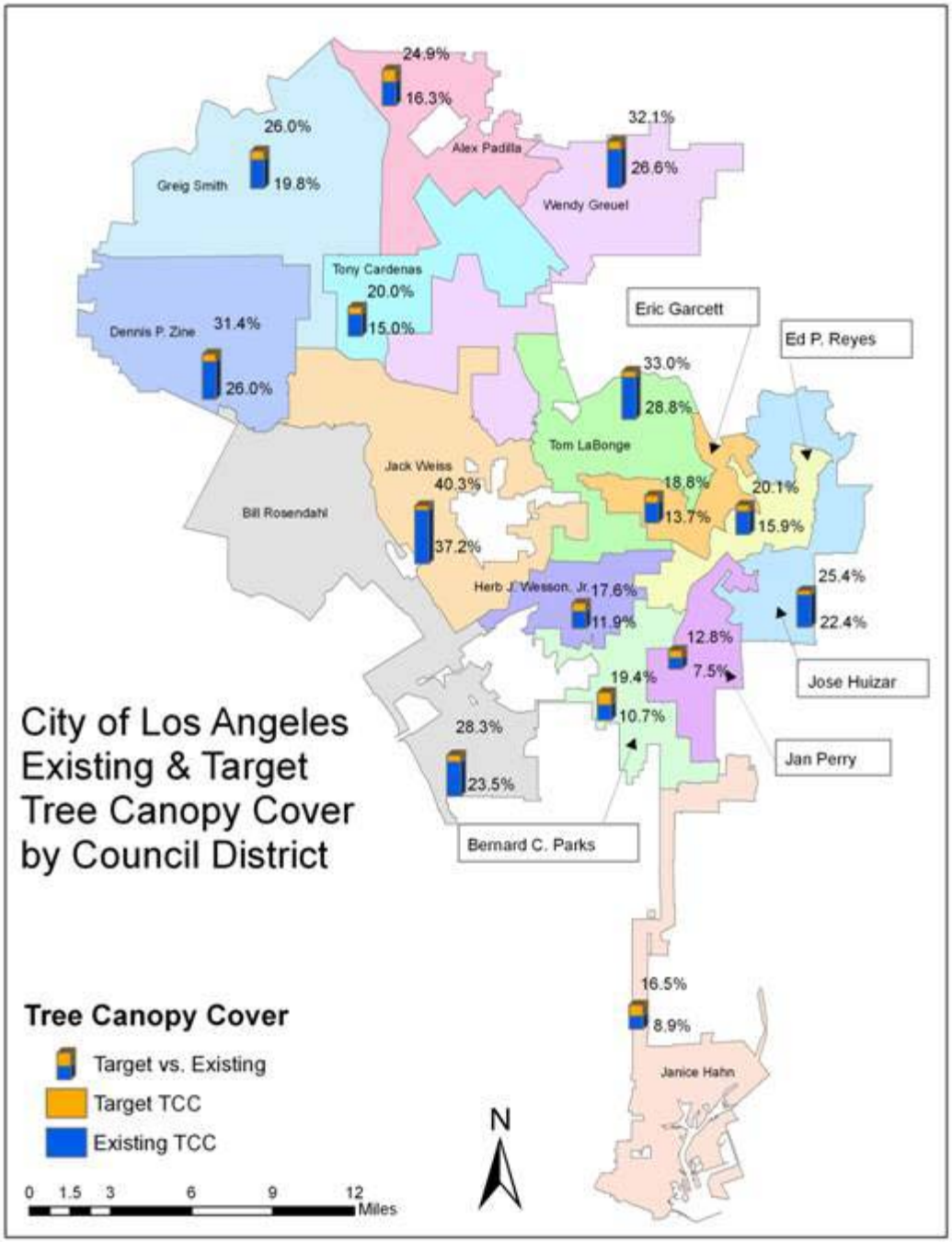


Target TCC for Los Angeles

- Each Council District has unique baseline of ExTCC to work from and PoTCC to fill
- ALL share same goal: fill same relative amount of Potential TCC
  - 50% of PoTCC
    - Assume 25% of potential is not plantable
- Shared Targets:
  - Vary by land use
  - Compare well to range of existing TCC
  - High enough to produce large benefits

Results – Target Canopy

- 5.5% Citywide (20.8% + 5.5% = 26.3%)
- 1.4 million trees
  - 73% small
  - 20% medium
  - 7% large

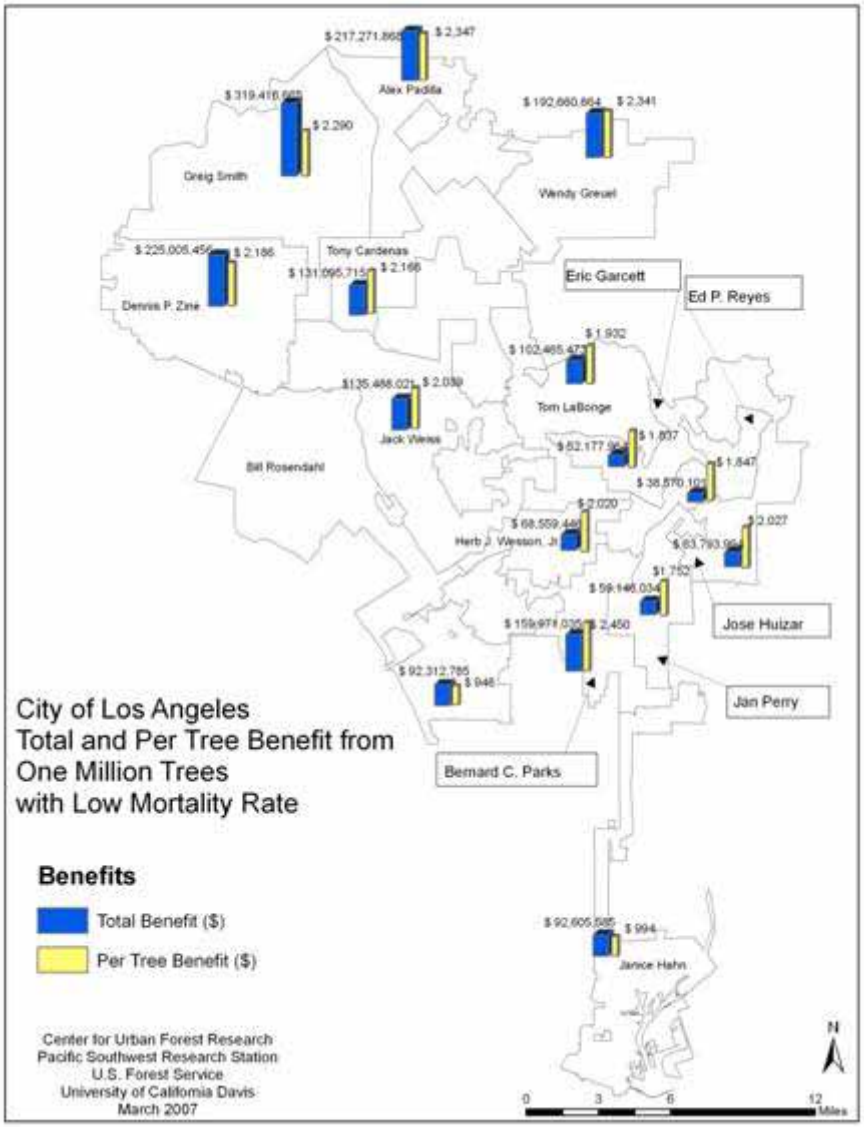


Project Future Benefits

- 1 million planted
  - 2006: 50,000
  - 2007: 160,000
  - 2008: 230,000
  - 2009: 270,000
  - 2010: 290,000
- 35-year period (2006 – 2040)
- 17% & 56% mortality
- 2 climate zones
- Small, medium, large trees for each
  - Yew, crapemyrtle (49%)
  - Jacaranda (42%)
  - Camphor, Shamel ash (9%)

Project Future Benefits

- $1.64 - $1.95 billion
- $1,639 - $1,951/tree
- $49 - $60 /tree/year
  - Aesthetic/other = 81%
  - Stormwater = 8%
  - Energy = 6%
  - Air quality = 4%
  - Carbon = 1%



State of the Urban Forest: San Francisco Bay Area

- Goals
  - Describe historic change in TCC
  - Quantify the value of ecosystem services from existing TCC
  - Quantify the value of benefits from increased TCC
- Area
  - 9 counties
  - 7 million people
  - 6,922 sq miles
  - 1,077 sq miles urban (16%)

SF Bay Area TCC Analysis: Methods

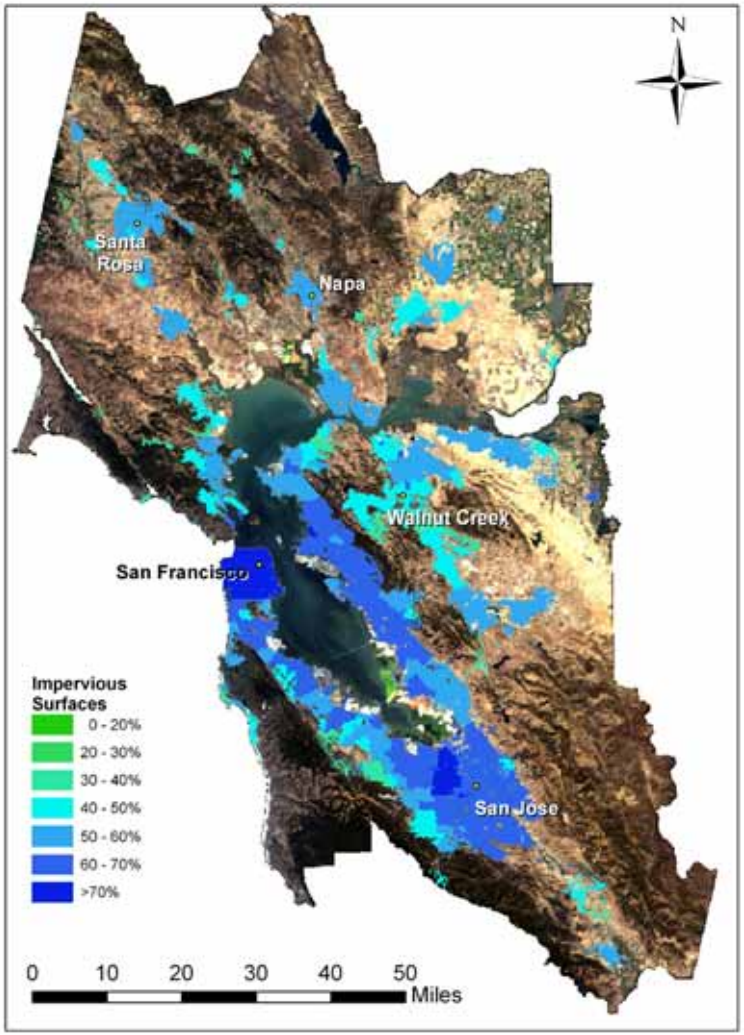
- LandSat TM: 1984, 1995, 2002 & Aerial Photos
- Land Use: ABAG
- 5 zones for benefit calculations
- Accuracy- 650 samples
  - TCC = 3.8%

SF Bay Area TCC Analysis: Methods

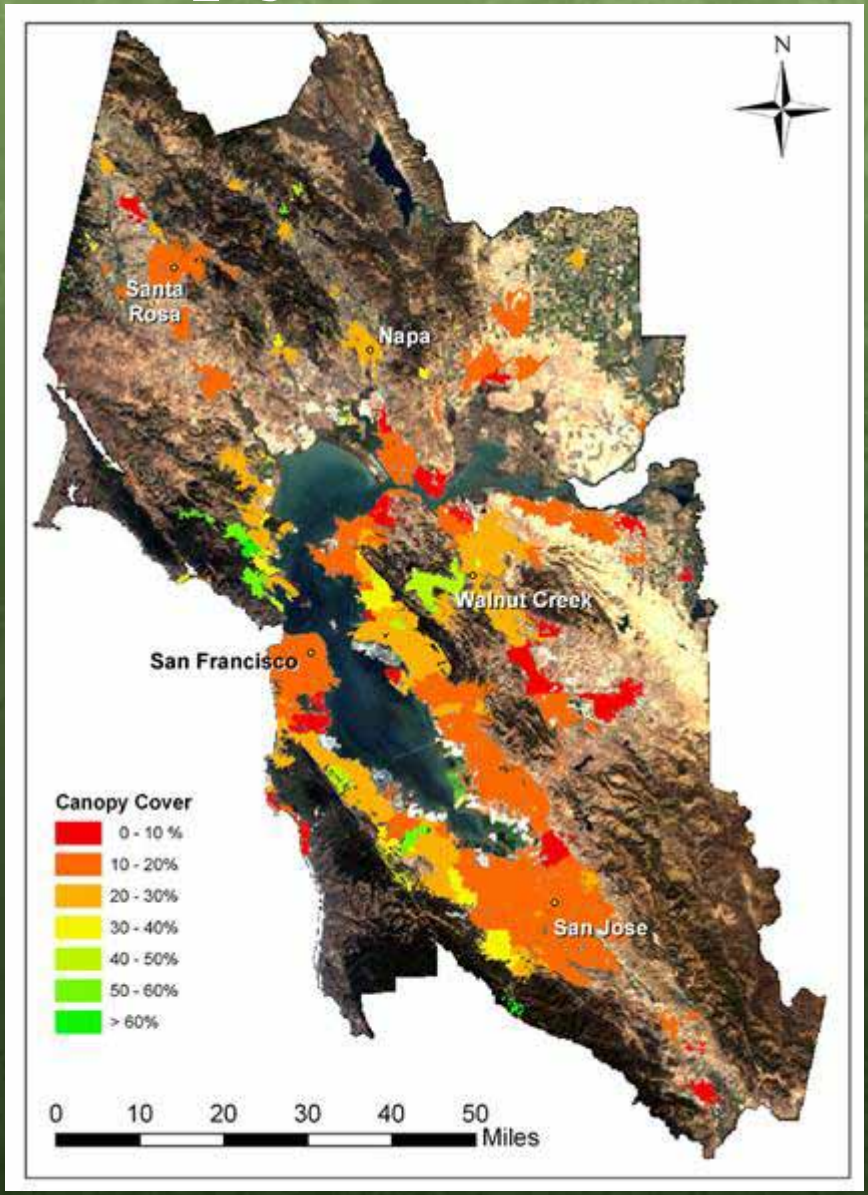
- Resource unit/TCC
  - RU/TCC by species & land use: SUFES, UFORE)
  - RU/TCC by size distributions: STRATUM SF, Berkeley, Modesto
- Monetize Benefits
  - Energy: $0.21/kWh, $1.73/therm
  - Air quality: Varies
  - Carbon: $6.68/ton
  - Interception: $0.0055/gal
- Future canopy
  - Increase TCC by 1.5%, 3%, 6%, 9%

SF Bay Area TCC Results: Historic Change

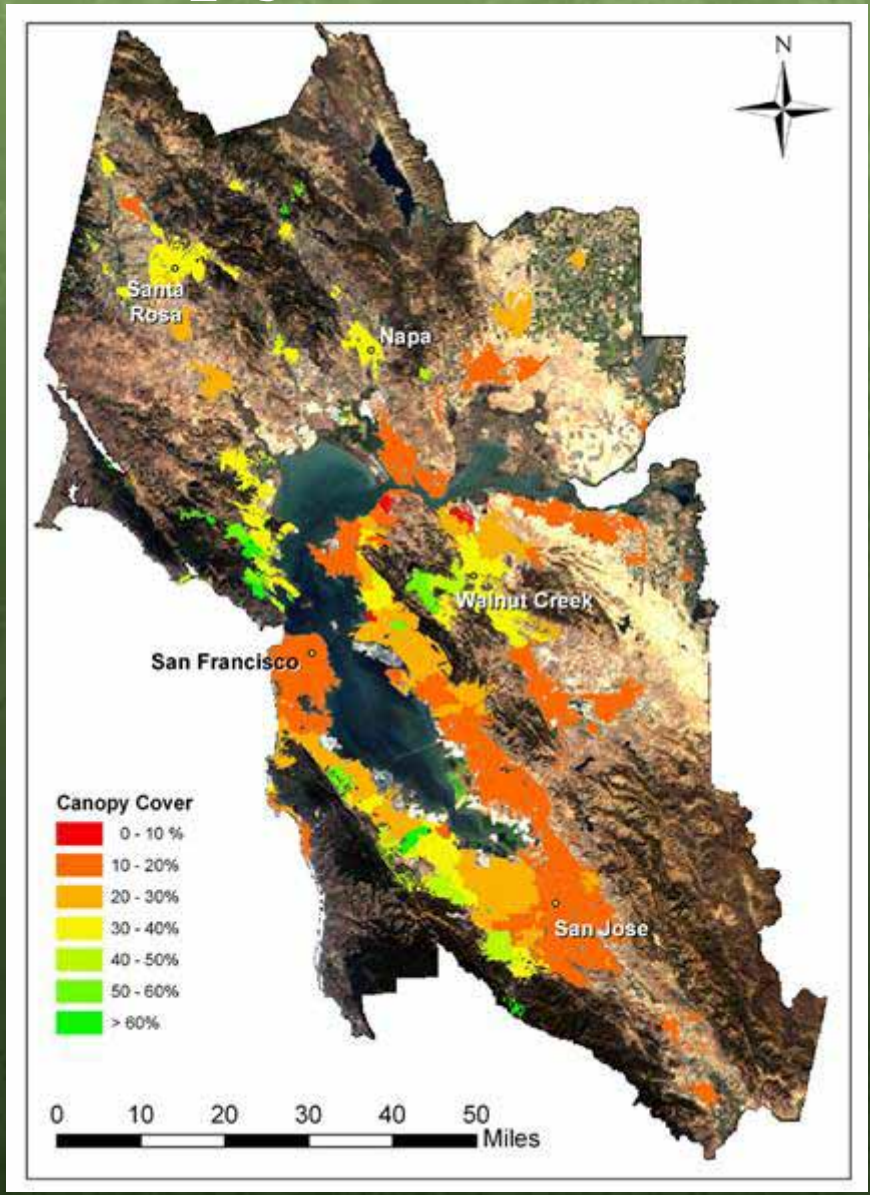
	1984	1995	2002
Canopy Cover	19%	25%	29%
Impervious Surface	39%	50%	56%
Pervious Surface	42%	25%	15%



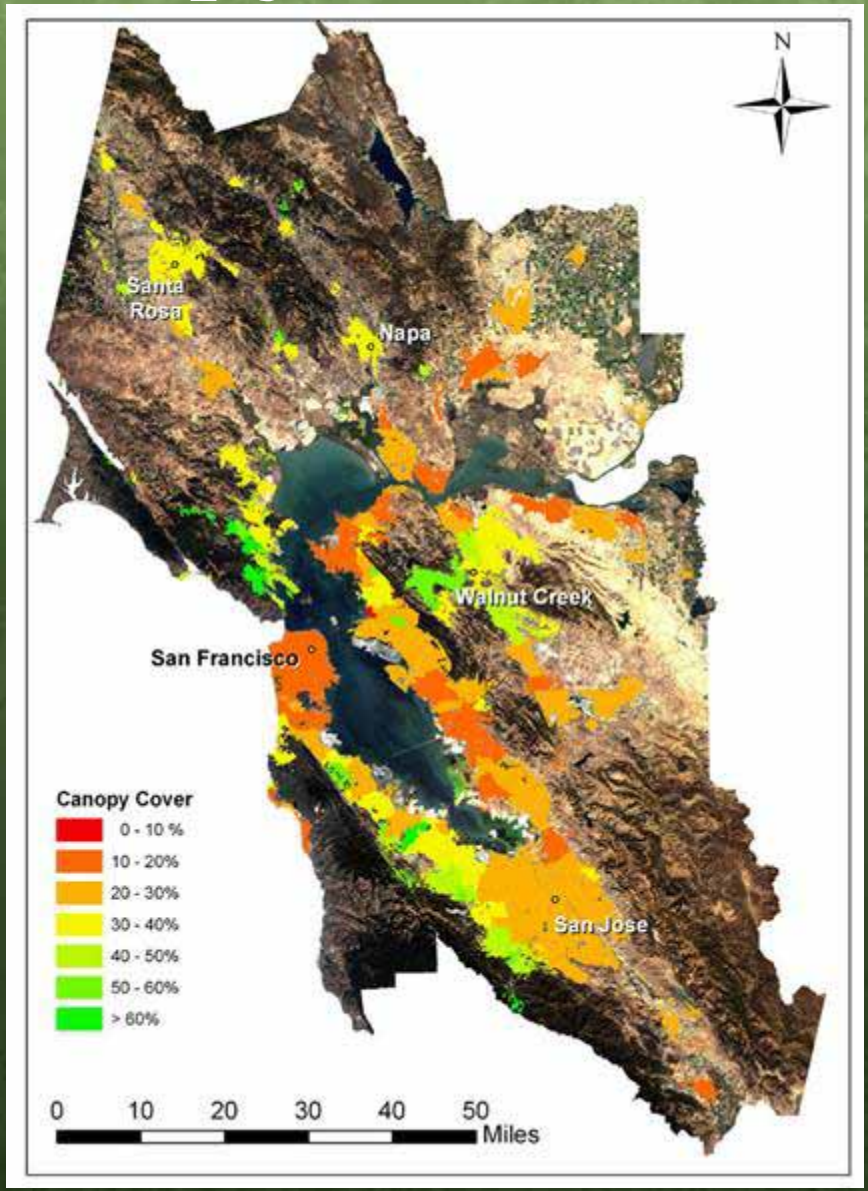
Canopy Cover 1984



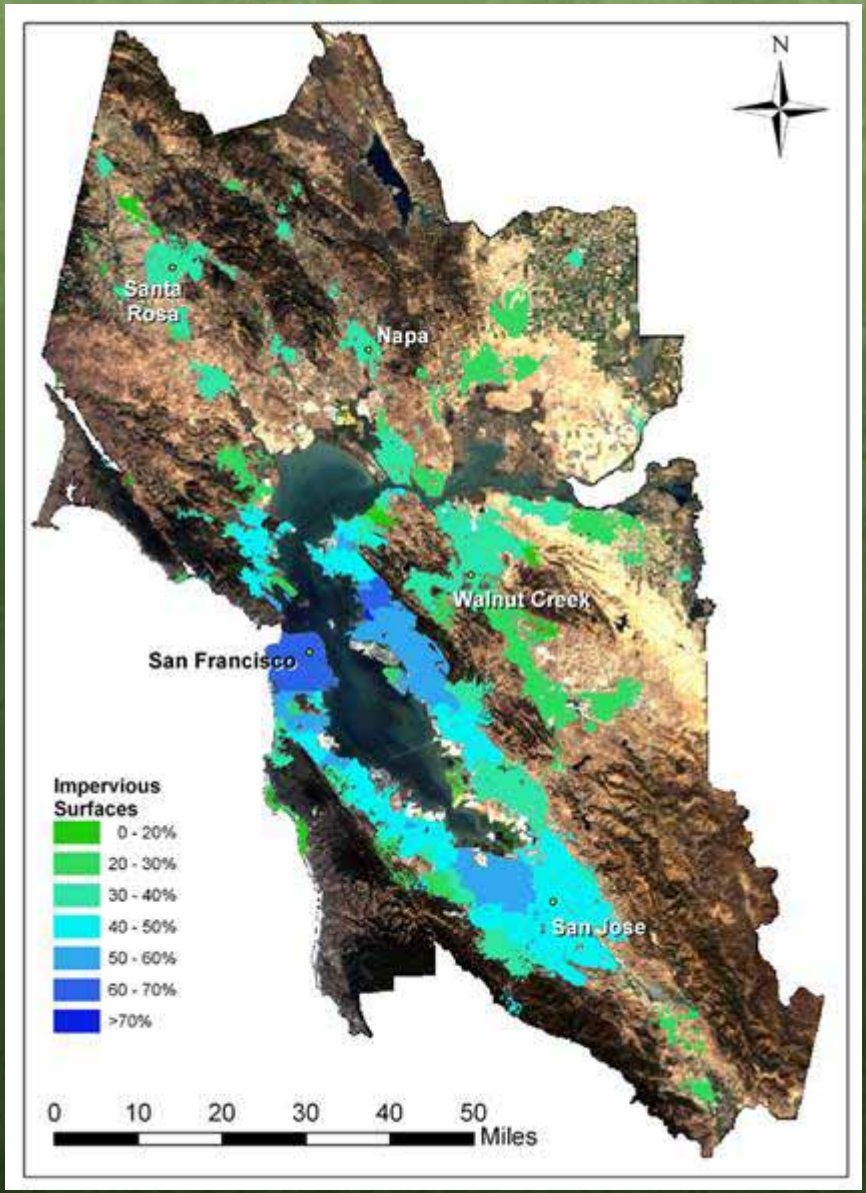
Canopy Cover 1995



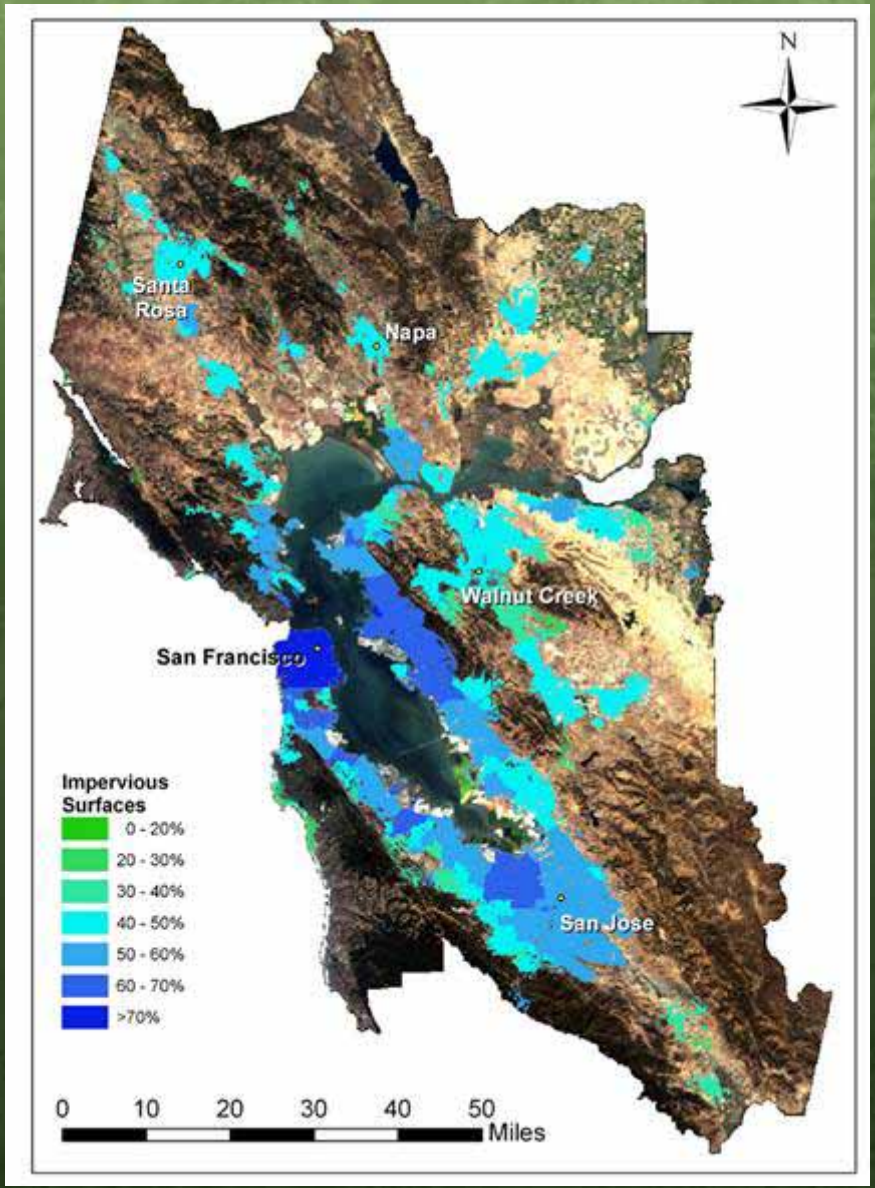
Canopy Cover 2002



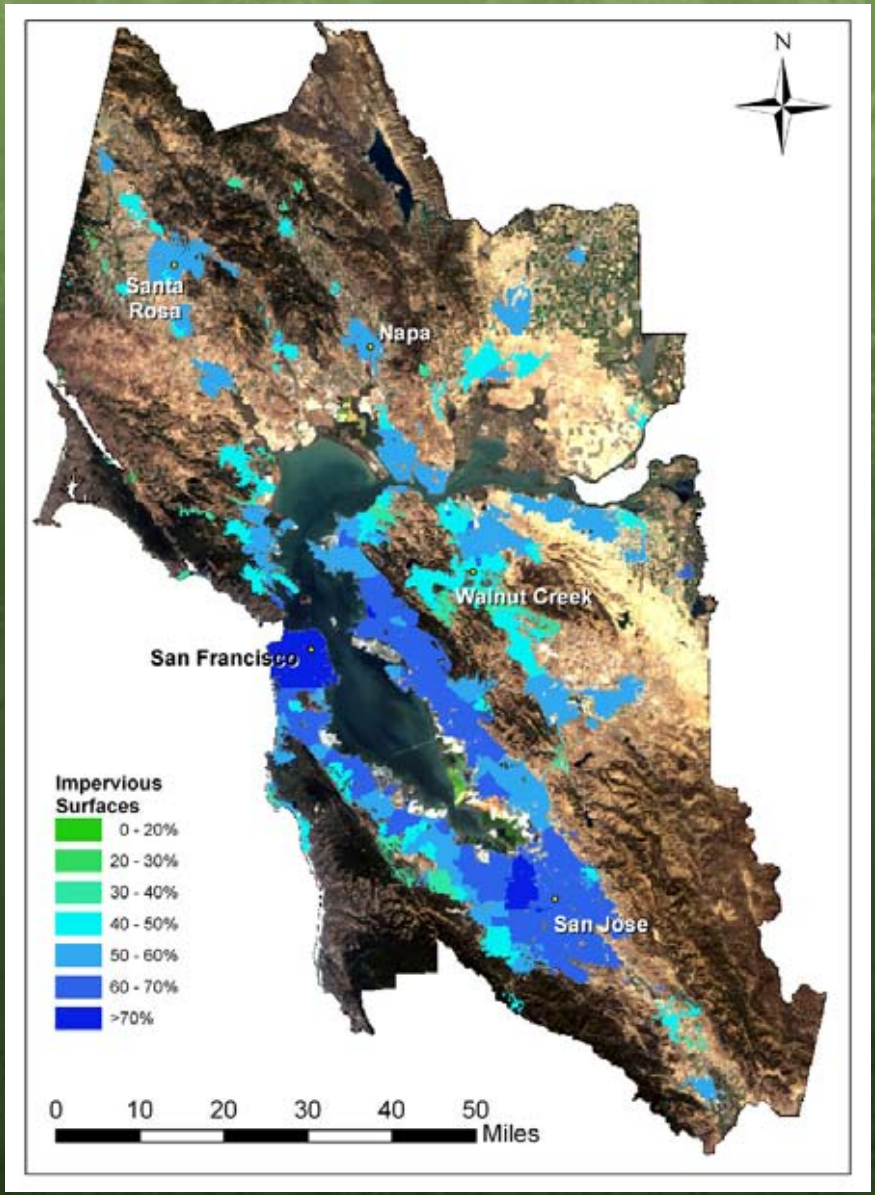
Impervious Surface 1984



Impervious Surface 1995



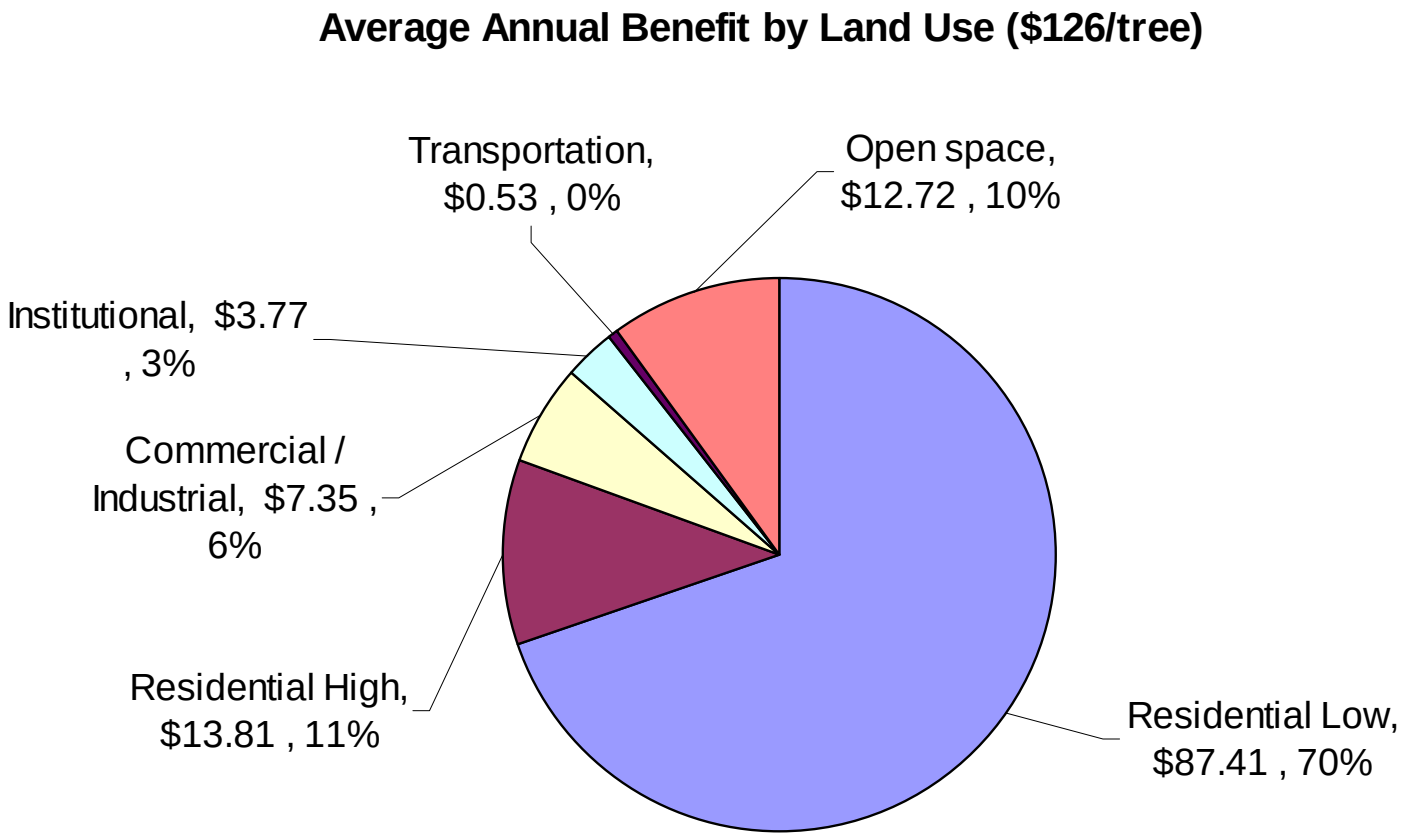
Impervious Surface 2002



SF Bay Area TCC Results: Current Canopy and Benefits

County	TCC (%)	Trees (M)	Trees/capita	Benefits (M$)	$/tree	$/capita
Alameda	23.4	6.6	4.6	690	104	476
Contra Costa	31.3	8.8	8.7	946	107	930
Marin	46.8	3.6	14.7	487	135	1,973
Napa	34.1	1.1	8.0	136	128	1,026
San Francisco	16.1	0.9	1.2	103	110	130
San Mateo	31.7	4.5	6.4	617	138	883
Santa Clara	28.9	10.2	6.0	1,535	151	903
Solano	22.7	2.4	5.7	233	99	567
Sonoma	33.7	3.1	6.7	422	135	905
Total	29.0	41.2	6.0	5,171	126	748

SF Bay Area TCC Results: Current Canopy and Benefits



SF Bay Area TCC Results: Current Canopy and Benefits

Benefit Type	Total $	% of Total	$/tree	$/capita
Energy	332,805,920	6.4	8.08	48.12
Carbon	3,939,997	0.1	0.10	0.57
Air Quality	8,844,034	0.2	0.21	1.28
Storm Runoff	102,419,038	2.0	2.49	14.81
Aesthetics/Other	4,723,246,582	91.3	114.72	682.89
Total	5,171,255,571	100.0	125.60	747.66

SF Bay Area TCC Results: Future Canopy and Benefits

TCC increase	TCC	Tree increase	Trees	Benefit ($M)	Increase (%)
0.0	29.0	0	41,172,735	5,171	0.0%
1.5	30.5	2,131,470	43,304,206	5,409	4.6%
3.0	32.0	4,262,940	45,435,676	5,646	9.2%
6.0	35.0	8,525,881	49,698,616	6,121	18.4%
9.0	38.0	12,788,821	53,961,556	6,595	27.5%

San Francisco Bay Area
3% Tree Canopy Cover Increase
New Trees (1,000s)
Exist. Trees (1,000s)
Added Annual Benefits ($1,000,000s)
Exist. Annual Benefits ($1,000,000s)
Sonoma
277
$35
3,115
$422
Napa
93
$11
1,061
$136
Solano
311
$27
2,359
$233
Marin
232
$29
3,621
$487
Contra Costa
845
$82
8,808
$946
San Francisco
175
$17
940
$103
Alameda
849
$78
6,614
$690
San Mateo
422
$51
4,459
$617
Santa Clara
1,058
$144
10,197
$1,535
Mendocino
Lake
Sutter
Placer
Yolo
Sacramento
San Joaquin
Stanislaus
Santa Cruz
San Benito
Monterey
Pacific Ocean
San Pablo Bay
San Francisco Bay
Center for Urban Forest Research
Pacific Southwest Research Station
U.S. Forest Service
University of California Davis
June 2007
0
10
20
Miles
N

Recommendations for Improving Region's Green Infrastructure

- Communications
  - Info Clearinghouse
  - Value of Trees 1-pager
- Adopt realistic TCC targets & develop strategies, plans, programs
- Parking lot program
- Municipal forest assessments
- Monitoring & Reporting

- Public-domain GIS
- Web-based
- Users update database

San Francisco Urban Forests - Microsoft Internet Explorer provided by USDA Forest Service

File Edit View Favorites Tools Help

Address http://216.103.100.65/mapguide/sftrees/index2.aspx

San Francisco Urban Forests

A collaboration between the City of San Francisco's Bureau of Urban Forestry and Friends of the Urban Forest

Zoom

Tasks

Layers

- Supervisor Dist - 2002
- Soils
- Trees
  - Trees

San Francisco Urban Forest Mapping System

Select from one of the options below to search for trees at different locations.

Search by...

Tools:

- Add a Tree
- View in Google Earth

Or click on the "Tasks" icon above.

Click the "Home" icon above to return to this page.

Hold down the "Ctrl" button and click on any tree to get information about that tree.

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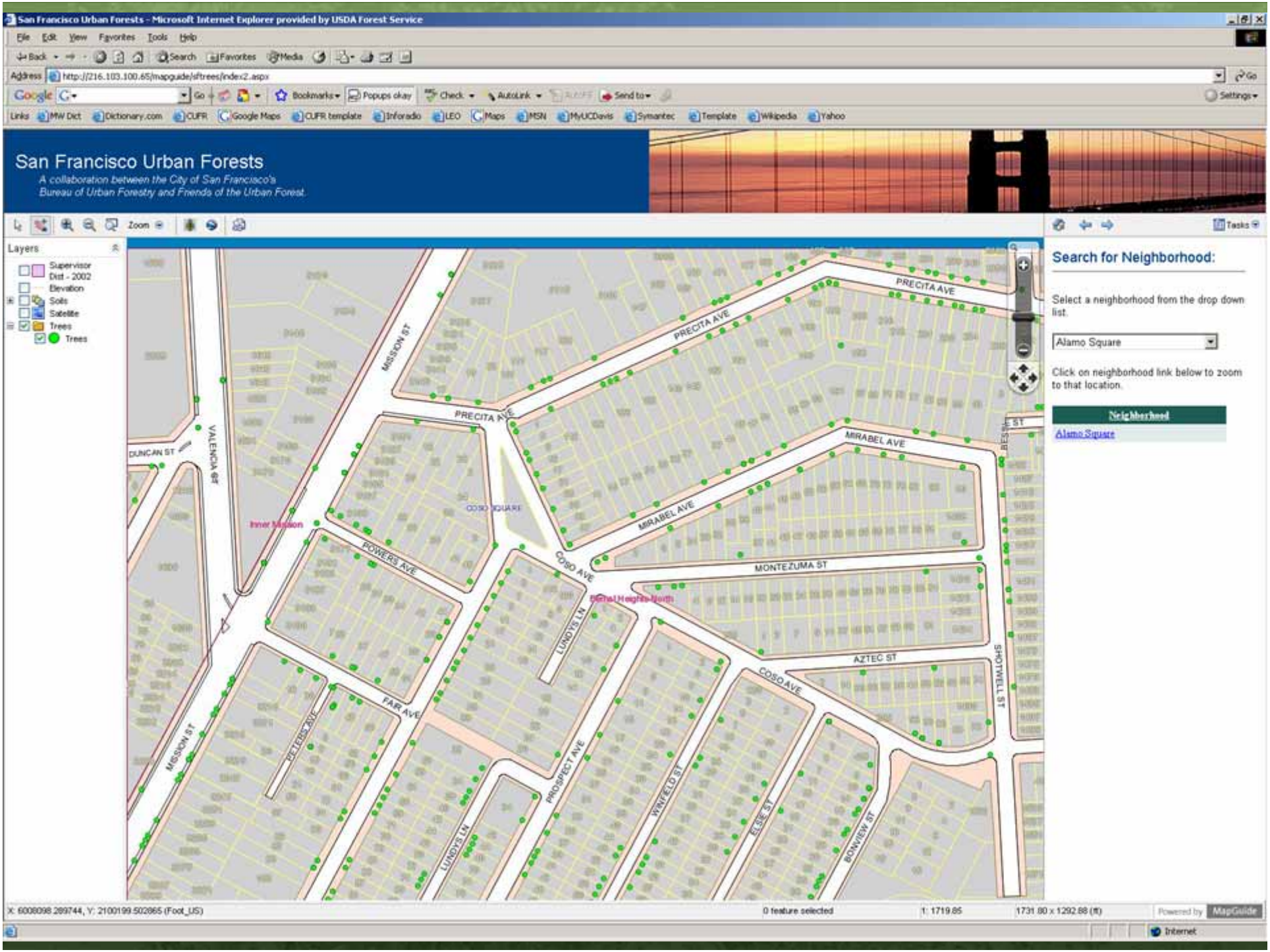
Done | Internet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http://216.103.100.65/mapguide/sftrees/index2.aspx
San Francisco Urban Forests
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Layers
Supervisor Dist - 2002
Elevation
Soils
Satellite
Trees
Trees
Search for Neighborhood:
Select a neighborhood from the drop down list.
Alamo Square
Click on neighborhood link below to zoom to that location.
Neighborhood
Alamo Square
PRECITA AVE
MISSION ST
VALENCIA ST
DUNCAN ST
MIRABEL AVE
COSO SQUARE
Inner Mission
POWERS AVE
COSO AVE
MONTEZUMA ST
Bernal Heights North
LUNDYS LN
AZTEC ST
SHOTWELL ST
FAIR AVE
PETERS AVE
PROSPECT AVE
WINFIELD ST
ELSIE ST
BONVIEW ST
X: 6008098.289744, Y: 2100199.502865 (Foot_US)
0 feature selected
1: 1719.85
1731.80 x 1292.88 (ft)
Powered by MapGuide

San Francisco Urban Forests - Microsoft Internet Explorer provided by USDA Forest Service

File Edit View Favorites Tools Help

Address http://216.103.100.65/mapguide/sftrees/index2.aspx

San Francisco Urban Forests

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Layers

- Supervisor Dist - 2002
- Elevation
- Soils
- Satellite
- Trees
  - Trees

Viewer Options

Select viewing options for status bar and tool tips.

Display distances in

- Metric (Kilometers, Meters)
- US/English (Miles, Feet)

Save

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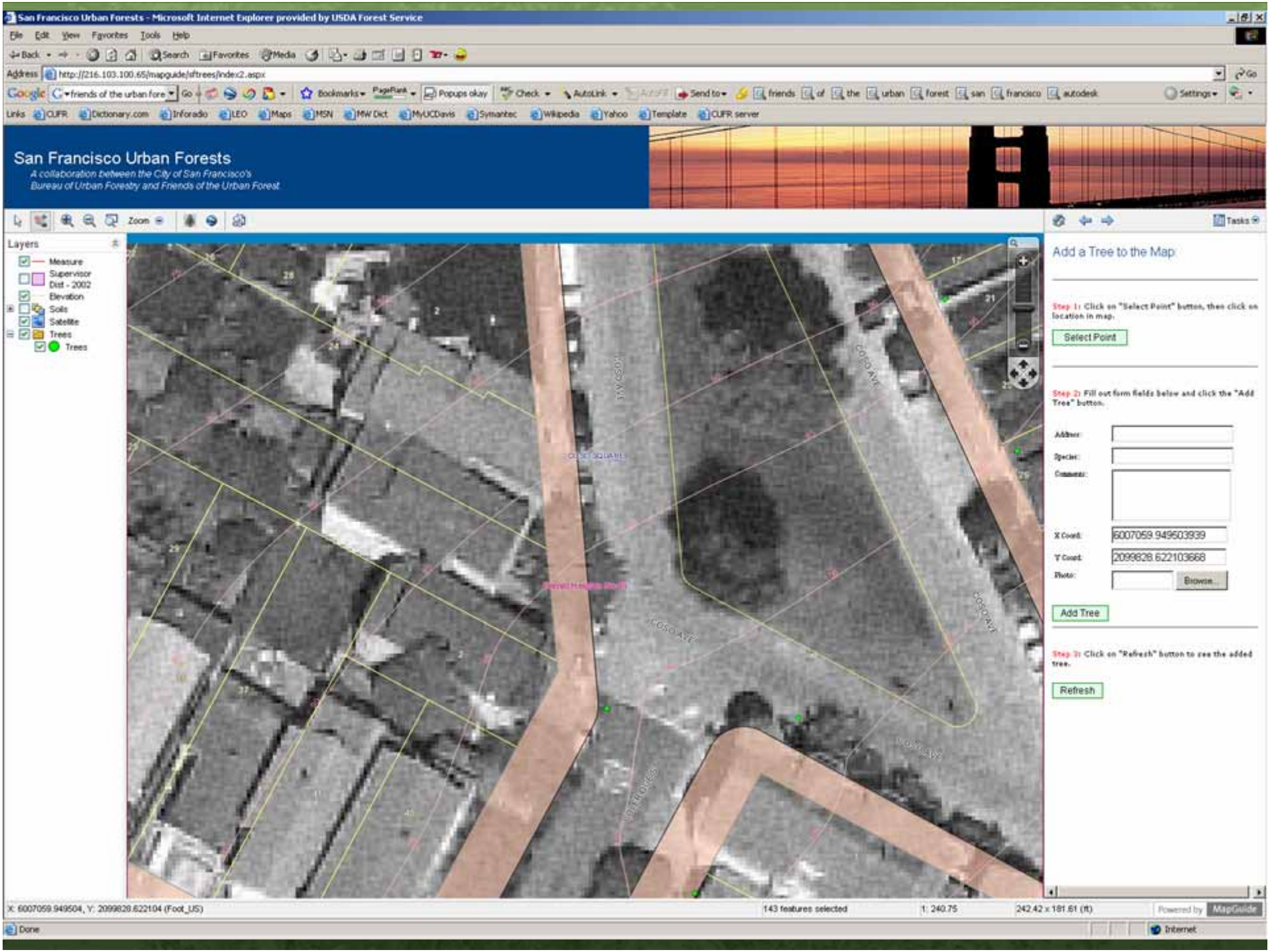
Done | Internet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Layers
Measure
Supervisor Dist - 2002
Elevation
Soils
Satellite
Trees
Trees
Tasks
Add a Tree to the Map
Step 1: Click on "Select Point" button, then click on location in map.
Select Point
Step 2: Fill out form fields below and click the "Add Tree" button.
Address:
Species:
Comments:
X Coord: 6007059.949603939
Y Coord: 2099828.622103668
Photo:
Browse...
Add Tree
Step 3: Click on "Refresh" button to see the added tree.
Refresh
X: 6007059.949604, Y: 2099828.622104 (Foot_US)
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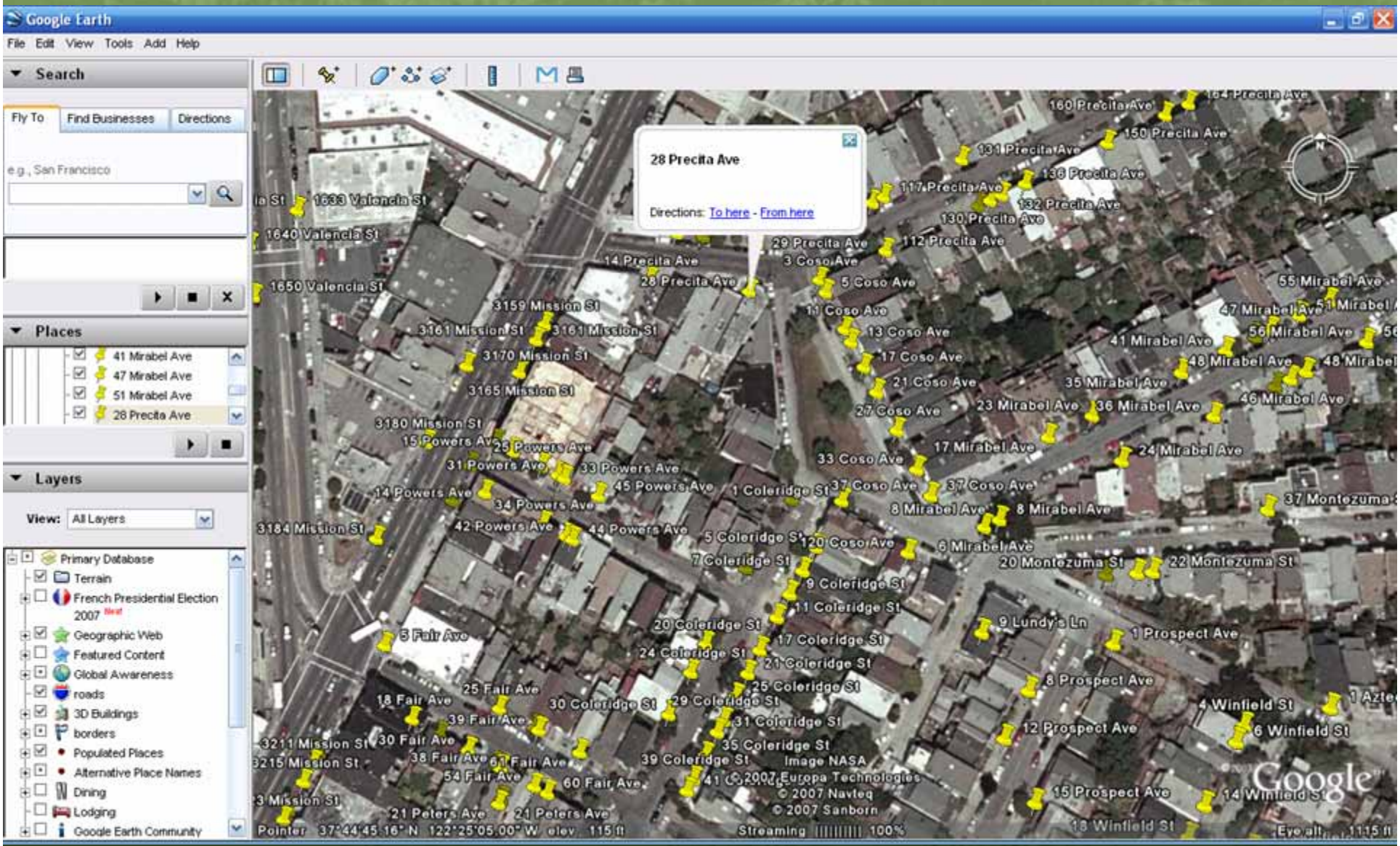
242.42 x 181.61 (ft)
Powered by MapGuide
Done
Internet

Data Collection in the Field


Google Earth
File Edit View Tools Add Help
Search
Fly To
Find Businesses
Directions
e.g., San Francisco
Places
41 Mirabel Ave
47 Mirabel Ave
51 Mirabel Ave
28 Precita Ave
Layers
View: All Layers
Primary Database
Terrain
French Presidential Election 2007
Geographic Web
Featured Content
Global Awareness
roads
3D Buildings
borders
Populated Places
Alternative Place Names
Dining
Lodging
Google Earth Community
28 Precita Ave
Directions: To here - From here
Image NASA
© 2007 Europa Technologies
© 2007 Navteq
© 2007 Sanborn
Google
Pointer 37°44'45.16" N 122°25'05.00" W elev 115 ft
Streaming 100%

The next steps . . .

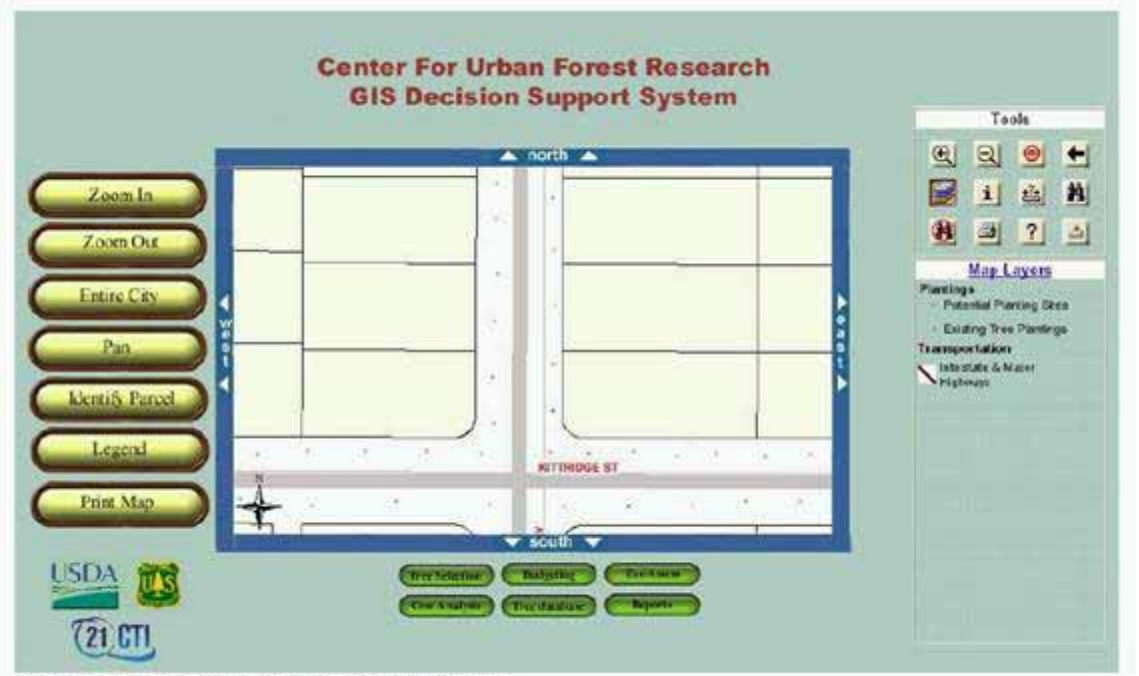
- Beta testing
- Integrate City and Non-profit databases
- On the ground tree inventory
- Cost-benefit analysis report
- Public release and share the goods!
- Ongoing open source community input

GIS Decision Support System

Conceptual Image of GDSS Main Screen

GIS Decision Support System

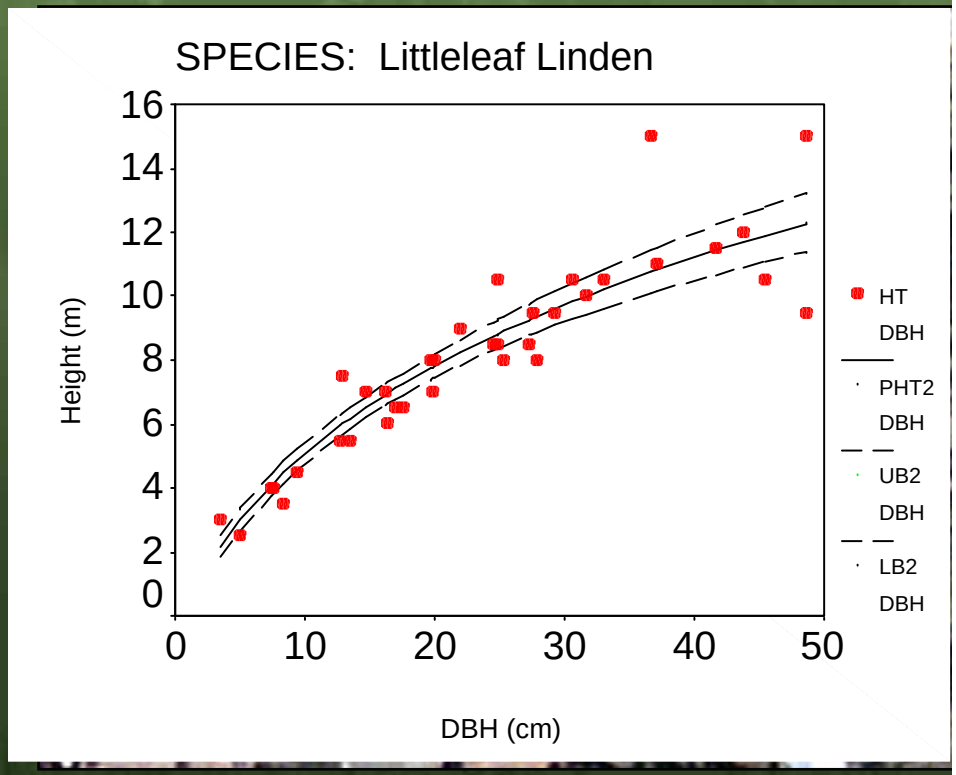
- Tree selection
- Benefit estimation
- Project database
- Ecological risk



Conceptual Image of GDSS Parcel Screen

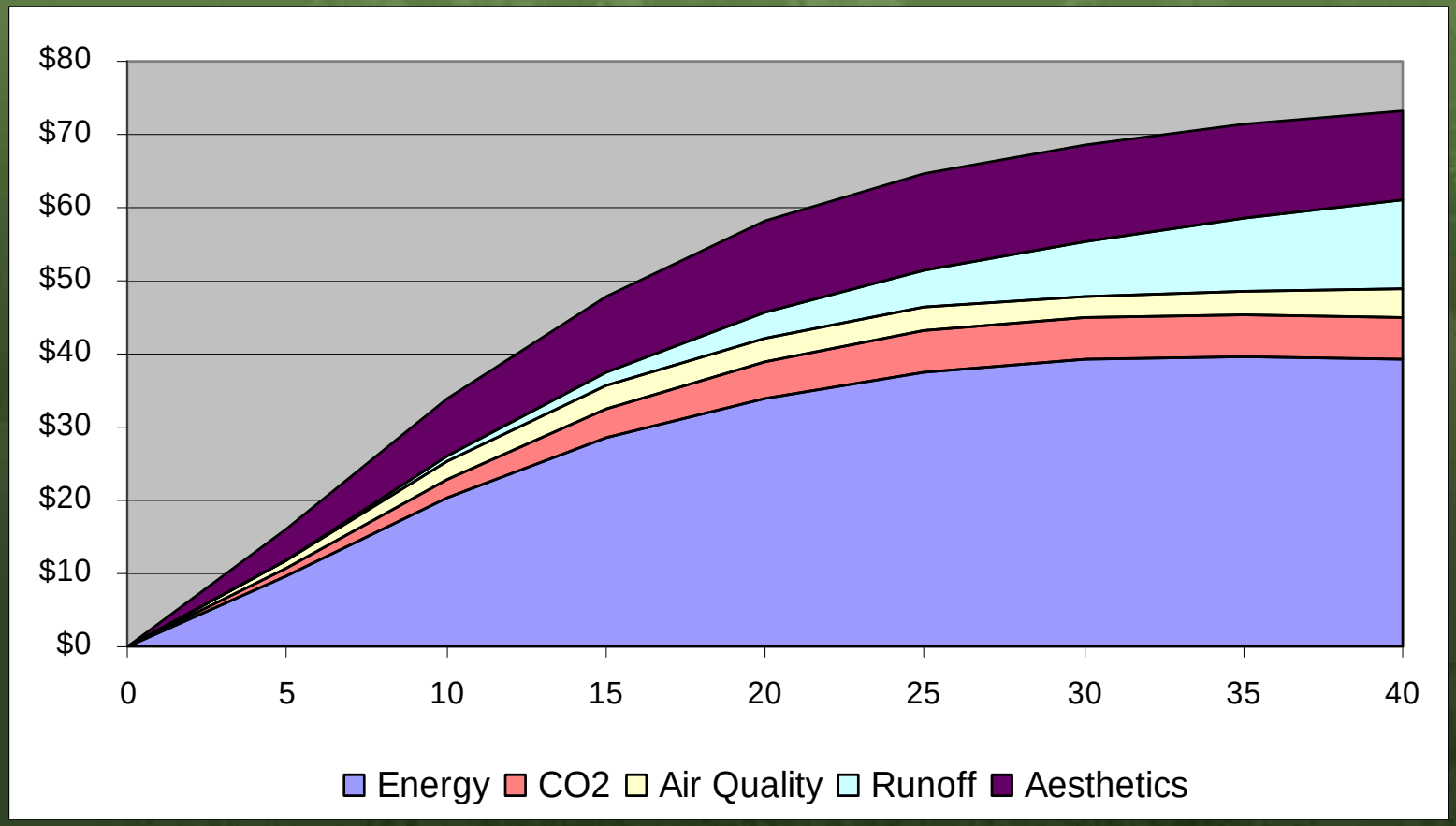
Monitoring Performance

- Tree Planting
  - ID#, species and location
  - Register tree(s) on-line or
  - Post-planting site visit (GPS)
- Survival, Growth, Performance
  - Orthorectified, digital aerial photos w/ color IR
  - Crown projection area of each program tree
    - Crown recognition algorithm
    - W/in expected growth bounds for age?
    - If no, intensive monitoring – program feedback
    - Calculate performance of sampled trees
  - Field verification of sample (condition)



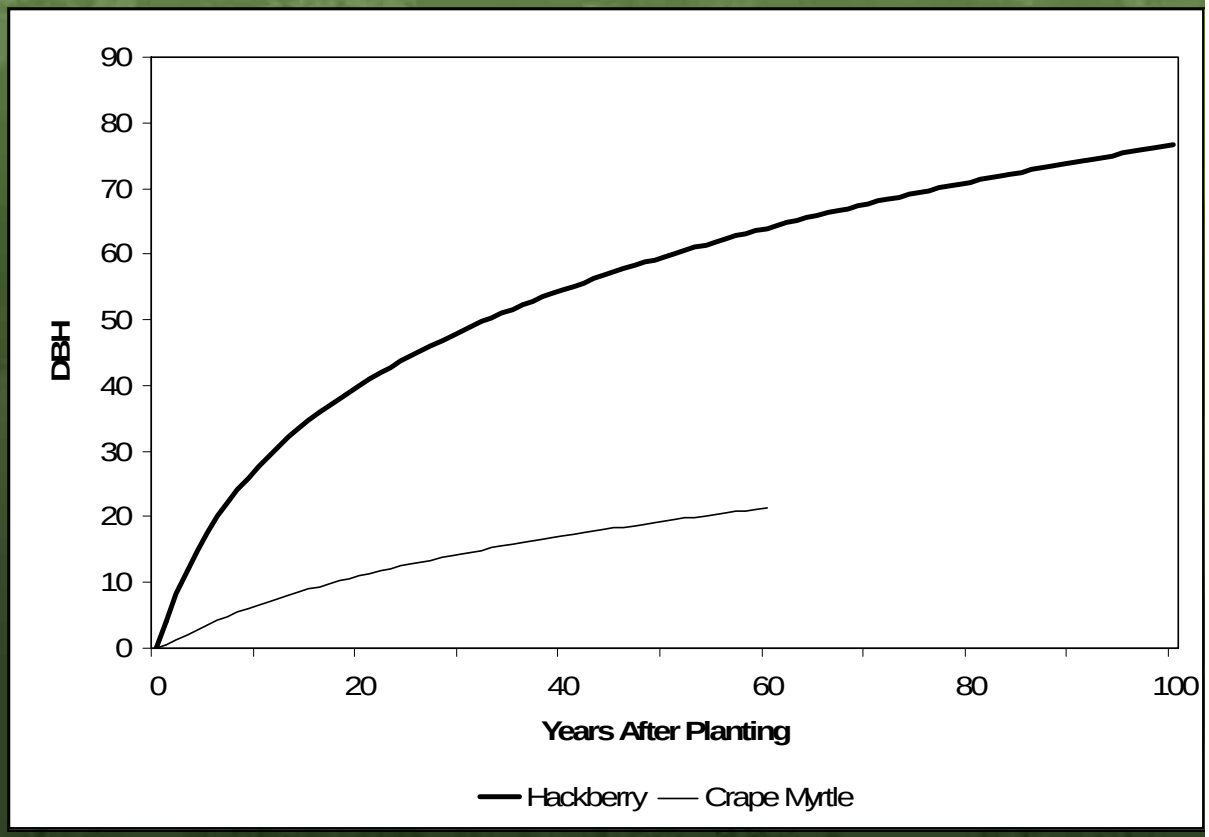
Implementing Programs

Tree Benefits Increase w/ Age
Red Oak



Size & Longevity Matter

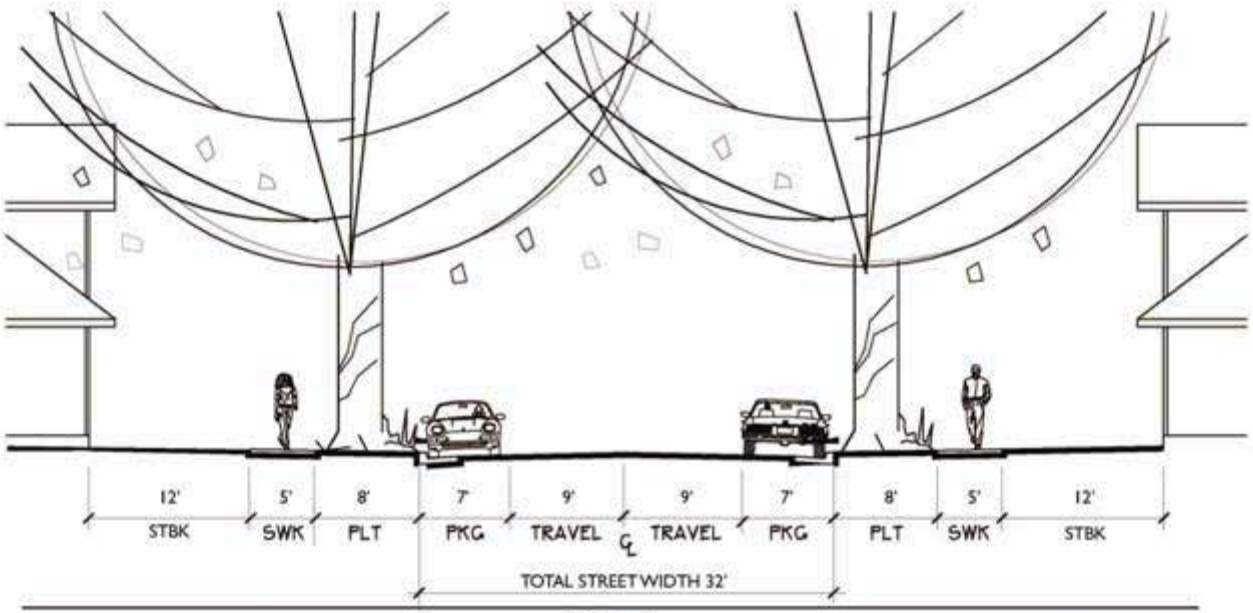
- CO2 after 60 years
- Crape myrtle 150 kg
- Hackberry 3,500 kg



Tree Species Matters

- Crown density
- Complexity
- Surface features
- Foliation period

Space Matters



Neighborhood	Street	Between	Planting strip: Section: PUE	SWK	PLT	Total street width	PLT	SWK	PUE	Tree: DBH	Height	Crown diameter
Curtis Park	Donner, N side		15.5	4.5	5	33	5	4.5	15.5	24	53	41
Curtis Park	Portola		12.5	5	5	41	5	5	12.5	22	50	43
Land Park	5th	17th and 19th	24.5	4	9	30	9	4	24.5	25	69	49
McKinley	D	33rd and Alhambra	19	6	15	33	15	6	19	30	85	57.5
McKinley	37th	H and F	21	4	5	31	5	4	21	26	67	54
Oak Park	1st Ave	34th and 35th	12.5	6	9.5	49	9.5	6	12.5	14	33	28
East Sacramento	38th	Folsom and R	36.5	4	7.5	37/58	7.5	4	36.5	34	54	68

Fig. 1—"Typical" treescape conditions for the studied streets with planting strips. Drawing, including tree height, crown, and diameter, is to scale and represents a potential future scenario that can be compared with dimensions on existing streets

Urban
Advantage

Urban
Advantage

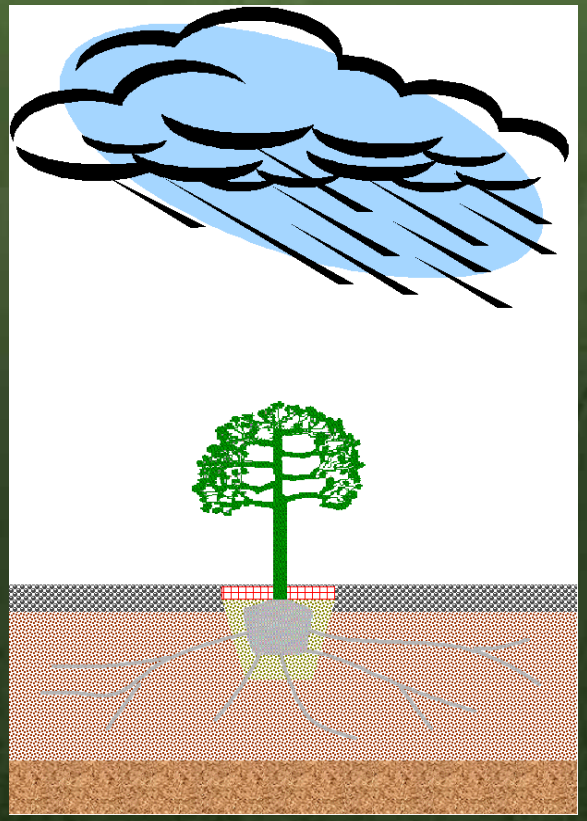
Urban
Advantage

Urban
Advantage

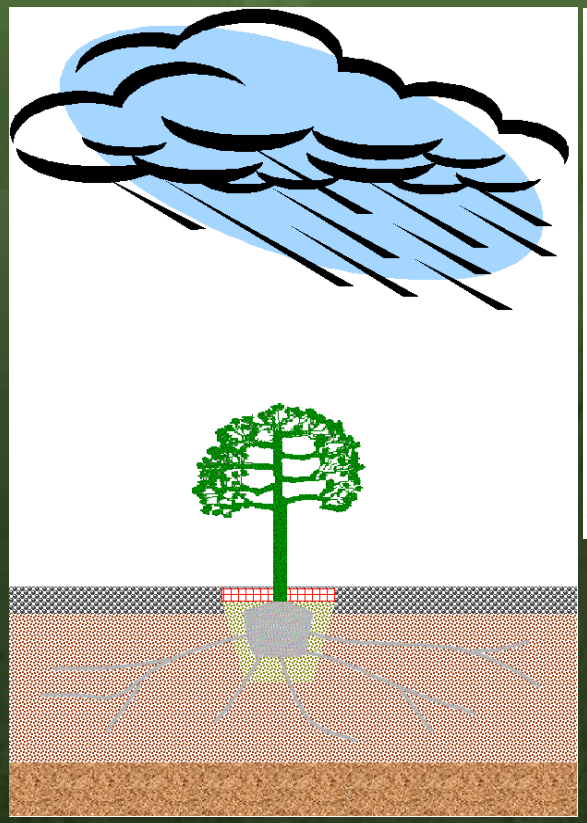
Green Infrastructure BioTechnology

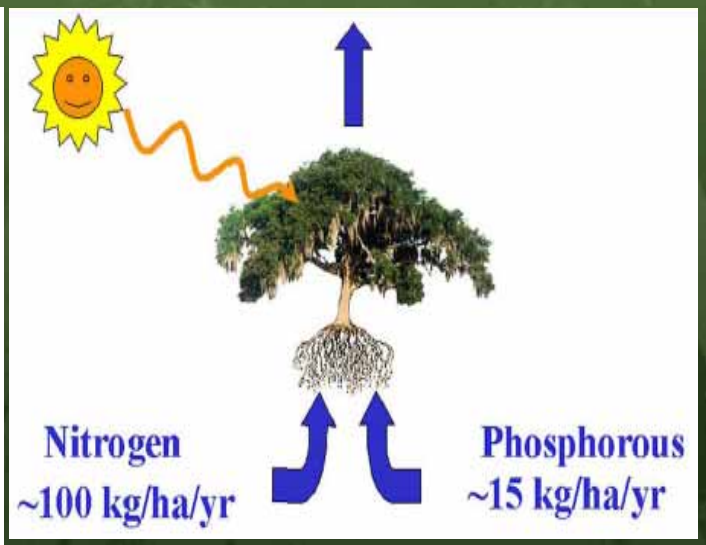
Engineered soil permits tree growth and reduces runoff

Green Infrastructure BioTechnology



Green Infrastructure BioTechnology





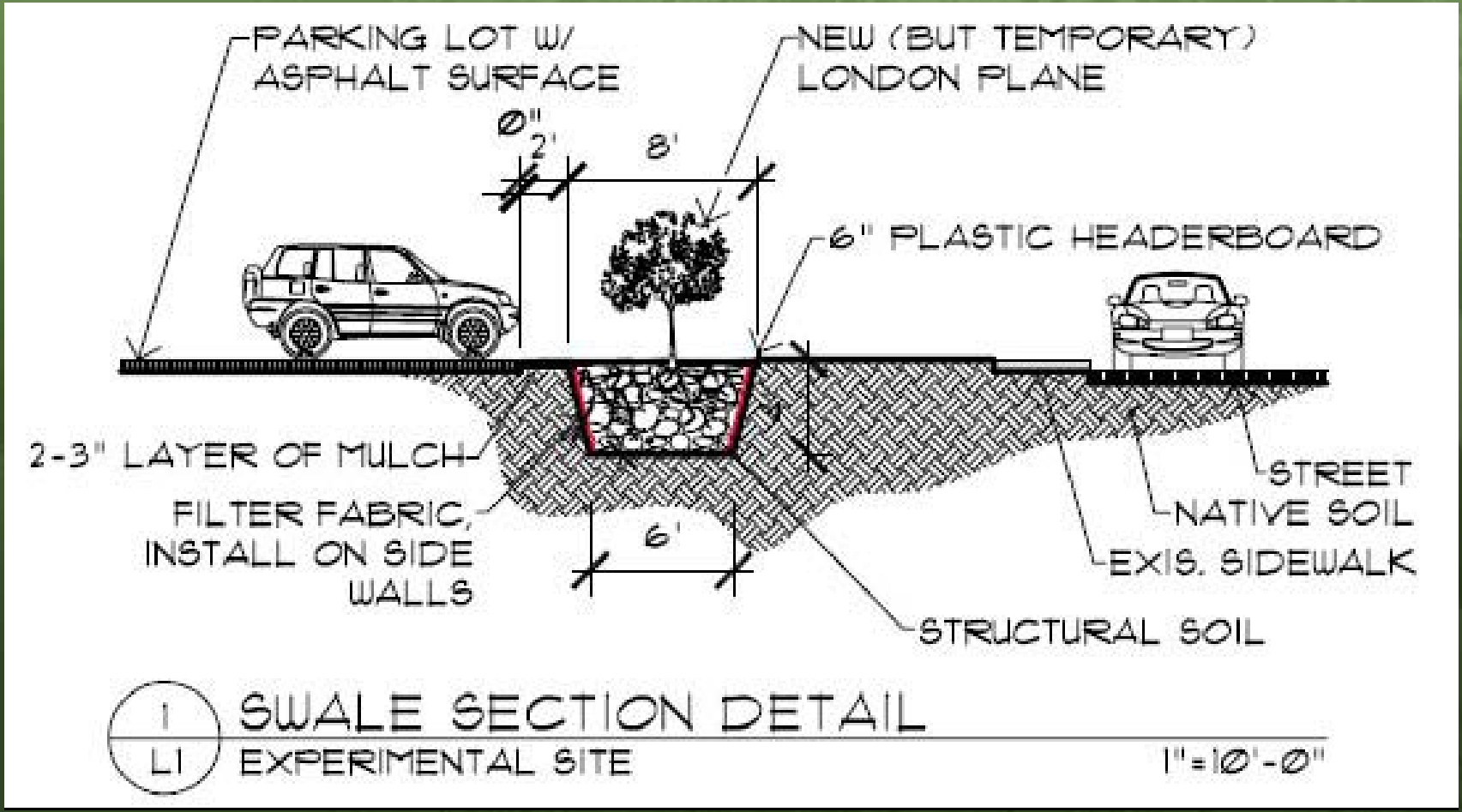
Trees: Solar powered green machines

Engineered Soil

Carolina Stalite soil (CS)

Davis soil

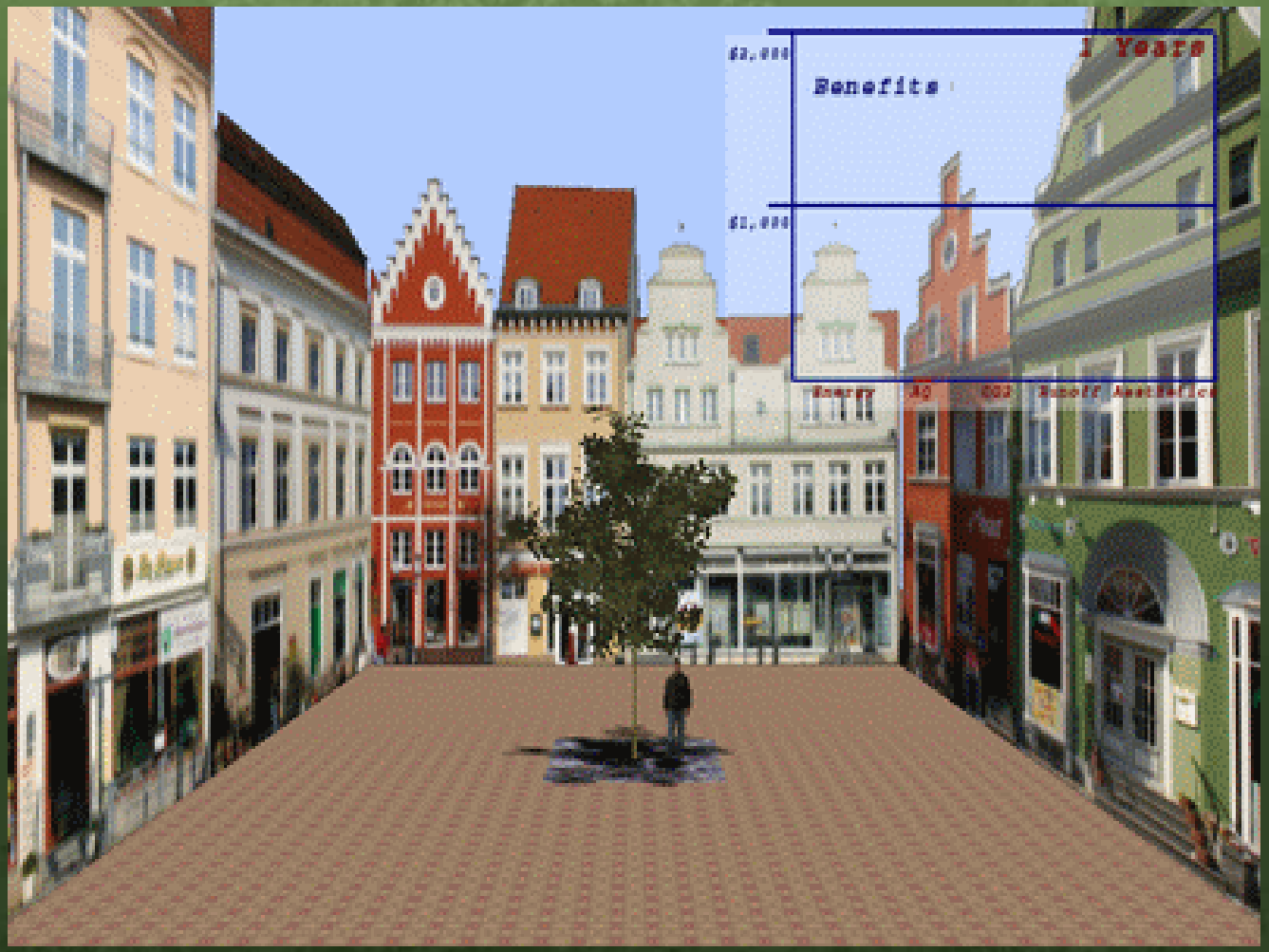
UCD Parking Lot



Parking Lot Measurements

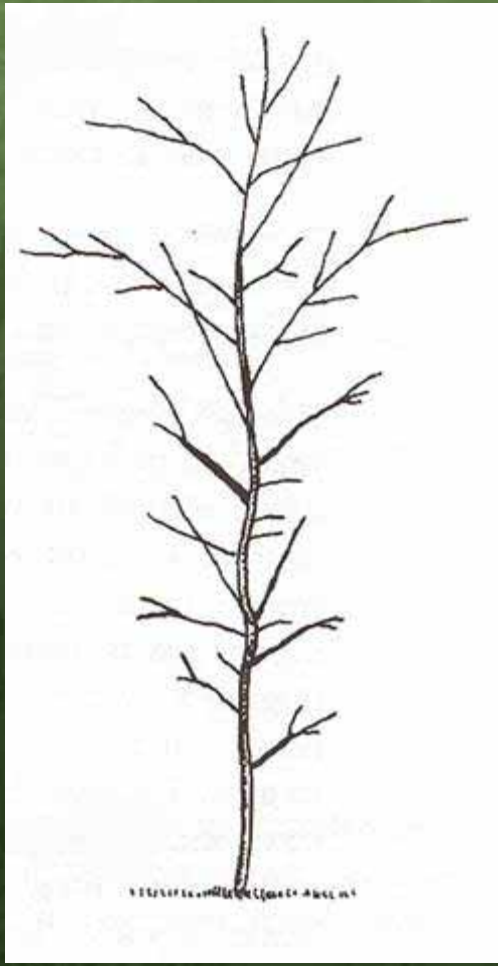
- Runoff quantity
- Water quality
- Surface runoff
- Subsurface moisture
- Tree growth

Space in Our Hearts & Minds

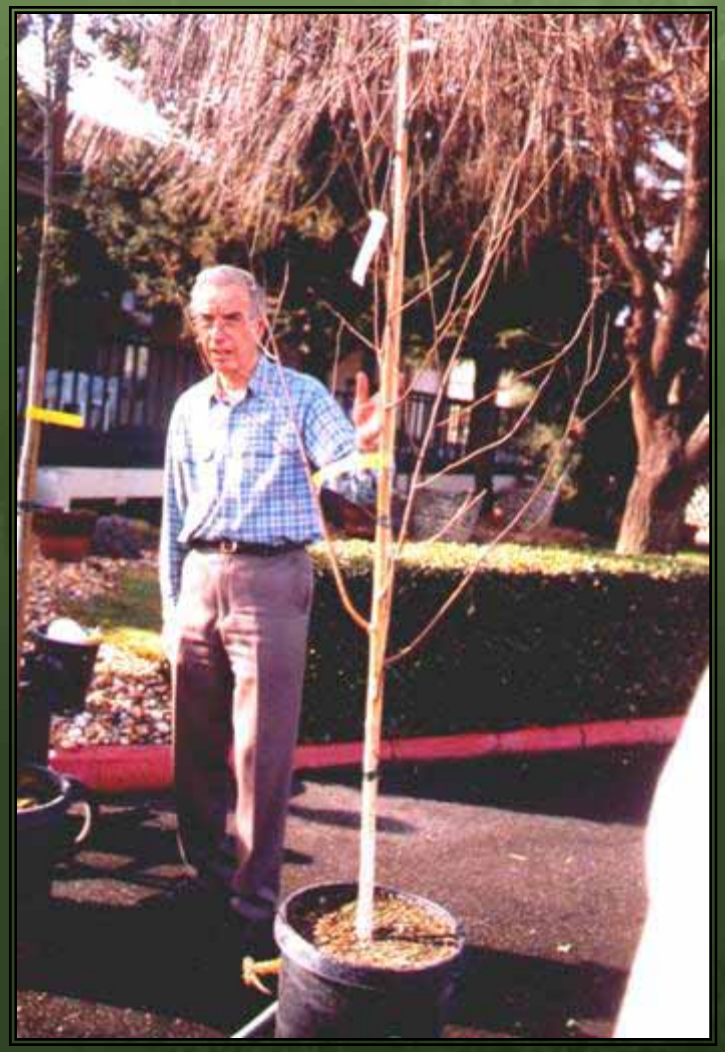


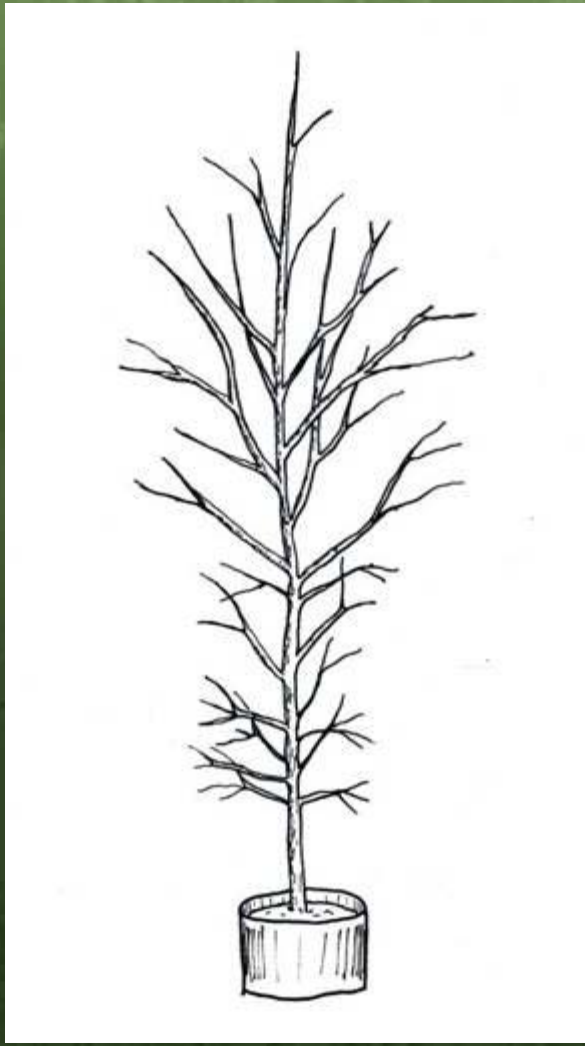
Quality Trees Matter

- Establish more readily
- Require less maintenance
- Improve chances for success



Arboriculture Starts in the Nursery





Guideline Specifications for Nursery Tree Quality

Selecting Quality Nursery Stock

A committee comprised of municipal arborists, urban foresters, nurserymen, U.C. Cooperative Extension horticultural advisors, landscape architects, non–profit tree groups, horticultural consultants, etc., developed the attached specifications to ensure high quality landscape trees. After more than a year of work, they succeeded in drafting a document entitled Specification Guidelines for Container–grown Trees for California. This document will be published and the guidelines promoted throughout the nursery and landscape industry. Its intent is to help landscape professionals develop their own comprehensive and detailed specifications to ensure that they obtain high quality container–grown nursery trees. The document is also intended to help nursery professionals in their efforts to improve the quality of trees grown in California. These specifications can be modified for specific simulations.

The following people worked on the **Guideline Specifications for Nursery Tree Quality:**

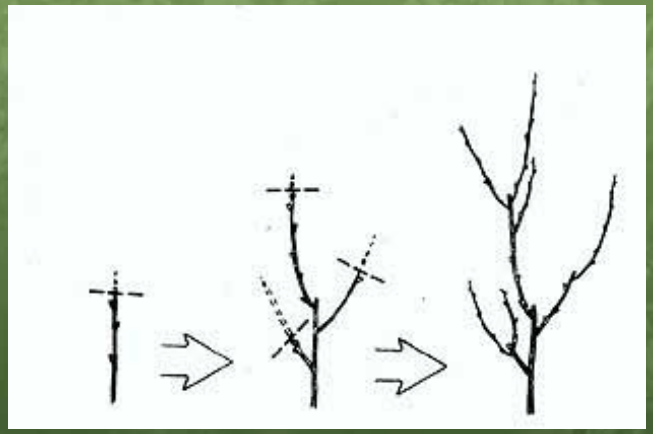
David Burger	UC Davis, Department of Environmental Horticulture, Davis
Barrie Coate	Consulting Arborist, Los Gatos
Larry Costello	UC Cooperative Extension, Half Moon Bay
Robert Crudup	Valley Crest Tree Company, Sunol
Jim Geiger	Center for Urban Forest Research UC Davis, Davis
Bruce Hagen	California Dept. of Forestry & Fire Protection, Santa Rosa
Richard Harris	UC Davis Department of Environmental Horticulture, Davis
Brian Kempf	Urban Tree Foundation, Visalia
Jerry Koch	City of Berkeley Division of Urban Forestry, Berkeley
Bob Ludekens	L. E. Cooke Company, Visalia
Greg McPherson	Center for Urban Forest Research, UC Davis, Davis
Martha Ozonoff	California ReLeaf, Sacramento
Ed Perry	UC Cooperative Extension, Stanislaus County
Markio Robert	Caltrans, LDA Maintenance Division, Oakland

Illustrations:

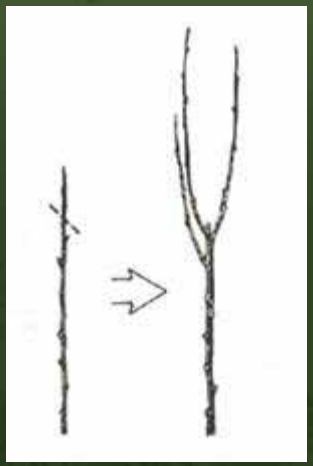
Front page, c) temporary branches C. Trunk Taper Illustration by Edward F. Gilman, Professor, Environmental Horticulture Department, IFAS, University of Florida.
All other Illustrations adapted from Integrated Management of Landscape Trees, Shrubs and Vines, Fourth Edition, 2003, Harris, Clark, Matheny
Photos: Brian Kempf
For more information contact Brian Kempf 559–713–0631 or brian@urbantree.org

Central Leader

Not topping is preferable.

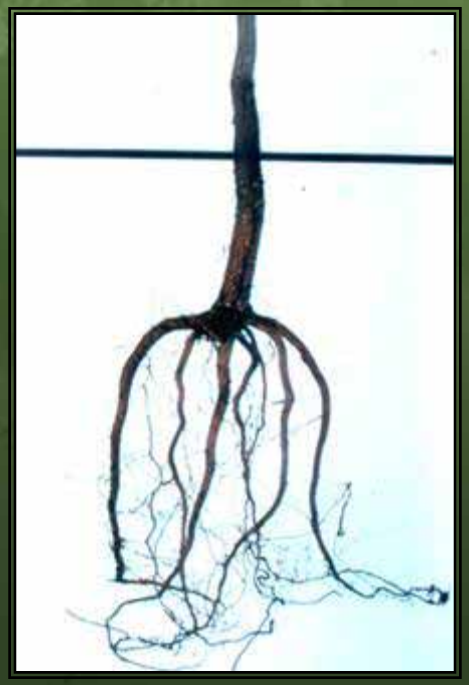


Topping and retaining a leader is acceptable.



Topping with out retaining a leader is not acceptable.

Tree Roots



preferable

not acceptable

Challenges

- Safety
  - Visibility
  - Lighting
  - Crashes
- Other Infrastructure
  - Roots, hardscape, sewers
  - Leaves and litter
  - Powerlines
  - Irrigation and subbase
  - Crows
- Other Environmental
  - BVOCs, allergens
  - Runoff water quality
  - Solar access
  - Water conservation
  - Solid waste

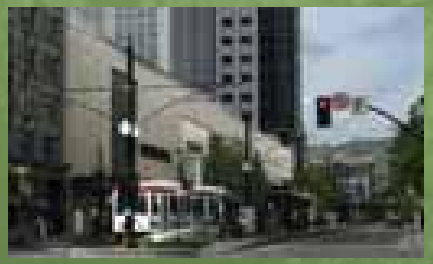
Eric Petersen / The Livingston Enterprise

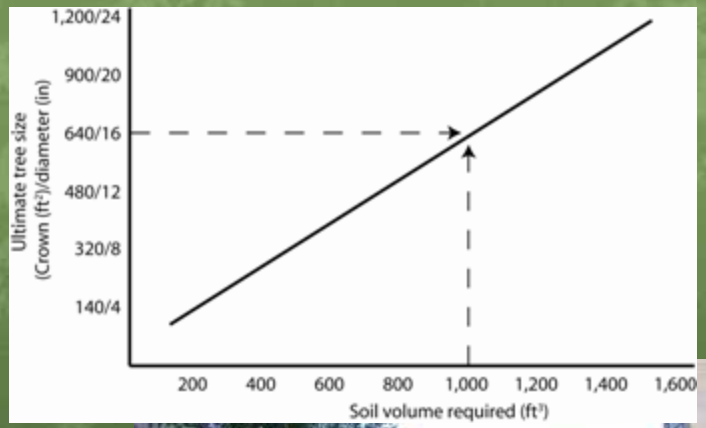
Opportunities

- Urban forestry in spotlight
- Carbon and air quality investments
  - utilities, cities, corporations
- How best create plan to implement?
- How best design plantings to maximize effect & minimize conflicts?
- How best communicate BMPs?
- How monitor and report?
  - Installation
  - Survival
  - Growth
  - Performance

Questions?

www.fs.fed.us/psw/programs/cufr




1,200/24
900/20
640/16
480/12
320/8
140/4
Ultimate tree size
(Crown (ft²)/diameter (in)
200
400
600
800
1,000
1,200
1,400
1,600
Soil volume required (ft³)