PLANTING THE SEEDS OF SUCCESS.

STRATUM: The who, what, when, where and how of street trees

Paula Peper, Center for Urban Forest Research,
Pacific Southwest Research Station, USDA Forest Service

Center for Urban Forest Research

USDA Forest Service
PSW Research Station
Davis, CA

Demonstrate new ways that trees add value - quality of life - to communities.

We convert research results into financial terms to stimulate community investment in trees.

Traditional & Urban Forestry

- Adapted methods/terms from traditional
  - Stand structure, growth rates, site indices
  - Carbon equations/estimates
  - Carbon protocols for California Climate Action Registry

Applications to Traditional Forestry

- Change in how U.S. looks national forests
  - Increasing recognition that rural forests have environmental and economic benefits beyond timber/wood product and biomass production.
  - Structure, function, value
    - Functions are expanding
    - New ways to assign value
    - How will value change/influence management?

Street Tree Assessment Tool for Urban Forest Managers

- Who?
  - STRATUM is designed for use by managers, foresters, tree non-profits, designers/planners, and landscape architects.
- What?
  - STRATUM is a tool that provides users with the ability to evaluate tree populations and programs.
  - Benefits *and* Costs

Why Street Trees?

- Accessible
- Urban heat island mitigation
- Canopy cover

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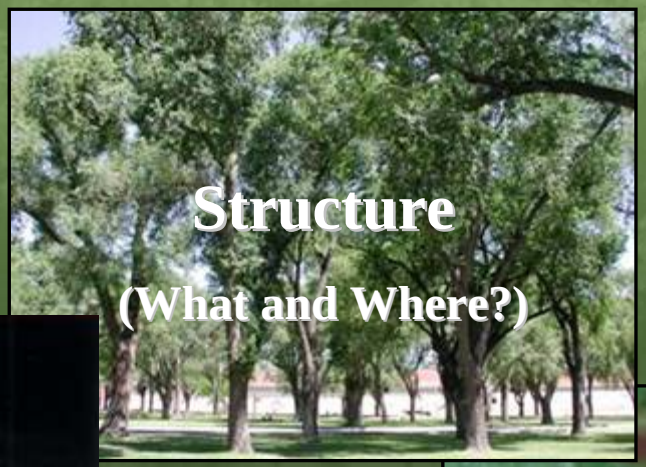
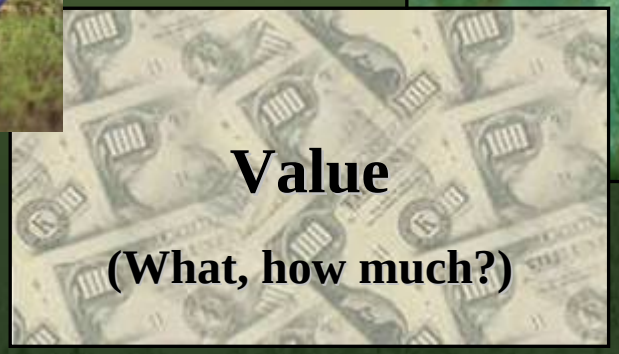
Benefit-Based Approach





STRATUM Research

Investment Value

Benefits *and Costs*

- Benefits
  - Air quality
  - Carbon
  - Stormwater interception
  - Energy savings
  - Property value
- Costs
  - Planting
  - Care & Maintenance
  - Infrastructure damage
  - Liability
  - Pest control

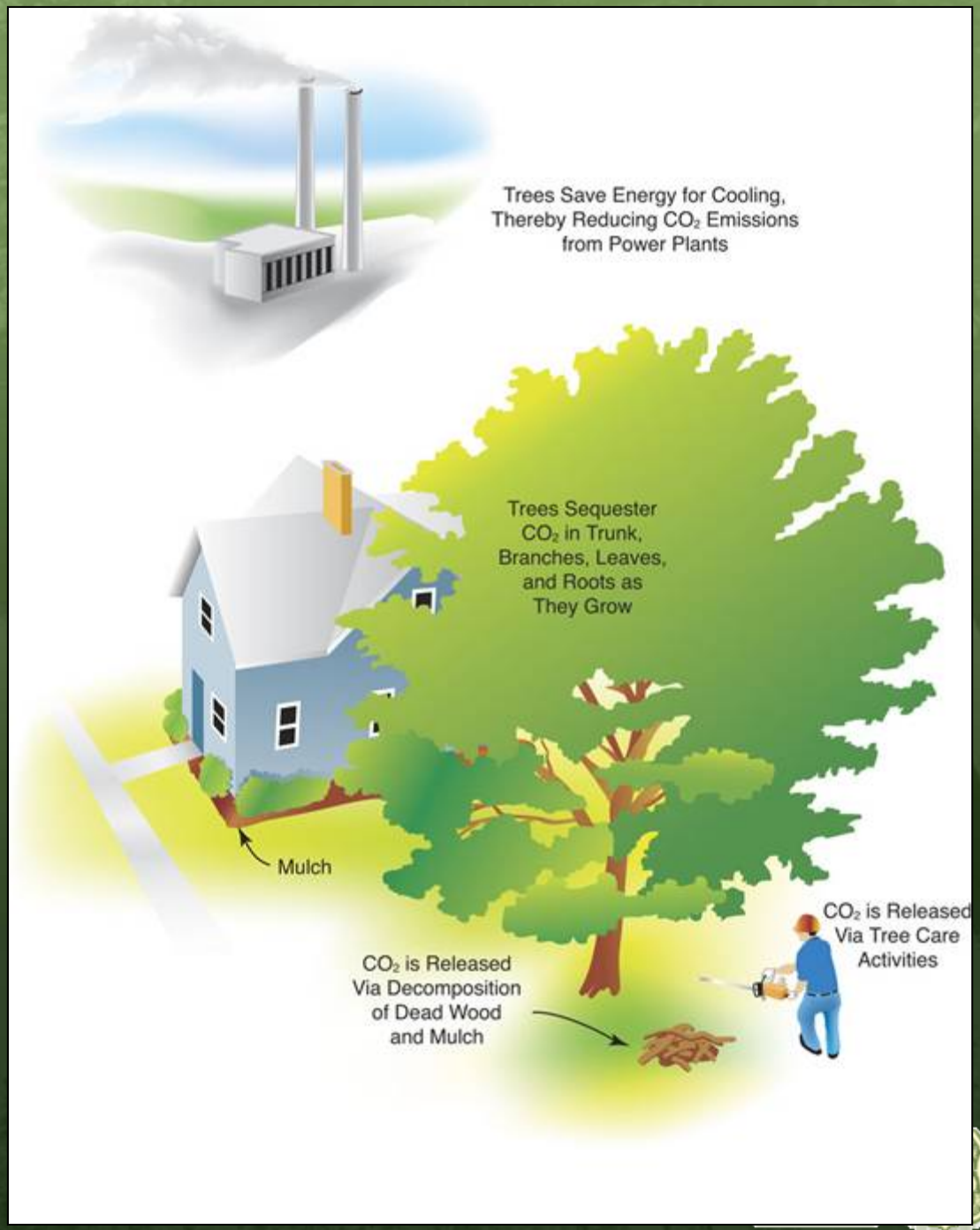
Conserving Energy

Reducing Atmospheric Carbon Dioxide

Typical 40-year old large tree

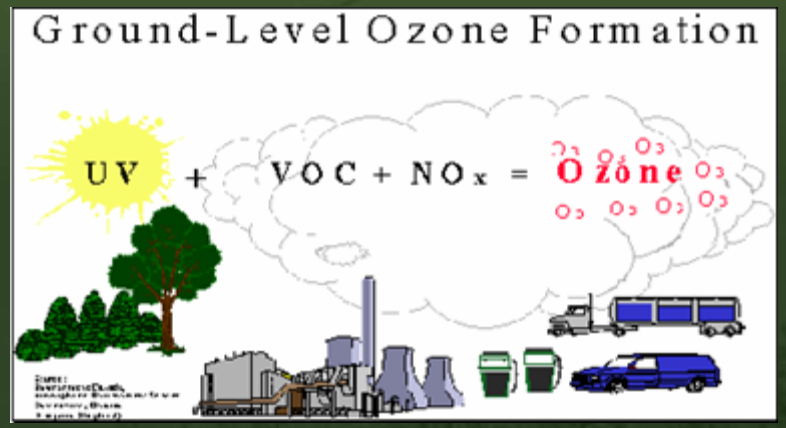
- Idaho:
  - Dbh 45 cm
  - Net annual= 362 kg
  - $2.67

- NY City
  - Dbh 40 cm
  - Net = 288 kg
  - $2.12



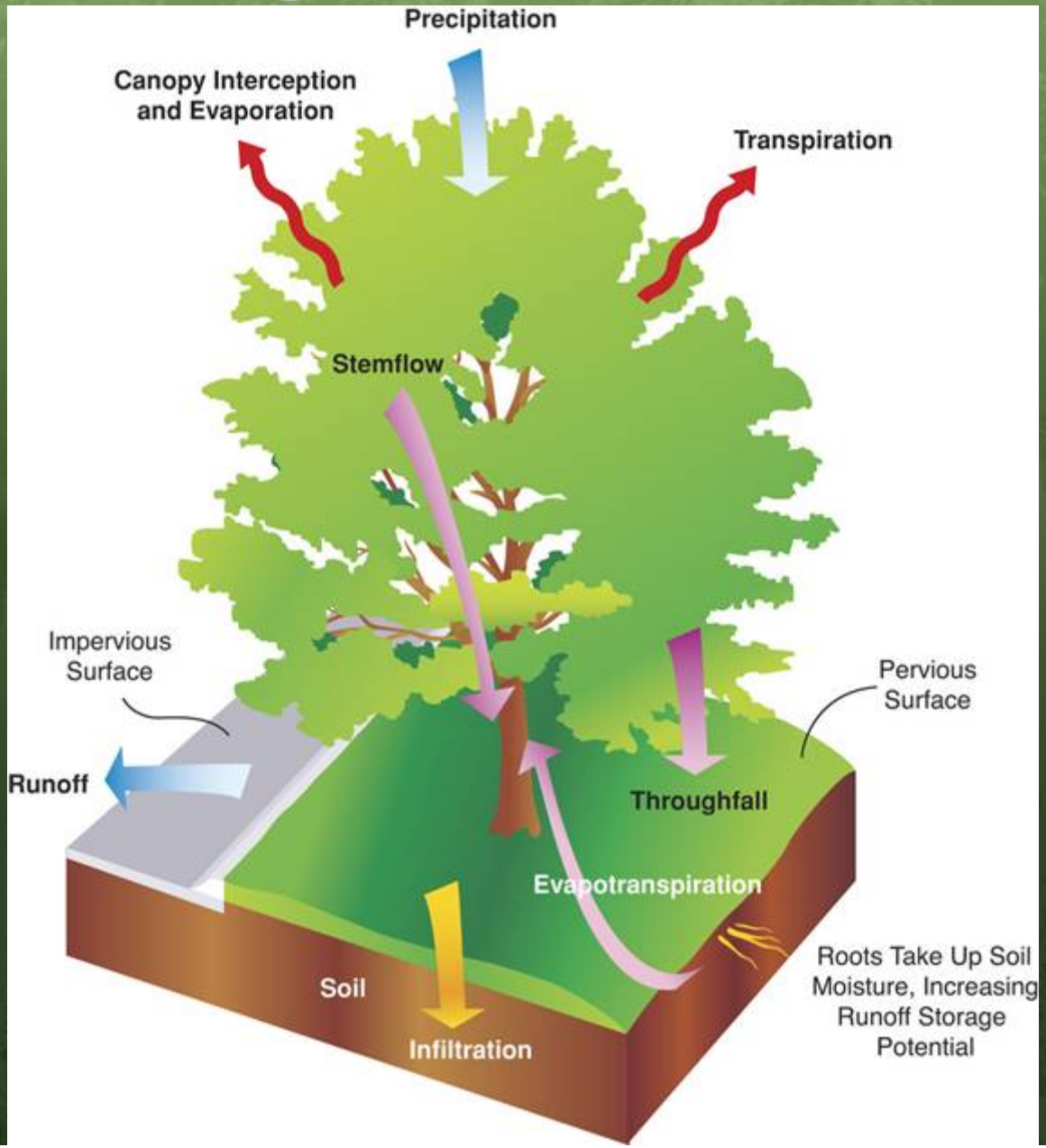
Improving Air Quality

- Ozone: 160 million people
- Particulates: 100 million people



- Large Tree – NE vs. Interior West
  - 2.6 lbs/year $20.78
  - 6.1 lbs/year $3.75

Reducing Stormwater Runoff



Priced Benefits

- Regional market prices –elec/gas (ConEd, PeoplesNatGas, Boston Elect. Municipal Utilities)
- Carbon trading credits - CO_2 ($15/ton)
- Cost of controlling air pollutants (Wang and Santini)
- Retention/detention costs—stormwater runoff
- Property/Aesthetics – 1 % median residential resale price

Tree Expenditures

- Planting, pruning, maintenance
- Administrative

Infrastructure Damage

Compendium of Strategies to Reduce Infrastructure Damage

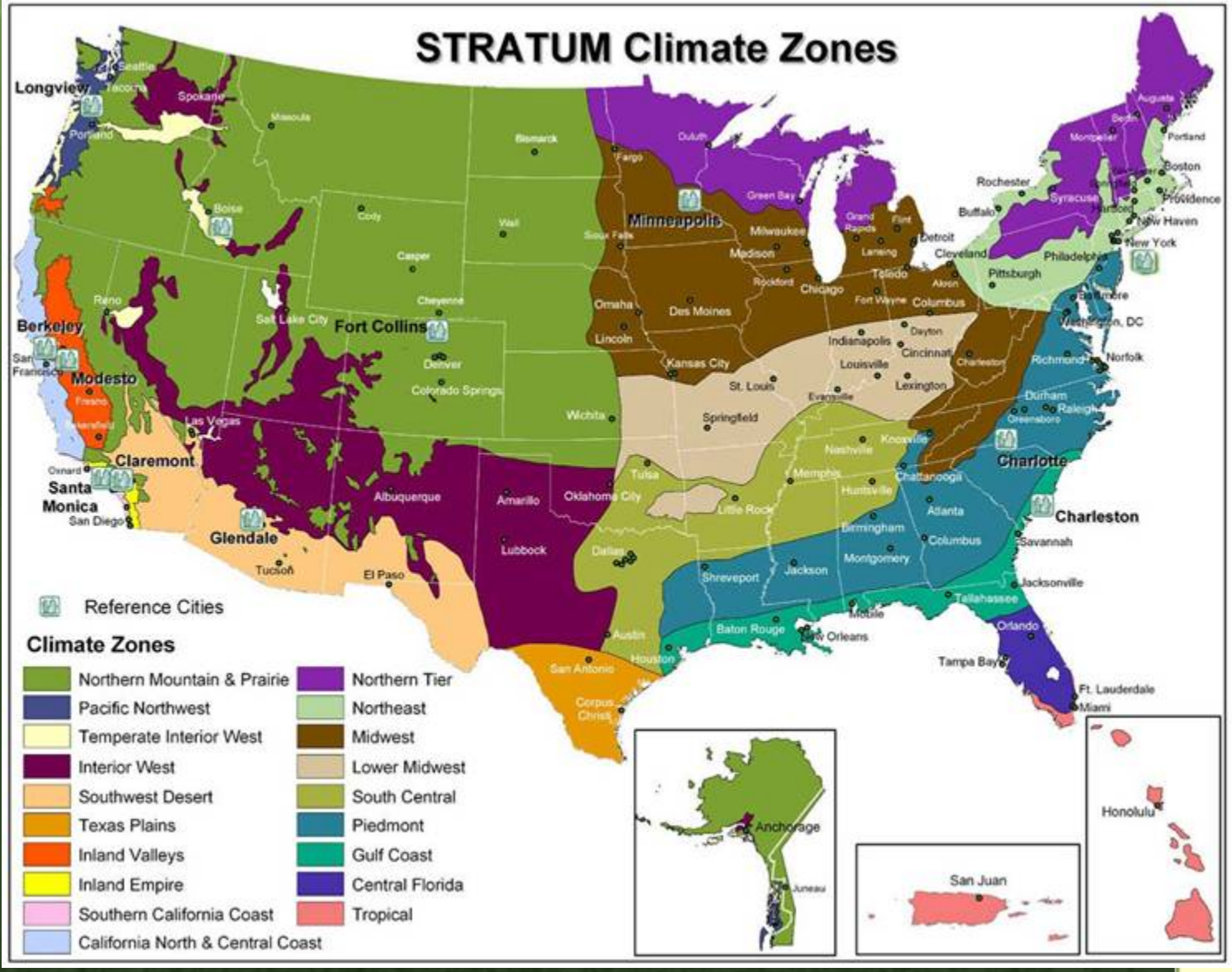
Other costs

- Sewer
- Pest control
- Liability – trip and fall, storm damage, vehicle accidents
- Catastrophic tree loss

Extensive Regional Differences

- Tree level
- Cost of resources
- Air quality monitoring
- Building vintages/climate
- Infrastructure/repair costs
- Liability issues
- Employee costs

Reference Cities



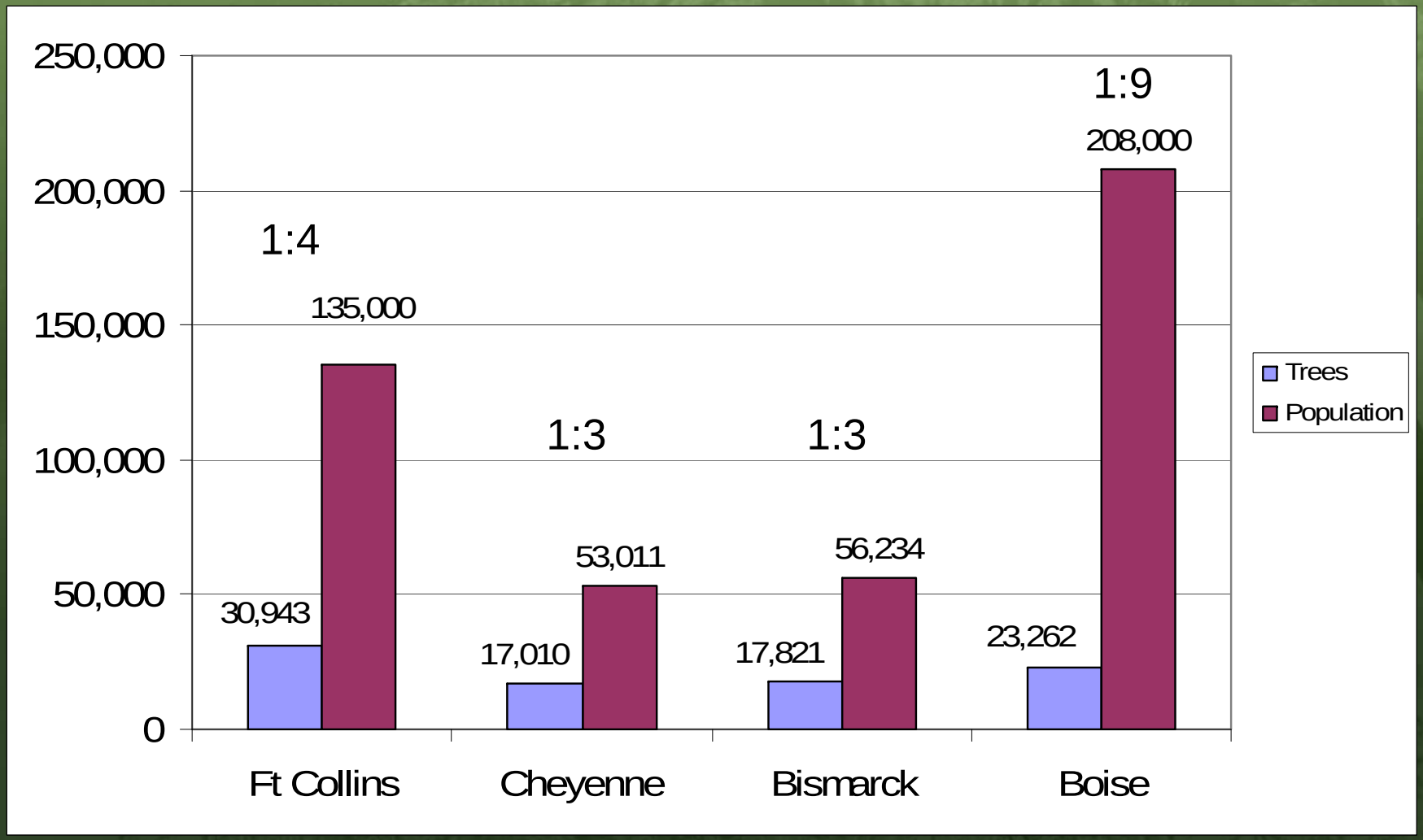
Reference City Research

- Collect data – predominant reference city street tree species
- Analyze growth rates and dimensions
- Estimate magnitude of annual benefits
- Price benefits
- Price tree care costs
- Calculate net annual benefits, benefit-cost ratios

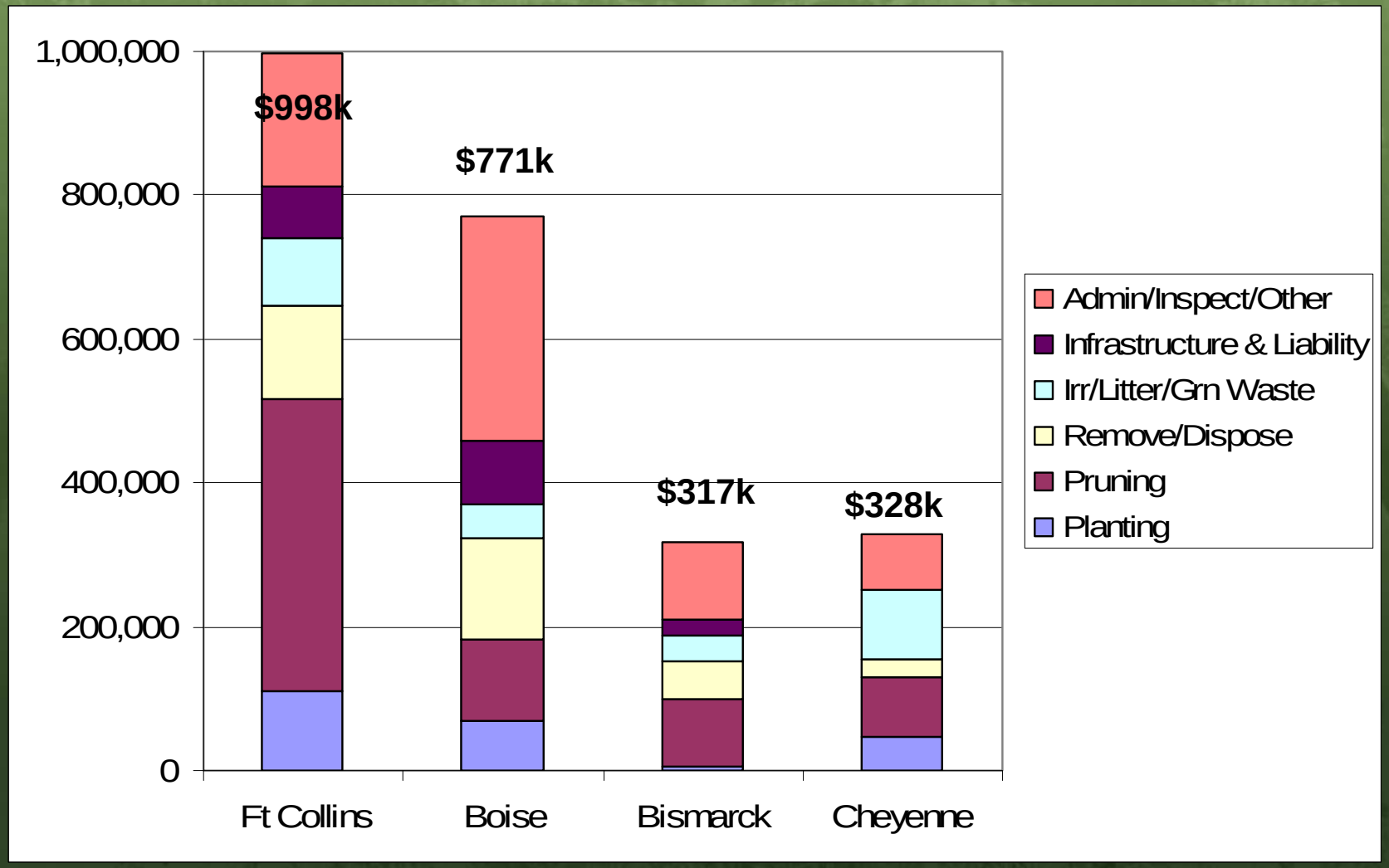
25 measurements per tree

- Diameter-at-breast-height
- Tree height
- Crown (bole) height, crown diameter
- Leaf area
- Utility lines
- Tree orientation and setback
- Condition and location
- Pruning level recommendation
- Grow space type and size
- Tree condition & maintenance
- Hardscape damage

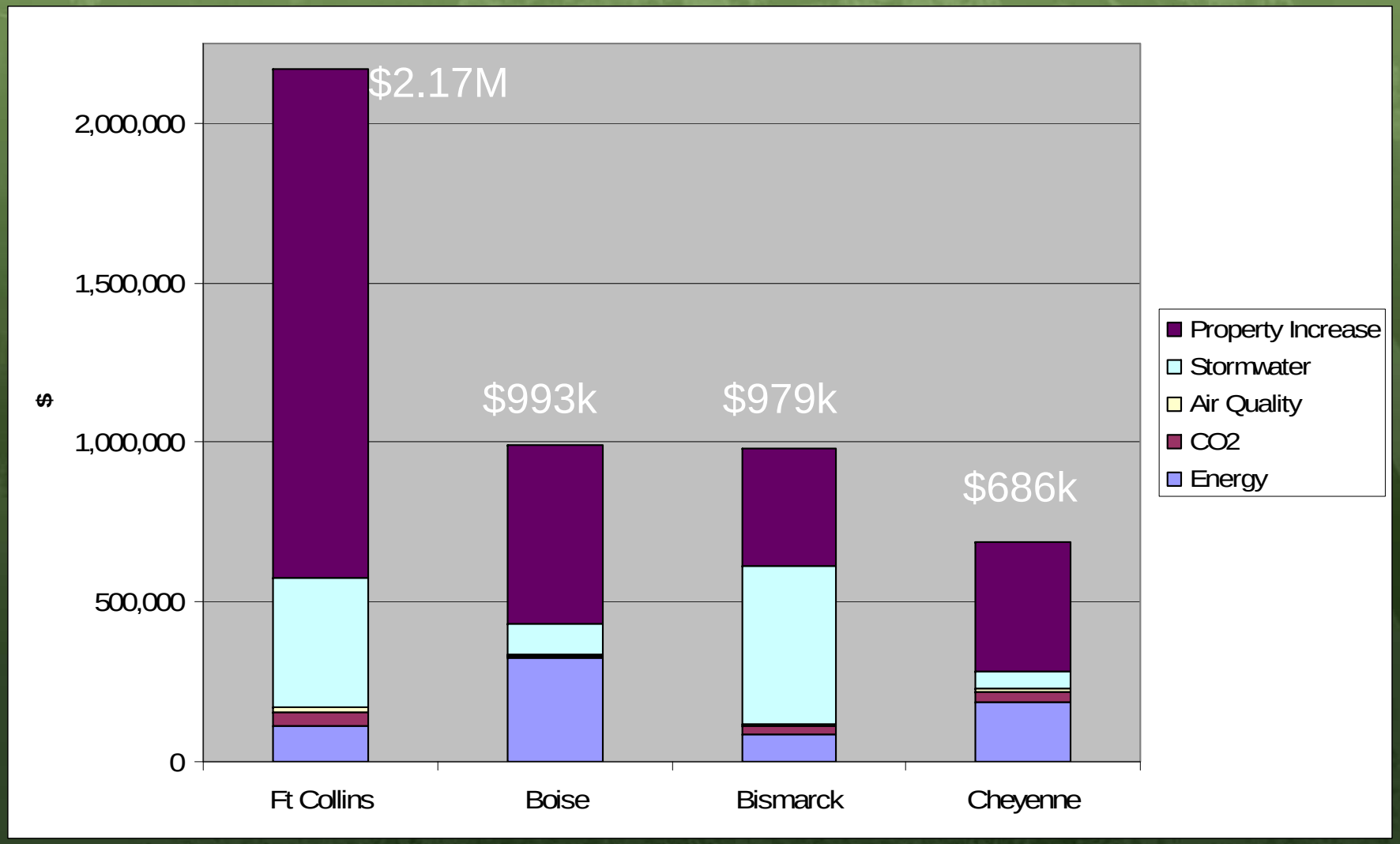
Tree & People Populations



Expenditures ($)



Benefits


$2.17M
$993k
$979k
$686k
2,000,000
1,500,000
1,000,000
500,000
0
$
Ft Collins
Boise
Bismarck
Cheyenne
Property Increase
Stormwater
Air Quality
CO2
Energy

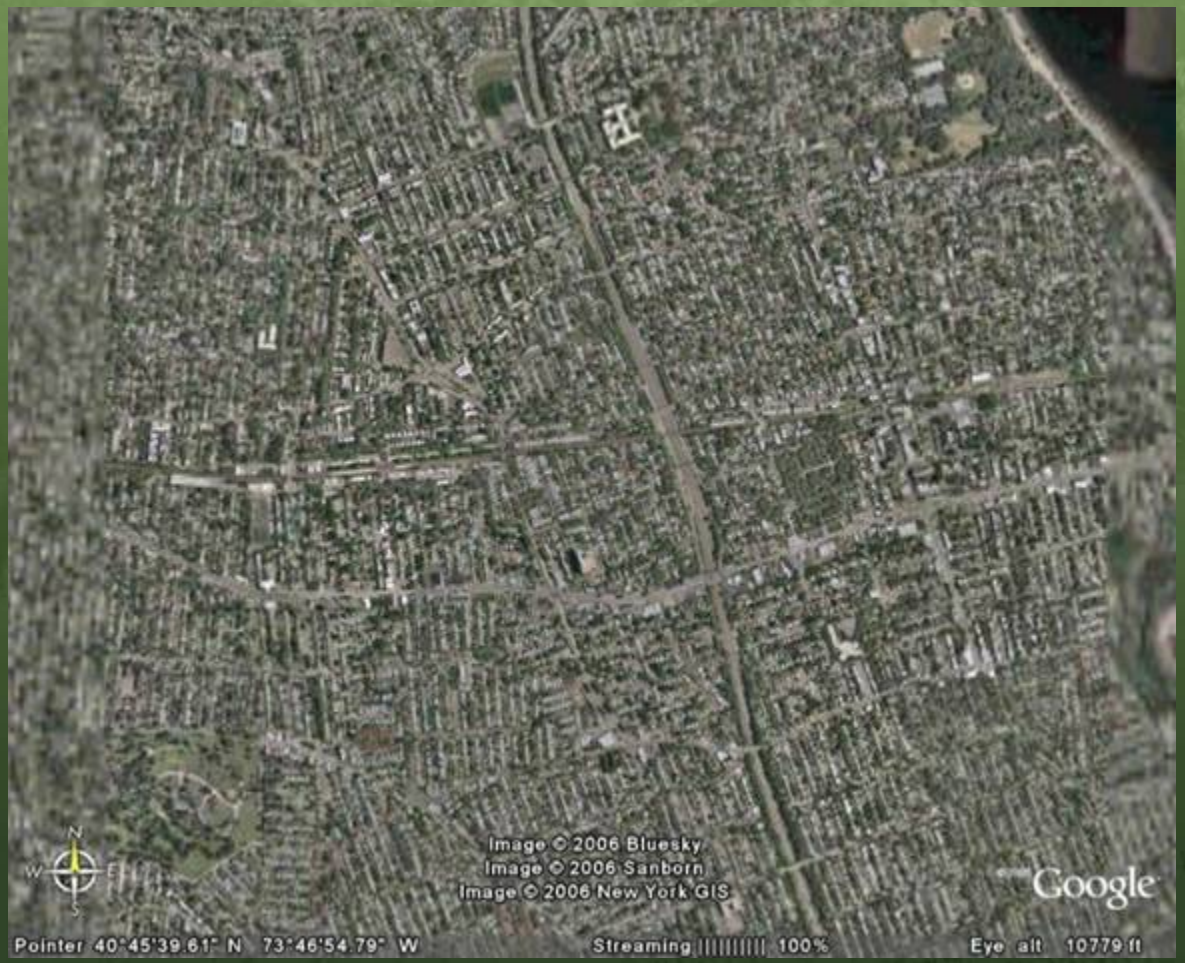
Comparison (?) per Tree

	Ft Collins	Cheyenne	Bismarck	Boise
Benefits	$70.15	$40.33	$54.94	$42.70
Costs	$32.24	$19.28	$17.77	$33.13
B/C Ratio	2.18	2.09	3.09	1.29

1st Place Bismarck
2nd Place Ft Collins
3rd Place Cheyenne
4th Place Boise

New York City
5.60

Planning Green Infrastructure

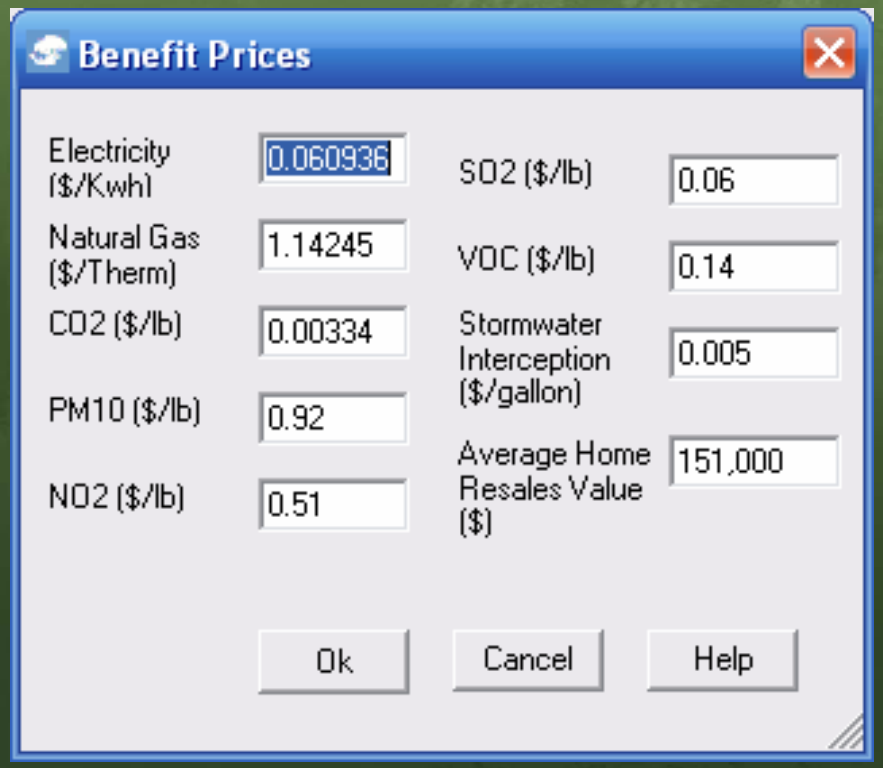


City expansion → Greater economic services obtainable from trees

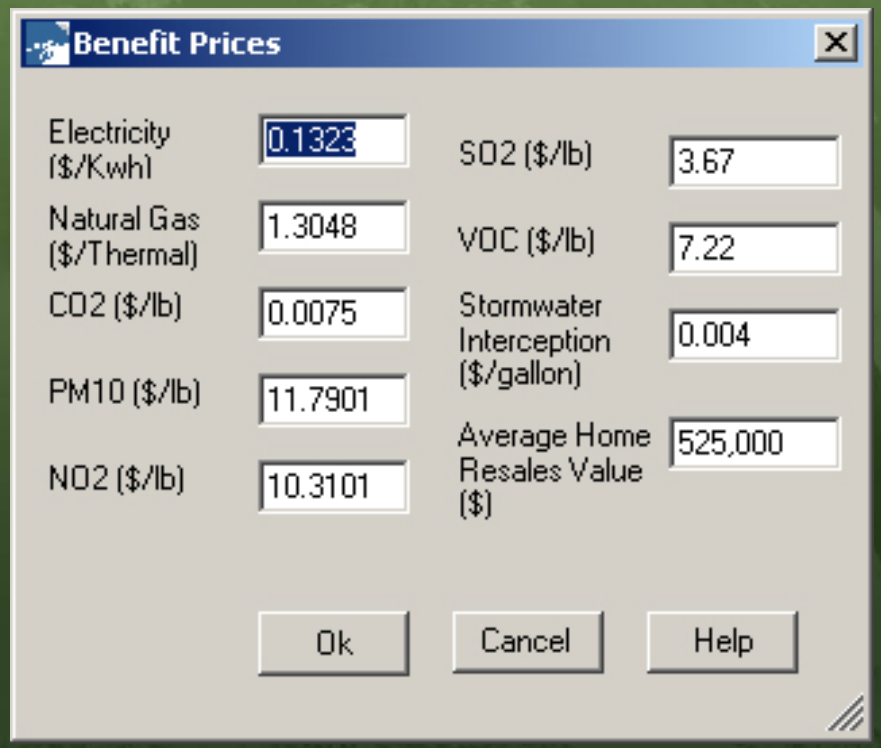
Regional Variation

- Local cost of living – benefit prices
- Tree age distribution
- Tree location
- Size counts
- Building vintages
- Etc.

Environmental Service Price Differences

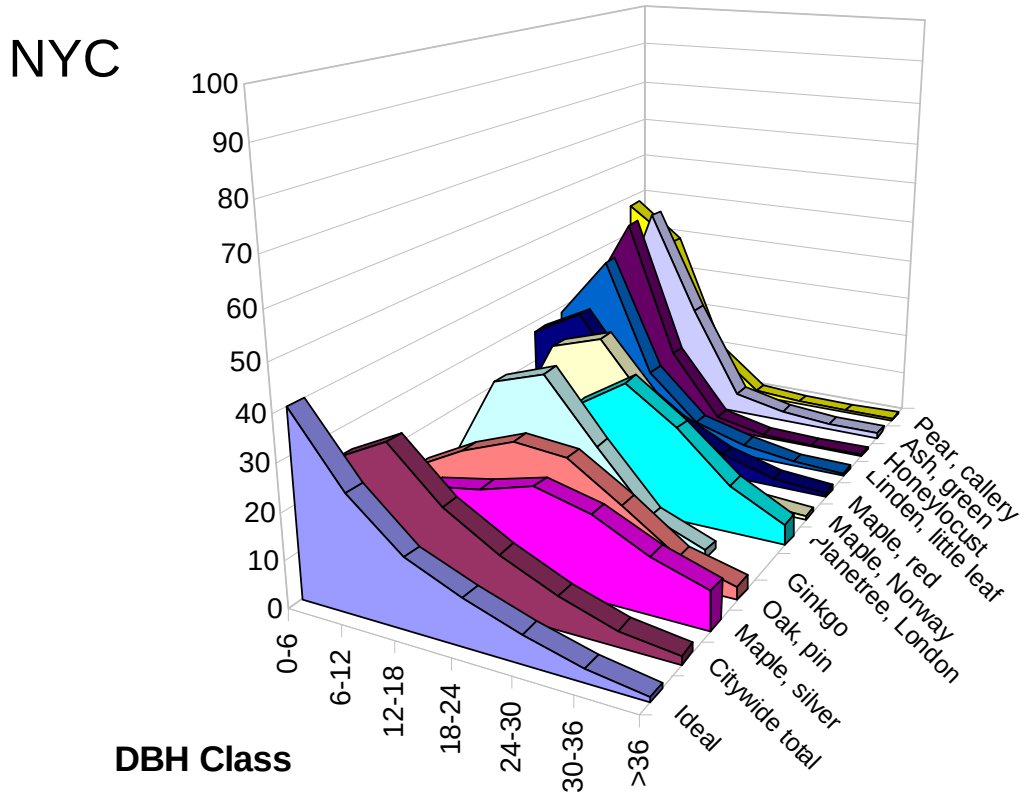


Boise



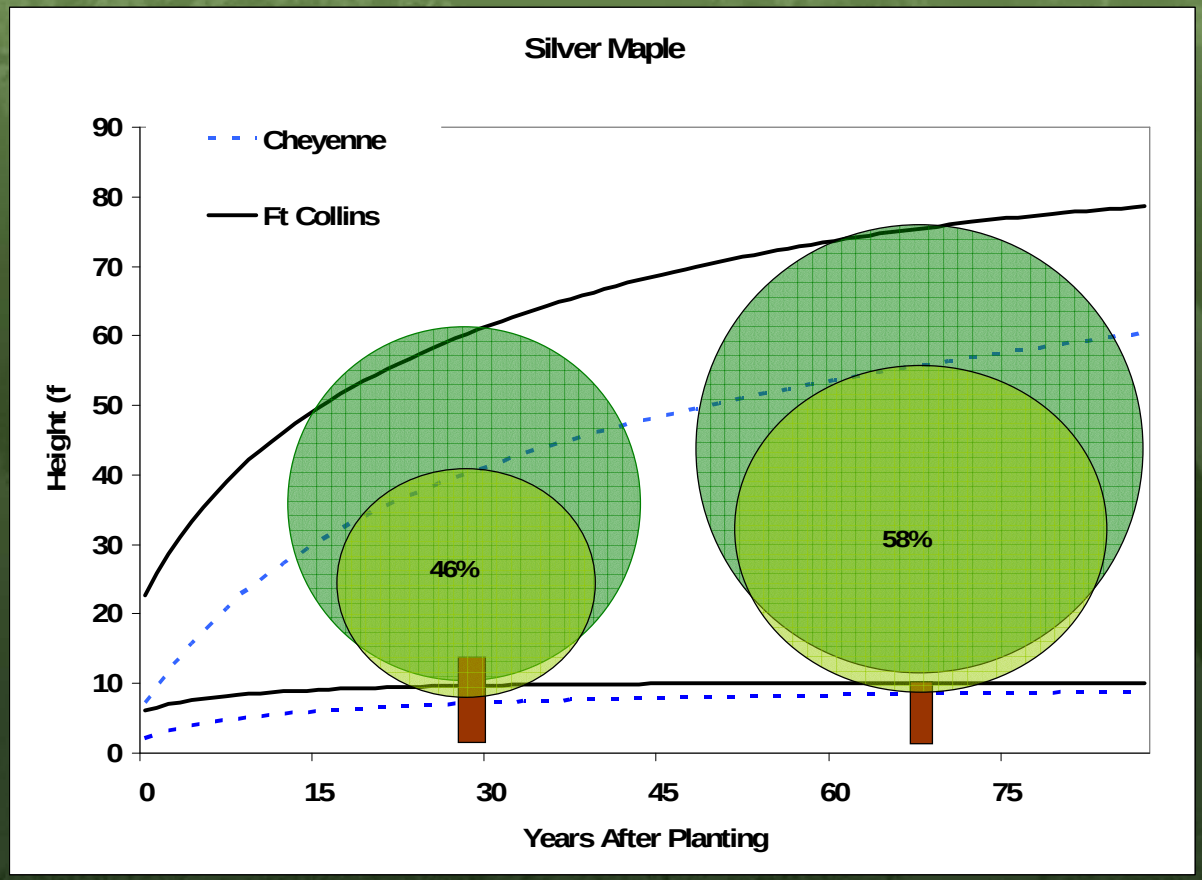
New York City

Relative Age Distribution



Tree Size & Location

Climate Affects Tree Size and Growth



Accounting for Growth Differences

Cheyenne Climate and Environmental Factors

- Weather:
  - 4th windiest city
  - Highest incidence of hailstorms
  - Average 14.4 inches precipitation annually
  - Low humidity and higher altitude (6138 ft)
- Soils:
  - Alkaline
  - Low water-holding capacity

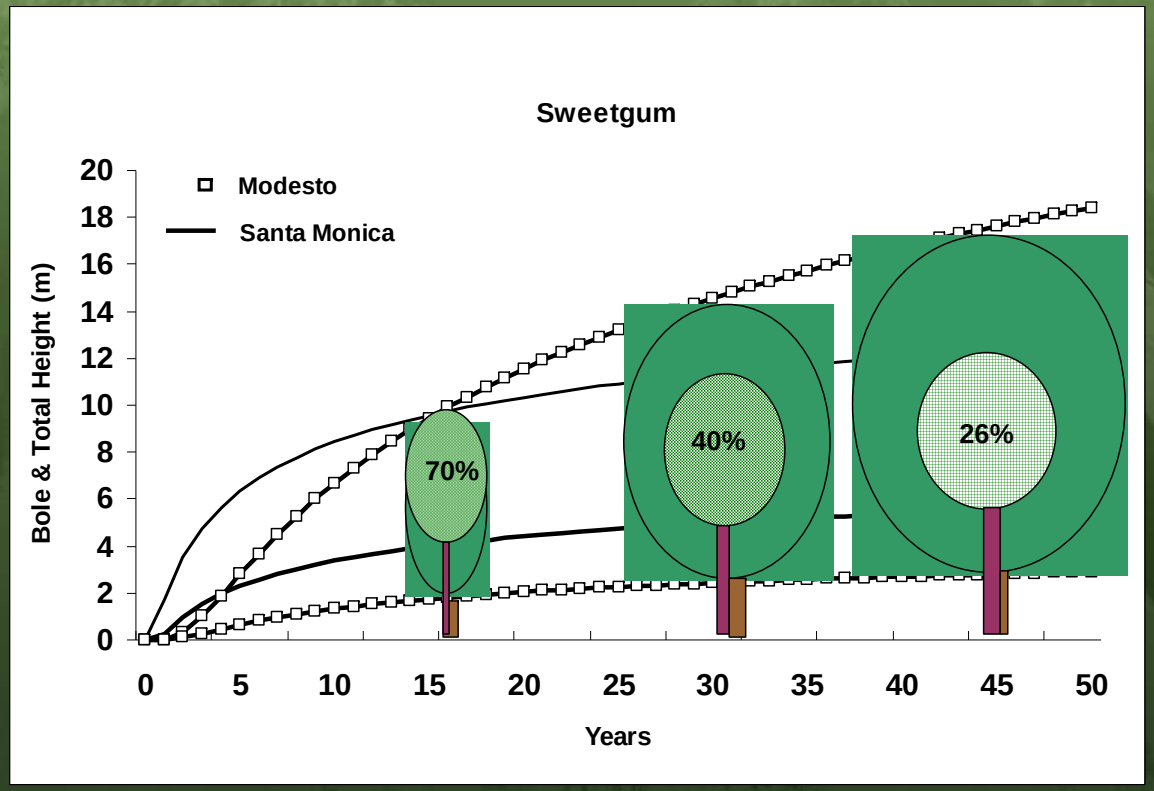
Cheyenne Trees

- Compared to like-aged trees
  - Shorter
  - Smaller dbh
  - Smaller crown diameter
  - Less leaf area

Dust cloud approaches during the 'Dust Bowl'

Municipal Forests: Planning + Tenacity =Benefits

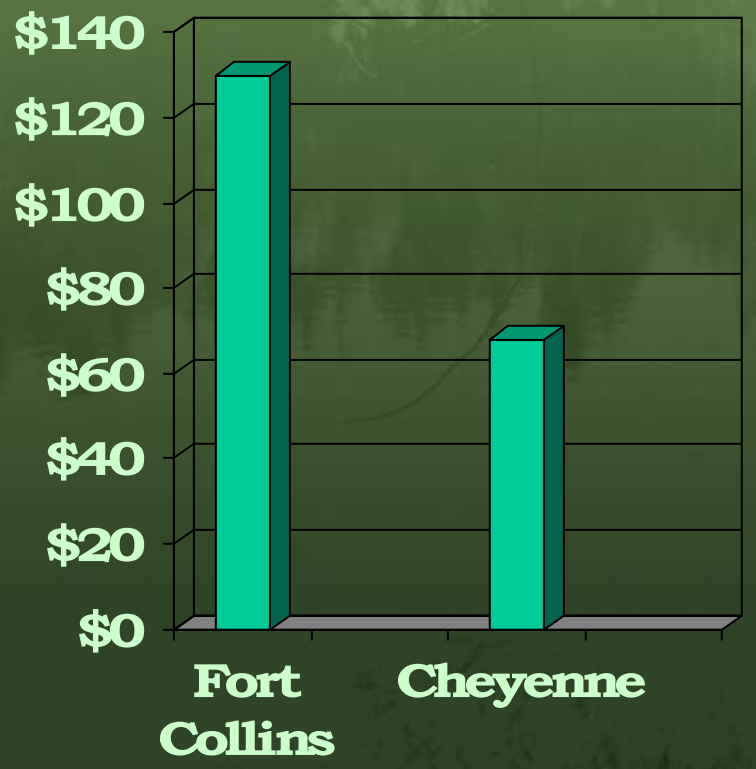
Care Affects Tree Size and Growth

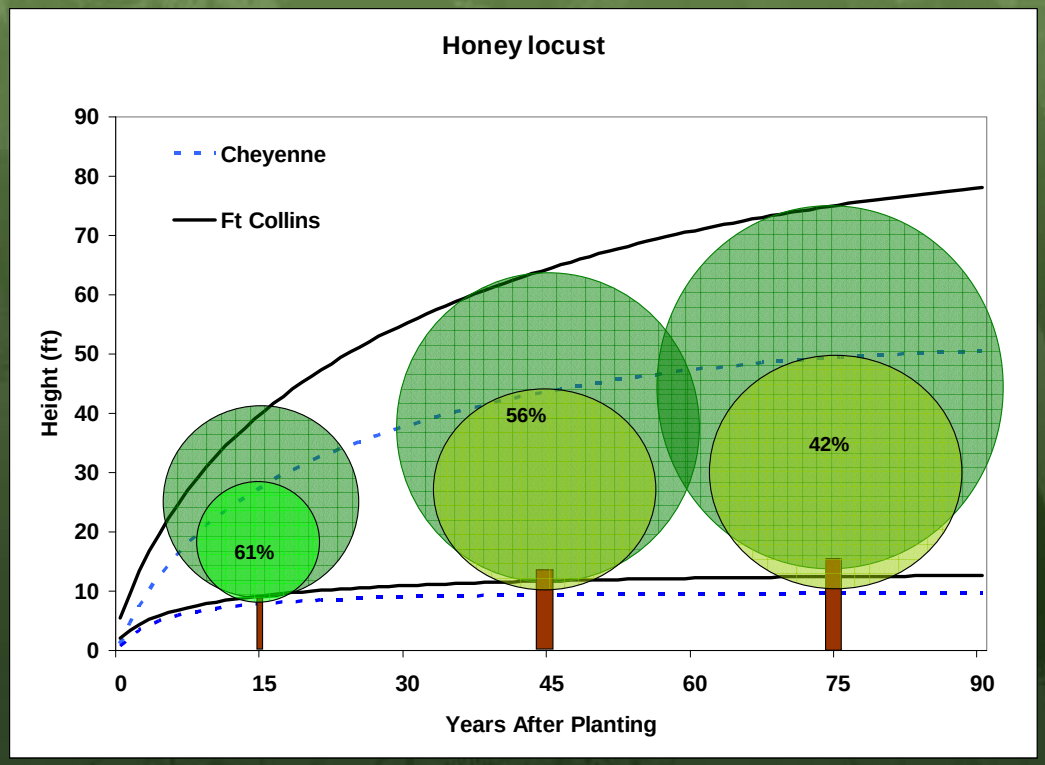


Are your pruning cycles

pruning dollars off of trees?

Tree Size and Benefits





Reference Cities capture many of the differences between U.S. regions

iTree STRATUM helps users begin benchmarking the health and sustainability of benefits of their street trees

STRATUM & Benchmarking

- What does this information mean?
- Benchmarking
  - ✓ Comparisons (internal & external)
    - Areas of success, need improvement
    - Prioritize management & investment
    - Baseline for future comparisons
    - Compare program with similar cities
    - Compare resources, budgets and outcomes

Indicators of Health and Stability

- Structure
  - ✓ Species importance
  - ✓ Age diversity
  - ✓ Condition
- Management
  - ✓ Planting
  - ✓ Pruning
  - ✓ Removal
  - ✓ Conflicts
- Economic
  - ✓ Expenditures
  - ✓ Benefits
  - ✓ Net benefits
  - ✓ Benefit-cost ratios

Structure: Key Indices

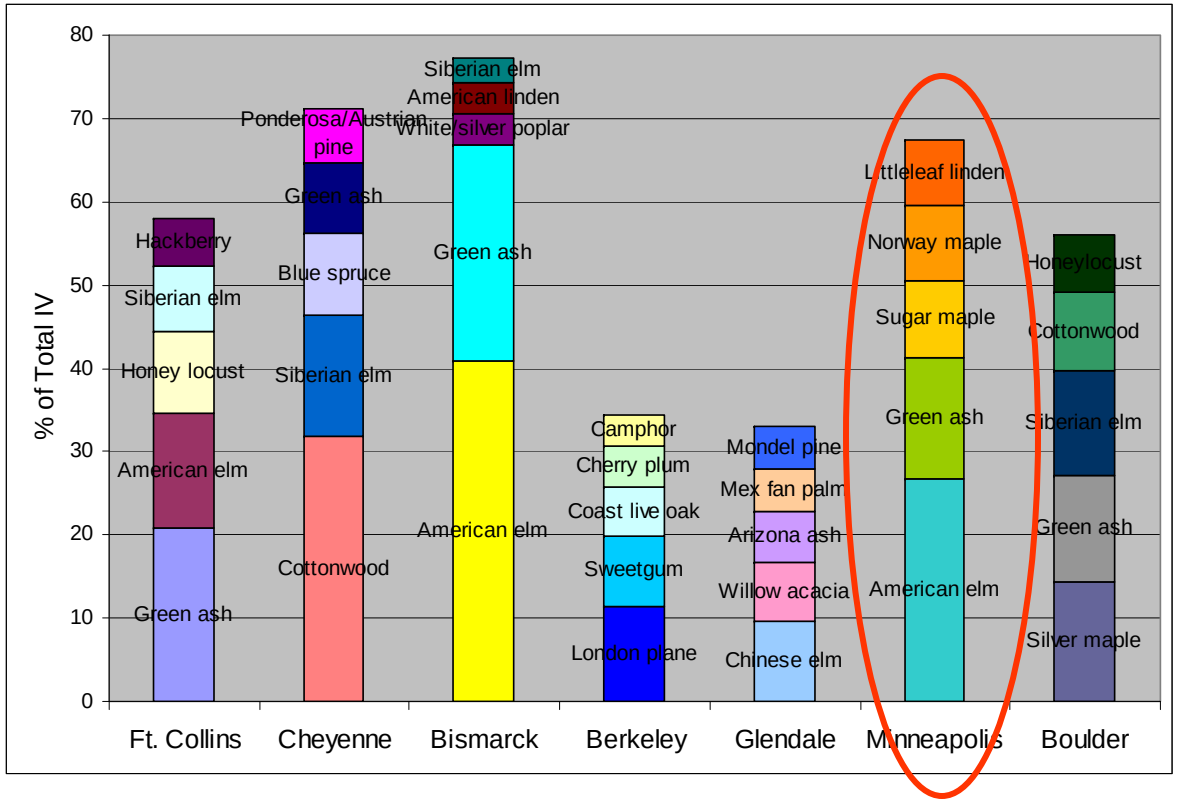
- Stability
  - ✓ Distribution of Importance Values among species
  - ✓ Age distribution
- Condition

Importance Values

- Relative contribution of a species to the entire population due to numbers and SIZE
  - ✓ Percentage of total tree numbers
  - ✓ Percentage of total leaf area
  - ✓ Percentage of total crown projection area
  - ✓ Ranges from 0-100 by species
- Why important?
  - ✓ Influences stability
  - ✓ Indicates reliance on functional capacity of each species
  - ✓ Linked to benefits and indicates future trends

IV Distribution Comparison

- Indicator
  - ✓ Total IV for top 5 species (%)
- 11 City Results
  - ✓ Mean = 57.8%
  - ✓ Std Dev = 15.6%
  - ✓ Range = 33-79%
- Minneapolis
  - ✓ 67.5%
  - ✓ Grade = D



Age Diversity

- Percentage of total tree numbers by DBH class
  - ✓ "Ideal" has 40% young, 30% maturing, 20% mature, 10% old
- Why important?
  - ✓ Influences stability
  - ✓ Influences short-term management costs and benefits
  - ✓ Indicates future population trends and management issues

Management Needs Indices

- Planting: % full stocking
- Pruning:
  - ✓ % safety and general prune
- Removals: % needed
- Conflicts: % sidewalk & powerline
- Why?
  - ✓ Prioritize needs
  - ✓ Budget for priority management
  - ✓ Identify species that perform well and poorly in different sites

Management: Planting Needs

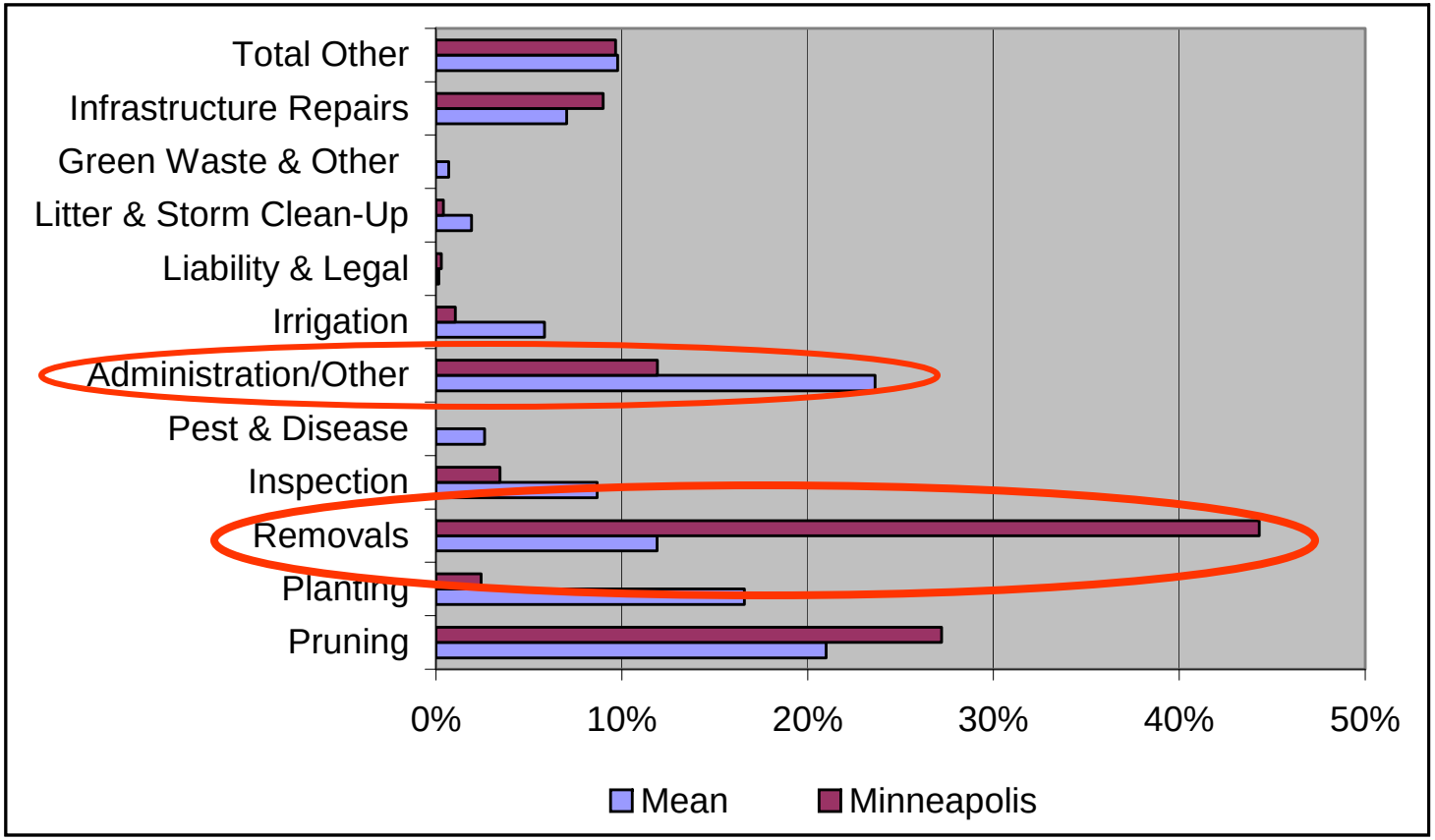
- Percentage of all street tree sites with trees (2 trees every 50-ft street is full stocking)
- Why is it important ?
  - ✓ How many trees can be planted
  - ✓ Ability to increase net benefits
  - ✓ How well treed our city streets are compared with others'

Economic Indices

- Expenditures
  - ✓ $/tree
  - ✓ $/capita
- Benefits
- Net Benefits
- Benefit-cost ratios
- Why is it important?
  - ✓ Evaluate return on investment
  - ✓ Compare across categories
  - ✓ Compare with other cities

Expenditures Comparison

- 11 City Results $/tree
  - Mean = $33.53
  - Minneapolis = $46.36
  - Grade = C



Recommendations

- Desired Future State of the Urban Forest?
  - Stocking
  - Stability
  - Management
  - Functionality

Learn more about i-Tree?

- Visit:
  - ✓ http://www.itreetools.org

i-Tree International?

- Canada
- Europe
  - Portugal
  - Italy
- Australia

- i-Tree Team meetings
  - integration
- Develop road plan
  - Reference cities
  - Resource units

Visit our Websites

Center for Urban Forest Research

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

i-Tree STRATUM

http://www.itreetools.org/

ppeper@fs.fed.us