Designing for Longevity

ENH 100
Davis, California

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Urban Ecosystems & Social Dynamics
Pacific Southwest Research Station,
USDA Forest Service
...early tree planting in the west
Imposing ourselves on the land

1910 - on G looking north from Fifth Street, Davis, CA

1913 - 6th and E Streets, Davis, CA
Cheyenne, Wyoming
Las Vegas Today

Eric Condra Photography, Paoli, IN http://www.flickr.com/photos/32838849@N08/4177942149/
Case Study: Sacramento
Gold Rush
Why Did They Plant?

- Health – swamp reduction
- Flood protection
- Shade
- Winter windbreaks
- Food
- Aesthetics
Sacramento’s “Park Neighborhoods”: What Worked, What Did Not?

- Sacramento’s “streetcar suburbs”
- Trees became drawing point
- Major planting 1860s through 90s
- Planting space
- Spatial relations between houses, infrastructure, trees
- What happened to trees over time?
- Was anything learned?
What and How

• Plane trees and elms
  – P. orientalis, occidentalis
  – U. glabra, procera, americana, thomasii, alata
• Palms
• Redwoods
• Eucalypts

• Planted 20’ apart
• Planting strips – came in late 1800s
  – 2.5’ to 15’
• lawns/lots
• 1938 – trees are 70 years old
"Leaners" on 17th street. Day after the storm. Feb. 10th, 1938.
Causes

• Improper planting
• Improper pruning
• Roots cut with street and sidewalk development
• Began systematic removals 35-50 ft spacing (until $$ ran out)
Trees in Planting Strips
(<15 feet)

- Smaller the space, more trees
- Smaller the space, higher mortality
- Smaller space, poorer condition (94% lawn trees in fair or better; only 79% strip)
- More replacement
Sidewalk Damage

Sidewalk Damage - Large Trees

% of Trees Damaging

Setback Between Tree Center and Sidewalk (ft)

- 85.7% of trees damaging when the setback is 2-4 ft.
- 61.1% of trees damaging when the setback is 4-6 ft.
- 53.3% of trees damaging when the setback is 6-8 ft.
- 33.3% of trees damaging when the setback is 8-10 ft.

Note: Graph shows a downward trend indicating a decrease in sidewalk damage as the setback increases.
Our research: Larger space = larger tree + longer life

Larger tree = greater benefits for longer period
Factors Affecting Tree Growth and Longevity

Still making some of the same old mistakes
Coast Redwoods
Coast Redwoods
Drainage
Cycle of Failure

- Plant trees
- They grow up
- Bad things happen
- We don’t like those trees anymore
- Time passes
- Same “bad” trees planted in same places again
When things go wrong...

...trees get the blame
Sustainability

• Maximize and maintain benefits through time

• Trees may not “belong” but are top mitigators of the harsh environments we create
Arborists and Landscape Architects -- Site Assessment: 3-Step Approach

• Assess the site above ground
• Assess the site below ground
• Select the best tree for that site (what does the tree need?)

Right Tree + Right Place
The Right Place

The Right Place

Aboveground

Belowground
Space for successful trees

Above ground

- Light and slope
- Wind, salt
- Wires, lights
- Buildings, signs
- Trees
- Vandalism
- Regulations
Space for Successful Trees

Below ground

- Soil pH and texture
- Compaction, drainage
- Salinity, contaminants
- Soil depth, rooting space
- Utilities
- Water access
Species Match Site Conditions & Requirements at Local Level
Develop Area
Specific Species Profiles
Local Tree Matrix

- Climate adapted
- Disease / pest susceptibility
- Soil tolerance
- Pruning needs
- Branch strength
- Root damage
- Longevity
- Availability
- BVOC Emission
- Pollen Emission
- Aesthetic Value
- Average

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Tree Growth in U.S.

- Started in 1998
- Completed 2010
- Goal
  - 16 Climate zones
  - Provide users with ability to import a tree inventory and receive info on benefits and costs
- Tree growth data
Tree Growth

- Over 17,000
- 171 species
- Overlap
  - Sweetgum 10
  - Honeylocust 10
  - Silver maple 9
  - Callery pear 9
  - Green ash 8
Comparisons and trends

- Overlap
  - Sweetgum 10
  - Honeylocust 10
  - Silver maple 9
  - Callery pear 9
  - Green ash 8
30-year old green ash
Green Ash

Growth (ft)

Years

0 5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80

0 10 20 30 40 50 60 70 80

Cheyenne
Boise
Ft. Collins
## Benefits ($) from 100 Green Ash over 40 Years

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Units in $1,000s
Cheyenne Climate

- 4th windiest city
- Highest incidence of hailstorms
- 14.4 in precipitation
- Low humidity and higher altitude (6138 ft)
- Alkaline soils
- Low water-holding capacity
Wyoming: Not for lightweights
Pruning Effects on $$

**Sweetgum**

- **60 ft**
  - $25
  - $100k
- **72%**
- **$18**
- **$72k**

**Years**

0 5 10 15 20 25 30 35 40 45 50 55 60 65

**Growth (ft)**

0 10 20 30 40 50 60 70
Pruning Effect on Benefits
(100 Trees over 40 Years)
Tree Foliage

- Intercept air pollution and particulates
- Intercept rainfall
- Process carbon dioxide
- Shade – heat island and energy
Poor pruning

- Increases maintenance cost
- Turns large trees into small
- Decrease life expectancy

Large
$213/tree

Small
$44/tree
Don’t Generalize -- Localize

Know local conditions and how trees respond to those conditions

Put the right tree in the right city....
Communicate
In most communities

the links are not connected
In most communities, we seldom communicate.
**Presidio Ecology and Design Charette, 2008**
**EDAW | AECOM**  **Project Director: Alexander Felson**

### Project Approach in Their Respective Fields

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<th>Evaluation</th>
<th>Design</th>
<th>Construction</th>
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**Typical Scope:**
Ecologists and designers typically craft their own scopes, neglecting to use each other's expertise.

**Typical Evaluation:**
Ecologists are typically involved in rigorous front end analyses and evaluation.

**Typical Design:**
Ecologists currently struggle to add effective input during the design process. While designers can incorporate ecology into design, ecologists cannot perform design tasks as easily.

**Typical Construction:**
The role of ecologists and designers is typically reduced during construction.

**Typical Post-Occupy:**
Designers typically have limited post-occuancy maintenance plans.

### Ideal Scope

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**Ideal Design:**
Collaboration on scope definition is essential to define means of interaction throughout project life cycle. This will maximize knowledge transfer through collaboratively defined tasks, leading to a stronger shared product.

**Ideal Construction:**
Designers can increase their understanding of sites through an integrated approach, ultimately improving on ecological analyses with strong information representation skills.

**Ideal Post-Occupy:**
Therefore, the designer should facilitate ecologist's involvement in order to more rigorously address key issues. Still, the ecologist needs to permit the designer "room to breathe."

**Communication during the construction period will maximize efficiency and accountability in following the established planning and design goals.**
Communicate to Build Longevity into Life Cycle
Nurseries

- Planting practices
  - Containers
  - Root issues
  - Species offerings
  - Cultivars
Retailers

- Stop holding stock
- Expand selection
- Reduce invasives
- Promote the benefits at less cost
Plan Space Correctly

Recent plans for 2-way residential street

TYPICAL 2 WAY RESIDENTIAL STREET

58' STREET SECTION (CITY OF SACRAMENTO IS 53' 6" PLT, 6.5' PKG)
NOT TO SCALE
Actual Two-way Streets

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.
Enough Space for Healthy Growth

12 ft
Red maple

- Shaded out one side
- Imbalance
- Top damaged by falling ash branch
Think about the Tree’s Needs

Overplanted—soil and water issues
Improper placement
Plant More Trees

...with forethought
Plant Larger Growing Trees

Photo courtesy of David Roberts
Smaller Space?

Plant smaller tree for fewer costs
+ more benefits
Maintain Existing Trees
Plan Ahead & Educate
To Optimize Tree Benefits and Plan for Sustainability

• Trees become integral component of infrastructure
• Masterplanning and design processes incorporate appropriate space for trees from outset
Sustainability

• Frequent interdepartmental communication – understand and educate each other
• Understand local tree performance/needs/limitations
• Plant for quality not quantity
• Prune to ANSI standards – with benefits in mind
• Educate, educate, educate
Urban forest sustainability involves many players.
Bottom Line: Trees are like puppies