Maximizing the Benefits of Trees Through Good Maintenance Practices

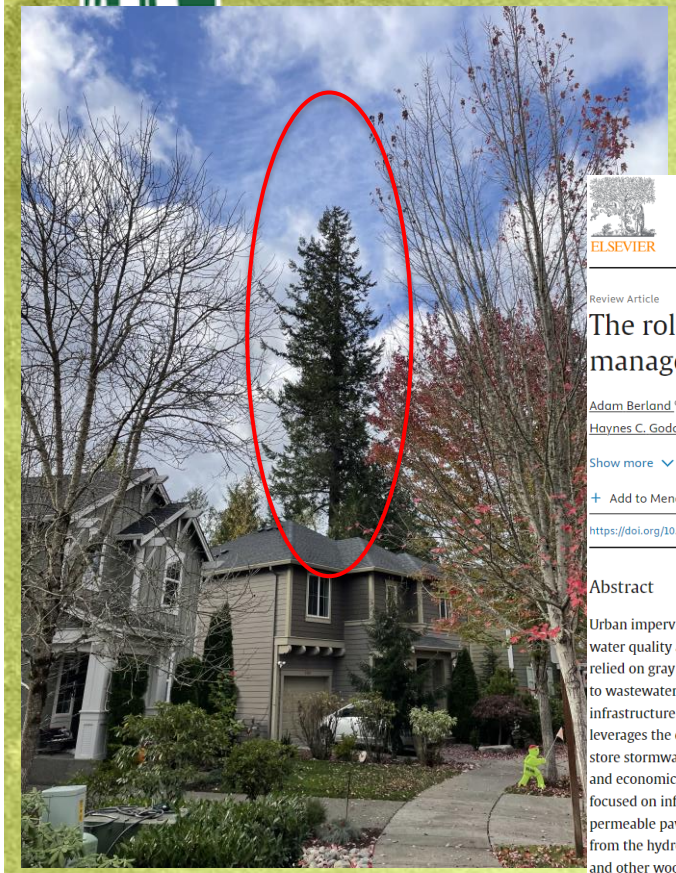
By Philip Bennett, Deputy Director, Parks & Public Works, City of Snoqualmie

Introduction

Learning Objectives

- Identify and understand the key environmental, social, economic, and public health benefits that healthy trees provide in park and urban landscapes.
- Understand how inadequate or absent maintenance can limit or negate the benefits of trees.
- Learn practical, achievable tree maintenance practices to support long-term tree health and maximize their value

Benefits of Trees - Stormwater



Anecdote

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Review Article

The role of trees in urban stormwater management

Adam Berland [a], Sheri A. Shiflett [b], William D. Shuster [c], Ahjond S. Garmestani [c], Haynes C. Goddard [c], Dustin L. Herrmann [d], Matthew E. Hopton [c]

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Abstract

Urban impervious surfaces convert precipitation to stormwater runoff, which causes water quality and quantity problems. While traditional stormwater management has relied on gray infrastructure such as piped conveyances to collect and convey stormwater to wastewater treatment facilities or into surface waters, cities are exploring green infrastructure to manage stormwater at its source. Decentralized green infrastructure leverages the capabilities of soil and vegetation to infiltrate, redistribute, and otherwise store stormwater volume, with the potential to realize ancillary environmental, social, and economic benefits. To date, green infrastructure science and practice have largely focused on infiltration-based technologies that include rain gardens, bioswales, and permeable pavements. However, a narrow focus on infiltration overlooks other losses from the hydrologic cycle, and we propose that arboriculture – the cultivation of trees and other woody plants – deserves additional consideration as a stormwater control measure. Trees interact with the urban hydrologic cycle by intercepting incoming precipitation, removing water from the soil via transpiration, enhancing infiltration, and bolstering the performance of other green infrastructure technologies. However, many of these interactions are inadequately understood, particularly at spatial and temporal scales relevant to stormwater management. As such, the reliable use of trees for stormwater control depends on improved understanding of how and to what extent trees interact with stormwater, and the context-specific consideration of optimal arboricultural practices and institutional frameworks to maximize the stormwater benefits trees can provide.

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Review Article

Towards optimized runoff reduction by urban tree cover: A review of key physical tree traits, site conditions, and management strategies

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HIGHLIGHTS

- Systematic review of the urban forestry and forest hydrology literature.
- Identification of physical tree traits that help optimize stormwater interception.
- Identification of physical tree traits that help optimize stormwater infiltration.
- Guidance for real-world applications in urban tree selection, care, and management.

ARTICLE INFO

Keywords:
Stormwater mitigation
Rainfall interception
Infiltration
Urban forestry
Urban forest management
Nature-based solutions

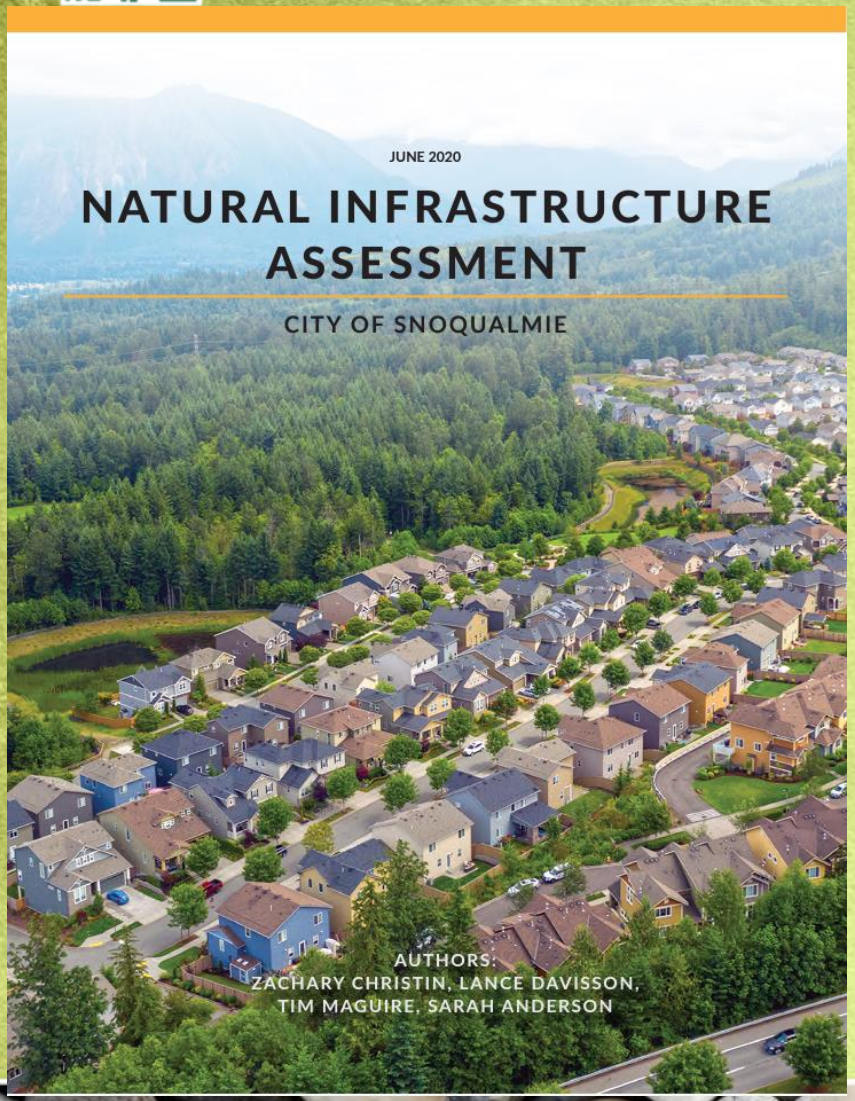
ABSTRACT

In this study, we conducted a systematic literature review to determine the physical tree traits, site conditions, and urban forest management strategies that provide optimal stormwater runoff mitigation through the interception of precipitation or enhanced infiltration of water routed toward the ground by urban tree cover. Our review found that foliar characteristics such as high leaf area index, low hydrophobicity, low inclination angles, and high surface roughness promote rainfall retention by the canopy, as do high bark water storage capacity and a denser crown. In addition, when soil conditions are suitable, infiltration can be enhanced by urban tree cover and promoted through efficient funneling of stemflow through the tree canopy, with this process facilitated by erectophile branching structure, bark of low microrelief and morphology conducive to water transport, and multi-leader canopies. Consideration of these traits should be made when selecting trees to enhance stormwater mitigation by urban tree cover. Applications related to the establishment, maintenance, and management of urban tree cover to maximize stormwater management benefits are also explored. Strategic selection and management of urban trees may significantly increase their collective capacity to reduce runoff volumes at a landscape scale.

Research

Ecosystem Service Valuation

Ecosystem Service Valuation: Example



EXECUTIVE SUMMARY

VALUING SNOQUALMIE'S NATURAL INFRASTRUCTURE

The Snoqualmie Natural Infrastructure Assessment establishes the stormwater retention, water quality and climate stability values of Snoqualmie's urban forest. Using geographically referenced land cover and a proven Ecosystem Service Valuation method, this assessment analyzes the natural infrastructure benefits delivered by the City's urban forest to the community at-large. Recommendations and resources are also provided. This assessment supports sustainable program development and improvements to the City's overall environmental and human health.

Urban forests provide extensive infrastructure benefits, which are often unvalued. This Assessment provides data to inform land managers and City leadership on the value, effective management and funding for maintaining and enhancing the City's urban forest resource. Assessment results focus on the substantial extent and value of Snoqualmie's natural infrastructure:

1. Snoqualmie's public forest resources encompass over 70% of the City's total owned lands.
2. City forest resources provide ecosystem services that return benefits to the environment and health of the residents who live in and around Snoqualmie.
3. Three key ecosystem services are evaluated through this assessment. Results show that public forests in the City generate a range of approximately $5.8 million (M) to $7.3M in evaluated goods and services each year.

TOTAL ANNUAL VALUE OF ECOSYSTEM SERVICES PROVIDED BY THE CITY-OWNED PORTION OF SNOQUALMIE'S URBAN FOREST:

Ecosystem Service	Low	High
Stormwater Retention	$5,760,484	$7,079,149
Carbon Sequestration	$45,820	$81,213
Water Quality	$57,472	$147,305
Total	$5,863,776	$7,307,668

+70%

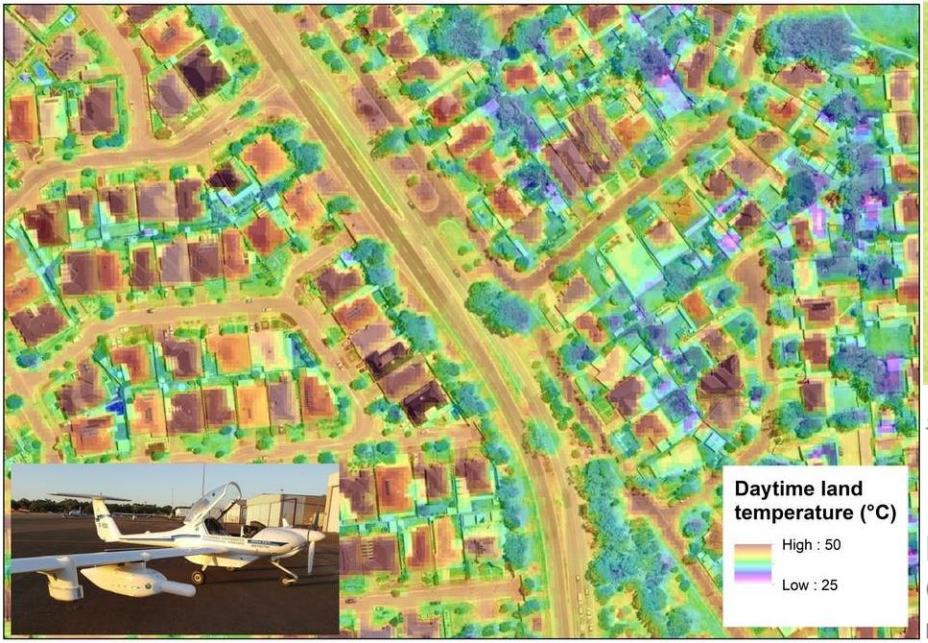
OF CITY OWNED LANDS ARE FOREST

$5.8M TO $7.3M

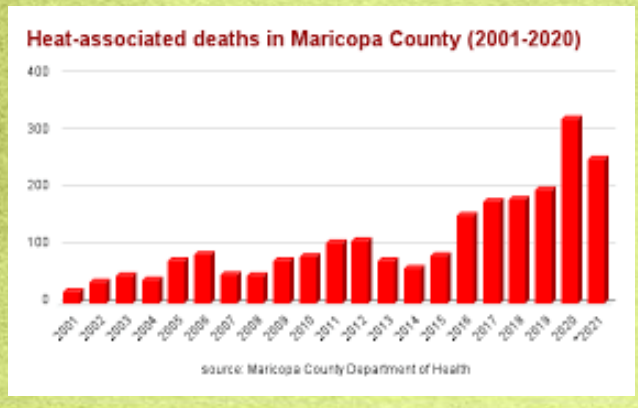
ANNUAL DOLLAR VALUE (IN MILLIONS) OF EVALUATED GOODS AND SERVICES GENERATED BY PUBLIC FORESTS

Assessment by The Keystone Concept

Benefits of trees: Casting Shade



https://phys.org/news/2020-03-urban-trees-extreme-degrees.html



In this study, tree shading more than doubled the maintenance interval on a street:

Journal of Arboriculture 31(6): November 2005 303

EFFECTS OF STREET TREE SHADE ON ASPHALT CONCRETE PAVEMENT PERFORMANCE

By E. Gregory McPherson[1] and Jules Muchnick[2]

Abstract. Forty-eight street segments were paired into 24 high- and low-shade pairs in Modesto, California, U.S. Field data were collected to calculate a Pavement Condition Index (PCI) and Tree Shade Index (TSI) for each segment. Statistical analyses found that greater PCI was associated with greater TSI, indicating that tree shade was partially responsible for reduced pavement fatigue cracking, rutting, shoving, and other distress. Using observed relations between PCI and TSI, an unshaded street segment required 6 slurry seals over 30 years, while an identical one planted with 12 crape myrtles (*Lagerstroemia indica*, 4.4 m [14 ft] crown diameter) required 5 slurry seals, and one with 6 Chinese hackberry (*Celtis sinensis*, 13.7 m [45 ft] crown diameter) required 2.5 slurry seals. Shade from the large hackberries was projected to save $7.13/m² ($0.66/ft²) over the 30-year period compared to the unshaded street.

Key Words. Avoided repaving costs; pavement distress; tree benefits; urban heat island.

on climatic conditions that affect pavement performance (Heisler 1977). "Oasis effects" of 5°C to 7°C (9°F to 12.6°F) have been measured as a result of direct shading of the ground surface and transpiration of water through leaves (Asaeda et al. 1996).

As pavement temperatures rise, volatilization of the asphalt binder and oxidation lead to a progressive hardening of the pavement, which results in increased fatigue cracking and reduced durability (Harvey et al. 2000; Srivastava and van Rooijen 2000). Higher surface temperatures make the pavement more prone to rutting (Pomerantz et al. 2000a). Better pavement performance due to extensive tree shade could translate into a less frequent repaving schedule and cost savings. The street superintendent in Modesto, California, U.S. estimated that repaving could be deferred 10 years on a well-shaded street and potentially up to 25 years on heavily shaded streets (Brusca 1998).

Trees as Public Health Infrastructure

For Real…….

A tree-lined street in Toledo, Ohio in 2006, before emerald ash borer infestation. Credit: Dan Herms, Ohio State University

Three years later, in 2009, after the invasive insect spread to the neighborhood. Credit: Dan Herms, Ohio State University

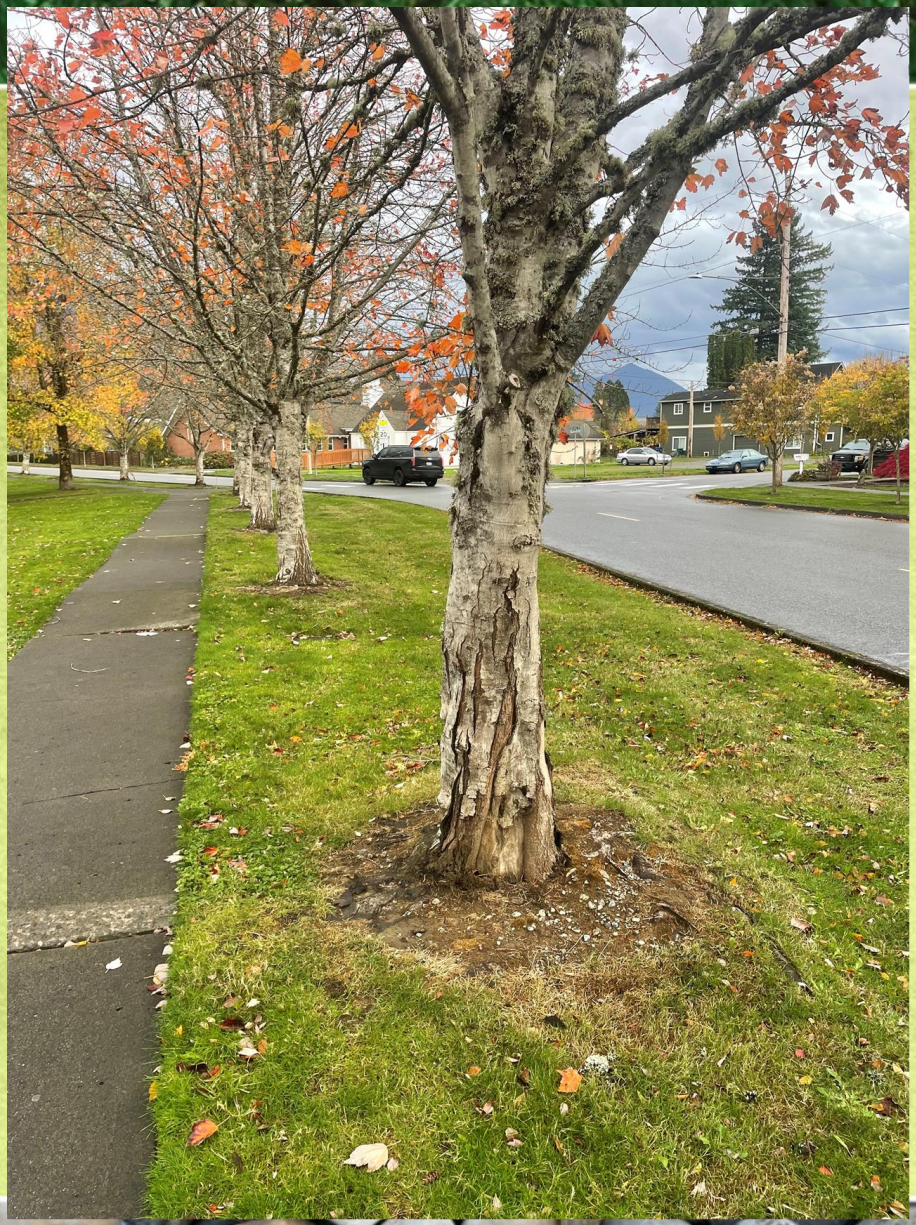
Tree deaths from emerald ash borer have been associated with a significant increase in human deaths from cardiovascular and lower-respiratory diseases. Donovan found that the more trees that died from the emerald ash borer (EAB) across 15 states, the more people in affected counties died. He and a co-author's 2013 study analyzed human mortality data from 1990 through 2007, spanning a period before and after EAB's arrival. His analysis showed that EAB's spread from Michigan, first recorded in 2002, was associated with an additional 15,000 deaths from cardiovascular disease and an additional 6,000 deaths from lower respiratory disease. Declines in trees due to EAB were also associated with declines in outdoor recreation, which also affects health. (Take note that EAB reached Oregon in 2022. It is expected to threaten and likely decimate Portland's multitudes of ash trees in the next five to ten years.

Living near trees lowers blood pressure. This and the next visual are courtesy of Geoffrey Donovan.

Good Tree Maintenance Practices

NOT
THIS

BUT FIRST – A Quiz



What happened here?

What caused this tree to fail?

Find 2 problems

What happened here?

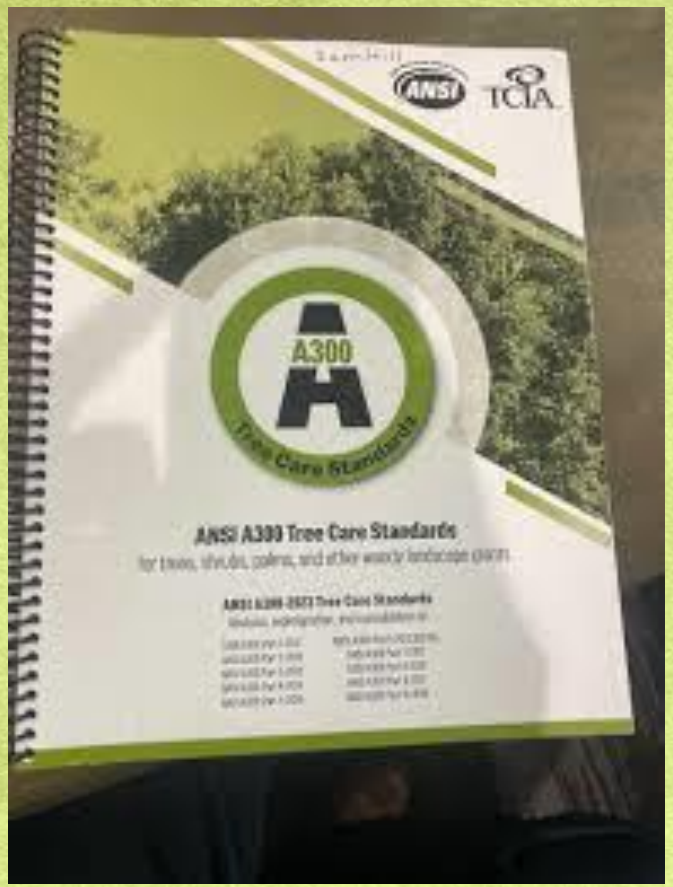
What happened here?

What happened here?

What happened here?

Good Tree Maintenance Practices

There are ANSI standards and Best Management Practices – it's all in there!



Planting

10.2.1 A site inspection shall be conducted to develop a **suitability and feasibility** assessment prior to developing work specifications

ANSI A300 Part 10 – Planting & Transplanting standards

Do you think that happened here?

Planting

10.2.1 A site inspection shall be conducted to develop a **suitability and feasibility** assessment prior to developing work specifications

Planting

10.3 Objectives (ANSI A300 Part 10)

The objectives may include:

Aesthetics;
Ecosystem services;
Air pollution mitigation;
Carbon sequestration
Erosion mitigation;
Habitat;
Public health;
Shade/energy conservation;
Water management;
Meet regulatory requirements;
Preservation;
Resolve conflicts with planned use or existing infrastructure;
Screening;
Sentimentality/commemoration;
and, site restoration.

Planting objectives example

Objectives:

-Water management
-Shade
-Public Health
-Aesthetics

Mulching

6.7.4.1 Coarse wood-chip mulch that is fresh or partially composted should be preferred for surface application

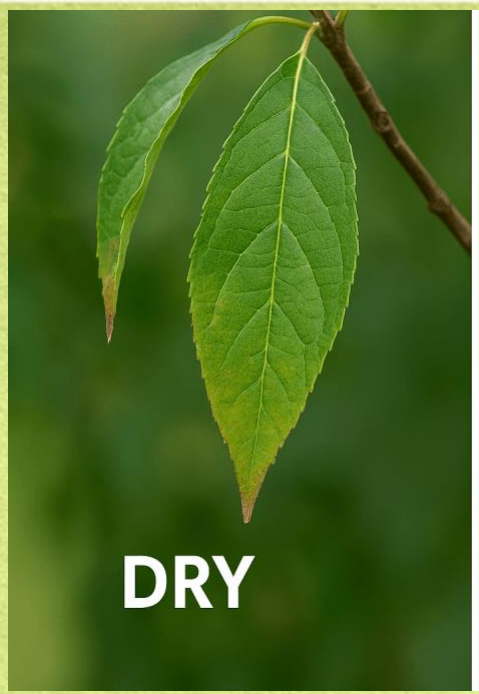
6.7.4.5 Mulch shall not be placed against tree trunks or cover **flares**

6.7.4.7 Mulch should be applied and maintained at a depth of 2-4 inches

Watering/irrigation

This is tricky business

-Irrigate/water trees in parks for *at least* the first 2 summers after planting (Western WA).



-Pay attention to soil type.
-Grass & trees have different water requirements
-Maintain mulch to help protect soil moisture

Pruning

Remember this?

In a landscape setting,
You. can't. walk. away.
just because the tree
is established

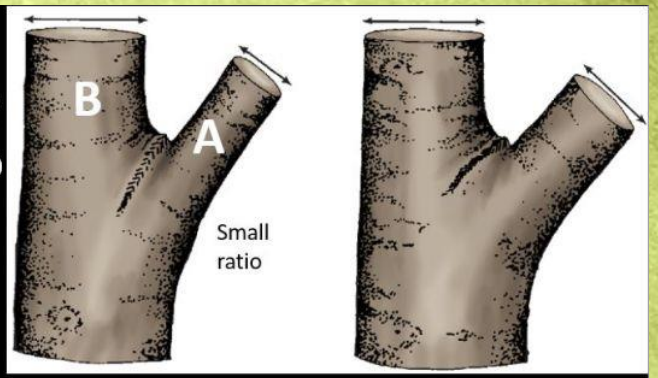
Pruning

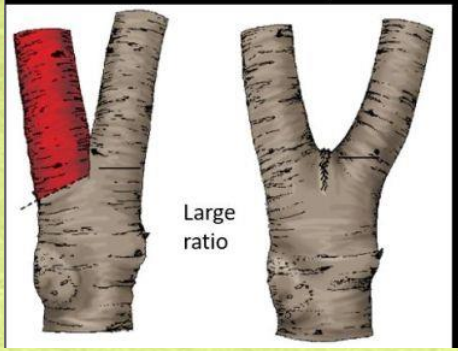
In time, this branch will be a problem.

Aspect ratio is the key

Aspect ratio is the diameter of ‘A’ compared to ‘B’ or A:B.

e.g. 3:4





Stronger unions

Weaker unions

Pruning

ANSI A300 Part 5

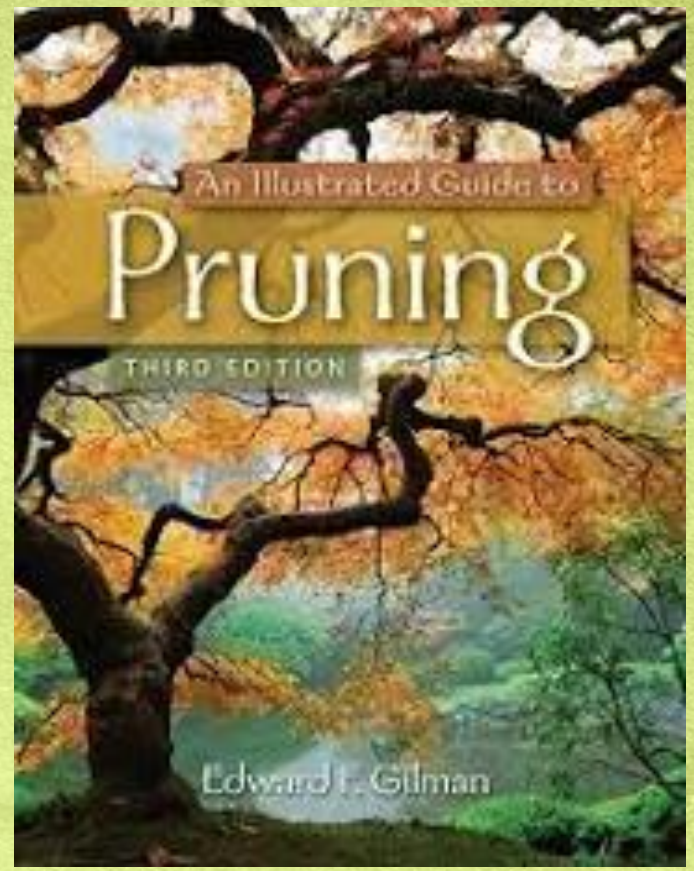
5.3 Pruning Objectives

5.3.1 Objectives may include

-Promoting or subordinating certain stems or branches

-Minimizing future interference with traffic, lines of sight, infrastructure or other plants

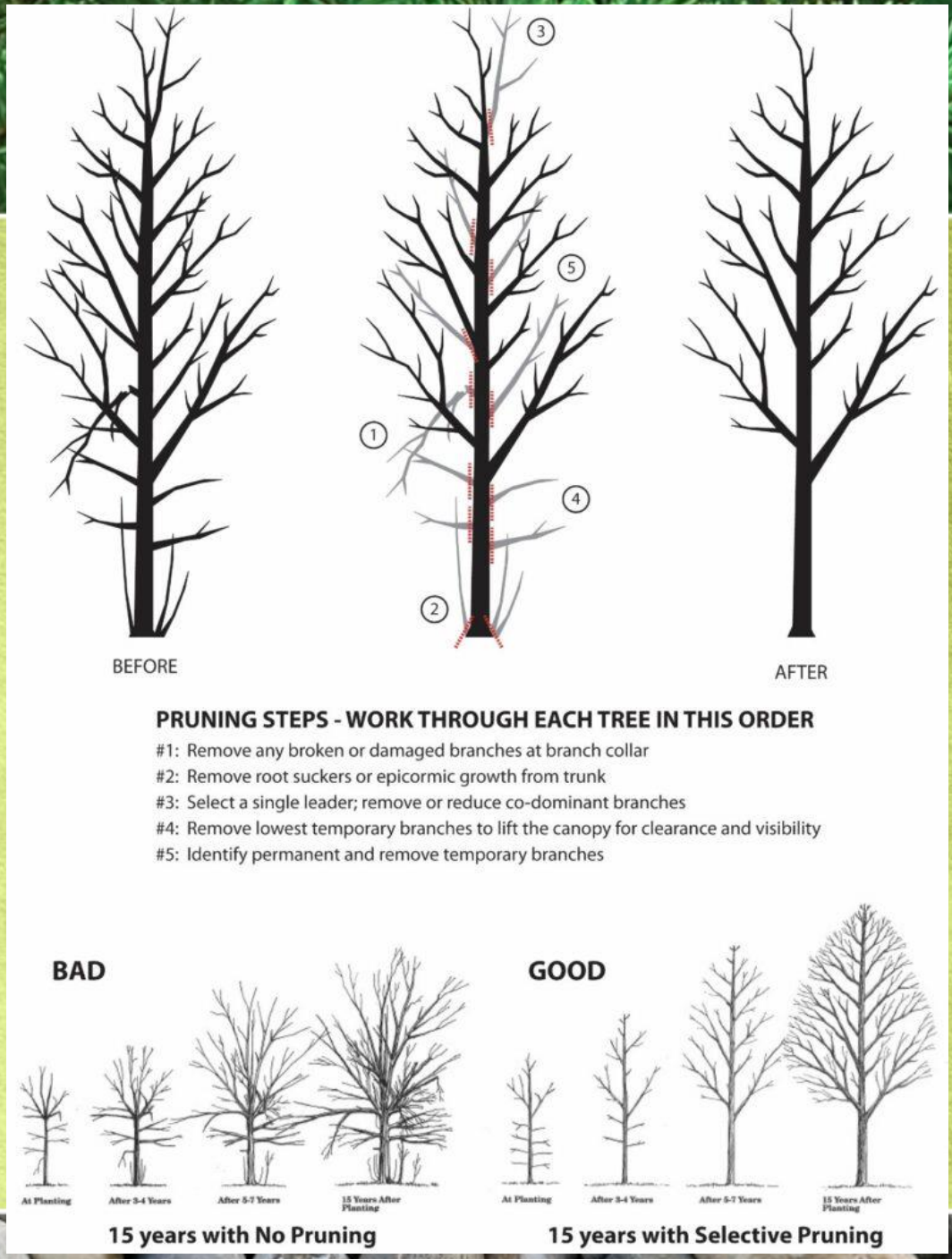
-Restoring plants following damage



Structural pruning

If you do it early, you can do it without a lift, and with a lot less effort/expense

Image from Friends of Trees



Pruning

2013

2014

2015

2016

Bad example

Questions?