

APRIL 2, 2018

# Town of Coulee Dam, Washington Urban Forestry Management Plan



# URBAN FOREST MANAGEMENT PLAN (UFMP)

FOR

Town of Coulee Dam  
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Coulee Dam, WA 99116

PREPARED BY:



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## **ACKNOWLEDGMENTS**

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## EXECUTIVE SUMMARY

An urban forest includes street and park trees and those planted in medians, parking lots, tree pits, and other urban spaces. An urban forest management plan (UFMP) recognizes the impacts of tough urban conditions on the natural landscapes and public trees and balances those impacts with the needs of humans who share this ecosystem. An ecosystem approach to urban forest management can help Coulee Dam maintain its character and provide environmental, social, and economic benefits.

Trees make places work, look and feel better. As well as playing a role in climate proofing our neighborhoods and supporting human health and environmental well-being, trees can also help to create conditions for economic success. This management plan takes a 21st century approach to urban trees, providing decision makers with the principles and references they need to fully realize this potential.

Coulee Dam has completed an inventory assessment of its street and park trees. The inventory will facilitate the ongoing commitment to maintain, enhance, and preserve Coulee Dam's tree canopy and guide Coulee Dam staff, landowners, contractors, utility companies, developers, planners, and residents in making decisions about their trees.

Coulee Dam's inventory and management plan was initiated to facilitate the agency's ongoing commitment to maintain, enhance, and preserve the community tree canopy. Project funds were provided from a grant obtained from the USDA Forest Service administered by Washington State Department of Natural Resources Urban and Community Forestry Program (WADNR). Staff support was provided by the Town of Coulee Dam Urban.

Four primary methods of community outreach were used:

- Interviews and group discussions with key stakeholders
- City staff interviews
- Public forum information meetings

### **Public Process**

A crucial element of developing the UFMP was soliciting information from city staff, key stakeholders, and citizens of Coulee Dam. Stakeholder input was used to assist CFC in identifying opportunities, issues, elements, actions, and goals for the UFMP. Various methods of gathering public input were used and included holding stakeholders public meetings, conducting interviews and soliciting comments from city staff. Every attempt was made to engage community members in the process of developing the UFMP.

### **S.W.O.T. Analysis**

Strengths, Weaknesses, Opportunities, and Threats (SWOT) exercises were conducted to organize input and comments provided by the public, program affiliates, stakeholders, and city staff. Strengths are beneficial aspects of the community such as Tree City designation (Figure 1). Weaknesses are factors that prevent the town from accomplishing urban forestry goals such as lack of local certified arborists.



Opportunities are presented by the environment within which the town operates such as opportunities to collaborate with the tribe. Threats arise when external conditions, often uncontrollable, jeopardize the success of the town's urban forestry goals such as climate issues. The lists included in Appendix B offer a synthesis of the range of insights, perspectives, and opinions regarding the current and future state of the Coulee Dam Urban Forest provided by participants in the public meetings; this information has helped inform the development of the program objectives and specific action steps in this plan. Please note that it is common for a specific issue to be identified in multiple, even contradictory, sections of the SWOT matrix because different perspectives yield different perceptions.



**Figure 1 – Tree City designation and Arbor Day celebrations are strengths of the urban forestry program.**

### **Purpose of the UFMP**

The starting point for success understands where you are and where you want to go. The UFMP principles will help Coulee Dam staff integrate the goals and objectives of the Town of Coulee Dam urban forestry program while managing the specific needs of the community trees.

Managing, maintaining, and preserving urban trees can only be achieved effectively by developing and implementing a strategic urban forest management plan. An urban forest management plan standardizes policies and practices for tree-related activities. This plan lays out components that encompass a long-term vision with short-term goals for the managing Coulee Dam's trees.

An Urban Forest Management Plan (UFMP) is a guide for ensuring that public trees and forests are appropriately cared for according to arboriculture standards and community goals. Coulee Dam's UFMP is a strategy to expand its urban forestry program to meet a range of policy, community, education, and management goals. The plan is a tool to explore community concerns and management conflicts, while offering a series of prioritized implementation actions based on inventory data, current urban forestry and arboriculture practices, and community outreach. The plan evaluates species composition, maintenance requirements, tree population trends, and the condition of the urban forest.

The capacity of the urban forest to provide benefits depends on how the resources are developed and managed. The UFMP will lead to improvements in urban tree management and stewardship in a coordinated, cooperative approach with city departments, program partners, and residents. The plan was prepared from a comprehensive analysis of tree inventory data, staff input, and community participation.



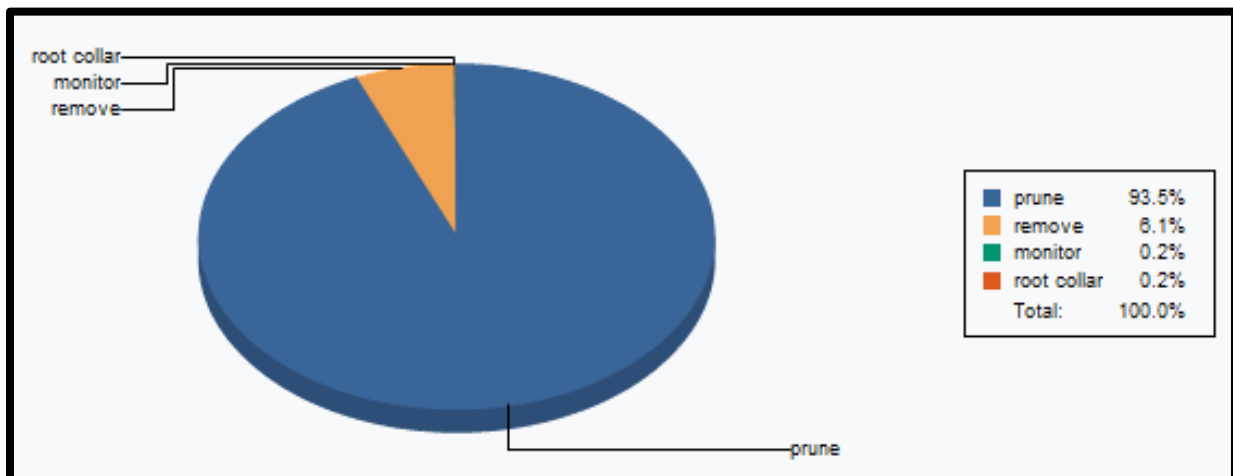
As a strategic and forward-looking document, this plan should be incorporated into the existing policies and requirements of the Coulee Dam City Parks and Recreation Comprehensive Master Plan, City Tree Ordinance, City Landscape Ordinance, Coulee Dam Storm Water Management Program, and agreements with other government agencies.

### **Coulee Dam Tree Inventory Summary**

Community Forestry Consultants, Inc. (CFC) used existing street and park tree inventory data and available planting sites data along streets as a basis for data results, maintenance requirements, and budget projections.

#### **Data results**

- Sites inventoried: 680 (partial)
- Appraised value of trees inventoried: \$3,183,000.00
- Trees requiring pruning maintenance: 510
- Trees requiring removal: 31
- Available street tree planting sites: 300



#### **Major Issues**

- High number of removals
- Structural defects (co-dominant stems; dead branches; crown dieback)
- Tree sidewalk conflicts
- Improper planting practices
- Limited tree maintenance
- Limited species diversity

### **Goals of the UFMP**

The management plan supports the mission of improving Coulee Dam's tree population through proper management of a valuable asset. The UFMP follows the vision to retain a high quality of life by improving Coulee Dam's urban forest management and thereby increasing the numerous, proven benefits derived from trees.

Relying on the UFMP for guidance, the city will partner with or engage in the following:

- community members, organizations, and volunteers to encourage tree planting and stewardship
- preserve and protect existing trees
- promote public safety, tree health, and structure
- implement cost-effective and proper arboriculture maintenance of the community trees
- increase public education and awareness of the value of community trees
- maximize the social, economic, and environmental benefits of the community forest for current residents and future generations

The UFMP guidelines promote consideration of public trees as major and important urban infrastructure and outlines best practices to incorporate trees into the city fabric. It provides for the development of a progressive long-range urban forestry program that will result in a healthier and safer forest in Coulee Dam. The UFMP is a tool to use in guiding the tree program and garnering support, cooperation, and funding for the tree program.

Lastly, it is understood that woody shrubs and ground cover plant communities are part of, and integral to, the overall health of the urban forest, but the primary scope of this plan is to focus on trees – the largest, longest-lived and most significant member of the landscape community. The implementation of the UFMP will ultimately contribute to the quality of life in Coulee Dam through enhancements to the tree population.

Coulee Dam Urban Forestry Management Plan goals:

- Coulee Dam Town Council adopts and implements an Urban Forestry Management Plan.
- Provide adequate tree maintenance funding to sustain Coulee Dam tree canopy based on council, stakeholder, and resident input.
- Maximize and expand the urban tree canopy. Create a tree planting plan; promote proper planting of new trees and diversification of species; incorporate tree planting into community planning.
- Coordinate and integrate local urban forestry goals into city and regional planning processes.
- Maintain and update the inventory of Coulee Dam trees to improve management and maintenance of the tree population.
- Review existing tree ordinance to incorporate the recommendations and goals of the city's tree management plan, adopt the ordinance into the city code, and implement ordinance enforcement practices.
- Create the 'Arboriculture Specifications and Standards of Practice for the Town of Coulee Dam and incorporate the manual into city operations.
- Provide education and public awareness of the importance of the trees to the community; educate city staff, contractors, and the community on proper tree care; and encourage greater participation in tree steward activities.

A higher level *20 Year Plan* which sets out the vision, goals and objectives that are to be achieved may be developed. The *20 Year Plan* (2016 - 2036) may be used to oversee the implementation of urban forest management. Nested within a 20-year plan are 5-year *management plans*, the first being this UFMP. Each successive 5-year

management plan should incorporate strategies, recommendations, and incomplete components from previous plans building upon the successes or failures of the previous management plan. Finally, each year there will be an *annual operating plans (AOP)* in which the details of the day-to-day activities are outlined (Figure 1).



**Figure 1: Temporal structure of the Strategic Urban Forest Management Plan**  
(source: A. Kenney).

The recommendations made in this plan are intended to be considered and implemented over a period of five years. A systematic tree planting and maintenance program, adequate funding, staffing, regulations, and resources today will allow Coulee Dam's urban forest to thrive, expand, and be sustainable.

The success of this plan is based on people's expectations of the benefits they may receive from the Coulee Dam's community forest and their willingness to invest in its sustainable management.

### **Urban Forestry Program Actions**

The primary actions and objectives of the plan are listed below and described in detail in the body of the management plan.

- Application of arboriculture industry standards for Coulee Dam tree care
- Engage International Society of Arboriculture (ISA) certified arborists to perform tree maintenance
- Maintain tree inventory data

- Proactive tree maintenance of Coulee Dam trees
- Annual analysis and mitigation of risk trees
- Implement a cyclic pruning program for young and mature trees
- Proper tree planting
- Mitigate tree/sidewalk conflicts
- Proper tree maintenance
- Canopy preservation

The recommendations and actions will expand and conserve Coulee Dam's tree resource and sustain the tree canopy for future generations. Although this commitment will come with costs, the long-term benefits are significantly greater and will result in a sustainable asset for the citizens of Coulee Dam today and tomorrow.

## INTRODUCTION

In 2016 the Town of Coulee Dam received a grant from Washington Department of Natural Resources Urban and Community Forestry program (WADNR) to develop and generate an urban forestry management plan for street and park trees. The Town of Coulee Dam contracted with Community Forestry Consultants, Inc. (CFC) to analyze inventory data, and engage the city staff, community and elected officials in the development an urban forestry management plan. As the owner the Town of Coulee Dam is responsible for the maintenance of trees at all publicly owned sites (Figure 2).



**Figure 2 – Aerial photo of a portion of Coulee Dam trees inventoried. Green and purple dots represent trees of different trunk diameters. Red dots indicate tree stumps. Yellow dots indicate potential new tree planting sites.**

### *Vision Statement*

The vision statement describes how Coulee Dam should look and function now and in the future. It implies an action goal that facilitates objectives of proper arboriculture practices, preservation, restoration, and stewardship of trees in Coulee Dam. This brief statement describes similar goals adopted by the Coulee Dam Parks and Natural Resources (CDPNR) board and iterated in town ordinance no. 726. The Coulee Dam vision statement includes sentiments about the environmental, social, economic, and ecological importance of trees and natural resources to Coulee Dam in terms of management, benefits, and sustainability.

### **Coulee Dam Urban Forestry Vision Statement**

The Town of Coulee Dam recognizing urban forestry as an equal part of the community infrastructure, will create, enhance, maintain, and sustain a vibrant, healthy, and structurally sound community forest resource for the benefit and enjoyment of Coulee Dam residents and visitors.

### ***Coulee Dam Canopy Cover Goals***

Canopy cover is the percentage of an area on the ground that, when considered in plan/map view, is covered by the crowns of trees. In a dense forest the canopy cover would be expected to approach 100%. On the other hand, open prairies are dominated by grasses and widely spaced trees creating canopy cover as low as 5%. In between lays a variety of treed urban environments.

In considering an urban forest canopy target, several factors should be noted. First, there are no widely agreed upon, figures for canopy cover targets in urban areas. A commonly-cited figure is 40%, the recommendation of American Forests, based on their “professional opinion that this tree cover is a reasonable target”.

Second, the issue of empirically deriving a percentage that is appropriate to the local environment seems to be given attention. Any study of canopy cover figures must consider local climate and soil factors and consider the differences in land development within a community.

Third, there is no attention given to the fact that the urban environment is far from homogeneous and varying local conditions within a city, particularly related to kind and design of development, will offer different constraints and opportunities. For example, it is unreasonable to expect that the same canopy cover can be achieved in a densely-built industrial area as in a residential neighborhood dominated by single-family homes. Thus, the notion that a single canopy cover figure can be – or should be – applied city-wide, would appear to be difficult to defend.

Each urban land environment (ULE) is associated with a different set of opportunities and constraints to tree growth and target value selection must recognize these.

- Right-of-way target value is best measured by stocking level, not canopy cover. Stocking level is a proportion of existing street trees to the total number of potential street trees (number of trees plus the number of available planting spaces).
- Park canopy varies between natural areas and active recreation areas and between segments of a park; canopy cover figures should be developed by CDPNR and city planners on a site-by-site basis.
- Residential areas should seek to achieve 50% canopy.
- Commercial/Industrial areas should seek to achieve 15% canopy.



The Town of Coulee Dam may establish land use canopy cover goals. Suggested land use areas and canopy cover goals are:

### **Canopy Coverage Goals**

- Single family; multi-family residential – 50%
- Developed parks – 35%
- Undeveloped/Natural parks – 80%
- Commercial – 15%
- Streets, right-of-ways (ROW) – 80% stocking level

The bordering topography and its remnant vegetation create a prominent visual background of an arid natural landscape that contrasts with the landscape of the recent developed properties which essentially has limited canopy coverage currently due to the small size of the trees and large number of available planting sites. In new sites planting density should be sufficient to achieve canopy goals. In established residential areas trees are a significant feature. They should be replaced when possible following a removal and remaining trees maintained to sustain existing canopy cover. The challenge for Coulee Dam is clear: given the length of time that trees need to grow, efforts to increase canopy must continue today and maintenance and preservation of existing trees and forests needs to start now to improve the canopy coverage.

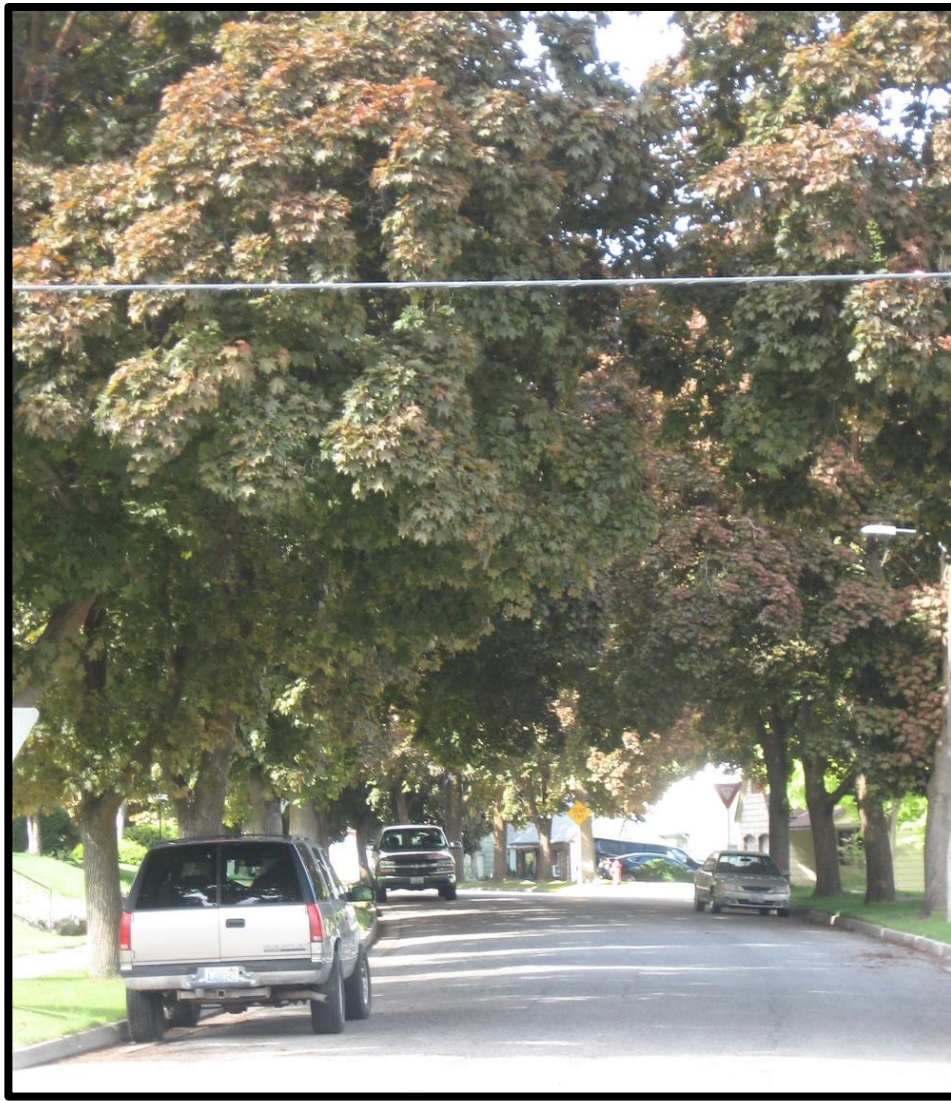
### **Town Plan and Policy Coordination**

There are existing plans and policies in the Town of Coulee Dam that affect and are affected by the tree population. The Coulee Dam UFMP will act as a stand-alone management tool for the town but should function within the context of other town plans and policies impacting trees. Trees can provide solutions and fulfillment of goals stated in other city plans and should be integrated where appropriate. Town plans should link together. Use the UFMP actively to seek linkages when working on other issues and then use trees to support and solve those broader public policy goals. Other town plans include but are not limited to:

- Comprehensive Recreation Plan 2018
- Comprehensive Management Plan
- Historic & Natural Resources Plan (1998)

### **Tree Benefits**

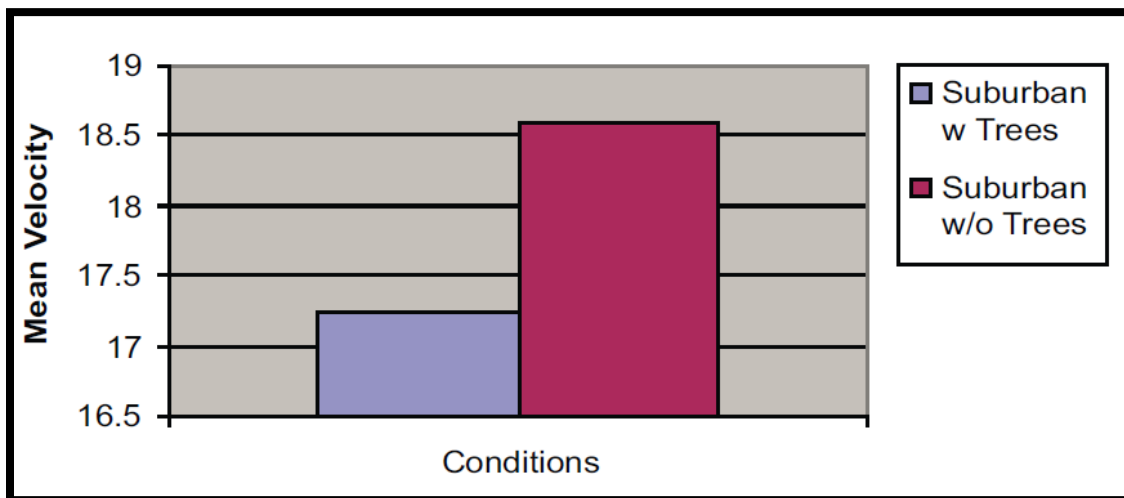
Few elements of the grey infrastructure of urban places can be said to boost property values, support retail activity, enhance tourism experiences, improve agency health, protect water quality, abate wind speeds, reduce air particulate, reduce storm water runoff, counter climate change, and ensure roadway safety all at once. Communities looking for these benefits may be surprised to find a solution right in their own backyards, along their streets, and in their parks. The green infrastructure of trees, along with parks and open space, provide a wealth of benefits to Coulee Dam (Figure 3).



**Figure 3 – Trees provide many benefits for Coulee Dam if maintained properly.**

Many scientific studies in recent years have addressed the role of trees in urban environments. Trees and urban forests provide environmental, ecological, economic, and social benefits. Urban trees and natural forestlands play a huge role in the quality of life in Coulee Dam. A summary of key values and benefits, and some supporting sources, is provided below.

**Street Tree Effect and Driver Safety.** Research indicates that trees contribute to a sense of safety. The significant reduction in driver speeds in the suburban condition indicates that street trees may provide positive operational values. Trees have a positive impact on the transportation network in the city and neighborhoods (Dumbaugh 2005; Wolf 2006; Naderi et.al. 2008). For the suburban landscape, the presence of trees significantly dropped the cruising speed of drivers by an average of 4.87 kilometers per hour (3.02 miles per hour). Faster drivers and slower drivers both drove slower with the presence of trees (Figure 4).



**Figure 4 – Trees significantly drop cruising speed of faster and slower drivers.**

**Vegetation and Violence.** A scientific study by the University of Illinois at Urbana-Champaign has demonstrated that contact with nature may reduce the incidence of aggression and violence in city neighborhoods. According to the study, levels of aggression were significantly lower among people who had some kind of nature outside of their apartments versus those who didn't. The impact of the physical environment on human aggression has been well established — crowding, high temperatures, and noise have all been linked to violent behavior. Some scientists believe that it's because people living under these conditions suffer from something called chronic mental fatigue, which can make them inattentive, irritable, and impulsive — all of which have been linked to aggressive behavior. It has been shown that exposure to green spaces, trees, and other vegetation can mitigate the harmful effects of chronic mental fatigue, reducing aggressive behavior in the process.

**Water Quality, Storm Water Retention.** Water quality continues to be an important issue to the community and ways to avoid nutrient loading and other forms of water contamination to the Columbia River Basin and Fiddle Creek drainage are critical. Water quality has the potential to be degraded by development due to erosion, storm water discharge, and on-site sewage treatment systems.

Urban trees are an effective tool available every day to improve water quality, conserve water resources, and reduce storm water runoff. Urban forests absorb rainfall, control surface water runoff, filter ground water and assist in ground water recharge. According to one study, 37,500 tons of sediment per square mile per year comes off developing and developed landscapes, and urban trees could reduce this amount by 95% (Coder 1996).

Trees can contribute to the overall goals of the Coulee Dam stormwater management and aid in solving their water quality issues in the surface water drainage basins. Trees are a current asset that can address stormwater and water quality issues important to the community and do it in an economically feasible manner.

Urban tree canopy reduces storm water runoff by intercepting and storing rainfall and increasing infiltration into the soil through improved soil structure. The US Environmental Protection Agency issued a report, *Using Smart Growth Techniques as Storm Water Best Management Practices*, which identified urban tree canopy as an innovative and sustainable means to dramatically reduce stormwater runoff and the costs associated with stormwater management. Trees contribute to water quality and quantity improvement through stormwater control, attenuation of peak flows, maintenance of base flow, erosion control and rainfall interception (Bernatzky 1983; Xiao et al 1998; Floyd 2002; American Forests 2007). Trees should be integrated into Coulee Dam's stormwater management program.

A tree canopy and continuous vegetation, which is adapted to the local environment, has a positive effect on slope stability (Reubens et al. 2007). Tree root systems enhance the shearing strength of the soil, enabling it to resist landslides and erosion (O'Loughlin 1974). Through interception, evapotranspiration and enhancing soil permeability, trees also improve the hydrological characteristics of the soil (Ziemer 1981). Trees on slopes can prevent, protect, and minimize the damage in the event of landslides, avalanches, or in the aftermath of wildland/forest fires.

**Air Quality Improvements.** Particulate matter poses a dangerous threat to human health and the environment. Regional haze can impair visibility in all directions over a large area. Air toxins such as carbon monoxide and sulfur dioxide contribute to respiratory problems. Trees absorb gaseous pollutants such as ozone, nitrogen oxides and sulfur dioxide; and they filter particulate matter such as dust, ash, pollen and smoke. Reductions in these pollutants results in improved public health and reduces the severity of ozone-induced asthmatic responses and other respiratory illnesses. Urban trees absorb carbon dioxide, a major greenhouse gas, at an approximate rate of 230-lbs per year per tree. According to the U.S. Department of Agriculture, "one acre of forest absorbs six tons of carbon dioxide and puts out four tons of oxygen. This is enough to meet the bi-annual needs of 18 people."

Trees improve air quality by producing oxygen, absorbing pollutants and sequestering carbon (Rowntree and Nowak 1991; Nowak 1992; McPherson et al 1999; American Forests 2007). A regional ecosystem analysis specific to Coulee Dam using tree inventory data can estimate the monetary value of pollution removal services provided by the urban forest.

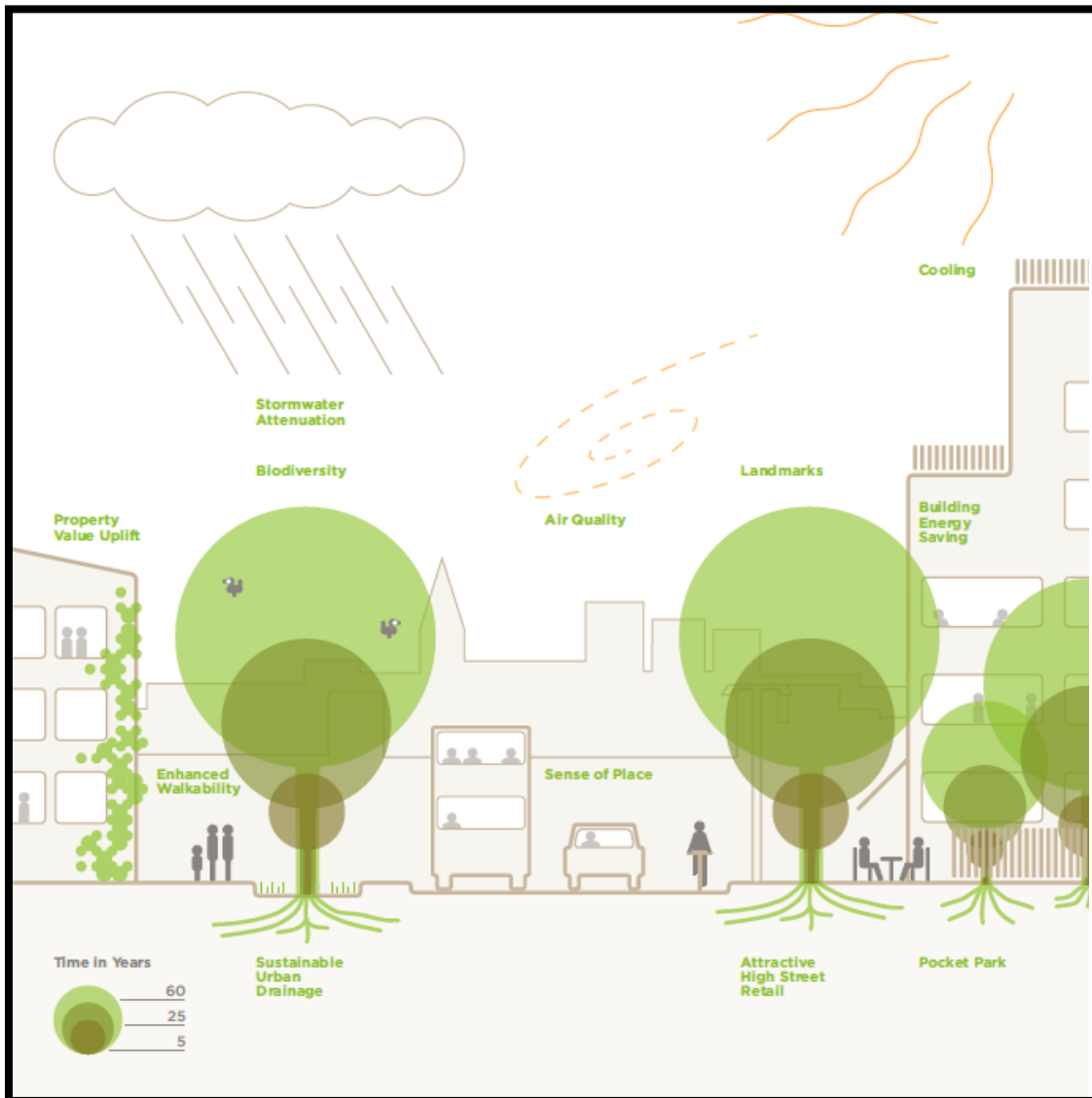
**The Economics of Aesthetics.** The Coulee Dam area has a limited economic base with Coulee Dam being the largest contributor to the local economy, followed closely by professional and administrative services and tourism. It is important to the community and fiscal revenues to remain competitive and attractive to businesses and customers, residents, and tourists. Recent population and development increases in Coulee Dam and neighboring communities continue to increase competition for businesses and customers.

Improving aesthetics has tangible economic benefits. Networks of parks, natural areas, and trails give a community a reputation for being a good place to live and visit. Increased recreational and community activity attracts new businesses, fosters expressions of creativity, and stimulates tourism. Businesses locate or re-locate based on a community's quality of life, including an abundance of open space, nearby

recreation and pedestrian friendly neighborhoods. Nationwide, easy access to parks and open space has become a new measure of community wealth – an important way to attract businesses and residents by guaranteeing both quality of life and economic health.

Aside from the potential price effect on residential property sales, trees in retail settings increase shoppers' willingness to pay for goods and services by 12%. Shoppers also indicate that they are willing to drive farther and stay longer if a retail district is well-landscaped with trees. Also, respondents consistently reported greater willingness to pay values for goods and services in the landscaped mall at an overall rate of 8.8%. Urban forests create an appealing consumer environment in business districts (Wolf 2003, 2005). Trees provide a critical solution that allows Coulee Dam to maintain its role as a regional housing provider, generate higher tax revenues, and keep property taxes at a lower rate.

Increases in land values or sale prices because of quality landscaping and the presence or retention of trees offers a secondary benefit to the local jurisdiction. The adjustments directly relate to additional revenue from sources such as real estate transfer taxes and property tax assessments (Behe et. al. 2005; Wolf, 2007).



**Health & Well-Being.** Trees provide a benefit to the health care industry and improve the mental and physical states of the community residents and visitors. Trees foster safer, more sociable neighborhood environments and have been shown to reduce levels of crime, including domestic violence. Views of nature reduce the stress response of both body and mind when stressors of urban conditions are present. Hospital patients with window views of trees recover significantly faster and with fewer complications than comparable patients without access to such views.

Public spaces with trees receive more users, increasing the frequency of casual social interactions and strengthening the sense of community. Trees along transportation corridors narrow a driver's field of vision, reducing traffic speeds and increasing pedestrian safety by providing a natural, physical barrier. Studies have found that urban highways lined with trees decrease driver stress, resulting in fewer incidents of road rage.



Parks, green space, and trees are important assets for Coulee Dam residents and visitors. Use of these resources by the community promotes the health and well-being of the individuals as well as the sense of community.

Overall, the service value of individual urban trees can be quantified as shown in the table below. Small trees are 25 – 30 feet at maturity; medium trees are 30 – 50 feet at maturity; and large trees are greater than 50 feet at maturity.

**Average annual net benefits values per tree by size**

Small	Medium	Large
\$13 - \$17	\$33 - \$39	\$60 - \$71

Source: Western Washington and Oregon Community Tree Guide: Benefits, Costs, and Strategic Planning, March 2007

While real costs must be borne by Coulee Dam and its residents because of the urban forest (e.g., storm damage, removals, planting, care, leaf removal, infrastructure impacts, etc.), the protection and expansion of the Coulee Dam urban forest will yield increased environmental, economic and social benefits. This plan specifies several actions the Town of Coulee Dam can take to maximize these benefits and engender community involvement and activism.

In nationwide surveys, city and town residents are very familiar with the benefits trees provide to their community (Figure 5).

	Unfamiliar	Somewhat unfamiliar	Somewhat familiar	Familiar	Don't know
Urban trees make walking or cycling through neighborhoods more enjoyable.	<b>1.44%</b> 2	<b>0.00%</b> 0	<b>5.76%</b> 8	<b>91.37%</b> 127	<b>1.44%</b> 2
Urban trees increase the life of streets and parking lots by keeping paved surfaces cooler in the summer.	<b>6.47%</b> 9	<b>10.07%</b> 14	<b>14.39%</b> 20	<b>66.91%</b> 93	<b>2.16%</b> 3
Urban trees improve air quality by filtering airborne pollutants and dust.	<b>0.00%</b> 0	<b>2.88%</b> 4	<b>5.76%</b> 8	<b>89.21%</b> 124	<b>2.16%</b> 3
Urban trees improve water quality by controlling pollution, erosion, and flooding during stormwater runoff.	<b>2.16%</b> 3	<b>2.88%</b> 4	<b>16.55%</b> 23	<b>76.98%</b> 107	<b>1.44%</b> 2
Urban trees increase residential and commercial real estate values.	<b>2.88%</b> 4	<b>3.60%</b> 5	<b>8.63%</b> 12	<b>82.73%</b> 115	<b>2.16%</b> 3
Urban trees increase visual quality, product pricing, patronage behavior, and shopper experiences in central business districts.	<b>2.88%</b> 4	<b>4.32%</b> 6	<b>15.11%</b> 21	<b>74.82%</b> 104	<b>2.88%</b> 4
Urban trees contribute to the psychological and social health of a community by reducing stress, crime, and other social issues associated with cities.	<b>2.88%</b> 4	<b>12.23%</b> 17	<b>20.86%</b> 29	<b>60.43%</b> 84	<b>3.60%</b> 5

**Figure 5 – Summary of US residents' familiarity with urban tree benefits.**

### **Coulee Dam Tree Committee (CDTC)**

The CDTC is sanctioned by city ordinance no. 726. Their purpose is to celebrate trees and promote a community commitment to sustaining Coulee Dam's urban forest. The CDTC forms the middle link, a communication link in a chain of moral authority among the CDPNR committee, community, city manager, and elected officials. CDTC does not function as an operations board and should stay out of operational functions of the program. Individual committee members do not have authority other than that specifically authorized by ordinance. **The committee provides leadership by first serving, and then seeking to put community interests ahead of any personal interests committee members may have.**

A tree committee fulfills one of the criteria to become Tree City USA. A tree committee can be a very useful resource for busy Coulee Dam staff working to develop and implement a strategic vision since it provides additional opinions from individuals who are interested in, and typically knowledgeable about, the subject at hand, and also helps maintain relationships with groups and individuals that may be able to assist with implementation.

The primary role of the CDTC for Coulee Dam's UFMP would be periodic (e.g., once a year) review of the plans, to track the status of the various recommendations, and evaluate the progress towards management goals.

The CDTC is engaged in many activities promoting the planting and preservation of community trees such as Arbor Day celebrations and community education programs and presentations.

#### **The CDTC can continue to support and involve Coulee Dam residents in the tree program through:**

- Reviewing a community tree plan
- Foster community support for community trees
- Public outreach meetings and presentations
- Program advocacy to city council, business leaders, civic groups, and other stakeholders
- Soliciting funds, including grants and donations
- Reviewing a street tree ordinance
- Assisting with Arbor Day celebrations, other events, and education programs

The CDTC committee should report to and be overseen by the staff member responsible for directing and managing the implementation of the UFMP. City staff acts as an ex-officio member of the committee.

## URBAN FOREST MANAGEMENT PLANNING

The pressures created by urban sprawl are leading to a reduction in forested land in North America. Poorly controlled land-use planning contributes to the haphazard urbanization of many small communities. Urban forests are largely ignored as an asset and the potential benefits they can offer to communities are often not acknowledged in the planning process. Relatively few communities across the United States have any form of urban forest management.

In natural forests trees in all stages of growth and decay are important to functioning of the ecosystem, and even when left alone a forest will convey many benefits to humans. The same cannot be said of city and park trees. The term “city trees” includes trees subjected to tough urban conditions including street and park trees and those planted along boulevards, in medians, in parking lots, in tree pits, and other urban open spaces. Their health and vitality are compromised primarily through limited soil volume, compacted soils, restricted root space, drought, and conflicts with other infrastructure.

Other urban activities such as mowing, leaf removal, vehicle and pedestrian traffic, vandalism, and pollutants submit community trees to additional stresses. Intense citizen use necessitates pruning and prompt removal of high-risk trees to maintain high safety standards. A sustainable urban forest requires careful management in order to maximize the benefits of green infrastructure while addressing the direct and indirect human influences on the trees.

Trees play an important role in the livability of Coulee Dam. The urban forest has been recognized as a visual amenity and for its environmental benefits for several decades but has only recently begun to be considered as a vital component of a community’s infrastructure and given the specific label of “green infrastructure” or “natural capital” (e.g., Benedict and McMahon 2002; Wilkie and Roach 2004; Ewing and Kostyack 2005). As a result, in Coulee Dam, as in many cities and towns, resource allocation for management of urban trees has been relatively limited, and staff has largely been occupied with responding to emergency situations and minimal maintenance rather than having the opportunity to pursue more proactive management practices.

As with any type of infrastructure, the urban forest requires regular maintenance and monitoring to ensure that it continues to function properly and provide benefits to its maximum capacity. Infrastructure such as buildings, offices, and equipment that are neglected for many years can only be repaired at a great cost to Coulee Dam. For the urban forest, this neglect typically comes in the form of failure to plant young trees to replace maturing populations, to adequately diversify tree species to protect against species-specific diseases, to prune trees early on to limit the risks posed by trees as they mature and failing to maintain mature trees properly.

Fortunately for Coulee Dam there are many opportunities to improve the urban forest through well-planned active management over time. This is one key area in which green infrastructure differs from built infrastructure; trees in cities and towns, like other infrastructure, require maintenance to remain safe and viable but their value to the community generally increases over time as they mature so that they become less and not more of a liability.

The recommended goals are for Coulee Dam to follow. It is up to Coulee Dam to provide the short and long-term support required to implement it. The goal is to provide specific guidance on managing, maintaining, and preserving trees within the urban and suburban infrastructure.

Employing the best management practices of the arboriculture and urban forestry industries, Community Forestry Consultants, Inc. offers the following management and maintenance recommendations to improve the health, quality, size, and diversity of the working forest of Coulee Dam.

## PROGRAM MANAGEMENT OBJECTIVES

The overall goal of strategic planning and management of the urban forest is to ensure a healthy, aesthetic, safe, and diversified tree cover that can provide a sustained supply of environmental, economic and social benefit to society. Research shows the average city tree lives only 32 years (Moll and Ebenreck 1989) and the closer to the city's center, the shorter the life of the average tree. To help address issues like these, a long-range plan is essential for management of a resource that is by its very nature a long-term matter.

Strategic plans define long-term and short-term goals for the city's urban forestry program. Management plans define how individual goals are achieved through action plans and timelines. Each goal must have an achievable and discernible outcome. The objective of this report is to provide a framework for a Strategic Management Plan for a five-year period.

### *Ordinance Review*

Enacting laws and policies that make public prohibitions and direct action in a certain way is not a popular way of influencing behavior. However, sometimes an issue is so important and complex that legislation and official policies are appropriate tools for local governments to use to protect its citizens and property. Managing urban forests is an important complex issue.

In recognition of the many benefits conferred by trees, hundreds of local governments are adopting street and park tree ordinances. Street and park tree ordinances apply mostly to publicly owned trees, as well as nuisance trees on private property.

Tree ordinances reflect the values of a community and the worth of a community's trees. A tree ordinance encourages tree maintenance to secure the beautification, air purification, noise and dust abatement, storm water management, water quality, property value enhancements, public health and safety benefits trees provide.

The key benefits to revising the tree ordinance are:

- Helps establish the tree management program;
- Provides reference to permanent procedures and legal authority;
- Legalizes a tree program through authorization of a tree board/commission;
- Establishes a permit review, approval, and appeal process for tree removal, planting, and pruning;
- Establishes the nature and degree of public responsibilities to community's trees according to specific standards and specifications;
- Establishes an official tree policy for the community;
- Specifies and ordines arboriculture standards for tree planting, pruning, and other tree work;
- Identifies standards and regulations for arboriculture practices;
- Ensures that the people who perform work on the trees are well qualified.

Street and park tree ordinances must resolve two key issues. First, the tree ordinance should identify municipal (and private property owner, if desired) responsibilities for tree ownership and planting, pruning, removing, and maintaining trees. Second, the tree



ordinance should establish a tree committee and provide the committee with authority to guide the management of public street and park trees.

It is apparent some common elements are not present in Coulee Dam's tree ordinance, are too vague, or do not address arboriculture practices. The town's tree ordinance requires revisions to existing components to align with goals and objectives of the UFMP and to address issues missing in most city and city tree ordinances.

The Coulee Dam tree ordinance lacks provisions recommended and found in other city tree ordinances. To ensure that public trees will be properly cared for, street tree ordinances usually contain most, or all of the sections listed below. The comments and examples are intended to help in revising the city tree ordinance. Municipalities should understand and plan for their own needs and abilities and not rely only on model ordinances from other places. The common elements and a brief description of each element follow on page 28 in Table two. Table three on page 29 shows the common elements in selected ordinances from other cities in the Northwest United States.

The following are examples of proposed revisions and additions to the Coulee Dam tree ordinance:

1. The definitions section should be expanded to include definitions for industry terms such as species, pruning or street tree and public terms such as right-of-way or planting strip. There is no definition section to cover industry terms not familiar to the public.
2. The ordinance stated clearly the regulatory body and delegator for public trees but there is no language regarding ownership of the trees.
3. There is no definition or language addressing boundary or border trees.
4. Disposal of urban forest products is not addressed in the ordinance.
5. A recommended species list and a prohibited species list section should be referred to in the ordinance by a document name independent of the ordinance to clarify the use and ability to update the list as industry planting standards and specifications change.
6. The ordinance should be expanded to include other pest infestations or disease infections that are considered incurable and epidemic such as spruce bark beetle, emerald ash borer, or pine bark beetle.
7. Severe maintenance treatments such as banning topping of public trees deserve individual recognition in the ordinance.
8. There are sections that refer to permit requirements for tree maintenance activities but no sections referencing permit revocation. These sections could be consolidated into one section that clarifies the permit process and revocation for all public tree maintenance activities.
9. The incorporation of a Risk Management Policy in the tree ordinance is strongly recommended as part of the city's tree risk management program. A risk management policy ensures continuity in the risk management program despite changes in the political and administrative components of the city.
10. A tree ordinance provides an opportunity to establish policy and back it with force of law if necessary. The infraction and damages section should address mutilation, damage, vandalism, illegal removals and improper pruning, etc. Penalties, fines and other levies should be based on the appraised value of the

- tree(s) as determined using the Council of Tree and Landscape Appraisal Guide, 9<sup>th</sup> Edition in addition to civil penalties.
11. As a general rule the fundamental program guidelines such as tree committee establishment and other more static items should be included in the ordinance. Industry standards and specifications that are subject to change as the arboriculture industry evolves should be placed in separate documents which can be cited in the ordinance.

**Table 1 - COMMON ELEMENTS FOR ORDINANCE EVALUATION**

Element	Explanation
Purpose	The goals and objectives of the ordinance. These are crucial to implementation, enforcement, and defense of the ordinance if challenged.
Authority	The source of the local government's authority to regulate – usually its own police powers and relevant state statutes (enabling legislation).
Definitions	Terms and phrases with special meaning within the body of the ordinance. Clear, concise definitions are important to ordinance comprehension.
Designation of Administrative Responsibility	The specification of a position, department, or committee responsible for enforcing the ordinance and carrying out specified duties. Ideally, limits of authority and responsibilities are clearly defined.
Plan and/or Permit Review Process	Explanation of how a new/proposed development or other action will be reviewed. Should detail information to be submitted with permit or platting requests, such as site survey of trees and proposed building locations.
Incentives	The methods that can be used to achieve conservation & compliance with ordinance (e.g. preserved trees credited to required project landscaping).
Preservation	What is to be preserved and how it is to be accomplished. There are many approaches to this, such as retaining ≥30% of existing tree canopy.
Construction Protection Measures	Specific measures required to protect trees during construction activities. Usually involves providing a protective zone for trunk and root structures.
Maintenance After Development	Specification of required maintenance of trees and vegetation after project has been completed, often including replacement for damage-killed trees.
Appeals	Provides for possible flexibility with a process for appealing decisions, which serves as a check on authority, but can potentially undermine management.
Enforcement	Provision for enforcement, and penalties for ordinance violations. May include fines, imprisonment, withholding of permits, work stoppage, etc.

Table 2 -COMMON ELEMENTS PRESENT IN SELECTED NORTHWEST CITY ORDINANCES

City	Purpose	Authority	Definitions	Designation of administrative responsibility	Permit Review Process	Incentives	Preservation	Construction Protection Measures	Maintenance after Development	Appeals	Enforcement
Bellevue	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓
Bellingham	✓	✓	✓	✓	✓					✓	✓
Bothell	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Clarkston	✓	✓									
Colville		✓	✓	✓					✓		
Covington	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Ellensburg		✓	✓	✓	✓					✓	✓
Enumclaw	✓	✓	✓	✓	✓					✓	✓
Grandview		✓	✓	✓	✓					✓	✓
Helena	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓
Coulee Dam		✓		✓						✓	✓
Lacey	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Missoula	✓	✓	✓	✓	✓		✓	✓		✓	✓
Olympia	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Omak	✓	✓	✓	✓				✓			✓
Port Townsend	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Pullman	✓		✓	✓	✓	✓	✓	✓	✓		✓
Redmond	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓
Spokane	✓	✓	✓	✓	✓	✓			✓	✓	✓
Vancouver	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Walla Walla	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Woodinville	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

Tree ordinances provide the town an opportunity to set policy and back it with the force of law when necessary. It provides clear guidance for planting, pruning, removing and other maintenance on street, park, golf and other public trees.

The ordinance should be flexible enough to fit the needs and circumstances of the town. The inventory data can provide the quantitative evidence for ordinance policy development.

Arboriculture and tree care maintenance and operations are very specialized fields of work. Many years of education and training are required to perform competently in the field and without harm to the trees. **Tree care performed to Coulee Dam's public trees should be accomplished by International Society of Arboriculture (ISA) certified arborists or ISA certified tree workers. The language of the ordinance should reflect this standard of tree care.**

There are many existing tree ordinances and tree ordinance-writing resources. A comprehensive list is provided in Appendix A.

### **Tree Inventory**

Many communities have public street and park trees, a shade tree commission, and plant trees, but how many know what the resource looks like, the condition it is in, the benefits it is providing, and how effective their program has been? Whether you are managing a retail store or natural resources, an inventory is critical. Without an inventory of the resource, you don't know what you have, its condition, and what kind of work is needed to maintain or manage it for the future.

As with any form of asset management, the foundation for ensuring maximum benefits from trees is a clear understanding of the characteristics of your tree population. An inventory also helps you better document the many benefits that trees are providing the community. Tree inventories are the foundation of an effective tree management program. It allows tree managers to identify current and potential problems and plan for budgets, removals, pruning, planting and other maintenance requirements. An inventory is a record of objective and quantifiable information about the condition and value of Coulee Dam's tree resources that can be used to document estimates for funding, personnel and equipment (Figure 6). Using and regularly updating the tree inventory moves the urban forestry program into proactive management.



**Figure 6 - Inventory data collection**

A park and street tree inventory provide information for planning, design and development impacts to trees, and management information for tree maintenance and plantings. It helps justify starting and managing a tree program and funding an existing program. An inventory of Coulee Dam's trees and planting spaces is a prerequisite for making sound decisions. Decisions may be based on tradition or poor judgement without an inventory rather than an accurate assessment.

An inventory provides the location of risk trees, the number of trees within the public right-of-way, the value of street and park trees, and the number of available planting sites. It helps identify insect or disease problems, maintenance needs, and budget priorities.

With this information, Coulee Dam staff can better plan and prioritize tree removals, maintenance work, and plantings and coordinate with the Town of Coulee Dam's urban forestry program with other city departments. They can also determine the value of Coulee Dam trees, which can help emphasize the importance of maintaining an asset. An inventory can be used to monitor tree conditions to quickly and accurately answer management questions, such as where and how many trees should be planted in a year. Over the years, changes can be seen in the number, age, condition, and species of trees. A well-maintained inventory can be used in cases of liability to demonstrate that there was no negligence in the inspection or care of these trees. An inventory will also improve the chances of receiving grants and other assistance by providing documentation of the extent and worth of street and park trees.

**The following objective will enhance management of the urban forestry program.**

- Contract for professional data collection to complete inventory of the tree population and audit of existing tree inventory data to insure accurate, consistent data collection and correct existing gaps in the tree inventory data.
- Maintain the assessment of the tree population to obtain accurate, functional data necessary to manage the urban forestry program.
- Maintain and update the tree inventory regularly as part of the urban forestry management program.

It is important that inventory data be accessible to tree managers, consistent, and accurate. All efforts should be made to ensure that the local tree inventory survey results can be used by the Town of Coulee Dam.

Maintaining the tree inventory and using an ArcGIS-based tree management software to manage trees establishes a systematic tree maintenance program which reduces costs. This is primarily because systematic maintenance in general leads to healthier trees that require less expensive maintenance over the long run than unhealthy, high-risk trees. A computerized tree inventory aids in reducing the subjectivity of tree management decisions and stimulates proactive responses.

Embed tree inventory data updates into routine management procedures. Data needs to be kept up-to-date. Once a baseline has been created, updating can be conducted on a rolling basis, integrating as much as possible of the survey work within maintenance and other routine works conducted. Some areas experiencing strong pressures or fast changes might need to be surveyed bi-annually while others may only need to be looked

at once every three years. Areas can be zoned based on level of use and development changes and surveyed accordingly.

### ***Framework for the 5-year Strategic Management Plan (2018 – 2023)***

The plan is intended primarily to provide guidance for Coulee Dam staff, CDTC members, and elected officials using the tree information database and a management cycle approach to monitor short to long term trends.

Traditional forestry is the management of trees or stands of trees for timber production and other values including wildlife, water quality, and ecological health. Urban forestry is the management of trees and other forest resources in urban ecosystems for the environmental, economic, social, health, and aesthetic benefits trees provide society.

Agency tree plans provide policy and standards for implementing and managing community tree programs. A community tree plan is to guide the management and maintenance of a community tree program, including tree removal, pruning, planting, funding, and volunteer opportunities. Tree plans should be consistent with other agency planning strategies and usually include a vision statement, goals, objectives, and strategies.

In any given city nationwide, buildings and roads receive careful planning and scheduled maintenance. It is widely recognized that neglect can result in deterioration leading to numerous potential expenses and risks. Why should trees receive any less planning, attention, and care? Tree management plans help cities proactively manage their tree resources to avoid risk, reduce liability, cut maintenance costs, and increase the value of trees. A comprehensive plan helps promote the health and sustainability of the community's trees, while providing a framework to make difficult decisions about tree removal, preservation, pruning, and planting. A proactive approach to tree issues reduces costs for maintenance, removal, and liability associated with tree failures.

Community Forestry Consultants, Inc. developed this comprehensive UFMP after analyzing the tree inventory data; making field observations; acquiring community input; and by applying national arboriculture standards and best management practices. This is a customized plan based on local conditions, resources, and priorities. The UFMP plan will help the members of the CDPNR committee, tree committee, Coulee Dam staff, Coulee Dam administrators, city council, and other concerned citizens understand the current condition of the community forest and shape its future.

While limited agency funds for urban forestry programs often constrain proactive tree care, management planning efforts can increase the effectiveness and reach of scarce resources and have significant impact on the landscape.

The UFMP can show CDTC members, city staff, and citizens how science informs tree management as well as promoting community values. It will help raise citizen awareness of the benefits of a healthy, diverse and well-managed urban forest. A strong management plan will serve as a tool to be used for garnering public support, cooperation, funds, and help the community sustain its trees for future generations.



**The objectives of the UFMP plan include:**

- Review, update, and evaluation of operating plans.
- Annual analysis and mitigation of risk trees.
- Proper tree selection and purchase.
- Proper tree planting.
- Proper tree maintenance.
- Adequate funding and staffing.
- Staff training.
- Contractor quality control and monitoring.

**Effective Administration**

Like the gray infrastructure of streets and utilities, trees are an essential part of a community's green infrastructure and should be administered effectively. The responsibility for administering a community tree program must be clearly defined and carried out on a regular basis. These responsibilities often are divided among appointed board members, city officials, a tree committee, and agency employees.

The size and complexity of an agency will determine how to organize the tree program. Coulee Dam's tree population and maintenance requirements require a staff person's time is funded and allotted to manage the tree program and to coordinate work with the city tree program, agency departments, and the public. To ensure good program administration, responsibilities need to be directly assigned and procedures defined clearly.

Community tree plans provide overall guidance to the long-term administration of public trees and must then be translated into effective actions. Bi-annual work plans for tree removal, tree maintenance, tree planting, periodic inspections, task scheduling, securing funding, and public education and involvement should be used to schedule the work required to meet the plan's objectives and goals. By using a bi-annual work plan and a budget based on this plan to prioritize and schedule tasks for the upcoming years, a tree program can become more efficient and avoid crisis management.

**Street Trees**

City streets are not just thoroughfares for motor vehicles. They often double as public spaces where people walk, shop, meet, and generally participate in many social and recreational activities that make urban living enjoyable. Urban foresters, designers, and planners encourage streetscape tree planting to enhance the livability of urban streets. Large, high quality trees play important roles in community improvement. Trees are as much a part of the city infrastructure as roads, buildings, and street lights. Extensive research has documented the environmental, social, and economic benefits of large trees for communities, municipalities, and regions.

Trees in small city business districts influence retail and shopping behavior in positive ways. The results of several studies suggest that trees are good for business. Shoppers prefer trees and consider trees an important amenity. They spend more, shop longer, and are willing to pay more for goods in business districts with mature, healthy trees.

Yet, city trees are too often placed into "tree coffins", cutouts in the sidewalk with an insufficient soil volume, oxygen level and water availability for roots, where trees grow

poorly, live fast, and die young (Figure 7). The sidewalk cutouts are enclosed with iron grates to create a contiguous surface for pedestrian travel. The iron grates usually girdle the trunk as the tree grows, damaging the tree they were intended to protect, and often lead to trip-and-fall hazards for people causing severe injuries.

Some common procedures exacerbate tree problems. For decades, it's been common to plant street trees in "tree pits." But if these excavations are too small, the root system cannot support the tree for more than a few years, according to James Urban, an authority on trees in built-up areas. The lack of room for roots stunts the tree's growth, and soon the tree begins to die, says Urban, principal of Urban Trees and Soils in Annapolis, Maryland.



**Figure 7 – Trees and other infrastructure compete for space along streets and in downtown areas.**

The trees may lift adjacent sidewalks which lead to risk issues for the town. Confined to ever-smaller cutouts and planting strips, it is no wonder that roots carve out their space at the expense of sidewalks, curbs, and driveways. The typical public works response is tree removal or aggressive root pruning which often leads to a slow, agonizing tree mortality or tree failure. If the trees are removed the city is left with vacant tree pits. When this happens, trees lose, and cities lose.

While some trees are associated with sidewalk damage, research in many cities has shown that trees are minor contributors to sidewalk failures. The soil type and soil's suitability for sidewalk construction and root growth all have a bearing on tree-sidewalk conflicts.

Those trees that do survive tend to experience stunted growth, pest and disease problems, mutilation described as pruning for clearance issues, exposure to road pollution, and vandalism. The trees are stressed and often decline and die, creating a public eyesore during the process. It is not surprising that some city officials and the public have a poor opinion of trees in downtown business districts and along city streets. The trees never reach their potential to provide the benefits for city dwellers.

One of the biggest challenges for arborists, urban foresters, city planners, landscape architects, soil specialists, engineers, and public works staff is to provide sufficient soil space for root growth and tree health, in a situation where space is at a premium. The trend is to downsize the urban forest and plant smaller trees.

The Coulee Dam downtown business corridor is under constant competition for space. Many infrastructure items must share the same space and co-exist (Figure 8). The key site condition factor to consider in resolving tree-sidewalk conflicts is to integrate trees



**Figure 8 – Trees located in small tree pits.**

into the infrastructure design up front. The fundamental solution to most city tree problems is simple: Give each tree access to more and better soil.

The downtown business district is the heart of Coulee Dam. As might be expected in the downtown, several organizations, property owners and tenants are stakeholders in the management of trees. Many areas of the downtown are planted with trees, many are recent installations, and most are planted in tree pits. Development and redevelopment of property in the downtown can mean additional planting opportunities or it can mean facing the loss of established trees to development of buildings, parking lots and street redesign.

When development does occur where trees currently grow, great care must be taken to protect those trees that are healthy and structurally sound whether on public or private property.

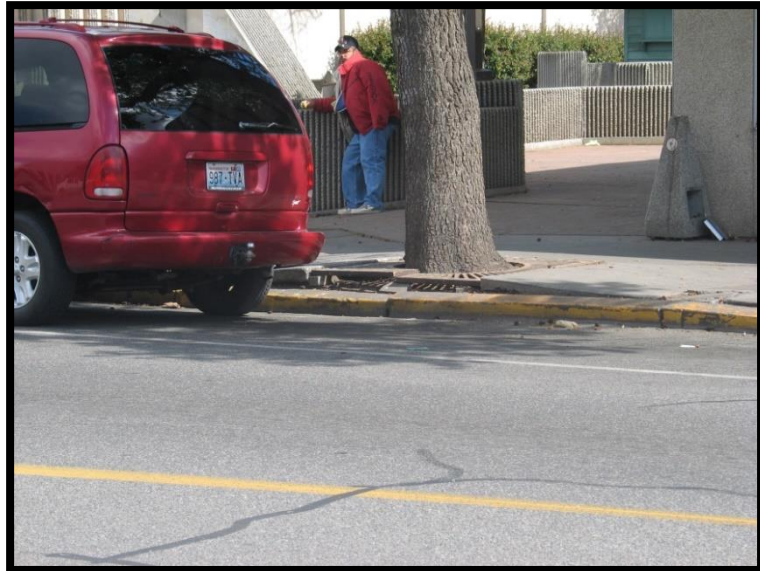
An American Forests article published in the early 80's stated that an oak or maple tree is capable of living up to 400 years in the forest, up to 80 years on a college campus, up to 30 years in a heavily used park, up to 20 years along a city street and about 4 years in a downtown planting pit. Thirty years after the article was published, the same design mistakes are still being made in cities across the United States. There are several challenges when planting trees in any downtown area:

- Limited Planting Space. This is one of the greatest challenges to maintaining a healthy urban forest in the downtown district. Small tree wells are the norm in downtown Coulee Dam (Figure 8, 9, 10). These are typically concrete walls on all sides; four feet square and leave little space for root expansion necessary for vigorous tree growth.
- Availability of Irrigation. There are trees planted in the downtown without an automatic irrigation system. They do not have automated irrigation, so rely on adjacent property owners for water, natural rainfall, or use of expensive water trucks.

Water is vital to ensure trees thrive. Lack of water is a primary stress to the tree and often leads to poor growth, premature defoliation and death. Installation of automated irrigation should be required on new development and new tree wells or water filtration systems that capture run off for trees before sending it down the drains.

- Difficult Growing Conditions. In any location tree growth is limited by the conditions present in its surroundings. In the downtown, limited growing space, poor soil, heat and exposure to sun and wind impose stress on trees. Incorporating new designs that find more growing space for trees and selecting trees more tolerant of harsh growing conditions will help.

- Owners and Tenants. Some business and property owners perceive trees to be an obstacle to business operations because trees create litter, block visibility of signs and displays and are difficult to maintain. The latest research indicates that trees in downtown corridors increase business, increase shopping time spent and increase the amount spent per visit (Wolf 2005). Trees and business owners in downtown corridors can co-exist and provide benefits to each other.



**Figure 9 – Tree grates girdle trunks and creates trip hazards.**

- Poor Maintenance. Many people do not understand how trees grow or how to best care for them. Trees in downtown areas often go without any regular care. Some trees are topped to clear signs and they become a liability to the adjoining property and the city. Education is crucial to helping owners, tenants and contractors understand proper pruning and tree care can create assets rather than liabilities.
- Tree Grates and Guards. As trees grow and mature, their trunks can come into conflict with the grates covering the planting hole. Roots from the trees often grow into the soil under the sidewalk, cracking and heaving the concrete. Grates can girdle trunks in a short time without maintenance. If left in place, the grates can damage the trees they were meant to protect. The grates are also trip hazards. Their use should be limited and temporary.

Often, the downtown and other business districts are selected as high priority areas to increase the beauty and attractiveness. Traditionally, downtown trees were installed according to traffic engineering design standards that did not consider the biology and



culture requirements of trees. The business district of Coulee Dam is characteristic of this design concept. Unfortunately, little can be done to improve the current planting spaces without a major change to the infrastructure.



**Figure 10 – Streets without space for trees require design changes.**

Tree plantings in the downtown business district and Coulee Dam add greatly to the economics and aesthetic appeal of the city. Tree selection for business and shopping areas must take into consideration the need for shoppers to view storefronts, as well as the need to provide enough shade for shoppers. Tree canopies should be open, as in thornless honeylocusts (*Gleditsia triacanthos inermis*). **The branching habit must be high enough to allow pedestrians to walk comfortably beneath the trees.** Other options are tall, narrow growing (fastigate) species. These trees can provide beauty, a look of uniformity, and a formal appearance to the shopping district.

Public streets and sidewalks constitute a large percentage of the Coulee Dam's impervious surface, generating runoff and pollutants. Reducing the amount of impervious surface, implementing low-impact development (LID) stormwater techniques and increasing vegetation planting within Coulee Dam rights-of-way can assist in creating greener business districts and neighborhoods. Techniques to accomplish this include reducing the amount of pavement, utilizing pervious pavers, installing rain gardens, and installing traffic circles and medians which can be planted with vegetation. These techniques can also help to achieve traffic calming goals and a better balance between vehicles, pedestrians and bicycles, and are part of a "complete streets" approach.

"Complete streets" is a term used to describe streets designed to enable safe, attractive, and comfortable access for all users. Transportation engineers define "green streets" as streets where green infrastructure practices such as reducing road widths are integrated in the design. Within green streets, LID techniques and vegetation planting will be prioritized.

#### **Objectives of urban forestry program for the downtown business district and other commercial corridors:**

- To preserve existing trees in parks and green belts on public lands in the downtown core.

- Improve appearance of downtown public spaces/sidewalks – add trees and landscaping. Improve appearance and sense of welcome in key areas of downtown. Support efforts to clean up and landscape publicly owned portions of the downtown area. This includes lawns, landscaped areas and street trees.

### ***Tree-based Strategies to Reduce Infrastructure Damage***

Methods to reduce infrastructure damage have been varied and numerous, with both preventive and remedial strategies employed. Three groups of strategies have been used based upon their action approach: tree-based strategies; infrastructure-based; or root zone-based. Often a combination of action types is used on the same tree to mitigate infrastructure conflicts.

Species selection is an important consideration in any planting situation and particularly important in downtown business districts. Matching a suitable species with the planting space is the first step in the process. Other considerations include drought tolerance, litter, maintenance requirements, and mature size. The trend is to plant small stature trees, but studies have shown that ultimate tree stature is not a good indicator of potential for hardscape damage. It is more important to consider the mature size of the trunk flare and buttress roots of the tree when selecting species for limited spaces.

Root system characteristics or root architecture is another tree-based strategy to consider when selecting plant material. There is very little scientific research available about the root architecture differences between species or the differences within a species and the influence rootstocks may have on root architecture. Yet, there is some empirical experience that can be applied. Ash trees generally have a wide, lateral root system while oak trees tend to have an oblique root system. Ash trees may not be suited for downtown corridors because of their root architecture and emerald ash borer issues. However, other factors influence plant choice such as soil type, drought tolerance, and litter. Ash would be a suitable candidate for a downtown tree if these factors were the primary criteria. The point is many factors influence species choice for downtown sites.

### ***Infrastructure-based Strategies to Reduce Infrastructure Damage***

Infrastructure damage is often caused by trees that outgrow their planting space. The objective of design strategies is to maximize the distance between trees and infrastructure to minimize the potential for conflict. Infrastructure-based strategies focus on prevention of problems. For new trees, providing adequate space by using larger planting spaces, tree islands, or narrower streets are key preventive strategies. The goal is to eliminate some hard surface when possible. For established trees, creating additional space using curving sidewalks and pop-outs, or eliminating sidewalks altogether are remedial strategies to consider. Bridges and ramps over existing root systems is an alternative but compliance with the Americans with Disabilities Act (ADA) must be considered.

Planting spaces of appropriate size for the desired species is critically important. The larger the planting space, the lower the potential for damage from trunk expansion, buttress root development, or surface root development. Various researchers have suggested planting strips be 10 feet wide and cutouts be 6.5 feet by 6.5 feet.



Although tree height provides some guidance in matching trees and planting space size, measuring the trunk diameter at ground level gives a direct assessment of the minimal planting space needed for a species. This measurement includes both the trunk flare and root buttress growth. To accommodate species with a surface-rooting characteristic, additional space beyond that needed for trunk diameter at ground level will be required.

Curving sidewalks away from the tree increases the distance between the tree and the sidewalk and the damage potential decreases. Sidewalk meandering—realigning the sidewalk's direction of travel—enables the community to provide more growing space for trees in an aesthetically appealing way (Figure 11). The amount of growing space created can be substantial and, therefore, sidewalk meandering is usually the most feasible way to retain large, mature trees. Also, increased distance from sidewalk edge to lateral roots or trunk flare allows for root pruning, when necessary, to occur further from the trunk, which reduces direct contact between the sidewalk and tree roots or trunk. Sidewalk meandering often requires permission from the abutting property owner to dedicate more of their property to the public right-of-way.



**Figure 11 - Re-routing sidewalks around a large tree is a successful option.**

There several remedies for solving tree sidewalk conflicts. These are discussed in detail in Appendix D.

### ***Recycling Wood Waste and Chip Disposal***

Tree removal is typically the most expensive tree maintenance operation on a per tree basis. Other costs associated with tree removal include stump removal and wood waste disposal.

Currently, most of the wood generated from park tree removals brings little economic return to tree management budgets. Some wood is donated to the local high school wood shop program for student projects. This does reduce landfill costs. The growing concern about the environment and overburdened landfills, coupled with an opportunity to augment the forestry budget, should prompt the CDTC to the possibility of processing waste wood as a revenue generating activity.

There are many opportunities today to recycle tree residue. The following options are available for agency use.

- Mulch (new tree installation, trails, landscape beds)
- Biomass fuel production
- Small scale sawmill operators (building materials)
- Secondary product production (park benches, furniture, wood sculptures)
- Woodworker associations (knotted and twisted wood pieces)
- Composting
- Firewood

Which option(s) to apply and implement will depend on city laws, agency policies and resources. An internal review and revisions of existing laws and policies governing agency wood waste utilization can improve the agency's ability to sell this material (USDA, NA-TP-02-94).



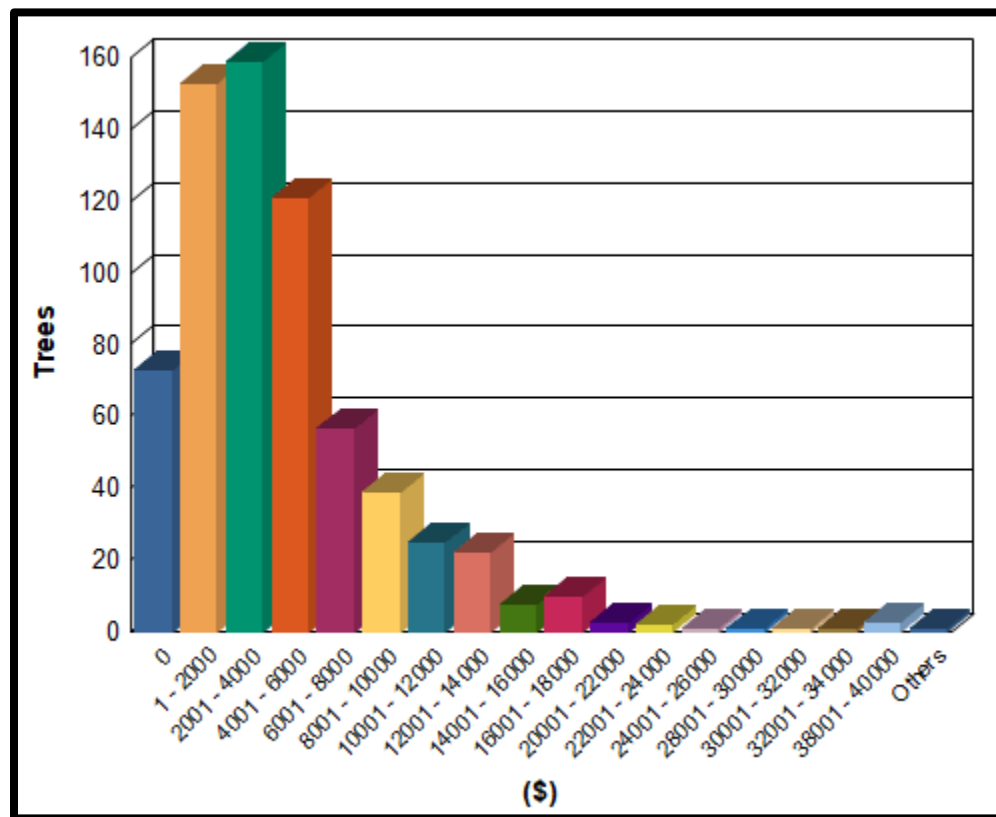
## INVENTORY and TREE MAINTENANCE SUMMARY

### Appraised Value

Trees in urban areas are valued differently than the timber value of their forestry counterparts or trees in undeveloped areas of the community. Appraised value of urban trees is based on the species of tree, the trunk diameter, the condition of the tree, and the location of the tree. Coulee Dam trees represent a considerable economic, social, recreational, and environmental asset to the community. **The 680 trees inventoried have an appraised value of \$3,183,000.00 (Table 1).** They represent a partial inventory of town trees.

The graph shows the number of trees in a range of dollar values. Most trees inventoried are in the medium diameter class size (12 to 24-inch DBH). Higher condition ratings come with improved maintenance which increases appraisal values.

Total Appraised Value: **\$3,183,000.00**



**Table 1 – The appraised value of inventoried trees was determined using processes from the Council of Tree & Landscape Appraisers Guide for Plant Appraisal, 9<sup>th</sup> Edition.**

Trees are the only asset owned by the City of Coulee Dam that increases in value as they age, but only if they receive proper maintenance.

### Tree Maintenance and Care

Coulee Dam staff makes decisions on tree maintenance and mitigation options and schedules the work. With populations of trees and limited funds, such as in Coulee Dam, scheduling becomes more important and requires prioritization. Pruning plans are essential, not only to ensure healthy, aesthetically pleasing trees but also to increase public safety, decrease liability, and demonstrate due diligence.

A variety of requirements can inform pruning plans, some more desirable than others. Common factors that determine pruning priorities are residential or business requests and emergency pruning. This kind of “reactive management” is most common in jurisdictions where no planning exists. Scheduling pruning based on these factors may increase liability for damages because many high and extreme risk trees remain unidentified until a failure occurs.

Healthy trees confer numerous benefits, yet poorly maintained trees can pose a considerable risk to the surrounding community. Broken branches and even entire trees can fall, especially during inclement weather. In paved areas, roots can cause cracks and buckles in pavement which may be tripping hazards. Leaves can clog gutters and fruits can rot and smell.

While the benefits of trees far outweigh the costs, careful maintenance is needed to manage risks that are often predictable, detectable, and preventable. Excluding immediate, acute problems (blow downs, pest outbreaks, and extreme vandalism) tree maintenance should be performed on mature trees following a two to five-year pruning cycle based on a management plan. The pruning cycle for Coulee Dam’s mature trees is based on the severity of pruning that may be required due to deferring tree maintenance.



**Figure 12 - Co-dominant stems are easily fixed on a young tree but often fail if not pruned correctly early in the life of a tree.**

Tree health can be greatly increased by regular pruning, especially when the tree is young. Immature trees that are not pruned can develop many structural problems such as weak branch structure, crossing branches, and co-dominant leaders (ISA 2005) (Figure 12). If corrected early, the tree can develop a strong support structure with a healthy canopy. This in turn will reduce the necessity of more expensive and often intrusive corrective pruning during the normal life of the tree. If tree condition is improved

at a young age and maintained during the tree's life, there will be less need for a reactive approach to pruning.

Most communities try to implement a two to five-year pruning cycle. The ability to implement a cyclic pruning program is limited by the staff and financial resources in Coulee Dam. Most cities and towns cannot afford to contract services for all trees. There are options available to deal with budget constraints. For example, contract pruning of large trees with significant structural defects near high use areas may be an initial management recommendation while small tree pruning is performed by Coulee Dam staff or trained volunteers. The objective is to start and maintain a cyclic pruning program within the fiscal and personnel resource constraints of Coulee Dam.

Industry standards such as ANSI 300, 133.1, or 60.1 define the standards and terms of arboriculture; specifications and best management practices determine how the agency applies the standards to manage its trees. The standards and specifications are applied universally to all public trees regardless of who is doing the work – Coulee Dam staff or contractor. The standards and specifications guarantee that, if invoked, a healthy, structural sound urban forest will be perpetuated. The standards and specifications also demonstrate Coulee Dam is implementing currently accepted practices by the urban forestry and arboriculture professions. The arboriculture specifications should, at a minimum, include specifications for removal, pruning, planting, species, tree preservation, risk rating system, and inventory methodology.

**Objective for tree care maintenance that should apply to all Coulee Dam staff and contractors.**

- Pruning treatments should follow the best management practices established by the ISA, ANSI Z133.1 and ANSI A300 standards and employ ISA certified arborists or certified tree workers to perform tree maintenance. In addition to ANSI standards, the city should develop pruning specifications that serve to define treatments for different species, ages of trees, pruning techniques and other pruning issues.

Proper pruning adds value to the landscape and is one of the few active management techniques that helps a landscape increase in value while minimizing liability concerns. Proper pruning, with an understanding of tree biology, can maintain good tree health and structure while enhancing the aesthetic and economic value the community forest creates for Coulee Dam.

### **Mature Tree Care**

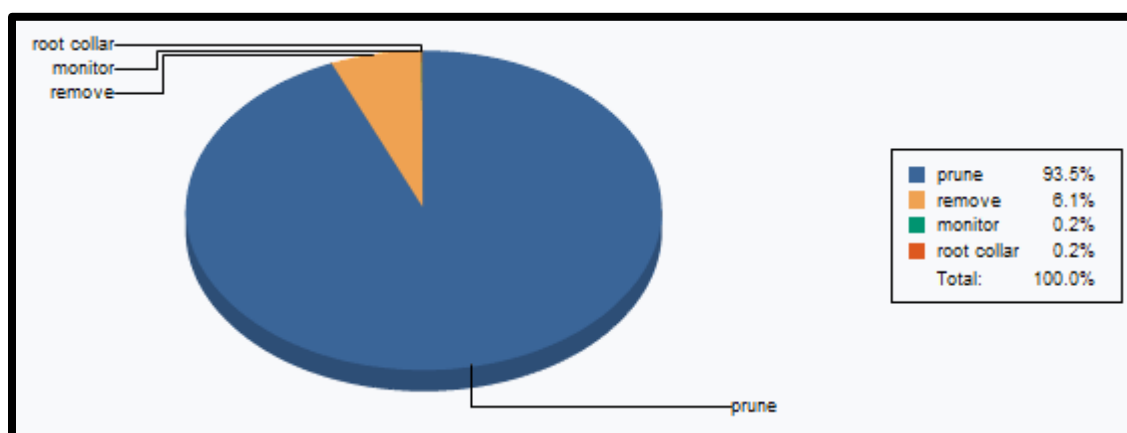
The benefits and values of trees are maximized when trees reach maturity. To maintain this high level of benefits for a longer period, Coulee Dam should commit to providing regularly scheduled maintenance to its mature trees and prepare for other, non-routine arboriculture treatments as needed. A comprehensive mature tree care program primarily centers on routine or preventive pruning, and the ability to fertilize, irrigate, control insects and diseases, and cable and brace trees when necessary.

If regular pruning is planned in a systematic manner, crews and equipment can work much more efficiently than if pruning is only done by request or in case of emergency. The cost difference can be dramatic. The ISA has compared efficiencies of both

methods and found planned pruning to be at least twice as productive. When crews examine the urban forest regularly for possible risks and tree health problems, there is a reduction in citizen calls for emergency pruning (Luley et al. 2002). Additionally, the crews often find problems that would not have been reported by residents. Regular pruning cycles can also focus on certain species that may require more attention; this is common when a pest needs to be controlled, for example. Regular, cyclic pruning maintains a greater safety level in the urban forest and can decrease liability for the agency (McGauley et al 2000).

Over 70% of the trees inventoried in Coulee Dam require maintenance (Table 3). Pruning represents more than 70% of the maintenance tasks. Regular pruning will improve the condition rating of many trees, reduce the potential for storm damage to trees, reduce the risk associated with community trees, and demonstrate proactive management of Coulee Dam's tree resources (Table 2, 3).

### Planned Tree Maintenance



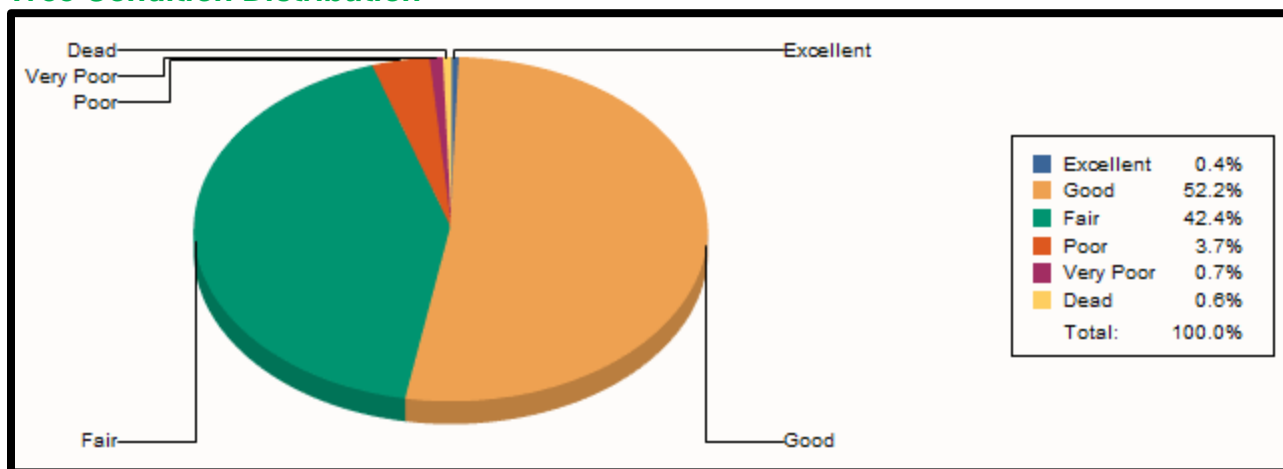
Town of Coulee Dam Tree Maintenance Task Details	
Task	Tree Count
Remove	31
Prune	475
Planting sites	300

**Table 2 – Tree maintenance tasks and tree count determined during inventory data collection.**

**Removal:** There are 31 trees inventoried that require removal. Removals are primarily due to trees that are dead or have significant structural defects. Typical removals average about 3% of the inventoried trees. This represents about 4.5% of inventoried trees.

**Prune:** There are 475 trees that require some type of pruning treatment. The common defects are co-dominant stems, dead branches, and minor dieback which can be corrected by subordination pruning treatments.

### Tree Condition Distribution



**Table 3 – Condition ratings of inventoried trees.**

Condition	Percent	Count
Excellent (90 - 100%)	0.4%	3
Good (80 - 90%)	52.2%	355
Fair (70 - 80%)	42.4%	288
Poor (50 - 70%)	3.7%	25
Very Poor (50 - 1%)	0.7%	5
Dead (0%)	0.6%	4
<b>Total</b>		<b>680</b>

### Young Tree Pruning Program

There are few newly planted or young trees in Coulee Dam. More new trees will be added as trees are removed, development changes, and to diversify the existing tree population. It is critical to understand the proper maintenance techniques required to ensure the longest and safest service life of these trees (Figure 13, 14). The major components of a young tree care program are pruning, mulching, and watering.

Pruning young trees to obtain good structure requires an understanding of the growth-habits of the various species being planted and of tree biology, anatomy, and physiology. Training pruning is used to develop a strong structural architecture of branches so that future growth will lead to a dominant central leader, strong branch attachment and proper branch spacing along the trunk. It consists of removal of dead, dying, diseased, interfering, conflicting, and/or weak branches.

Many young trees may have branch structure that can lead to potential problems as they grow, such as codominant stems, many limbs attaching at the same point on the trunk or crossing/interfering limbs. When trees are small, these problems can be remedied easily and inexpensively. If structural problems are not corrected while trees are young, they can become safety risks as they grow larger and create potential liability.

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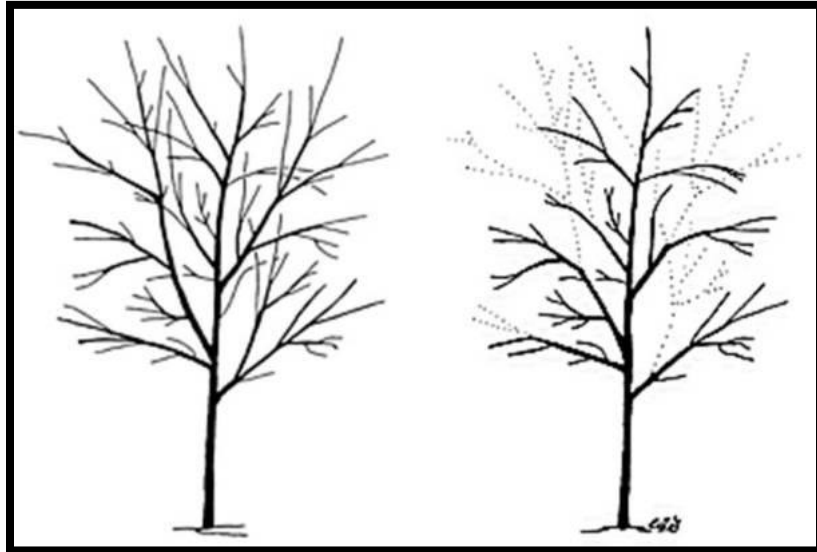


**Figure 13 – Frequent wounding by mowers and weed eaters often causes trunk decay.**

URBAN FORESTRY MANAGEMENT PLAN  
TOWN OF COULEE DAM, WASHINGTON

All newly planted trees should receive their first training pruning the third year following planting. Training pruning should be minimal when a tree is planted, because it is already under stress from transplanting and needs as much of its leaf canopy as possible in order to manufacture food and increase root growth for proper establishment in its new site. Only dead or broken branches should be removed at the time of planting, and in the next two years.

The training pruning program would also be accomplished on a cyclical basis, but the work would be scheduled during a three-year cycle rather than the two to five-year cycle for the routine pruning of larger established trees. As mentioned above, newly planted trees should receive their first training pruning three years after planting. This work can be accomplished throughout the year (Figure 14).



**Figure 14 – Tree structure in young trees.**

An optimum time to perform this pruning is late winter–early spring prior to bud break. The leaves are gone allowing clear visibility of the branches and trees will react positively to pruning at this time of year. Also, it is usually a time of the year when city staff workloads are less demanding. Training pruning can be accomplished from the ground with a minimum amount of equipment. Coulee Dam should develop an organized, documented approach to cyclical tree maintenance that can be easily managed by staff.

**Objectives that promote stewardship, longevity, structural integrity, and health of the community forest.**

- Educate mower and weed eater operators about equipment operation around tree trunks.
- Maintain the GIS-based inventory to manage the composition, character, and distribution of the urban forest.
- Establish a long-term tree care and management program for public trees to enhance urban forest and ecosystem health and function, that includes structural pruning of young trees, cyclical pruning and crown cleaning of older trees, line-of-sight and height clearance pruning of street trees, removal and replanting efforts, risk identification for street and park trees.



- Identify and address serious and persistent tree-related infrastructure conflicts, to include street, sidewalk and utility impacts along with maintenance and installation impacts within utility easements.
- Consider opportunities to expand the use and marketing of wood waste by-products such as turning wood from removals into lumber.
- Maintain industry-appropriate storm and risk tree response protocols.
- Maintain, promote, and apply industry-appropriate pruning and planting standards through staff training and hiring of ISA certified arborists.
- Monitor tree population for insect pests and diseases, particularly invasive.
- Review operating plans on a bi-annual basis.
- Review and update the Urban Forestry Management Plan on a 5-year cycle, or as needed, to adjust to changing circumstances.

### **Tree Maintenance Pruning Cycle**

- I. **Pruning Schedule:** The maintenance pruning schedule shall be dictated by tree species, age, function, and placement.
  - Trees less than 7 years old should receive structural pruning on 3-year cycle.
  - Trees 7-20 years old should receive structural pruning every two to five years.
  - Trees 20 years old and older receive maintenance pruning every five to seven years to clean dead, diseased, dying, and defective branches from the crown.
  - Trees adjacent to roadways, walkways, signs, and street lights are annually inspected for safety and clearance issues and maintenance pruned as necessary.
- II. **Pruning Practices:** To encourage the development of a strong, healthy tree, the following guidelines shall be followed when pruning. General pruning shall not be conducted without a clear objective or outcome. Prune first for safety, next for health, and finally for aesthetics. When removing branches, the pruning cut shall not damage the branch bark ridge and branch collar.

**\*\*\*\*Structural pruning, subordination, and crown cleaning should be the first pruning treatments applied to any tree regardless of size\*\*\*\***

**Structural Pruning:** Pruning to influence the orientation, spacing, growth rate, strength of attachment, and ultimate size of branches and stems resulting in a strong tree.

**Subordination:** Pruning to remove the terminal, typically upright or end portion of apparent branch or stem to slow growth rate so other portions of the tree grow faster.

**Crown Cleaning:** Crown cleaning shall be performed to remove dead, diseased, dying, and defective branches, which reduces hazards, promotes, health, and improves appearance. Large branches should be removed with the aid of ropes and rigging equipment to minimize the risk of tree injury from falling debris.

**Crown Thinning:** Pruning treatment used to remove lateral branches. It should be conducted from the outer edge of the canopy. It should be used judiciously.

**Crown Raising:** Raising shall be performed to provide vertical clearance from thoroughfares, signs, street lights, and structures. Always maintain live branches on at least two-thirds of a tree's total height. Removing too many lower branches will hinder the development of a strong main stem.



## TREE RESOURCE EXPANSION

### *Tree Resource Expansion*

There is a clear need for a tree planting plan to guide the arboriculture future of Coulee Dam's community trees. Such plans will minimize the unintended but gradual degradation of the urban forest over time, as well as maximize the potential for a sustainable and diversified tree canopy and the associated benefits. The trees in Coulee Dam—a relatively even-aged, limited, and undiversified population—are not only significant design elements but also represent the canopy cover at this stage.

A challenge for Coulee Dam is to plant enough new and replacement trees each year to increase the canopy cover, maintain newly planted trees, and ensure the trees thrive. Removals without replacement and planting small trees in large spaces lead to net canopy loss. Without a clear plan to guide tree plantings, the City of Coulee Dam may plant trees but not achieve a net increase in tree canopy.

Tree planting plans include input from local citizens, city staff, state agencies, organizations, businesses, planners, developers, CDTC members, affiliated green industry professionals, and elected officials. They are integrated with other comprehensive agency and city plans to create a blueprint for administration and management of the planting program.

The goal is to provide specific guidelines on locating, planting, and caring for trees. Removing, pruning, planting, and preserving trees; educating stakeholders; and improving coordination and communication among citizens, CDTC, city staff, and elected officials are critical components in the development of the tree planting plan. A tree planting plan will help town managers quickly determine how best to apply funding that often becomes available in small and unpredictable amounts. A plan should not only specify what (species) and where (location) but when (timeframe) and why (underlying goals).

The community tree plan should address some important questions about landscape design, development impacts, including the kinds of neighborhood and other landscapes that are present, their function, and their attractiveness; how the landscapes should look and function in the future; and how the landscapes should be protected or modified to reflect community goals.

### **Design objectives can include the following:**

- Plant only the quantity of trees that can be maintained properly. If there is only funding to maintain 50 newly planted trees don't plant 100.
- Increase tree planting on Coulee Dam owned property, including parks, public buildings, ball fields, and other developed sites.
- Promote additional street tree plantings while considering infrastructure (e.g., utility) limitations.
- Review new site development proposals to maximize tree planting and preservation opportunities.
- Encourage tree planting and preservation on private property.

- Develop guidelines for reviewing tree selection and/or location regarding the aesthetics of specific architectural and development projects in the community core.
- Consider the development of a Coulee Dam Master Street Tree Plan to express unified visions and themes for street trees across the community.
- Important landscapes, such as main entrances and exits, will be identified and considered in tree and flower planting. An overall image of Coulee Dam will be developed through the coherent planting of trees along streets and parks.
- The final selection of trees and their placement for a landscape shall be made in the field while considering the many elements of that landscape.
- The tree species chosen for planting, besides meeting design criteria, must be biologically adapted to site conditions and well suited for the level of care they will receive.

Implementing a tree planting plan and using inventory data to prioritize planting and maintenance establishes a systematic program which reduces costs. This is primarily because systematic, planned maintenance in general leads to healthier trees that require less expensive maintenance over the long run than unhealthy, high risk trees. Maintenance practices and standards for new tree plantings should be a component of the tree landscaping plan as well as strategies for funding maintenance programs. Developers should be encouraged and expected to use creative design strategies to achieve the intent of the tree planting plan.

Tree planting in Coulee Dam can significantly impact that community's landscape for years to come. Yet planting decisions, including the selection of species and location, are often made without the benefit of a long-term strategy or plan. Tree planting might occur as part of a larger capital construction project or be driven by a donor request or the need for a volunteer project.



**Figure 15 - For every dollar spent on tree planting and establishment, a 250% return on investment is provided to the city in terms of the total services provided at tree maturity.**

As the inventory of existing trees continues, places where trees could be planted should also be noted. Knowing the number of available planting sites can help when the community is budgeting for and ordering new trees.

There are many available new planting spaces Coulee Dam. It is a common activity promoted by cities, local and national trade, and professional and citizen organizations. These new trees are the future environmental, economic, and social fabric for the Town of Coulee Dam (Figure 15). The inventory collected available planting sites with an emphasis adjoining residential land use. Over 300 available street planting sites were

collected. Many more exist in Coulee Dam but parameters will need to be established by site in conjunction with field evaluations to determine available planting spaces.

The key to maintaining a healthy, sustainable community forest is the implementation of regular, bi-annual tree plantings, regardless of grant money or catastrophic events. Many trees do not need be planted, but a consistent bi-annual addition of trees to the community forest is critical to maintain a perpetual canopy.

### **Objective to guide the Coulee Dam tree planting program.**

- The bi-annual quantity of trees to plant is directly dependent on the quantity of trees Coulee Dam staff and resources can maintain.

### **Tree Planting Practices**

Across the country we are striving to restore our community forests but the road from nursery to working forest is arduous. The sight of new trees struggling rather than thriving in the landscape is common whether the site is residential or commercial, public or private.

As in most cities, trees planted in the past were planted too deeply. Root collars were buried and trees in this situation fail to thrive. Installation practices need to insure the root collar is at grade level and the root system is free of defects (Figure 16).

In general, the tree-planting holes should be relatively shallow (typically slightly less deep than the measurement between the root collar and the bottom of the root plate) and quite wide (three to five times the diameter of the root system). Care should be taken so that the root collars of the new trees are at the same level or slightly higher than the surrounding soil grade (Figure 17).

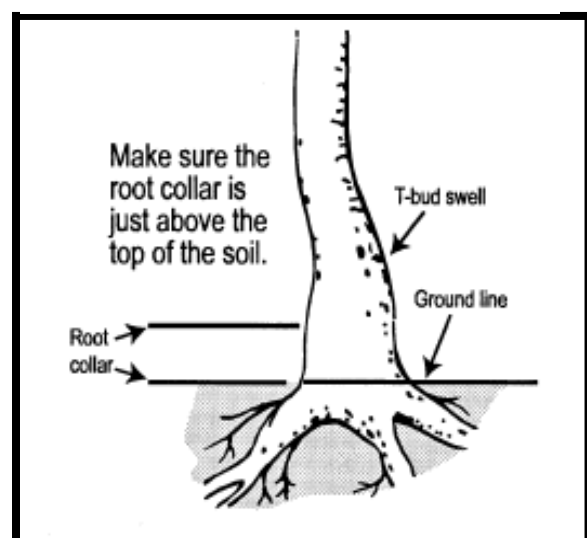
In most situations, it is not recommended to add soil amendments to the planting holes, as this can lead to differences between texture and structure of soils inside the planting holes and the surrounding soil. Such differences can lead to either water being wicked away from or accumulating in the planting holes.

Tree staking or guying should be the exception and not the rule. Tree staking hardware should

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**Figure 16 - Maple tree planted too deeply.**



**Figure 17 – Root collar at grade level**

only be installed when necessary to keep trees from leaning (e.g., windy sites) or to prevent damage from pedestrians and/or vandals. Stakes should only be attached to trees with a loose, flexible material, and all staking material must be removed as soon as the root system anchors the tree.

### **Mulching**

Mulch should be applied to the surface of the soil around each newly planted tree. Mulch should never be piled up around the trunk (creating mulch volcanoes), but rather should be pulled away from the root collar (Figure 18). Mulch that buries the root collar provides shelter for insects, fungi, and mammals that could damage the tree. Mulch should be applied to an area three times the diameter of the root system to a depth of two to four inches. Mulch not only suppresses competition from grass and weeds, but also provides a zone where turf maintenance is not needed, thereby keeping lawn mowers and string trimmers safely away and thus preventing mechanical damage. Mulch also helps to hold moisture in the surface of the soil where most of the feeder roots are to be established.



**Figure 18 - Incorrect mulch applications can degrade trunk tissue causing tree mortality.**

### **Trees and Water**

Trees growing in urban and forest situations experience internal water stress. Water may be a significant growth limiting factor in both situations. Observations of urban trees across a wide geographic range has demonstrated some clear patterns: newly transplanted street and park trees die if supplemental water is not provided, mature trees may die during mild, periodic droughts, and climate conditions in Coulee Dam dictate the need for supplemental water for newly transplanted trees and mature trees.

How should trees be watered? It seems like a simple question, but providing a helpful answer is difficult. The subject is complex and there are no simple answers. There are many factors to consider, e.g., time of year; species; age; and size of tree; soil texture, structure and depth; area of root zone; distance from trunk; topography; irrigation system and frequency; local rainfall patterns; and water quality. That's more than most people want to think about.

Coulee Dam staff will need to know the rootzone depth, surface area of soil accessible for irrigation, soil textural class, and the amount of plant available water. With these four pieces of information an assessment of the amount of water held in the tree root zone can be made, which provides a determination of the amount of water that should be applied via irrigation.

### **Diversification**

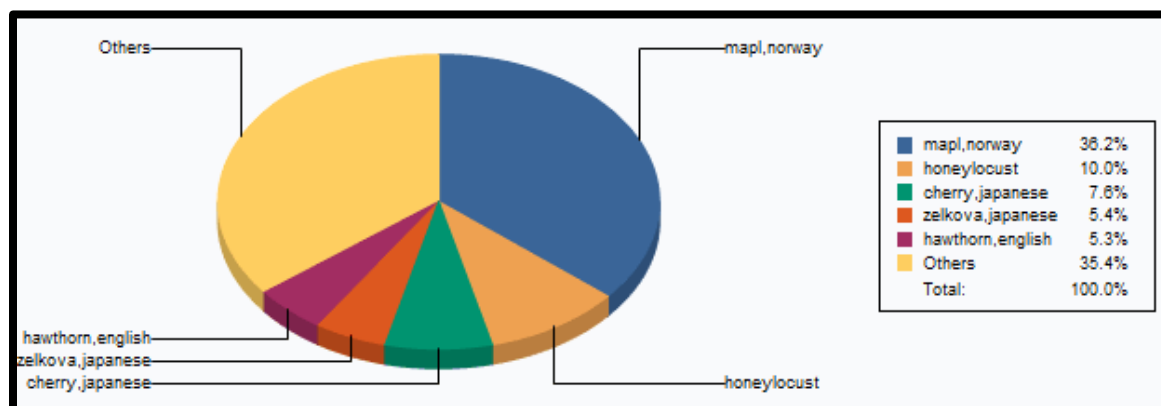
The current tree inventory utilizing TreeWorks™ was completed in 2015. The current tree inventory data base includes 680 trees and more than 300 planting sites. There are



more than 50 different species found in Coulee Dam's tree population (Table 4). This appears to be a diverse population, but distribution figures indicate the population is dominated by a few genera. Over 80 percent of the trees are represented by seven genera. The seven genera are maple, cherry, honeylocust, hawthorn, zelkova, ash, and horsechestnut. Maples comprise more than 40% of the population.

Species diversity in new plantings throughout the city should be a primary concern. The dangers (e.g., disease and insects) of planting monocultures have proven to be devastating throughout the United States. An older, common industry guideline for maintaining species diversity in urban settings is the 10-20-30 rule. That is, no single species should make up more than 10 percent of the trees in a population, no more than 20 percent of any one genus, and no more than 30 percent of one family in the total tree population (Santamour, 1990). Current industry standards recommend that no more than 10% of the tree population is comprised of any one genus as a guiding principle.

Diversity is an important measure of a forest's resilience. A more diverse forest, both in total number of species represented and in their relative abundance, is better able to adapt to environmental changes as well as disease and insect infestations, particularly foreign invasive plants, pests, and diseases. When just a few species dominate the composition of a tree population, these changes or infestations will significantly impact the entire population.



**Table 4– Species distribution. The top five species are shown.**

Over 90% of the public tree population is represented by seven genera.

<b>Genus</b>	<b>Count</b>	<b>Percent</b>
Maple	282	41.4%
Cherry	68	10.0%
Honeylocust	68	10.0%
Hawthorn	39	5.7%
Zelkova	37	5.4%
Ash	31	4.5%
Horsechestnut	31	4.5%
Others	124	10.0%
<b>Total</b>	<b>680</b>	<b>100%</b>

### Objectives to increase species diversity.

- Coulee Dam should adopt a tree planting diversity guide that states that no more than 10% of the tree population is comprised of any one genus as a guiding principle.
- Coulee Dam should emphasize a diversity of species in the planting program. Avoid species that have high maintenance costs, invasive characteristics, high storm damage potential or a history of failure such as Siberian elm, cottonwood, and willow. See appendix C for potential trees to plant.

### *Diameter Distribution*

A well distributed age-class helps maintain a stable canopy cover. If all the trees within an area or neighborhood are approximately the same age they will mature and decline more or less at the same time, leaving that area with a deficient urban forest canopy plus expense of replanting. In many parts of Coulee Dam, trees of similar age class dominate the landscape. To mitigate the impacts of an even age canopy maturing at the same time, Coulee Dam should take steps to increase the age class and species distribution where possible (Miller, et. Al., 2015; Vargas, et. Al. 2007).

For example, western cities established the following standard for desired age structure:

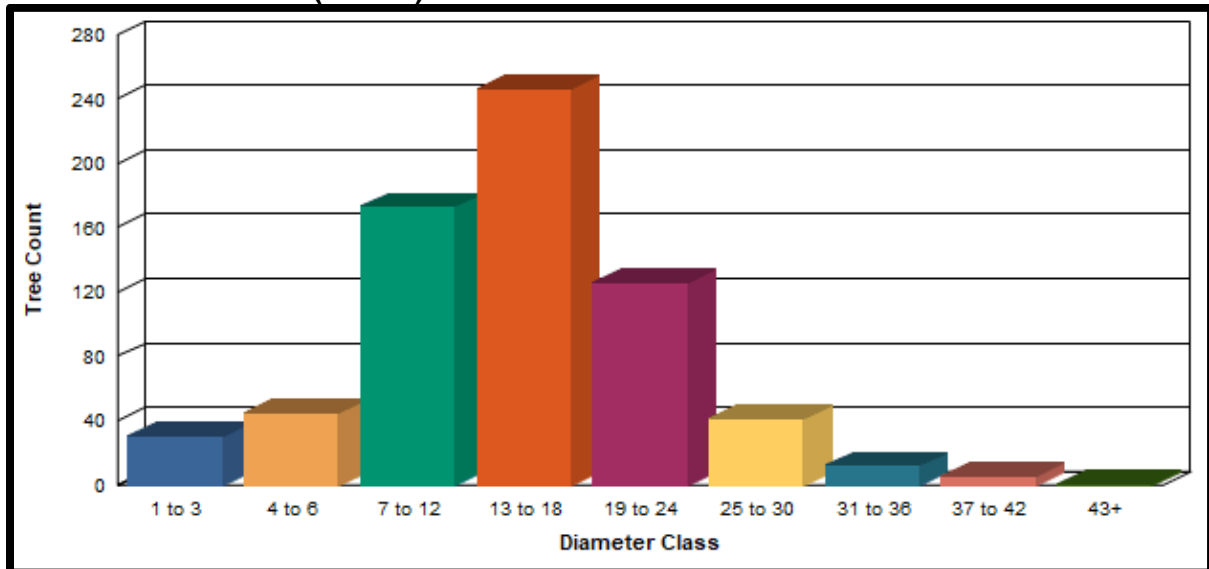
- 40% young (< 6-inch DBH)
- 30% maturing (6 – 12-inch DBH)
- 20% mature (12 – 24-inch DBH)
- 10% old (> 24-inch DBH)

Coulee Dam's tree population ranges for the same categories of desired age structure:

- 11% young (< 6-inch DBH)
- 25% maturing (6 – 12-inch DBH)
- 54% mature (12 – 24-inch DBH)
- 10% old (> 24-inch DBH)

The graph (Table 5) below depicts the (DBH) diameter distribution for the trees inventoried. A population exhibiting the diameter distribution characteristics indicates Coulee Dam has not planted many trees recently. This graph is one that mimics a population that peaks in the middle diameter classes and gradually decreases as diameters increase. It represents a population that will perpetuate itself for some time in the future, since there is most trees in the lower diameter classes to replace trees that are over mature.

The optimum diameter distribution has the largest number of trees in the smallest diameter classes. As each group of trees within a specific diameter class matures, the numbers within the group diminish through attrition. To perpetuate a specific species, the largest representation must be in the smaller diameter classes. As a rule of thumb for any given species, twice as many trees need to be planted as are removed as in any one year to maintain the exponential shape of this graph. Management activities should strive to improve Coulee Dam's population distribution to reflect current industry standards and plant species that will become large trees.

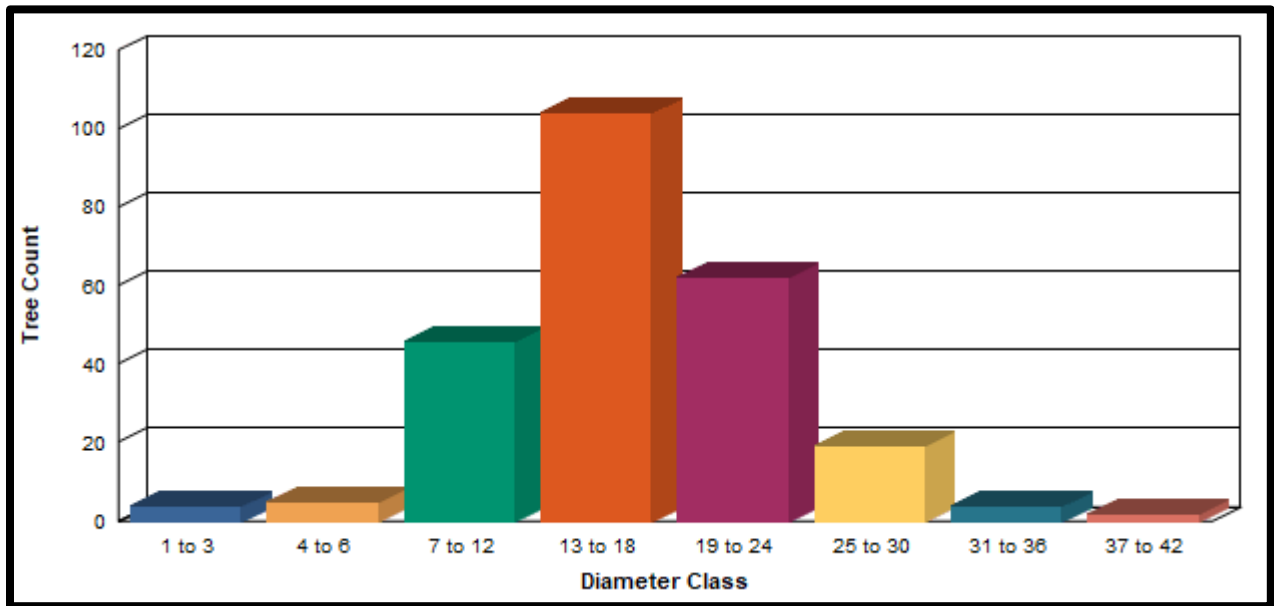
**Diameter Distribution (inches)**

**Table 5 – Diameter distribution of inventoried trees (Diameter breast height – 54 inches above grade level).**

Diameter Class	Percent	Count
1 to 3	4.6%	31
4 to 6	6.6%	45
7 to 12	25.4%	173
13 to 18	36.2%	246
19 to 24	18.5%	126
25 to 30	6.0%	41
31 to 36	1.8%	12
37 to 42	0.7%	5
43 +	0.1%	1
<b>Total</b>	<b>100%</b>	<b>680</b>

The graph (Table 6) simulates a situation in which plantings of one species have tapered off in the recent past (10 – 30 years). The population peak is centered on the 13 to 24-inch diameter class. This species will have peaks that continue moving up the scale over time as the few smaller diameter trees move into larger diameter classes. Norway maple is an example of this diameter distribution in Coulee Dam.





**Table 6 – Diameter distribution showing population curve of Norway maple where planting decreased in the last 20 – 40 years.**

As species age the population curve is centered on the larger diameter classes. These species will soon be missing from Coulee Dam's landscape. This trend is good for some species that Coulee Dam wants to eliminate such as boxelder, Russian olive, or Siberian elm. However, if the bur oak shows this trend, it means an important species is dwindling from the landscape.

#### **Objectives to reach industry tree population ranges.**

- Coulee Dam should increase tree planting and increase maintenance of existing trees until tree population ranges reflect industry recommendations listed above.

#### **Tree Establishment Plan**

Mortality of landscape trees can reach 70% in the first year after planting. There are fundamental factors and procedures critical to tree establishment. If these are fully considered and acted upon, significant reductions in transplant losses can be expected. The principal elements essential for successful tree establishment have been identified as tree physiology; rooting environment; plant quality and planting and post planting maintenance.

Tree physiology considers the genetic potential of trees to establish in a given environment and species characteristics which may reduce the impact of a stress. High plant quality is an essential foundation for any planting project. Planting and post-planting practices are fundamental to establishment success. The rooting environment is critical in ensuring future resource availability and Coulee Dam. Failure to consider any one of these factors increases the likelihood of a high mortality rate in a tree planting scheme.

While it is appreciated by professionals involved in urban tree management that trees are planted into suboptimal conditions for growth, the extent and diversity of stresses urban environments impose is frequently under-estimated. In view of the resource life-history an amenity tree has in terms of irrigation, fertilizers (if applied), transport costs, planting materials, labor, etc., in addition to the actual loss of the tree, the persistence of these failure rates can no longer be accepted.

The average historical cost to plant and water a new 2-inch caliper tree for the Town of Coulee Dam is \$400.00 per tree. CFC recommends that 10% of tree management funds be dedicated to new tree planting in the initial operating plan. This figure would include trees planted in new available planting spaces and tree planting connected to a tree removal. This percentage of a tree budget dedicated to tree planting reflects average municipal tree program budgets ((Hauer R. J. and Peterson W. D. 2016). This figure allows Coulee Dam to maintain industry target goals for tree population ranges and is a quantity Coulee Dam staff can maintain.

## TREE RISK MANAGEMENT

### *Tree Risk Management*

The forest is an integral part of a community's infrastructure, and trees often dominate the landscape. Trees are a very desirable landscape component of the urban and urban/rural interface. Trees provide numerous benefits to those living and working in Coulee Dam and the Columbia River Valley. These benefits increase as the age and size of the trees increase. All trees germinate, grow, mature, decline, and eventually die. Along the way, trees may undergo all sorts of physical alterations naturally or aided by poor maintenance practices, such as limb loss, onset of decay, structural changes or other conditions that can predispose a tree to fail. All trees have a varying level of risk for failure. In assessing and managing trees, we should strive to strike a balance between the risk that a tree poses and the benefits that Coulee Dam derives from trees.

Tree risk management is the application of policies, procedures, and practices to identify, evaluate, mitigate, monitor, and communicate risk. It is impossible to maintain trees free of risk; some level of risk must be accepted to experience the benefits that trees provide. These statements provide a foundation for balancing tree risk and the benefits that trees provide:

- Trees provide a wide variety of benefits to society
- Trees are living organisms and naturally lose branches or fail
- The risk to human safety is extremely low
- The City of Coulee Dam has a legal duty of care
- The City of Coulee Dam should take a balanced and proportionate approach to tree risk management

Fortunately, tree failure is an infrequent occurrence. Serious damage, injury, or death from tree failure is rare. Tree failures during normal weather conditions are often predictable and preventable. However, any tree, whether it has visible weaknesses or not, will fail if the forces applied exceed the strength of the tree or its parts. It is important to manage risk trees despite the small number of risk trees in Coulee Dam. The tree inventory identified 31 trees for removal. All the trees are low risk removals. Ultimately Coulee Dam has the responsibility for maintaining a safe environment.

No agency can budget for all removals at once, so a priority of work must be established and implemented to demonstrate due diligence of care. For Coulee Dam tree removals this process begins by removing trees larger than 15-inch DBH designated for removal during tree inventory data collection.

These responsibilities include high risk trees or limbs that could damage property and cause injuries or even death, trees that block required traffic sight lines and signs, or tree roots that raise sidewalks, invade segmented pipes, or disrupt activities. The human and financial impact of these problems can far outweigh the costs that an agency would have incurred in providing proper, proactive care.

**Coulee Dam Tree Risk Policy Statement:** Coulee Dam shall have an active policy to maintain the safety of people and property on roadways, parks, and other public property from potentially high and extreme risk trees. The Town of Coulee Dam will strive to mitigate, in a reasonable time, trees deemed high-risk. When available fiscal and human

resources limit the ability of Coulee Dam staff to mitigate high-risk trees, priority shall be placed on trees deemed to carry the highest risk. The standard of care for evaluating tree risk will incorporate the following International Society of Arboriculture (ISA) Guidelines: 1) ANSI A300 Pruning Standard Part 1- 2008, 2) ANSI A300 Part 9-2011 Tree Risk Assessment; 3) the International Society of Arboriculture's (ISA) Tree Risk Assessment-Best Management Practices (ISA-TRA-BMP); 4) ISA TRAQ tree risk rating system; and 5) CDTC protocol described in this document. The Public Works manager shall administer this program and have final judgment in all matters concerning the mitigation measures taken for any tree considered a hazardous.

**Goals:** Tree risk assessment has two primary goals. The first is to ensure the safety of people and property that may be in the range of one or more trees with a high potential of failure by identifying and mitigating the situation before damage is caused. The second is to promote tree health and structural integrity by practicing proper tree maintenance to reduce future hazardous trees by developing a tree risk management program that acts to reduce risk to an acceptable level. This is accomplished by taking all reasonable steps to ensure the safety of people and/or property before accidents occur. The goal is not to strive for zero risk since this is unattainable. Rather, the goal is to identify the trees that pose risk beyond an acceptable level to public.

The Town of Coulee Dam, or staff acting on their behalf, has a duty of care to ensure that the trees in their care do not create an unreasonable risk. The liability associated with trees can best be avoided by clearly assigning the responsibilities for tree inspection and care and then documenting that this responsibility is regularly met. Cities and other property owners are expected to conduct bi-annual work, including yearly tree inspections, removal, pruning, and other maintenance. The goal of tree risk management is to provide a systematic and defensible approach by which those risks can be assessed and managed to a reasonable level.

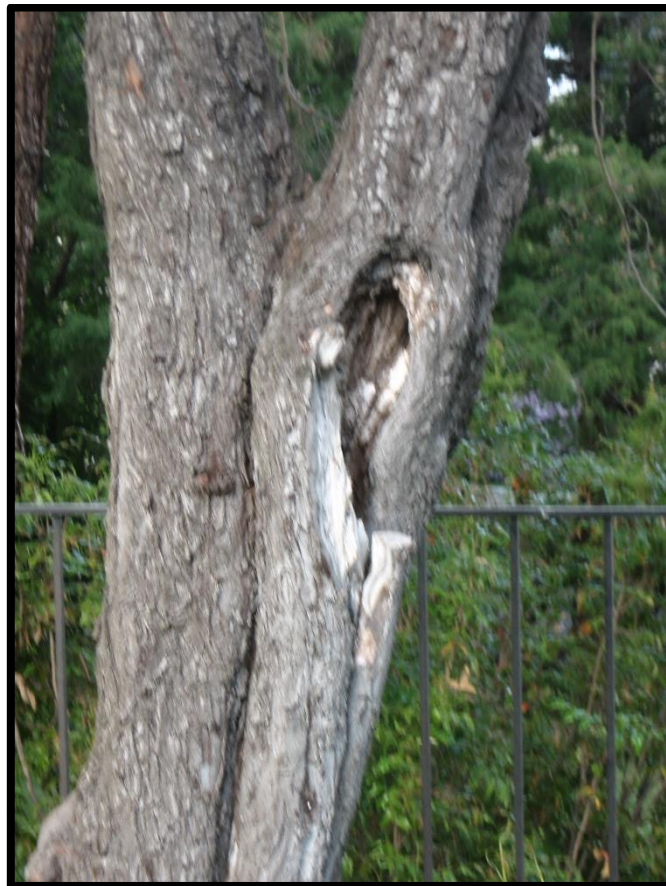
**Objectives for the tree risk management plan that reduce exposure to liability:**

- A tree inventory will be completed and maintained. Dates of inspection, condition of inventoried trees, and pruning and other maintenance needs will be recorded.
- Bi-annual inspections of community trees should be completed, and accurate inspection records should be kept.
- High and extreme risk trees and tree branches should be removed as they become known.
- Only trained, ISA qualified tree risk assessors, and insured tree care professionals who follow arboriculture industry practices should be hired for any tree maintenance work on public trees.
- Coulee Dam staff and other city staff as needed will participate in training on tree risk awareness and management, safe arboriculture procedures, first aid, safe equipment use, and tree risk incident procedures to develop basic surveillance skills for visually scanning trees to detect and report potentially high risk/ hazardous trees.
- Visual clearance for intersections, traffic signs, and signals shall be maintained.
- Requests by city departments, property owners, and others should be responded to promptly.

- Implement a risk tree mitigation action plan based on levels of risk.
- Implement a cyclic pruning program.

Tree risk assessment can also be used as an educational tool to demonstrate the necessity for urban forest planning. Proper planting and aftercare combined with regular pruning and periodic inspections, reduces the likelihood that weaknesses or defects will become hazardous. Proper management will lead to permanent reductions in liability.

Public safety is the major concern for urban forest managers. Coulee Dam has a legal duty to exercise reasonable care to protect residents and the public from foreseeable risks. Coulee Dam managers, administrators, staff, and elected officials must demonstrate reasonable care to minimize the risk associated with trees in public areas (Figure 19). It is imperative for all Coulee Dam departments to follow established risk management policies.



**Figure 19 – Maple tree with codominant stems and included bark. These defects can be easily fixed when a tree is young. Agencies have a legal duty to exercise reasonable care to protect the public from foreseeable risks associated with urban trees.**

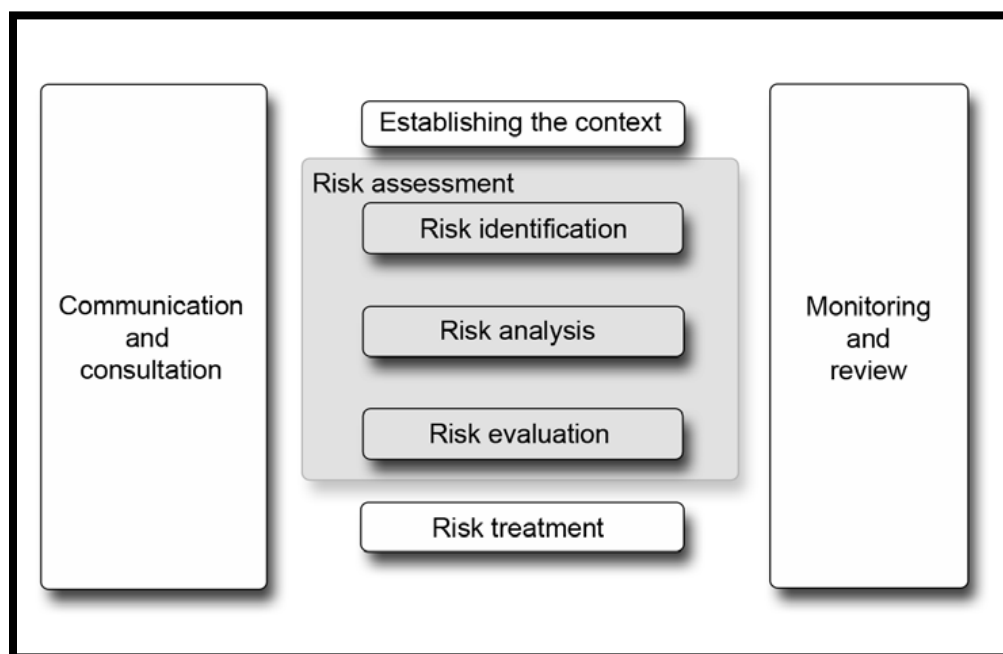
### **Tree Inspections**

Coulee Dam has a legal responsibility to exercise due diligence that trees in parks and streets adjacent to city properties are reasonably safe. The standard of care or due diligence is the action a reasonably prudent person should exercise in same or similar

circumstances. Coulee Dam's UFMP defines the standard of care for tree risk management and assessment. Coulee Dam shall meet or exceed all arboriculture industry standards in its tree risk management program through the following actions:

- Establish, adopt, and implement UFMP and policy.
- Ensure that all tree inspectors are trained and qualified to exercise due diligence while conducting tree risk assessments for Coulee Dam.
- Undertake systematic inspections of trees on a schedule as described in the UFMP.
- Document the inspections and communicate the results to the appropriate person as defined in the UFMP.
- Undertake/recommend appropriate risk management action according to guidelines in the UFMP to reduce tree failures in the management program.
- Adhere to industry standards for general tree care activities.

Tree risk assessment is the systematic process to identify, analyze, and evaluate tree risk (Figure 20). It requires assessing the tree or tree parts for the likelihood of failure impacting a target and the consequences of failure impacting a target. Inspections are the first line of defense in proactive risk management and maintenance programs.



**Figure 20 – Contribution of risk assessment (highlighted) to the risk management process (ISA Best Management Practices)**

#### **Major Defects and Conditions that Increase Potential for Tree Failure**

- Dead parts (dead branches greater than 2-inches in diameter)
- Large broken and/or hanging branches greater than 2-inch diameter
- Cracks, splits, and cavities
- Codominant stems with weak branch attachments (included bark)
- Decayed wood or missing wood

- Unusual tree architecture – recent leans, topped trees, lack of trunk taper, asymmetric structure, excessive branch end weight
- Root loss – construction damage, under mining, decay
- Root defects – stem girdling roots, decay

Conditions affecting trees change constantly; none of us will ever be able to predict every tree failure. Conducting a tree risk assessment neither assures nor requires perfection. Risk assessment should, however, ensure that all reasonable efforts have been made to identify extremely and potentially high-risk trees present at the time of assessment.

Coulee Dam tree maintenance contracts shall include a qualified tree-care contractor with all necessary training, equipment, and qualified employees to evaluate tree risk. A list of qualified tree and available tree contractors shall be established that are available to assist in the case of natural events that create a high-risk tree situation if the primary contractor cannot handle the work within the allotted time frame.

### **Tree Risk Assessor Qualifications**

Each assessor shall have a current certification as an ISA Certified Arborist and qualification as an ISA Tree Risk Assessor with a minimum of two years' experience in the field conducting tree risk assessments.

### **Risk Awareness Personnel and Qualifications**

Coulee Dam staff, landscape and tree maintenance personnel, both contractors and Coulee Dam employees not meeting assessor qualifications shall attend an initial class on tree risk awareness, pruning maintenance, and tree risk incident procedures to develop basic surveillance skills for visually scanning the right-of-way plantings to detect and report potentially high risk/ hazardous trees.

A staff training log record verifies that Coulee Dam staff and subcontractors are receiving ongoing and pertinent continuing education. It serves as documentation if litigation occurs and demonstrates the agency is taking a proactive rather than a reactive tree risk management program.

**Inspection Cycle:** The evaluation cycle or inspection interval may range between one and five years, depending on the age of the tree, level of risk, specific conditions, KUF goals and resources, or regulations. The inspection may occur prior to normal storm seasons for the area. Mature trees and species with known failure histories may need to be inspected more frequently. Occurrence of tree or branch failures between inspections will indicate the adequacy of the interval between inspections. Additional inspections should be made following storm events. Intervals of 18 months between inspections alternate between leaf on and leaf off and provide opportunities for assessment during different growing seasons. An advantage to risk assessment during leaf off allows for a clear view of tree structure.

### ***Risk Tree Abatement***

Agencies, utilities, and property managers may have laws, ordinances, or risk management plans that define the level of acceptable risk. Safety is the priority but may not be the only basis used by the risk manager to establish acceptable levels of risk;



budget, a tree's historical or environmental significance, public perception, and other factors may come into the decision-making process.

### **Mitigation and Action Strategy**

The risk manager assisted by a qualified tree risk assessor/forestry staff organizes a tree risk team of employees and writes a Bi-annual Work Plan (BAWP). The goals, objectives, and activities are prioritized for the year based on funding, priorities, capabilities, assessment intervals, recent tree inventories, and previous year's failure logs.

Implementation of the BAWP includes:

- Pending mitigation actions from previous year.
- Identify trees and regions that need to be assessed or re-assessed based on assessment intervals.
- Assess the tree population by risk rating and condition classes. Trees with highest risk rating, in the poorest condition class, and with multiple targets occupying the target zone are the most problematic in the short term for Coulee Dam.
- Document removals, prunes, and other mitigation requirements in TreeWorks™.
- Assignment and schedule of KUF staff and/or contractors to implement mitigation actions.
- Monitor and document work results.
- Report results of BAWP and review risk management actions.

Considerations to use in setting priorities are outlined in this plan. The risk manager/city forester acts to reduce risk to acceptable levels by implementing correction measures based on thresholds from the tree risk rating system. Remedial actions are taken dependent on what part of the tree might fail; the likelihood of failure; the potential targets; and potential damage to the target. Extreme and high-risk trees shall be removed, while moderate risk trees may be mitigated/monitored/inspected and stabilized as appropriate. Trees that are retained should be inspected on a scheduled basis. The determination of which trees to inspect and how often should be part of a tree risk program. Tree risk inspections should be performed by an ISA certified tree risk assessor.

With the initiation of a cyclic pruning program, at a minimum, each tree will be re-inspected once every cycle. Pruning crews will systematically work through the community and when they are assessing pruning needs they can also evaluate risks. Any new risks can be added to the database and then further inspections can be requested if required. Simple risk abatement through pruning can be addressed as part of the cyclic pruning program.

## OPERATING PLANS

**Bi-Annual operating plans** will direct the day-to-day operations and can be used to project budget requirements for all aspects of urban forest maintenance. The bi-annual plan will include contract inspection, contract monitoring, planting, pruning, removals, tree risk inspections, plant health care, and maintenance of the inventory. Initially, the bi-annual plan will need to address priorities derived from the inventory, but eventually will be focused on proactive management objectives. Preparation and review of the bi-annual plan is the responsibility of CDTC members and city staff. An example is provided in Table 8.

The preparation of operating plans for this management plan is based on historical expenditures on tree maintenance, inventory data, and regional industry standards. Operational costs also consider industry estimates for community population size, annual tree care funding, tree management policy and planning, contract tree services, tree populations, tree operations, and staffing profiles (Table 7). Industry costs in part are derived from the *Municipal Tree Care and Management in the United States: A 2014 Urban & community Forestry Census of Tree Activities* (Hauer R. J. and Peterson W. D. 2016).

<b>Coulee Dam Tree Population Summary and Estimated Tree Care Costs (\$/yr./tree)</b>			
	<b>Street and Park Tree Maintenance</b>	<b>Planting cost/tree</b>	<b>Removal costs/tree (includes stump removal)#</b>
<b>Tree count</b>	680	10 % of annual operating budget	\$800.00
<b>Costs</b>	\$45.00/year/tree	\$400.00 (Two-inch caliper)	Variable depending on tree diameter
<b>Total Costs#</b>	\$30,600.00	\$3,060.00	\$4,500.00

#Removal cost figure is based on an average of \$800.00/tree.

**Table 7 – Model operational tree maintenance costs based on historical costs and regional industry standards**

Operational costs are based on Coulee Dam census figures, historical maintenance costs, and a tree population of 680. Costs per tree are derived from the *Municipal Tree Care and Management in the United States: A 2014 Urban & community Forestry Census of Tree Activities* (Hauer R. J. and Peterson W. D. 2016).

Removal costs vary depending on tree size and location. Small tree removal cost is about \$200.00/tree. Large tree removal costs can range from \$600.00 to \$1,000.00/tree. Tree pruning costs are variable depending on tree size and structural issues. Small tree (< 12-inch DBH) pruning costs should average \$300.00/ tree. Large tree (> 12-inch DBH) can range from \$400.00 to \$700.00/tree.

PROGRAM ACTIVITY	J	F	M	A	M	J	J	A	S	O	N	D
<b>PLANNING</b>												
Work priorities												
Organize activities												
Modification												
<b>TREE REMOVALS</b>												
Review inventories												
Field inspections/Risk assessments												
Announce/hold public hearings												
Schedule tree crews - Conduct removals												
Stump grinding/reseeding												
Inspections												
<b>TREE PRUNING</b>												
Review inventories												
Field inspections/risk assessment												
Schedule crew - Conduct tree pruning												
Inspections												
<b>TREE PLANTING</b>												
Review inventories/survey potential planting sites												
Survey neighborhoods; notify adjacent property owners												
Purchase trees												
Install trees												
Water trees												
Inspections												
<b>COMMUNITY EDUCATION AND OUTREACH</b>												
Education programs												
Report to Park Board of Commissioners												
Arbor Day Recognition												
Neighborhood Tree Committee												
<b>STAFF TRAINING</b>												
Professional development												
Safety training												

Table 8 – Example of a Bi-annual Work Plan

## OPERATIONAL REVIEW

Operational reviews may evaluate many components of an organization's forestry program. Reviews provide summaries of existing conditions, identify short-comings, and ultimately suggest goals, guidelines, and rationale that, once adopted will serve as a gauge for the standardization and optimization of program resources.

Coulee Dam's goal is to have a larger, healthy, diverse, functional, and structurally sound urban forest and thriving residential and business communities. The dynamics of balancing urban forest management and other city infrastructure needs, responsibilities, and assets are diverse and complex and suggest a dedicated, interdisciplinary, flexible approach and organization. However, the current constraints for comprehensive and effective urban forest management in Coulee Dam can be considered formidable.

### *Budget*

The lack of sufficient dedicated financial resources for the urban forestry program precludes making significant improvements to the tree population. Currently, the line item assessment does not provide sufficient operational funds for tree planting, preventive tree maintenance, increased staff and support personnel, or equipment to meet industry standards for a town the size of Coulee Dam.

Existing public funds for urban forest management are dispersed for various tasks, and are usually expended only on an emergency basis, by limited citizen requests, for individual capital projects, or for limited aspects of urban forest management, such as development site inspection. The Public Works Superintendent position has management authority over dedicated funds for comprehensive urban forest management activities and input on the expenditures made by other departments that impact city trees.

### *Technical and Professional Resources*

An adequate complement of professionals who, individually or collectively, understand the technical, operational and administrative factors in urban forest management is needed to prescribe and monitor Coulee Dam's urban forestry activities, enforce policies and regulations, apply technical standards and practices, and review plans that affect the forest resource. Without this professional component in sufficient numbers, urban forest management decisions and actions often default to inadequately prepared decision-makers, which can have long-term, negative consequences for the forest resource.

### *Political Support*

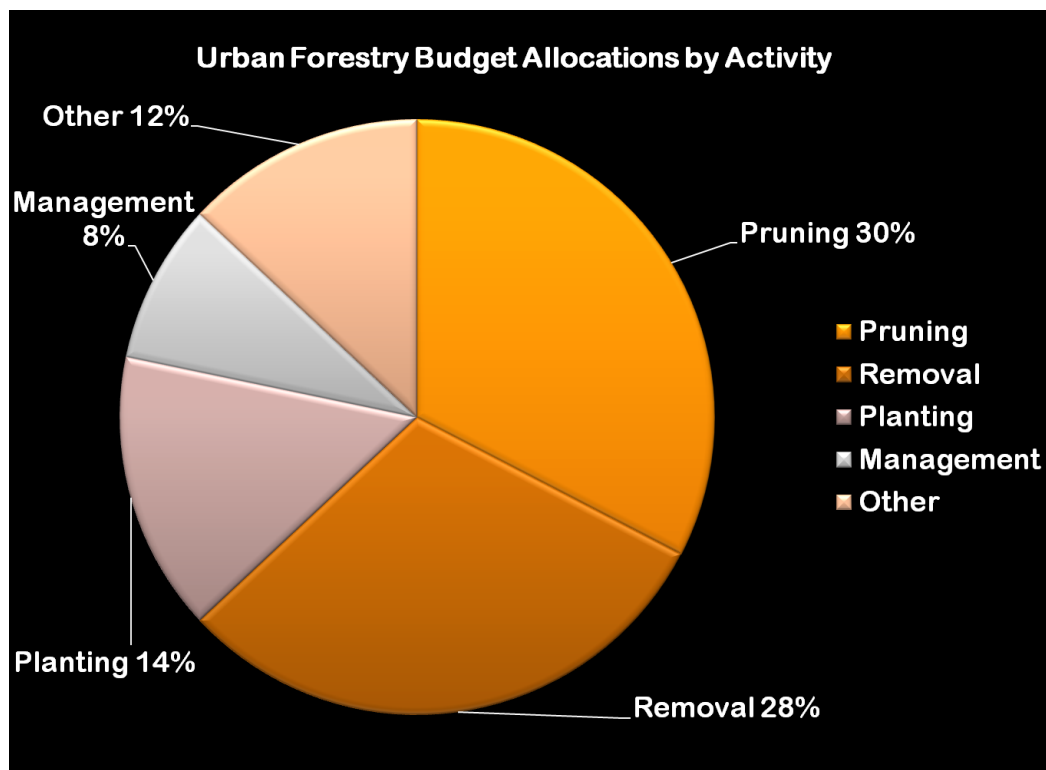
Support from elected officials and the citizens are critical to implement and maintain an effective comprehensive urban forest management program. The citizens own both the public and private urban forests, and without greater political support and increased citizen understanding and commitment, urban forest management in Coulee Dam may not reach its full potential.

### **Levels of Service (LOS) and Extrapolated Maintenance Costs**

Levels of service are quantifiable measures of capacity, such as acres of park land per capita, labor hours per tree pruning based on DBH or visitor use per day. A budget plan is a function of the agency's priorities and preferred level of service toward achieving urban forestry objectives in the UFMP.

The Town of Coulee Dam must decide on an operating level of service it wishes to provide and accept the level of risk associated with the decision. The current level of service associated with risk tree abatement and pruning is a reactionary response to tree failure and is exposing the agency to a very high level of risk.

Typical tree budget allocations found in urban forestry programs across the United States allocate funding in these areas (Figure 21). Coulee Dam's current forestry budget allocations do not follow industry standards. These are approximations but provide an accurate representation of fund allocations. The priority should be to take care of what you have before substantially adding to the street tree population.



**Figure 21 – Typical fund use in urban forestry tree budget allocations**

A systematic approach accurately identifies moderate to high risk trees and initiates the timely removal or corrective treatment of hazardous trees. The level of service associated with proactive management defines and funds specific goals such as eliminate extreme and high trees in ten years or prune cyclically every five years.

If 4.5% of the entire tree population is projected for removal and 70% of the tree population requires pruning treatment, workload estimates based on total tree population

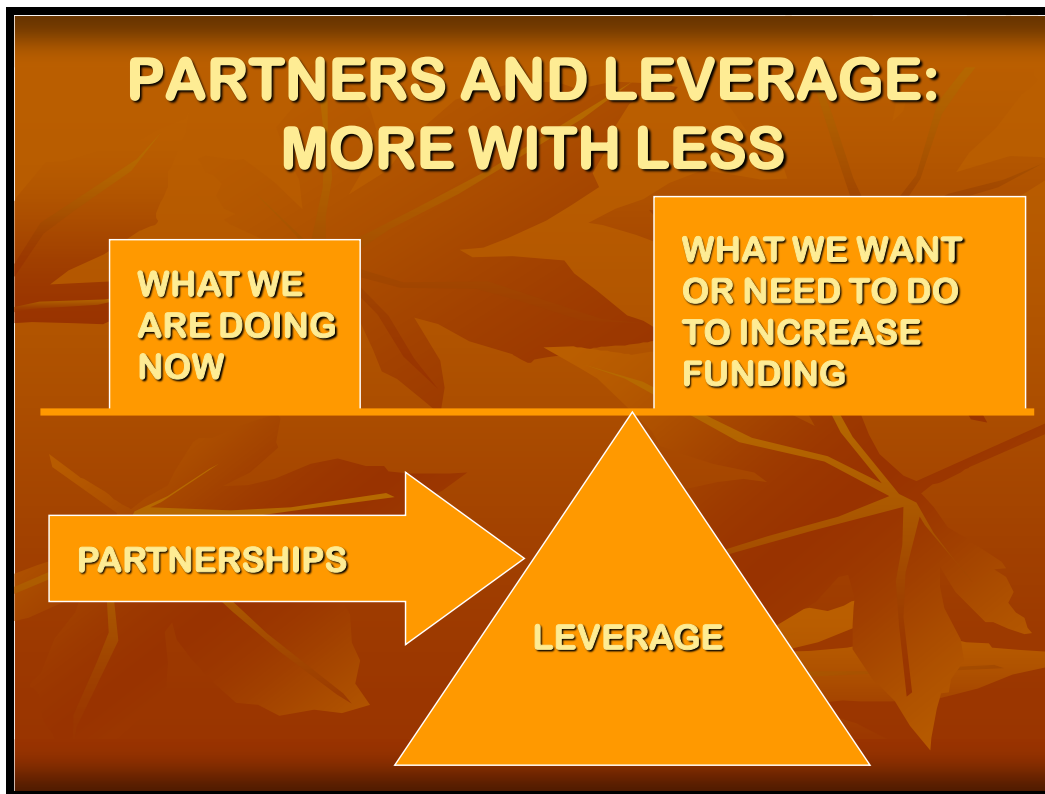
can provide budget estimates to develop levels of service that may be adopted by the agency.

### **Program Funding**

The consulting team reiterates that to implement this UFMP and to realize the benefits of a healthy urban forest all aspects of this UFMP must be adequately supported with human and financial resources. Traditional funding comes from the city's tree assessment. An average of approximately 4/10 of one percent of municipal budgets across the western US go to urban forestry programs. This source of funding is in competition with all other city services and often urban forestry is considered an amenity rather than a necessity.

Urban forestry must generate enough interest in the stakeholders to position the program for recognition and sufficient funding. The program must change how stakeholders think about urban forestry and alter their beliefs about urban forestry. The role of CDTC is not to move trees up the city list of importance. It is more critical to demonstrate how trees can help each city function whether it is police, fire, storm water management, riparian sites or air quality. Urban forestry must be thought of as a solution to community problems and an economic engine worthy of city funding. Urban forestry provides essential benefits, opportunities for investment, solutions to city problems, and connections to people. Many of the objectives and recommendations of the UFMP will assist in generating these outcomes.

Alternative funding sources for community forestry programs are about associative re-positioning or changing who you partner with to leverage resources. In the graphic below 'What we are doing represents' tax dollars supporting our programs. These are dwindling and sporadic from year to year. By developing partnerships with various groups, we can leverage their resources to get 'What we want or need to do to increase funding'. Examples of partnerships and alternative fund sources are listed below the graphic.



Examples of alternative funding sources:

- Grants
  - Government
  - Private
- Inter-governmental charges: Maintenance fee recovery for road bond projects or right-of-way projects.
- Capital Improvement Funds: Trees as infrastructure cited in ordinances (Austin and Houston, Texas)
- Direct Charges
- Mitigation Payments: You damage or destroy trees, you pay for it. Use ISA appraisal formulae to recover costs of damage or destruction of public property (trees).
- Special Events
  - Festivals
  - Tree Run/Walk
  - Christmas Tree Recycling
  - Business Grand Openings and Building Dedications
  - Birthday Milestones: First, 40<sup>th</sup>, 50<sup>th</sup>, etc.
  - Arboretum Plantings and Dedications
  - Community Entrance Tree Planting
  - Church Planting Projects
  - Civic Group Planting Projects
- Sales, Merchandising & Promotions



- Historical Tree Merchandise
- Trail of Trees/Tree Books
- Tree Give-A-Ways
- Firewood/Lumber/Nuts/Fruits and Other Tree Products
- Memorial, Anniversary, and Tribute Trees
- Sweepstakes/Contests
- Donations
  - Individuals
  - Utility Bill Donations
  - Donation Cans at Events
  - Trust In Agency Funds
  - Tourism Industry
  - Business Sponsorships
  - Event Sponsors
  - Carbon Credits
  - In-Kind By Citizens (NeighborWoods programs)

The Town of Coulee Dam has taken proactive steps in conducting an inventory and developing a management plan. To accomplish the mission and to achieve and sustain the community forestry goals, Coulee Dam should strive to attain all aspects of this strategic management plan. The costs associated with the implementation of the management plan must be developed within the context of the overall financial structure and administration of the Town of Coulee Dam. On adoption of this strategic management plan it is imperative that the Town of Coulee Dam and CDTC develop long-range budget forecasts for its implementation.

## PROGRAM ACTIONS

There are four program management elements that must be addressed on a bi-annual basis: Community Forestry Management Plan Adoption and Implementation, Tree Inventory, Proper Tree Maintenance, Tree Planting, and Risk Mitigation Program. Although each is essential to the maintenance of the community forest, a bi-annual operating plan should be established to determine where budget dollars will be spent. KUF staff has established public safety, responsible management of existing trees, and tree planting as high priorities.

### ***Priority: Urban Forestry Management Plan Adoption and Implementation.***

The UFMP is straightforward and comprehensive and contains appropriate goals and activities for Coulee Dam. The objectives of the UFMP are clear and far-sighted. The goal is to change the forest as it is today into one that reflects the goals of the management plan. The 5-year plan should be reviewed bi-annually to determine progress, review the activities accomplished, aid in the development of bi-annual operating plans, and plan for future activities to complete the UFMP recommendations. This ensures important components of the UFMP are accomplished and progress is made towards achieving a sustainable tree program. Long-range planning time horizons can be several years or a decade, but five years is most commonly used and is a realistic time frame for implementation of the goals and recommendations of the UFMP.

### ***Priority: Tree Inventory Maintenance***

A significant component of an urban forest program is a professional analysis of the tree population. Using the TreeWorks™ software, the inventory of all public trees should be completed and maintained to provide an accurate accounting of public trees. Using accurate, consistent inventory data and professional interpretation and planning, leads to healthier, safer, trees with lower maintenance costs and increased benefits to the community provided by public trees.

### ***Priority: Proper Tree Maintenance***

After planting an appropriate species at a site that can support adequate growth, maintenance practices such as mulching, watering, and pruning should be employed for three to five years. If trees are pruned properly three or four times during the first twenty years, they will need less frequent and less costly pruning in later years. Pruning promotes sound structural development of a tree's trunk and branches. The most important period for pruning occurs when the tree is young. Pruning large trees is costly and usually consumes a large part of any tree program's budget. By prioritizing the proper planting and pruning of young trees, a substantial savings can be realized by the entire tree program.

Early pruning performed properly will lead to long-lived healthy and safe mature trees. Pruning young trees properly produces substantial cost savings for the city. Training young trees can provide a strong branching structure that requires less frequent pruning as the tree matures. Improved stewardship to increase the health and survival of recently planted trees is one strategy for increasing cost-effectiveness.

Additional training in young tree structural pruning and education regarding the growth habits of the various species being planted, as well as tree biology, anatomy, and

physiology would be beneficial for Coulee Dam staff, CDTC members, and volunteers responsible for this task. This training can be received through several sources, including urban forestry consultants, the state's Community Forestry Program, and the Pacific-Northwest Chapter of the International Society of Arboriculture. The tremendous aesthetic and financial benefits to be gained in the years to come from proper pruning of young trees are a strong incentive for educating personnel about proper pruning techniques. The added knowledge gained by the individuals could augment the sense of professionalism in their jobs.

Large trees are a significant component of Coulee Dam's landscape. They form a canopy over streets, parks, and private properties. A mature tree is a costly management element, but it is an important element because of safety and tree health issues. The consequences of lack of care for large trees are the creation of more risk trees and poor tree health.

Enforcing standards for pruning and other tree care is crucial in providing correct and consistent plant health care. The International Society of Arboriculture has developed pruning standards for trees. The standards are divided into four categories: crown cleaning, crown thinning, crown raising, and crown reduction.

Crown restoration, pruning for views, and other pruning are considered specialty pruning. Other helpful sets of standards to consider and include are the ANSI Standards for Arboricultural Operations—Pruning, Trimming, Repairing, Maintaining, and Cutting Brush—Safety Requirements (ANSI Z133.1, 2000) and the ANSI Standards for Tree Care Operations—Tree, Shrub, and Other Woody Plant Maintenance—Standard Practices, Pruning (ANSI A300(Part 1), 2001, Pruning). These safety and pruning standards are designed specifically for tree care operations and should be incorporated into Coulee Dam standards for tree care.

The primary structural defects in trees in Coulee Dam are codominant stems and dead branches. These are defects that caused many of the previous failure events and have the potential to cause many future failures if not dealt with in a timely manner.

### ***Priority: Risk Management and Mitigation Program***

Risk management is the application of policies, procedures, and practices used to identify, evaluate, mitigate, monitor, and communicate tree risk. Risk mitigation is the process of reducing risk using an established hierarchy based on risk ratings, budget, resources, and policies. A tree risk management program provides information to develop a systematic approach to accurately identify the high to severe risk trees and initiate the timely removal or mitigation treatment to reduce the risk to an acceptable level.

### ***Priority: Tree Planting***

New tree planting is an essential part of Coulee Dam tree management. The health and stability of the Coulee Dam urban forest depends in large part on judicious tree selection, location, and tree planting today, as well as regular maintenance of young trees.

The key for successful tree planting is to plant quantities Coulee Dam staff has the ability to maintain. Increase new plantings each year, but in quantities that match the maintenance abilities of Coulee Dam staff and resources.

To ensure that newly planted trees thrive and are healthy provide planting standards. These can best be expressed as general guidelines with references to technical publications. A great deal of information about the size of planting pits, staking, and other planting practices has been developed by International Society of Arboriculture. The Town of Coulee Dam and the WADNR Community Forestry Program can provide other resources and training programs to ensure successful tree planting programs.

The primary issue in tree planting is improper installation causing the root collar to be buried and timely watering. This is a significant problem on trees planted recently in Coulee Dam. Many of these trees can be replanted since they were planted within the last two years. Root collar depth issues often cause premature death and decline in young trees. In older trees it can be a source of stem girdling roots which may lead to whole tree failure.

## CONCLUSION

Community Forestry Consultants, Inc. has completed its assignment of evaluating and making recommendations regarding the community forest of Coulee Dam. This management plan provides Coulee Dam with the framework to implement the best management practices for the community forest. The management and maintenance needs for a successful urban forestry program have been developed from the best management practices available in the urban forestry and arboriculture industry.

The urban forest management plan should be considered a “living,” working document. The work objectives recommended in it should be reviewed bi-annually and adjustments made appropriately for the following year. The entire document should be revised on a five or ten-year basis to determine if management and urban forest conditions have changed significantly.

Timely action needs to be taken to prevent tree failures, preserve tree resources, and maintain the trees of Coulee Dam. Trees are valuable assets to Coulee Dam. The healthier the trees are the more Coulee Dam’s vision and livability for their community is achieved. To realize these benefits, tree planting, pruning and removing; increased education, preservation and funding, and management is needed. The focus goes beyond the individual tree to trees throughout city.....to the working community forest.

The recommendations will help conserve Coulee Dam’s tree resource and sustain the tree canopy for future generations. Although this commitment will come with costs, the long-term benefits are significantly greater and will result in a sustainable asset for the citizens of Coulee Dam today and tomorrow.

## APPENDIX A – Tree Ordinance Writing Resources

### Guidelines for Developing and Evaluating Tree Ordinances

Bernhardt, E.A. and Swiecki, T.J.  
California Dept. of Forestry and Fire Protection  
<http://www.isa-arbor.com/tree-ord/ordintro.htm>

### Tree Ord Software

Unique software for cities is available to help them develop ordinances that will ensure the future of their community forests. TreeOrd, an interactive CD-ROM, was developed by the Tree Trust with a grant from the USDA Forest Service. The cost is \$60 plus shipping and handling. [http://www.mnstac.org/RFC/tree\\_order\\_form.PDF](http://www.mnstac.org/RFC/tree_order_form.PDF)

### Tree Ordinance Development Guidebook

Georgia Forestry Commission  
<http://www.gfc.state.ga.us/CommunityForests/documents/2005TreeOrdinance-100.pdf>

### Landscape Ordinances Research Project

A resource home page for urban design, city planning, urban forestry, site design, landscape architecture, architecture, site engineering, land use law and land development--highlighting legal standards and technical requirements for site development plan  
<http://www.greenlaws.lsu.edu/sitemanager.htm>

### U.S. Landscape Ordinances: An Annotated Reference Handbook

by Buck Abbey, D. Gail Abbey  
This comprehensive reference brings together and explains the planning ordinances which govern the landscapes of 300 U.S. cities. In it, the author demystifies the complex planning laws that regulate such areas as the design of parking lots, vehicular use areas, landscape buffers, and tree plantings.

### Guide to Developing a Community Tree Preservation Ordinance

Presented by the Community Tree Preservation Task Force of the Minnesota Shade Tree Advisory Committee, this guide describes the planning process, typical ordinance elements, and resources available for the task.  
<http://www.mnstac.org/RFC/preservationordguide.htm>

### Guide to Writing a City Tree Ordinance – Model Tree Ordinances for Louisiana Communities

<http://www.greenlaws.lsu.edu/modeltree.htm>

### Research Article – Kathleen Wolf

[http://www.cfr.washington.edu/research.envmind/Roadside/Trees\\_Parking.pdf](http://www.cfr.washington.edu/research.envmind/Roadside/Trees_Parking.pdf)

### Developing a Successful Urban Tree Ordinance

Charles C. Weber, Alabama Forestry Commission

### Tree City USA Bulletin #9 How to Write a Municipal Tree Ordinance

National Arbor Day Foundation  
<http://www.arborday.org/programs/treecitybulletinsbrowse.cfm>

COMMUNITY FORESTRY CONSULTANTS, INC.  
APRIL 2, 2018

URBAN FORESTRY MANAGEMENT PLAN  
TOWN OF COULEE DAM, WASHINGTON

**Tree City USA Bulletin # 31 Tree Protection Ordinances**

National Arbor Day Foundation

<http://www.arborday.org/programs/treecitybulletinsbrowse.cfm>

**Guidelines for developing urban forest practice ordinances** Bell, P.C., Plamondon, S., and Rupp, M. Oregon Department of Forestry, Forest Practices Program, Urban and Community Forestry Program. This guide is designed to assist cities and counties in the development of urban forest practice regulations.

[http://www.oregon.gov/ODF/URBAN\\_FORESTS/docs/Other\\_Publications/UrbanFP.pdf](http://www.oregon.gov/ODF/URBAN_FORESTS/docs/Other_Publications/UrbanFP.pdf)

**Urban and community forestry: A guide for the Northeast and Midwest United States**

Ascerno, M. et al. U.S. Forest Service, Northeastern Area State and Private Forestry. 216 pp. + appendix. 1992. This manual updates a 1990 edition which focused on the interior western region of the U.S. Includes chapters on history, benefits (aesthetic, social, recreational, wildlife, economic, and physical), programs, inventories, planning, ordinances and policy, site evaluation, tree selection and planting, soils, and maintenance. Undated; probable publication date, 1992.

**Municipal tree manual.** Hoefer, P.J., Himelick, E.B., and DeVoto, D.F., Urbana, IL, International Society of Arboriculture. 42 pp. Prepared in cooperation with the Municipal Arborists and Urban Foresters Society. The purpose of this manual is to be a guide for preparing new, or revising old, municipal tree ordinances.

**General Code Publishers**

[www.generalcode.com/webcode2.html](http://www.generalcode.com/webcode2.html)

**LexisNexis Municipal Codes**

<http://municipalcodes.lexisnexis.com>

**American Legal Publishing Corporation**

<http://www.amlegal.com/library>

**Municipal Code Corporation**

[www.municode.com](http://www.municode.com)

[http://www.municode.com/resources/code\\_list.asp?stateID=49](http://www.municode.com/resources/code_list.asp?stateID=49)



## **APPENDIX B – S.W.O.T. Analyses**

May 17, 2017; February 10, 2018 – Public Meeting Forum and City Staff

### **STRENGTHS:**

- Park and Natural Resources board
- Beauty (streets & parks)
- Civic groups
- Park staff
- Community pride in trees
- Tree City status
- Migratory birds
- Water resources
- Tree choices

### **WEAKNESSES:**

- Inadequate funding for tree maintenance
- Lack of natural rainfall
- Multiple communities – differing opinions
- Park Staff training – limited experience
- Public education
- Tribal relations
- Limited access to ISA certified arborists
- Council priorities
- Limited staffing
- Lack of clear vision
- Lack of survival of new trees
- Public apathy
- Tree/sidewalk conflicts
- Harsh climatic conditions

### **OPPORTUNITIES:**

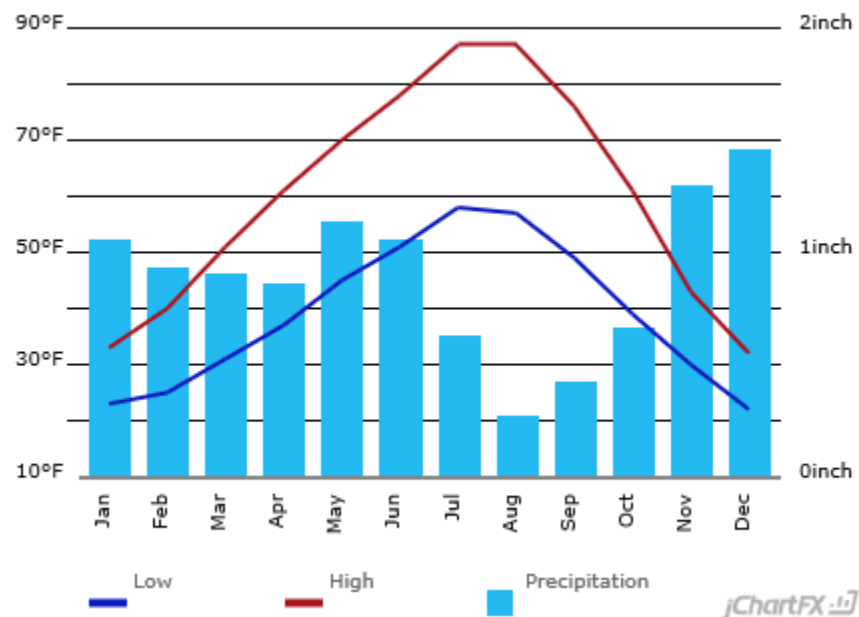
- People residing outside the city limits
- \$\$\$ off to water trees,
- Education homeowners
- Tribal involvement
- New trees – proper planting and selection
- Canopy expansion
- Funding
- Volunteer opportunities
- Species diversity
- Ordinance development

THREATS:

- Limited H2O
- DED, EAB, ALB – invasive insects and diseases
- Inadequate maintenance
- Lack of clear vision
- Rapid population growth
- Boulevard strip parking
- Infrastructure conflicts
- Public complacency
- Climate issues
- Species diversity
- Community consensus

## APPENDIX C – Potential Landscape Plant List

Coulee Dam is in USDA hardiness zone 5a. Minimum temperatures average twenty-three. Average number of days above 86 degrees is 30 to 45 according to American Horticultural Society plant heat-zone map. Coulee Dam experiences a cold semi-arid climate, with long, cold and moderately snowy winters, hot and dry summers, and short springs and autumns in transition. Nights are much cooler than daytime highs. Snow usually occurs from late October/early November to March.



The plant list provides options to try. It is not finite and merely represents some potential choices to increase diversity in Coulee Dam. The plant list below is composed of many species not in the tree population of Coulee Dam or in limited quantities. These trees may be hardy to Coulee Dam and are not natives but will adapt to the area.

Diversification and willingness to try new species are the keys to a successful planting program. Another source of cold hardy plant material is available at

[http://www.ndsu.nodak.edu/forests/comm\\_forestry/doc/08-09/TreesforND1-08.pdf](http://www.ndsu.nodak.edu/forests/comm_forestry/doc/08-09/TreesforND1-08.pdf)

## Small Trees – Less than 25' mature height for narrow parking strips and under utility lines

### Amelanchier x grandiflora 'Autumn Brilliance' (treeform) Autumn Brilliance Serviceberry

Height: 20'  
Spread: 15'  
Hardiness: -30  
Tree form of serviceberry with an upright spreading crown, white flowers and a reliable, bright red fall color. The fruit is edible. Tolerates some drought.

### Cumulus Allegheny Serviceberry Amelanchier laevis 'Cumulus' (treeform)

Height: 25'  
Spread: 20'  
Hardiness: -30  
A serviceberry with a distinct upright and oval tree habit, fleecy white flowers in spring and a yellowish to orange-scarlet fall color. Smooth gray bark.

### American Hornbeam Carpinus caroliniana

Height: 25'  
Spread: 25'  
Hardiness: -40  
A small tree with an irregular spreading habit, with a rounded outline. Dark green leaves change to yellow, orange and scarlet in the fall. Smooth, gray, irregular twisting bark adds interest in winter. Will grow in heavy shade and wet soils.

### Lavalle Hawthorn Crataegus x lavallei

Height: 25'  
Spread: 20'  
Hardiness: -40  
A small, dense oval canopy tree with shiny dark green foliage turning to bronzy copper-red in the fall. Usually

thornless or with small one inch thorns. Quite free of rust and very adaptable.

### European Euonymus Euonymus europaeus

Height: 15-30'  
Spread: 10-20'  
Hardiness: -30  
A narrowly upright tree in youth broadening as it ages with a rounded outline when mature. Early leaf out with a flat dark green color turning from yellow to reddish purple in fall. Fruits ripen pink to red in September and are quite attractive.

### Amur Maackia Maackia amurensis

Height: 25'  
Spread: 25'  
Hardiness: -25  
A small round headed tree. Leaves emerge a silvery gray and gradually become dark green. Fragrant pale white flowers light the tree in July and August. Bark peels with maturity exposing a shiny amber to brown color, becoming curly in texture. Prefers moist, well drained soil, but is quite adaptable to environmental conditions.

### Merrill Loebner Magnolia Magnolia x loebneri 'Merrill'

Height: 30'  
Spread: 30'  
Hardiness: -30  
An upright habit becoming round with age. Leaves are thick and rigid, dark green and turn yellow in fall. Flowering peaks in April, where the tree resembles a white cloud covered with fragrant snowy blossoms. A vigorous grower and cherished landscape tree.

### Yulan magnolia

### Magnolia denudata

Height: 35'  
Spread: 30'  
Hardiness: -30  
Tree with spreading branches somewhat irregular, producing an informal outline. Leaves are thick and resilient turning yellow in fall. Flowers are fragrant, white and 4-6 inches wide, blooming in spring. New nursery stock.

### Galaxy Magnolia Magnolia x 'Galaxy'

Height: 20 - 25'  
Spread: 15'  
Hardiness: -20  
A tree form magnolia with a strong central leader and pyramidal to oval shape. The foliage is lustrous green and flowers are large, 8 to 10 inches wide, blooming in spring on bare stems, pink outside and white inside. Good selection for a landscape or street where space is limited or confined.

### Royal Star Magnolia Magnolia stellata 'Royal Star'

Height: 20'  
Spread: 15'  
Hardiness: -30  
A hardy, compact, rounded tree with deep green foliage and yellow fall color. The large fragrant flowers bloom in early spring, before the leaves break. An excellent ornamental tree for small sites in urban landscapes.

### Flowering Crabapples Malus sp. (Red Flowers) Hardiness: -20 (-30)

'Adams'  
Height: 20'  
Spread: 20'

Dense and rounded symmetrical habit. Pink flowers, red persistent fruit.

**‘Amazam’** American Masterpiece  
Height: 25’  
Spread: 18 - 20’  
Pyramidal habit. Bright red leaves emerge and mature to dark maroon. Brilliant red flowers change to unique pumpkin orange fruits in fall that persist through winter.

**‘Bechtel’** Klehm’s Improved Crab  
Height: 15 - 20’  
Spread: 15 - 20’  
Rounded form, dense dark green foliage, turning orange to orange red in fall. Large double pink flowers cover the tree in spring. Improved strain for disease resistance. Seldom fruits, very tidy tree.

**‘Centzam’** Centurion Crabapple  
Height: 20’  
Spread: 15’  
Narrow upright habit, spreading slightly with maturity. Purple emerging leaves changing to bronze-green. Rose-red flowers ripen to bright red fruits persisting through the winter.

**‘Prairifire’** Prairifire Crabapple  
Height: 20’  
Spread: 20’  
Upright spreading habit becoming rounded. Reddish stems with foliage changing from purple to red hued green. Excellent color change from crimson buds to dark pink flowers to deep red fruits which persist through winter.

### Flowering Crabapples

### Malus sp. (White Flowers)

Hardiness: -20 (-30)

**‘Adirondack’**  
Height: 18’  
Spread: 10’  
Densely upright inverted cone shape. The cut of this cultivar combined with an overabundant white flowers in spring makes this a “standard” to which other flowering crabs are compared. Bright red fruits carry interest through winter.

**‘Hargozam’** Harvest Gold Crab  
Height: 25’  
Spread: 15’  
Upright, moderately columnar habit. White flowers in spring are but a precursor to the golden fruits which adorn this tree through winter making it a show stopper in the landscape.

**Professor Sprenger’**  
Height: 20’  
Spread: 20’  
Stark upright habit makes for a larger more stately looking tree than other crabs. Red buds bloom white with pink tones ripening to orange-red fruits and endure on the noble frame through winter.

**‘Sentinel’**  
Height: 20’  
Spread: 12’  
Vase shaped, an unusual form for a crab makes its mark as an excellent street tree under power lines. Flowers are white with a touch of pink, fragrant, with bright red fruits that carry through the winter.

like drops of rain from this elegant tree.

### Persian Parrotia Parrotia persica

Height: 20 - 30’  
Spread: 15 - 25’  
Hardiness: -20  
Small single stemmed tree with upright to wide spreading branches, oval outline. Pink to purple emerging leaves blend to glossy green and turn a beautiful succession of yellow to orange to red in fall. An excellent selection for streets and landscapes, given size, color display and remarkable resistance to pests and disease.

### Prairie Gem Pear Pyrus ussuriensis ‘Mordak’

Height: 25’  
Spread: 20’  
Hardiness: -30  
Densely branched and compact tree with a round canopy. Leaves are bright green, thick and leathery turning golden yellow in fall. White flowers blanket the tree in early spring. Excellent pear for urban plantings.

### Ivory Silk Lilac Syringa reticulata ‘Ivory Silk’

Height: 25’  
Spread: 15’  
Hardiness: -20  
Tree form lilac, oval and compact with upward curving branches. Foliage is dark green, flowering when young. Displays large white flower clusters in early July.

## Medium Trees – 25 to 50' mature height

### Black Alder

#### Alnus glutinosa

Height: 40 - 50'

Spread: 30 - 35'

Hardiness: -30

Fast growing tree with a broadly pyramidal habit, somewhat irregular. Dark green leaves change to yellow in the fall. These trees thrive near water and perform well in poor soils. Good tree for an alternative to willows and other poplars. The 'Pyramidalis' cultivar has an excellent narrow form and recommended for confined space areas.

### European Hornbeam

#### Carpinus betulus

Height: 25 - 40'

Spread: 25 - 35'

Hardiness: -20

Pyramidal shape, quite dense with dark green leaves. Fall color is usually yellow but during cold winters can turn dark red. Heat and drought resistant.

'Fastigiata', a columnar cultivar, is taller, but only spreads 15', making it preferable for confined urban spaces.

### European Beech

#### Fagus sylvatica

Height: 40 - 50'

Spread: 15 - 40'

Hardiness: -20

Stately tree, narrowly compact to densely pyramidal to broadly oval, branching close to the ground. Leaf color varies dramatically between cultivars. It is said that the right cultivar of this tree can enhance any landscape. Care should be used with Planting lower branching trees to avoid creating a traffic nuisance.

#### 'Fastigiata'

#### Fastigate Beech

Trees deep green, tight form makes it one of the most striking columnar trees.

### 'Riversii' Rivers

#### Purple Beech

Broadly oval habit, foliage has striking purple shades, spring through summer.

#### 'Zlatia'

#### Golden Beech

Upright pyramidal habit, young leaves are yellow maturing to golden green.

### Maidenhair Tree

#### Ginkgo Biloba

Height: 40 - 55'

Spread: 15 - 35'

Hardiness: -25

Young trees are irregularly shaped, but finish broadly symmetrical. Usually all marketed trees are male due to the offensive smell of the female trees in fruit. The leaves are uniquely lobed and bright green on both sides, changing to bright to golden yellow in fall. Having outlived most of its enemies Ginkgo is a fine specimen for urban Planting.

#### 'Autumn Gold'

Very uniform and balanced pyramidal tree. Spreading at maturity.

#### 'Magyar'

Narrow pyramidal form with a strong central leader. Well spaced branches.

#### 'Princeton Sentry'

Narrow tapering growth almost columnar. Tallest of the three.

### Honeylocust

#### Gleditsia

Height: 35 - 45'

Spread: 35 - 40'

Hardiness: -20

Usually a tree with a squat trunk and open spreading branches. Cultivars are thornless, or have very few thorns. Often overused in landscapes which can promote pest and disease problems.

#### 'Halka'

Heavy caliper and full even crown with an oval form. Yellow in fall.

### 'Moraine'

Rapid growth with a vase shape and rounded outline. Golden fall color.

#### 'Shademaster'

Irregular vase with rectangular outline. Good form for street use. Yellow in fall.

#### 'Skyline'

Broadly pyramidal, good branch angles. Form lends itself to urban design.

### American

### Hophornbeam

#### Ostrya virginiana

Height: 30 - 45'

Spread: 25'

Hardiness: -30

Rounded oval shape made up of slender branches, sometimes arching up or down. Leaves are bright green turning yellow to brown in fall often persisting adding winter interest along with the hop like fruits. Tolerates dry conditions and free of major disease and insect problems.

### Amur Corktree

#### Phellodendron

#### amurense

Height: 30 - 45'

Spread: 40 - 50'

Hardiness: -30

Broadly spreading tree, leaves deep to lustrous green with a brief display of yellow or bronze in fall. The bark of mature trees is unusual and quite striking. Remarkably free of pests, pH adaptable, tolerant to drought and pollution making it a great urban tree if given enough space to fill out.

#### 'His Majesty'

Male, free of seed litter. Thick leathery leaves on stout branches.

### Korean Mountainash

#### Sorbus alnifolia

Height: 40 - 50'

Spread: 20 - 30'



Hardiness: -30  
Form changing from pyramidal to rounded outline at maturity. Leaves differing from other mountain ashes, look more beech like, as does the trunk. Striking tree with an excellent combination of form, foliage, flowers, fruit and bark. Considered the best of the Mountain Ashes.

### **American Linden** **Tilia americana**

Height: 35 - 50'  
Spread: 20 - 35'  
Hardiness: -40  
Tall stately trees, cultivars generally smaller in size especially when used in urban areas. Leaves are generally 4 to 8 inches long and about as wide in a range of green shades. Bark is gray to brown with narrow lateral furrows. The wood is soft and easily prunes, but is elastic enough to handle most weather extremes. These trees will entirely block the sun in their shadow so place them appropriately.  
**'Boulevard'**  
Dense, narrow pyramidal habit with ascending branches. Yellow in fall.  
**'Legend'**  
Rounded pyramidal habit, yellow fall color.  
**'Lincoln'**  
Slender, upright and compact form with light green leaves, 25' by 15' in 25 years.  
**'Redmond'**

Full pyramidal form, uniform with large leaves and red branches, winter interest.

### **Littleleaf Linden** **Tilia cordata**

Height: 40 - 45'  
Spread: 45'  
Hardiness: -30  
Trees are pyramidal, rounding with maturity. Leaves are generally smaller, 2 to 3 inches long and wide, (except Glenleven) finely serrated and turn yellow in fall. Trunks are usually straight and bark smooth. Likes well drained alkali soils, but pH adaptable and tolerates pollution well. Makes an excellent selection for any urban planting.  
**'Chancellor'**  
Fastigate in youth, becoming pyramidal with age. Good branch development.  
**'Corzam' Corinthian Linden**  
Narrowly pyramidal, 15' spread. Yellow in fall. Excellent tree for limited space.  
**'Glenleven'**  
**Glenleven Linden**  
Fast growing with a straight trunk, leaves twice the size of 'Greenspire'  
**'Greenspire'**  
Single straight leader, good branch angle. Tolerates difficult conditions.  
**'Olympic'**  
Very symmetrical pyramid form, better branching than some other cultivars.

### **Kentucky Coffeetree** **Gymnocladus dioica**

Height: 50 - 65'  
Spread: 40 - 50'  
Hardiness: -30  
Sharply ascending branches, rising to form a narrow oval crown. The bark is unique, developing on young stems. Spring leaves are late to emerge, their pinks and purples are a nice contrast to greening trees. Seldom bothered by pests or disease, pollution tolerant and strong, upright growth make this an excellent street tree.

**'Stately Manor'**  
Male selection, no seed pods.

### **Butternut** **Juglans cinerea**

Height: 40 - 60'  
Spread: 30 - 50'  
Hardiness: -30  
Round topped tree with wide spreading crown of large horizontal branches and stout laterals. Leaves are dark green and woolly, white ridges and gray furrows make up the mature bark. Fruit debris may be a nuisance. Performs well in the rocky, dry and limestone based soils, a prevalent soil type in Spokane. Usable as Boulevard and Park tree.

## **LARGE TREES – 50' OR LARGER AT MATURE HEIGHT**

### **Catalpa** **Catalpa speciosa**

Height: 60 – 90'  
Spread: 60 – 75'  
Hardiness: -30  
Narrow, oval-upright, open and irregular habit with light to medium green foliage. Coarse texture in all seasons. Showy, white flowers in June. Drought tolerant tree.

### **Hackberry** **Celtis occidentalis**

Height: 50 - 75' (100')  
Spread: 40 - 50'  
Hardiness: -50  
Cold tolerant tree will uncommonly obtain heights of 100 feet, but in urban settings usually does not exceed 60'. Rounded or vase shaped crown with graceful splaying of the branches. No spectacular foliage or flower display, more the trees unique character and ability to tolerate adverse conditions that make it an

excellent choice for a Park or Boulevard.

### **White Oak** **Quercus alba**

Height: 60 - 80'  
Spread: 50 - 70'  
Hardiness: -30  
Juvenile shape is pyramidal maturing with a broad and majestic crown. Leaves are bluntly lobed, dark green to blue-green. Autumn color varies from brown to red. A

challenge to transPlant and establish, but worth the effort.

**Bur Oak**  
**Quercus macrocarpa**

Height: 55 - 80'

Spread: 50 - 70'

Hardiness: -40

Weakly pyramidal or oval to start, developing into a large broad-rounded tree with a massive trunk. Foliage is partially lobed, dark green above and grayish below, turning yellow-brown to purplish in fall. Corky bark on smaller branches adds interest. Adapts to a wide range of soil types, drought and pollution tolerant, makes an excellent tree for urban areas where acorn debris can be managed.

## Appendix D – Tree Sidewalk Conflict Resolution Options

There are several other options to address tree sidewalk conflicts in addition to those mentioned in the body of the management plan. These are discussed and illustrated below.

Pop-outs or bulbs are like curving sidewalks. Space can be increased for newly planted or existing trees by removing a section of curb and extending the planting space into the street. Sidewalk cutouts or "borrowing" space from the adjacent sidewalk creates sidewalk cutouts. This alternative minimizes the sidewalk width for a limited distance adjacent to the tree. The cutout provides a larger grow space for trees and reduces the size of the pruned roots and their proximity to the root flare. Borrowing has limitations, as the room for tree expansion before infringing on the free passage of pedestrians is minimal. Furthermore, the ADA imposes strict regulations as to the amount of free space provided.



**The sidewalk cutout option can be used in some scenarios on downtown streets. The trees are shown before mulch was applied.**

Sidewalk ramping allows existing roots to remain intact by re-pouring concrete over the roots to create a gradually sloped ramp. It is used when removal of roots would



compromise the stability of a high-quality tree. Damaged sidewalk slabs are removed, and 4-6 inches of topsoil is placed on top of the existing grade. A sand or foam backer is placed adjacent or around the subject roots. A new sidewalk is then installed on top of this new base material. This option enables the sidewalk to be replaced in its original position. Sidewalk ramping does not prevent future damage but can delay it by five years or more.

Concrete slabs of nonstandard size or shape can increase the space available for established trees. This technique serves as a design alternative to the curving sidewalk but produces a similar result.



**Sidewalk ramping raises the sidewalk over the root system.**

Infrastructure-based strategies can also include the use of certain materials that provide a larger, uncompacted soil volume, such as pervious concrete, asphalt, decomposed basalt, stone dust, pavers, or rubber sidewalks, instead of concrete.

Flexible paving comes in many forms, which include:

- Interlocking pavers

- Common brick and pavers
- Rubber bricks

Flexible paving is used in conjunction with root pruning when retaining original grade is required and when the level of the paving surface is ramped above or lowered below existing grade. The selected flexible paving material is installed over a compacted sand base. Cities have utilized rubberized, reusable brick in different dimensions that is bonded together with specialized glue. Some of the newer rubberized pavers do not require glue to bind them, but instead use specially designed dowels, which hold the pavers together. Although the use of flexible paving does not prevent future damage, it does provide more time between repairs making repairs easier and less costly. These materials may be used as alternative cover treatments when removing tree grates.



**Rubber sidewalk installation.**

Concrete modifications usually involve expansion joint materials such as dowels, rebar and sleeves, and articulating sidewalk joints. Sidewalk grinding can be employed as temporary measure that restores the offset or heaved portion of a sidewalk to original grade.



### ***Root-based Strategies to Reduce Infrastructure Damage***

Root-zone based strategies often use root guidance systems or soil replacement, modification, and management techniques. They include continuous trenches, engineered or structural soils, root channels or paths, steel plates, Silva cells, and root barriers.

Root pruning may be considered an option, but it is a serious wound to the tree and may affect the stability of the tree. Age, tree condition, species, root size and location, and proximity to the trunk should be considered before using root pruning as a treatment.



**Root pruning should be limited or not used.**





**Root channels can be used to direct root growth.**

There are limitations and constraints associated with each strategy. Typically, the solution to avoiding infrastructure conflicts in downtown areas involves a combination of techniques. Trees, considering our ecological problems, are now being recognized as significant solutions to some of our urban problems. Trees are a necessary component of urban corridors, not just street side ornaments. Too often trees are not integrated into the infrastructure design up front. Consequently, a large amount of money is spent on mitigating root-hardscape conflicts.



**Silva cells utilize a modular framework of interlocking cells. An underground planter is constructed which is backfilled with a large volume of high quality, uncompacted soil. The cells meet load bearing standards and can also help manage storm water on site.**

Several new practices are being used in conjunction with the extensive construction and renovation occurring in the downtown (E.g. Silva cells, large raised planters, and moveable planters for trees in places they can't be planted). Tree grates are beginning to be removed, trees in pits are being raised to grade level, mulch installation, and planting a greater variety of species is happening in the downtown currently. In each of these scenarios it is critical to start with quality nursery stock and plant the tree correctly. Without these first steps an accurate assessment of these practices cannot be made. It is important to assess each of these tree planting treatments under conditions that have followed the best management practices of the arboriculture industry consistently. It provides Coulee Dam information about which treatments or combination of treatments succeeds in the downtown corridor.

## GLOSSARY

**Acceptable risk:** degree of risk that is within the tolerance or threshold of the owner, manager, or controlling authority.

**Advanced assessment:** an assessment performed to provide detailed information about specific tree parts, defects, targets, or site conditions. Specialized equipment, data collection and analysis, and/or expertise are usually required.

**Aerial inspection:** inspection of parts of a tree not visible from the ground, including the trunk, stems and branches: aerial inspections may include evaluation of internal decay.

**ANSI A300 standards:** in the United States, industry-developed, national consensus standards of practice for tree care.

**ANSI Z133.1 standards:** in the United States, industry-developed, national consensus safety standards of practice for tree care.

**Arborist:** professional who possesses the technical competence gained through experience and related training to provide for or supervise the management of tree and other woody plants in residential, commercial, and public landscapes.

**Best management practices (BMP):** best available, industry-recognized courses of action, in consideration of the benefits and limitations, based on scientific research and current knowledge.

**Boundary tree:** a tree with the property line going through any part of the trunk.

**Border tree:** a tree located near a property line but has roots, branches, and leaves that extend over the property line.

**Branch architecture:** the normal structure of the scaffolding branches of a particular tree species compared to the tree you are assessing of the same species.

**Branch tear out:** a branch that pulls out of the parent stem leaving a large ripped wound. It is usually associated with included bark.

**Canopy:** refers to the upper layer or habitat zone, formed by mature tree crowns and including other biological organisms (epiphytes, lianas, arboreal animals, etc.).

**Cavity:** open or closed hollow within a tree stem, usually associated with decay.

**Certified Tree Risk Assessor:** An ISA Certified Arborist who has completed the Pacific Northwest (PNW) tree risk assessment course and/or ISA Tree Risk Assessment Qualification course.

**Codominant stems:** forked trunks, branches, or stems nearly the same in diameter, arising from a common junction and lacking a branch bark ridge.

**Consequences:** effects or outcome of an event. In tree risk assessment, consequences include personal injury, property damage, or disruption of activities due to the event.

**Cracks:** separation in wood fibers.

**Crown:** Leaves and branches of a tree measured from the lowest branch on the trunk to the top of the tree.

**DBH:** diameter breast height measured on trunk (4.5 feet above soil surface)

**Decay:** process of degradation by micro-organisms.

**Defect:** an imperfection, weakness, or lack of something necessary. In trees, defects are injuries, growth patterns, decay, or other conditions that reduce the tree's structural strength.

**Drive-by windshield assessment:** limited visual inspection from only one side of the tree performed from a slow-moving vehicle; also may be called a "windshield" assessment.

**Duty of care:** legal obligation that requires an individual to use a reasonable standard of care when performing tasks that may potentially harm others.

**Excellent condition:** No apparent problems or maintenance required.

**Exposed roots:** roots growing on the surface, usually a species characteristic of compacted soil. Care not to damage exposed roots should be taken.

**Fair condition:** Trees in fair condition have well defined issues (dead branches; co-dominant stems) that warrant some corrective pruning or maintenance within the next pruning cycle.

**Failure (tree failure):** breakage of stem, branch, roots, or loss of mechanical support in the root system.

**Failure potential:** in tree risk assessment, the professional assessment of the likelihood for a tree to fail within a defined period of time.

**Girdling roots:** root that encircles all or part of the trunk of a tree, or other roots, that constricts the vascular tissue and inhibits secondary growth and the movement of water and photosynthesis.

**Good condition:** Trees in good condition have minor issues or defects that do not require immediate attention and maintenance could occur later in the city pruning cycle.

**Harm:** personal injury or death, property damage, or disruption of activities.

**Hazard:** situation or condition that has exceeded an acceptable threshold of risk and is likely to lead to a loss, personal injury, property damage, or disruption of activities; a



likely source of harm. In relation to trees, a *hazard* is the tree part(s) identified as a likely source of harm.

**Hazard tree (synonym hazardous tree):** a tree identified as a likely source of harm.

**High risk tree:** The tree or part of it has reached a stage where it could fail at any time.

**Impact (verb):** striking a target causing a disruption that affects activities.

**Included bark:** bark that becomes embedded in a crotch (union) between branch and trunk or between codominant stems. Causes a weak structure.

**Inspection frequency:** the number of inspections per given unit of time (for example, once every three years).

**Inspection interval:** time between inspections.

**Lean:** angle of the trunk.

**Likelihood:** the chance of an event occurring. In the context of tree failures, the term may be used to specify: 1) the chance of a tree failure occurring; 2) the chance of impacting a specified target; 3) the combination of the likelihood of a tree failing and the likelihood of impacting a specified target.

**Limited visual assessment:** a visual assessment from a specified perspective such as foot, vehicle, or aerial patrol of an individual tree or a population of trees near specified targets, to identify specified conditions or obvious defects.

**Mallet:** a broad-headed hammer made of wood, plastic, or resin used for “sounding” a tree.

**Mitigation:** the process for reducing risk.

**Negligence:** failure to exercise due care.

**Owner/manager:** the person or entity responsible for tree management, or the controlling authority that regulates tree management.

**Poor condition:** Trees in poor condition have irreversible problems.

**Probability:** the measure of the chance of occurrence expressed as a number between 0 and 1, where 0 is impossibility and 1 is absolute certainty.

**Probe:** a stiff, small-diameter rod, stick, or wire that is inserted into a cavity or crack to estimate its size or depth.

**Qualitative risk assessment:** a process using ratings of consequences and likelihood to determine risk significance levels (that is, “extreme”, “high”, “medium”, or “low”) and to evaluate the level of risk against qualitative criteria.

**Quantitative risk assessment:** a process to estimate numerical probability values for consequences and to calculate numeric values for risk.

**Residual risk:** risk remaining after mitigation.

**Risk:** the combination of the likelihood of an event and the severity of the potential consequences. In the context of trees, risk is the likelihood of a conflict or tree failure occurring and affecting a target, and the severity of the associated consequences- personal injury, property damage, or disruption of activities.

**Risk aggregation:** the consideration of risks in combination.

**Risk analysis:** the systematic use of information to identify sources and to estimate the risk.

**Risk evaluation:** the process of risk identification, analysis, and evaluation.

**Risk management:** the application of policies, procedures, and practices used to identify, evaluate, mitigate, monitor, and communicate tree risk.

**Risk matrix:** a tool for ranking and displaying risks by assigning ratings for consequences and likelihood.

**Shall:** A word that designates a mandatory requirement within the ANSI standards or contract documents. Compare to should.

**Should:** word that designates an advisory recommendation in the ANSI standards or contract documents; compare to shall.

**Sounding:** process of striking a tree with a mallet or other appropriate tool and listening for tones that indicate dead bark, a thin layer of wood outside a cavity, or cracks in wood.

**Standard of care:** degree of care that a reasonable person should exercise in performing duty of care; a measurement used to assess whether an individual acted in a reasonable manner.

**Stocking level:** A proportion of existing street trees to the total number of potential street trees (number of trees plus the number of available planting spaces).

**Structural defect:** feature, condition, any naturally occurring or secondary conditions such as cavities, poor branch attachments, cracks, decayed wood or deformity of a tree that indicates a weak structure or instability that could contribute to tree failure.

**Taper:** change in diameter over the length of trunks, branches or roots.

**Target (risk target):** people, property, or activities that could be injured, damaged, or disrupted by a tree.

**Target zone:** The area where a tree or tree part is likely to land if it were to fail.

**Tree risk assessment:** systematic process used to identify, analyze and evaluate tree risk.

**Tree risk management:** the application of policies, procedures, and practices used to identify, evaluate, mitigate, monitor, and communicate tree risk.

**Unacceptable risk:** a degree of risk that exceeds the tolerance of the owner, manager, or controlling authority.

**Urban forest:** management of naturally occurring and planted trees in urban areas.

**Visual tree assessment (VTA):** method of assessing the structural integrity of trees using external symptoms of mechanical stress (such as bulges, reactive growth, etc.) and defects (cracks, cavities, etc.).

**Wood decay:** the process of wood degradation by micro-organisms.



## REFERENCES

- American Forests. 2007. Urban Forest Ecosystem Analysis. URL: <http://www.americanforests.org/resources/urbanforests/analysis.php>
- American Forests. 2001. "Regional Ecosystem Analysis for the Willamette/Lower Columbia Region of Northwestern Oregon and Southwestern Washington State. Washington, DC: American Forests.
- American National Standard for Arboricultural Operations (ANSI Z133.1; A300; 60.1 - 2006) American National Standards Institute.
- Appleyard, H. S. G. "A Strategy to Establish Trees among High-Density Housing." in *Journal of Arboriculture*, 2000, 26, pp. 78-86.
- Behe, B. et. al. 2005. Landscape Plant Material, Size, and Design Sophistication Increase Perceived Home Value. *Journal of Environmental Horticulture* 23(3):127-133. September 2005
- Benedict M.A. and McMahon E.T. 2002. Green Infrastructure: Smart Conservation for the 21st Century, Sprawl Watch Clearinghouse Monograph Series. URL: [www.sprawlwatch.org](http://www.sprawlwatch.org) (verified June 2007).
- Bernatzky, A. 1983. The Effects of Trees on Urban Climate. *Trees in the 21st Century*. Berkhamster Academic Publishers, pp. 59–76.
- Center for Urban Forest Research (CUFR), USDA Forest Service. 2005. <http://wcufre.ucdavis.edu/>
- Coder, Kim 1996. Identified Benefits of Community Trees and Forests. University of Georgia. October 1996
- Clark, J.R., Methany, N. P., Cross, G. and Wake, V. 1997. A model of Urban Forest Sustainability. *Journal of Arboriculture* 23(1): 17-30.
- Clark, J. R. and N. P. Matheny. 1994. A Photographic Guide to the Evaluation of Hazard Trees in Urban Areas, Second Edition. International Society of Arboriculture, Savoy, IL.
- Dirr, M. A. 1998. Manual of Woody Landscape Plants. Their Identification, Ornamental Characteristics, Culture, Propagation and Uses, Fifth Edition. Stipes Publishing L.L.C., Champaign, IL.
- Dumbaugh, E. "Safe Streets, Livable Streets." *Journal of the American Planning Association*, Vol. 71, No. 3 (2005).
- Dunster, J. and Murray, S. 1997. Arboriculture and the Law in Canada. International Society of Arboriculture. Vancouver, British Columbia. 225 pp.

- Dwyer, J., McPherson, E., Schroeder, H. and Rowntree, R. 1992. Assessing the benefits and costs of the urban forest. *Journal of Arboriculture*, Vol. 18, pp. 227–234.
- Floyd, T. 2002. Urban Catchments Enhanced by Green Corridors. Reproduced from the *Stormwater Industry Association Bulletin*, No. 108.
- Fraser, E.D. and Kenney, W.A. 2000. Cultural background and landscape history as factors affecting perceptions of the urban forest. *Journal of Arboriculture* 26(2): 107-113.
- Grahn, P., and Stigsdotter, U. 2003. Landscape Planning and Stress. *Urban Forestry and Urban Greening*, Vol. 2, pp. 1-18.
- Harris, R. W., J. R. Clark and N. P. Matheny. 1999. *Arboriculture. Integrated Management of Landscape Trees, Shrubs, and Vines*, Third Edition. Prentice Hall, Upper Saddle River, NJ.
- Hauer R. J. and Peterson W. D. 2016. *Municipal Tree Care and Management in the United States: A 2014 Urban & community Forestry Census of Tree Activities*. Special Publication 16-1, College of Natural Resources, University of Wisconsin – Stevens Point. 71pp.
- International Society of Arboriculture (ISA). “Pruning Young Trees.” 2005. (visited Thursday, August 14, 2008).  
[http://www.treesaregood.com/treecare/pruning\\_young.aspx](http://www.treesaregood.com/treecare/pruning_young.aspx)
- International Society of Arboriculture. 2004. <http://www.isa-arbor.com/home.aspx>  
[http://www.treesaregood.com/treecare/insect\\_disease.asp](http://www.treesaregood.com/treecare/insect_disease.asp)
- Jacobson, Susan K. 1999. *Communication Skills for Conservation Professionals*. Island Press. Washington D.C. 351pp.
- Korfmacher, K. S. 2001. The politics of participation in watershed modeling. *Environ Manage* 27:161–176.
- Kuo, F. 2003. Social Aspects of Urban Forestry: The role of arboriculture in a healthy social ecology. *Journal of Arboriculture*, Vol. 29, No. 3, pp. 148–155.
- Luley, C. J., S. Sisinni, and A. Pleninger. “The Effect of Pruning on Service Requests, Branch Failures, and Priority Maintenance in the City of Rochester, New York, U.S.” in *Journal of Arboriculture*, 2002, Vol 28:3, pp. 137-143.
- Matheny, N. and Clark, J. 1998. *Trees and Development: A Technical Guide to Preservation of Trees During Land Development*. International Society of Arboriculture.
- McPherson, E. and Simpson, J. 1999. *Carbon Dioxide Reductions Through Urban Forestry: Guidelines for Professional and Volunteer Tree Planters*. USDA Forest Service.

McPherson, E. 1994. Energy-saving potential of trees in Chicago. In: McPherson, E., Nowak, D. and Rowntree, R. (editors). *Chicago's urban forest ecosystem: results of the Chicago Urban Forest Climate Project*. USDA Forest Service.

Miller, Robert W., Richard J. Hauer, Les P. Werner. 2015. *Urban Forestry. Planning and Managing Urban Greenspaces*. Third Edition. Waveland Press, Inc., IL 520pp.

Moll, G., Ebenreck, S. 1989. *Shading Our Cities*. Island Press, Washington, 333 pp.

Merullo, Victor D. and Michael J. Valentine 1992. *Arboriculture and The Law*. International Society of Arboriculture. Champaign, IL 110 pp.

Nowak, D., Crane, D., Stevens, J., and Hoehn, R. 2003. *The Urban Forest Effects (UFORE) Model: Field Data Collection Manual*. USDA Forest Service. 30 pp.

Nowak, D., Kuroda, M. and Crane, D.E. 2004. Tree mortality rates and tree population projections in Baltimore, Maryland, USA. *Urban Forest and Urban Greening* 2: 139-147.

Nowak, D. 1994. Atmospheric Carbon Dioxide Reduction by Chicago's Urban Forest. In: McPherson, E., Nowak, D. and Rowntree, R. (editors). *Chicago's urban forest ecosystem: results of the Chicago Urban Forest Climate Project*. USDA Forest Service. p. 83-94.

Nowak, D. 1992. Urban forest structure and the functions of hydrocarbon emissions and carbon storage. In: *Proceedings of the fifth National Urban Forestry Conference*. American Forestry Association, pp. 48-51.

O'Loughlin, C.L., 1974: A study of tree root strength deterioration following clear felling. *Can. J. For. Res.* 4: 107–113.

Reimchen, T. E.; et. al. 2002. Isotopic Evidence for Enrichment of Salmon- Derived Nutrients in Vegetation, Soil, and Insects in Riparian Zones in Coastal British Columbia. *American Fisheries Society Symposium* 2002.

Rowntree, Rowan A. 1984. "Forest Canopy Cover and Land Use in Four Eastern United States Cities." *Urban Ecology* 8:55-67.

Rowntree, R. and Nowak, D. 1991. Quantifying the role of urban forests in removing atmospheric carbon dioxide. *Journal of Arboriculture*, Vol. 17, No. 10, pp. 269–275.

Reubens, B.; Poesen, J.; Danjon, F.; Geudens, G.; Muys, B., 2007: The role of fine and coarse roots in shallow slope stability and soil erosion control with a focus on root system architecture: a review. *Trees* 21: 385–402.

Santamour, F. S., Jr. "Trees for Urban Planting: Diversity, Uniformity, and Common Sense." in *Proceedings of the 7th Conference of METRIA: Metropolitan Tree Improvement Alliance*, 1990, 7:57-65.

Sorte, G. 1995. The Value of Nature and Green Spaces to the Urban Resident: *Homo urbanensis*. Proceedings of the IFPRA World Congress.

Ulrich, R., and Parsons, R. 1992. Influences of Passive Experiences with Plants on Individual Well-being and Health. In Relph, D. (editor): *The Role of Horticulture in Human Well-Being*, pp 93–105.

United States Department of Agriculture (USDA) Forest Service. 2005. Benefits of Urban Trees. Urban and Community Forestry: Improving Our Quality of Life. <http://www.urbanforestrysouth.org>

United States Department of Agriculture Forest Service NA-TP-02-94, 1994. Recycling Agency Trees. A Guide for Marketing Sawlogs from Street Tree Removals in Agencyities. USDA, Morgantown, West Virginia. 52p.

United States Department of Agriculture Forest Service NA-TP-03-03, 2003. Urban Tree Risk Management: A Community Guide to Program Design and Implementation. USDA Forest Service, Northeastern Area, St. Paul, Minnesota. 194p.

Vargas, Kelanine E., et.al. 2007. Interior West Community Tree Guide. Benefits, Costs, and Strategic Planting. USDA Forest Service General Technical Report PSW-GTR-205.

van den Hove, S. 2000. Participatory approaches to environmental policy-making: the European Commission Climate Policy Process as a case study. *Ecol Econ* 33:457–472.

Walton, J. T. 1998. Stormwater runoff reduction by urban trees in Austin, Texas. In *Cities By Nature's Desig*, Proceedings of the 8th National Urban Forest Conference, Ed. C. Kollin, Washington, DC: American Forests, pp. 82 - 85.

Wolf, Kathleen L. 2007. City Trees and Property Values. *Arborist News*: August 2007 p. 34-36

Wolf, Kathleen L. and Stacey J. Ray, 2005. Trees are Good for Business. International Society of Arboriculture-Pacific Northwest Chapter, Silverton, OR.

Wolf, K. 2003. Public response to the urban forest in inner-city business districts. In *Journal of Arboriculture*, 29 (3).

Wolf, K. L. and N. J. Bratton. 2006. Urban Trees and Traffic Safety: Considering U.S. Roadside Policy and Crash Data. *Arboriculture and Urban Forestry*, 32, 4, 170-179.

Xiao, Q., McPherson, E., Simpson J., and Ustin, S. 1998. Rainfall interception by Sacramento's urban forest. *Journal of Arboriculture*, Vol. 24. pp 235–244.

Ziemer, R.R., 1981: Roots and the stability of forested slopes. *Erosion and Sediment Transport in Pacific Rim Steeplands*. IAHS Publ. No. 132: 343–361.