THE PUBLIC BENEFITS OF PRIVATE FORESTS

AN ECOSYSTEM SERVICES VALUATION
OF PRIVATE FOREST LANDS IN PIERCE COUNTY, WASHINGTON

EARTH ECONOMICS

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Earth Economics is a leader in ecological economics and has provided innovative analysis and recommendations to governments, tribes, organizations, private firms, and communities around the world.

EARTH ECONOMICS

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LIST OF ABBREVIATIONS

CBO	CONGRESSIONAL BUDGET OFFICE
ESV	ECOSYSTEM SERVICES VALUATION
FPA	FOREST PRACTICES ACT
GIS	GEOGRAPHIC INFORMATION SYSTEMS
GNN	GRADIENT NEAREST NEIGHBOR
LEMMA	LANDSCAPE ECOLOGY, MODELING, MAPPING, AND ANALYSIS
NPV	NET PRESENT VALUE
OMB	OFFICE OF MANAGEMENT AND BUDGET
RMZ	RIPARIAN MANAGEMENT ZONE
WDNR	WASHINGTON DEPARTMENT OF NATURAL RESOURCES
WMZ	WETLAND MANAGEMENT ZONE

EXECUTIVE SUMMARY

Forests are among Pierce County's most valuable natural assets, supporting clean water and air, bolstering climate stability, and sustaining local communities. But as the pressure to develop forest lands in Pierce County increases, so does the risk that the critical services provided by forest lands will be lost. While the forest lands owned and maintained by the state and federal governments are likely to stay intact, privately owned forests are at the greatest risk of converting into developed areas to accommodate Pierce Counties growing population.

This report values some of the ecosystem goods and services provided by privately owned forest lands in Pierce County. The analysis reveals that privately held forest lands provide between $259 million and $942 million worth of ecosystem services every year. In present terms, these lands are valued between $26 billion and $94 billion when considering a 100-year timeframe. While ensuring these lands are not subject to conversion will protect the value of services they provide, this report also examines how specific forestry practices can impact the value of services provided by forests.

INTRODUCTION

Forests are among Pierce County's most valuable natural assets, supporting clean water and air, bolstering climate stability, and sustaining local communities. Despite this, Pierce County has one of the highest rates of forest conversion in Washington State. (Forest Land Conversion n.d.) While much of the forest land is owned by the state or federal government, a significant portion is owned by private citizens. Any effort to conserve or sustainably manage forests must engage private landowners who bear the ultimate responsibility of stewarding forests which provide benefits to both the individual landowners and the general public

A critical first step in addressing the conversion of forest land in Pierce County is creating a common understanding of the true value of forests. To that end, this study presents a valuation of the public benefits provided by privately owned forest land in Pierce County. For the purposes of this study, privately owned forest lands are defined as holdings of contiguous forest land of five acres or more owned by individuals, corporations, Native American tribes, clubs, and organizations. In addition, this study explores how specific forestry practices carried out by forest land owners can impact the quality, and thus the value, of ecosystem services.

By valuing ecosystem services, and linking their value to the practices for forest land owners, Earth Economics seeks to draw a stronger connection between individual forest management, and public ecosystem service benefits. Empowered with an understanding, of these connections, Pierce County residents and policymakers alike will be better positioned to ensure the sustainable management of privately held forest land, providing both ecological and economic benefits for landowners and the general public for generations to come.

PIERCE COUNTY HAS ONE OF THE HIGHEST RATES OF FOREST CONVERSION IN WASHINGTON STATE

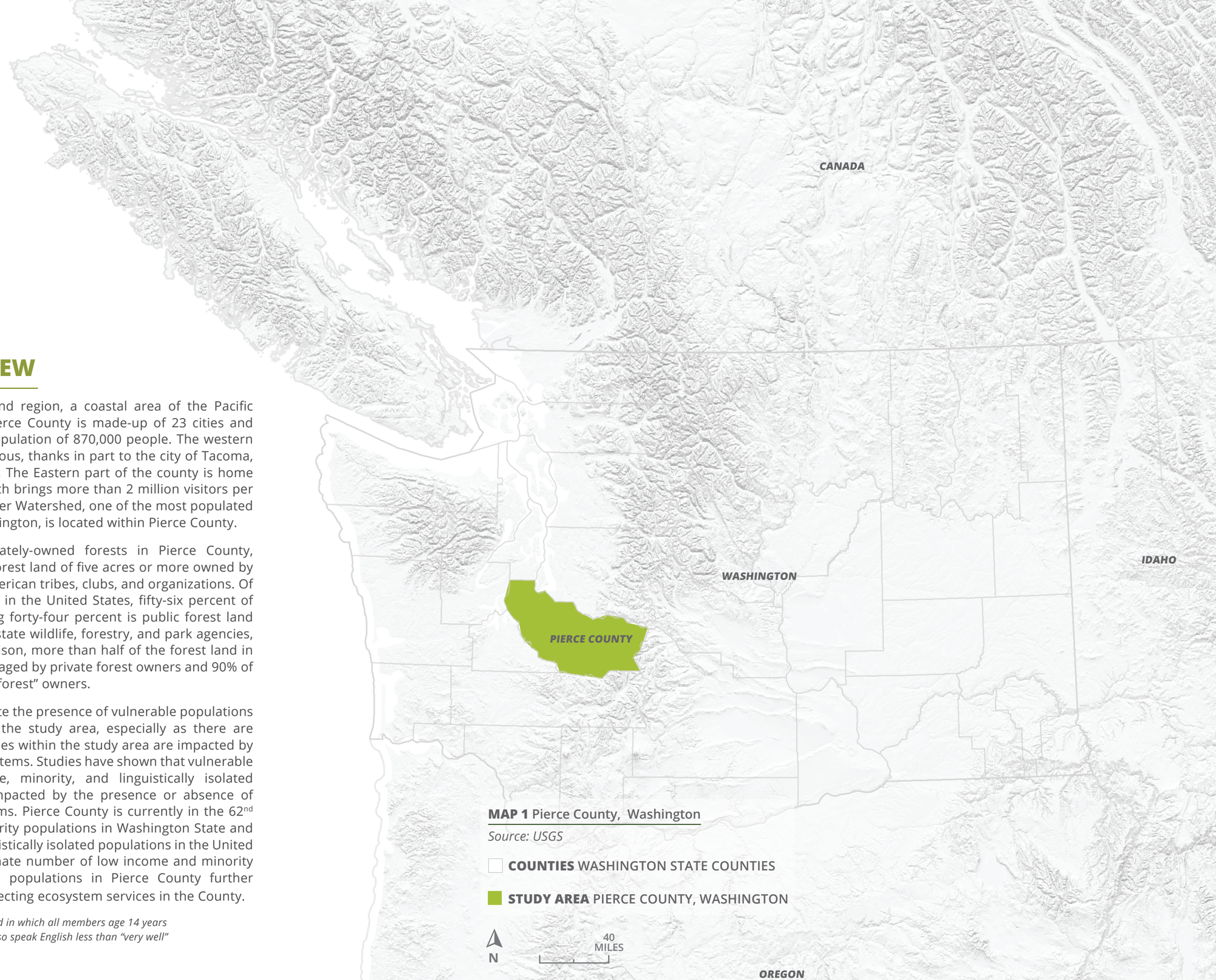
STUDY SITE OVERVIEW

Pierce County is in the Puget Sound region, a coastal area of the Pacific Northwest in Washington State. Pierce County is made-up of 23 cities and towns and has a rapidly growing population of 870,000 people. The western part of Pierce County is more populous, thanks in part to the city of Tacoma, the third largest city in Washington. The Eastern part of the county is home to Mount Rainier National Park which brings more than 2 million visitors per year. Most of the Puyallup-White River Watershed, one of the most populated and farmed basins in Western Washington, is located within Pierce County.

This assessment focuses on privately-owned forests in Pierce County, defined as holdings of contiguous forest land of five acres or more owned by individuals, corporations, Native American tribes, clubs, and organizations. Of the 751 million acres of forest land in the United States, fifty-six percent of it is privately owned. The remaining forty-four percent is public forest land owned by the federal government, state wildlife, forestry, and park agencies, and local governments. For comparison, more than half of the forest land in the United States is owned and managed by private forest owners and 90% of these lands are classified as "family forest" owners.

Demographic indicators that illustrate the presence of vulnerable populations also provide important context in the study area, especially as there are varying degrees to which communities within the study area are impacted by the services provided by local ecosystems. Studies have shown that vulnerable populations, including low income, minority, and linguistically isolated populations, are more intensely impacted by the presence or absence of services provided by local ecosystems. Pierce County is currently in the 62nd percentile for low income and minority populations in Washington State and is also in the 62nd percentile for linguistically isolated populations in the United States.[1] Recognizing a disproportionate number of low income and minority families, and linguistically isolated populations in Pierce County further underscores the importance of protecting ecosystem services in the County.

[1] Linguistically isolated is defined as a household in which all members age 14 years and over speak a non-English language and also speak English less than "very well"

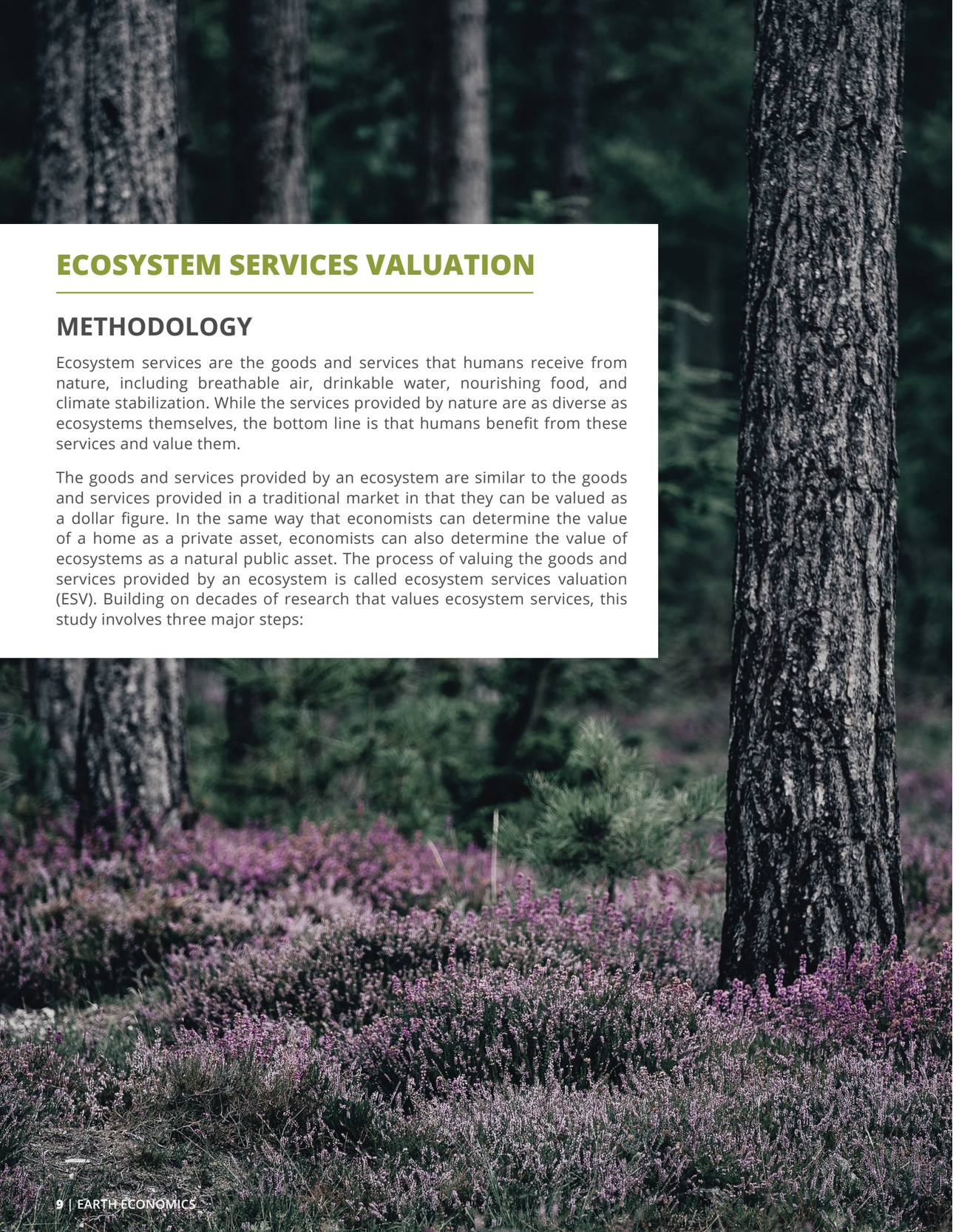


MAP 1 Pierce County, Washington

Source: USGS

COUNTIES WASHINGTON STATE COUNTIES

STUDY AREA PIERCE COUNTY, WASHINGTON



ECOSYSTEM SERVICES VALUATION

METHODOLOGY

Ecosystem services are the goods and services that humans receive from nature, including breathable air, drinkable water, nourishing food, and climate stabilization. While the services provided by nature are as diverse as ecosystems themselves, the bottom line is that humans benefit from these services and value them.

The goods and services provided by an ecosystem are similar to the goods and services provided in a traditional market in that they can be valued as a dollar figure. In the same way that economists can determine the value of a home as a private asset, economists can also determine the value of ecosystems as a natural public asset. The process of valuing the goods and services provided by an ecosystem is called ecosystem services valuation (ESV). Building on decades of research that values ecosystem services, this study involves three major steps:

1 IDENTIFICATION AND QUANTIFICATION OF LAND COVER CLASSES

Geographic Information Systems (GIS) data were used to calculate the extent of each land cover type (e.g., deciduous forest, evergreen forest) within Pierce County. The base land cover for this analysis is the LEMMA (Landscape Ecology, Modeling, Mapping, and Analysis) GNN (Gradient Nearest Neighbor) structure map, which provides 30x30m resolution categorization of land cover, focusing on forest characteristics.

Land cover was also modified to enable a more detailed description of the natural capital of the study area. Identifying the spatial attributes of land cover data allows the application of more granular study values. This can increase accuracy as each attribute provides information that narrows the scope of values and mitigates uncertainty.[2] For this study, spatial attributes were constructed to describe unique locations of forest lands within the landscape. In this analysis, two spatial attributes that affect ecosystem service values for forest lands are considered: proximity to urban areas and riparian zones that act as a buffer to Pierce County waterways.

2 IDENTIFICATION AND VALUATION OF ECOSYSTEM SERVICES

For each land cover type, the ecosystem services provided by that land cover were identified. For example, forests comprise a large portion of Pierce County, and each acre of forest provides a suite of ecosystem services unique to that land cover (e.g., water quality, carbon sequestration, habitat).[3]

Earth Economics then valued these services using the benefit transfer method (BTM). BTM is broadly defined as "the use of existing data or information in settings other than for what it was originally collected." BTM begins by identifying peer reviewed studies that value ecosystem services in locations similar to Pierce County using a variety of well accepted valuation methods.[4] Each value estimate in these studies is then transformed into a dollars-per-acre-per-year format to ensure "apples-to-apples" comparisons, as these estimates are "transferred" to the study site. In this sense, BTM is similar to a home appraisal, in which the features and pricing of similar nearby homes are used to estimate the appraised value of other homes. While neither process is perfect, they are able to quickly and efficiently generate reasonable values for policy and project analysis.

3 ANNUAL VALUE OF ECOSYSTEM SERVICES

The sum of all annual estimates for the ecosystem services provided per-acre by each land cover type was then scaled by the extent of corresponding land cover classes within the study area to calculate the total annual contribution of ecosystem services within the study area. The annual contributions of all land cover types were then combined to calculate the total annual value contributed by ecosystem services to the local economy.

[2] Rosenberger 2013

[3] For a comprehensive list of possible ecosystem services, please see Appendix A.

[4] For a comprehensive list of valuation methods, please see Appendix B.

TABLE 1 SPATIAL ATTRIBUTES

This table describes how each spatial attribute was derived and the datasets involved in calculating the boundaries of each spatial attribute.

ATTRIBUTE	SOURCE
Riparian	U.S. Fish and Wildlife Service, 2016 National Wetlands Inventory
Urban	Washington State Office of the Chief Information Officer (OCIO) and The Department of Ecology 2015 Urban Growth Area Boundaries

TABLE 2 ATTRIBUTE ACREAGES FOR PRIVATE FOREST LANDS IN PIERCE COUNTY

This table presents the results of forest type analysis, with regard to the spatial attributes described in Table 1.

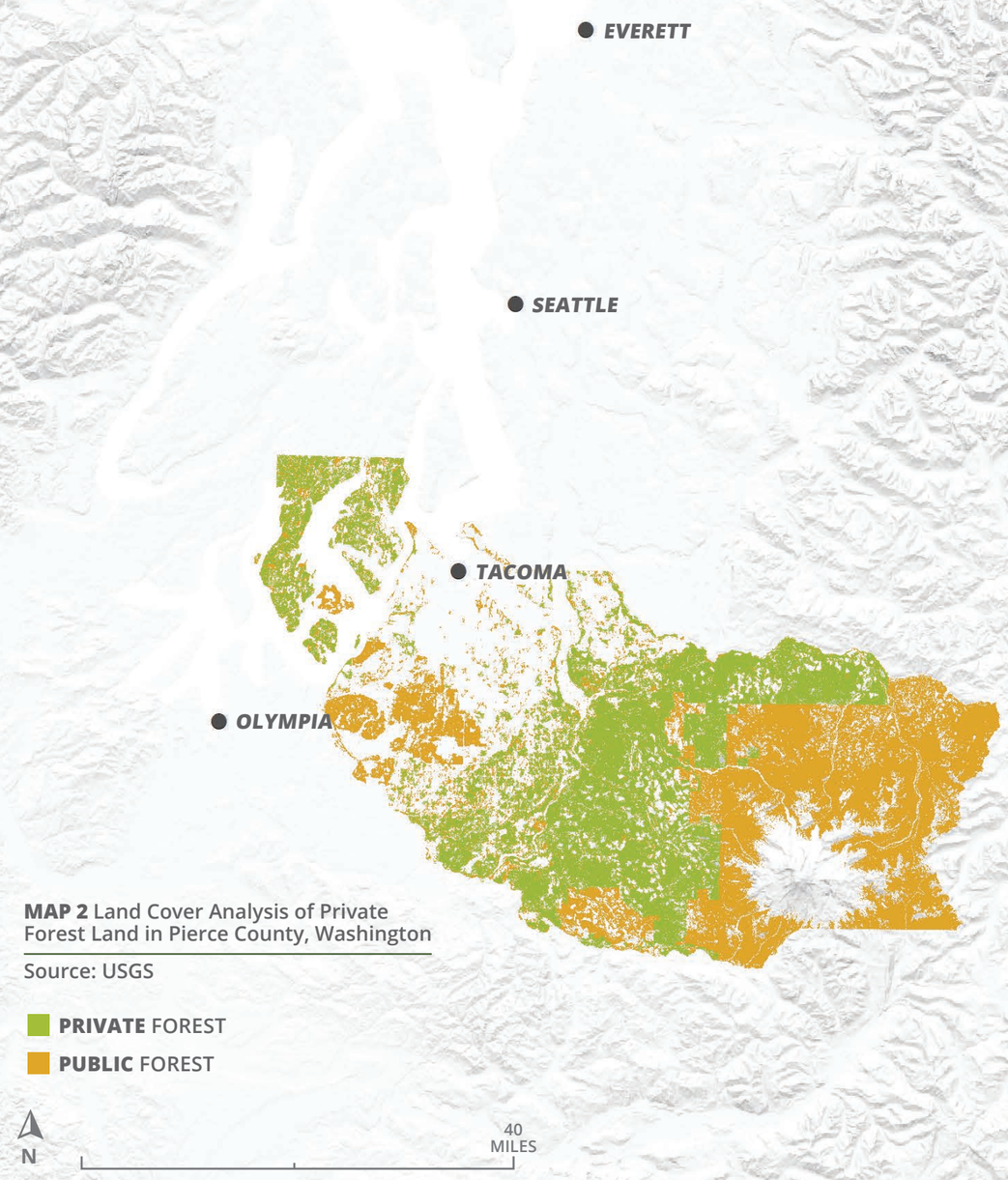
FOREST TYPE	ATTRIBUTE		ACRES
	RIPARIAN	URBAN	
Deciduous Forests			27,827
	R		4,033
		U	2,642
	R	U	306
Evergreen Forests			128,872
	R		31,037
		U	7,707
	R	U	1,078
Mixed Forests			52,408
	R		10,892
		U	4,515
	R	U	828
		TOTAL ACRES	271,317

TABLE 3 ECOSYSTEM SERVICES BY ATTRIBUTE

The table below reports which ecosystem services could be valued for each land cover type. Where valuation estimates for particular ecosystem service–land cover combinations were not available, the cell has been left blank. This is not meant to suggest that such ecosystem services contribute no value at all—only that rigorous research on those contributions provided by specific land cover types were not available at the time research was conducted.

FOREST TYPE	ATTRIBUTE		ECOSYSTEM SERVICE						
	RIPARIAN	URBAN	AIR QUALITY	CARBON SEQUESTRATION	ENERGY & RAW MATERIALS	HABITAT	SOIL RETENTION	WATER SUPPLY	WATER QUALITY
Deciduous Forests			x	x		x	x	x	x
	R		x	x		x	x	x	x
		U	x	x		x	x	x	x
	R	U	x	x		x	x	x	x
Evergreen Forests			x	x	x	x	x	x	x
	R		x	x	x	x	x	x	x
		U	x	x	x	x	x	x	x
	R	U	x	x	x	x	x	x	x
Mixed Forests			x	x		x	x	x	x
	R		x	x		x	x	x	x
		U	x	x		x	x	x	x
	R	U	x	x		x	x	x	x

[3] For a comprehensive list of possible ecosystem services, please see Appendix A.
[4] For a comprehensive list of valuation methods, please see Appendix B.



MAP 2 Land Cover Analysis of Private Forest Land in Pierce County, Washington

Source: USGS

PRIVATE FOREST

PUBLIC FOREST

ECOSYSTEM SERVICES VALUATION

RESULTS

For this analysis, seven ecosystem services were valued across three forest types present in Pierce County. Table 4 summarizes the values of ecosystem services across all forest types. The values reported are the aggregate of all ecosystem service values associated with a given forest type. The services provided by privately owned forest lands each year are valued between $260 million and $941 million.

The Ecosystem Services Valuation (ESV) conducted for this report does not provide a complete estimate of all potential benefits provided by private forest lands in Pierce County. Due to data limitations, only seven of 20 ecosystem services could be valued. As such, if the full suite of ecosystem services could be valued, we expect the value of privately-owned forest lands in Pierce County to be even greater.

TABLE 4 ECOSYSTEM SERVICES VALUED

For this analysis, seven ecosystem services were valued across three forest types present in Pierce County, WA.

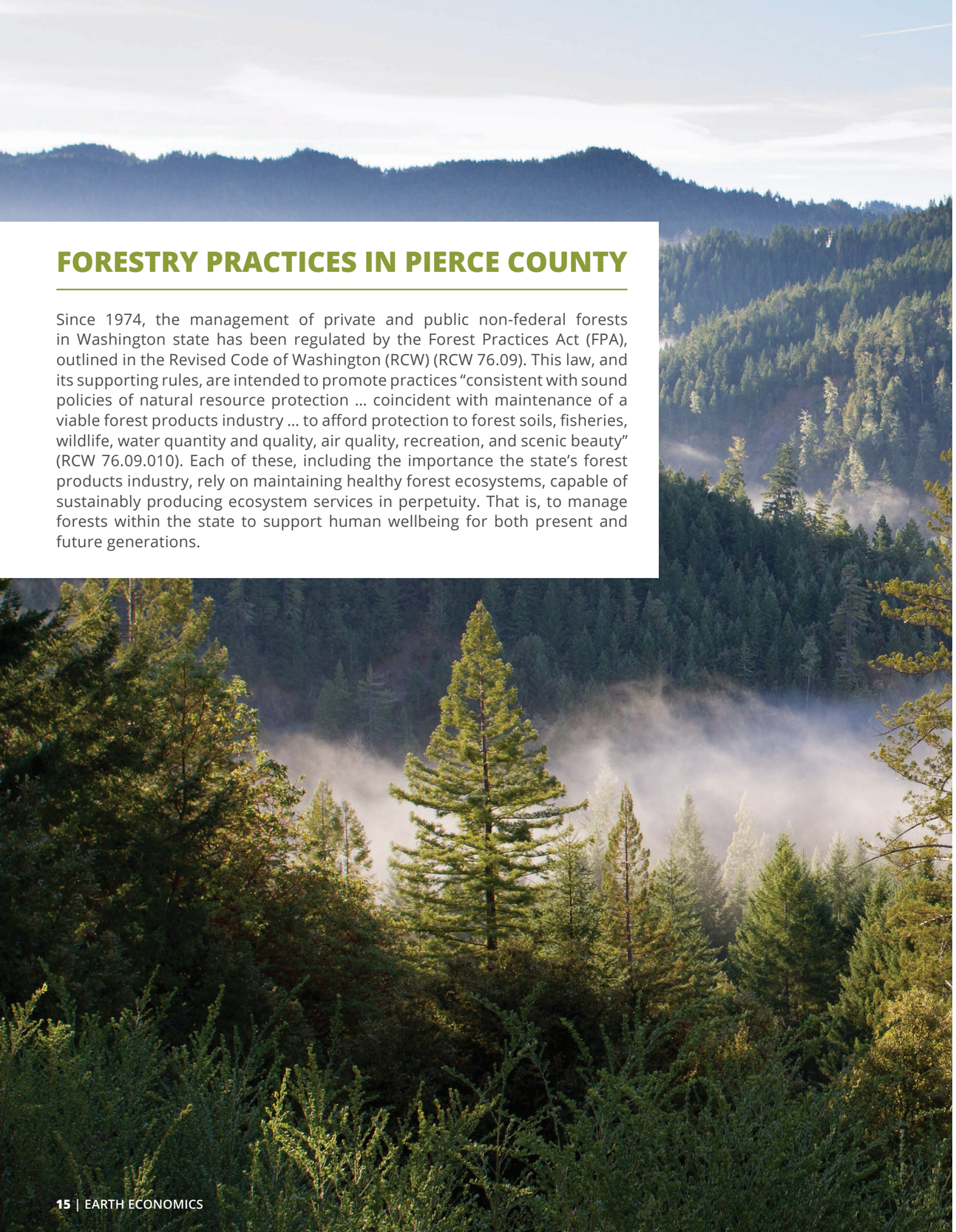
- AIR QUALITY
- CARBON SEQUESTRATION
- ENERGY & RAW MATERIALS
- HABITAT
- SOIL RETENTION
- WATER SUPPLY
- WATER QUALITY

TABLE 5 ECOSYSTEM SERVICES BY FOREST TYPE

The table below summarizes the values of ecosystem services across all forest types.

FOREST TYPE	ATTRIBUTE		ACRES	USD/ACRE/YEAR		USD/YEAR	
	RIPARIAN	URBAN		LOW	HIGH	LOW	HIGH
Deciduous Forests			27,827	$800	$2,700	$25,056,600	$74,904,400
	R		4,033	$900	$6,400	$3,633,300	$25,829,100
		U	2,642	$1,330	$3,200	$3,515,800	$8,367,400
	R	U	306	$1,330	$6,400	$407,300	$1,959,800
Evergreen Forests			128,872	$900	$2,800	$122,328,800	$362,445,700
	R		31,037	$1,000	$6,500	$31,706,100	$202,519,800
		U	7,707	$1,500	$3,300	$11,188,800	$25,338,700
	R	U	1,078	$1,500	$6,500	$1,565,000	$7,034,100
Mixed Forests			52,408	$824	$2,700	$43,167,700	$140,815,400
	R		10,892	$900	$6,400	$9,759,400	$69,704,000
		U	4,515	$1,700	$3,800	$7,613,900	$16,986,300
	R	U	828	$1,770	$7,000	$1,396,300	$5,795,600
		TOTALS	271,317	$12,672	$50,667	$259,339,934	$941,700,250

[3] For a comprehensive list of possible ecosystem services, please see Appendix A.
[4] For a comprehensive list of valuation methods, please see Appendix B.



FORESTRY PRACTICES IN PIERCE COUNTY

Since 1974, the management of private and public non-federal forests in Washington state has been regulated by the Forest Practices Act (FPA), outlined in the Revised Code of Washington (RCW) (RCW 76.09). This law, and its supporting rules, are intended to promote practices "consistent with sound policies of natural resource protection … coincident with maintenance of a viable forest products industry … to afford protection to forest soils, fisheries, wildlife, water quantity and quality, air quality, recreation, and scenic beauty" (RCW 76.09.010). Each of these, including the importance the state's forest products industry, rely on maintaining healthy forest ecosystems, capable of sustainably producing ecosystem services in perpetuity. That is, to manage forests within the state to support human wellbeing for both present and future generations.

FOREST MANAGEMENT PRACTICES AND ECOSYSTEM SERVICES

While there are a great many ways in which forest practices could be organized, they generally fall into three broad categories: **wetlands and riparian zone management; design and maintenance of roads, trails, and landings; and harvest and post-harvest management**. Forest management practices within each if the identified categories, and the manner and degree to which it is implemented, can be expected to affect forest ecosystems, including both the quantity and quality of standing timber, as well as soil quality, soil retention, biodiversity and habitat, water quality, and even the hydrology throughout a given forest, and sites downstream. Moreover, each practice, and the manner and degree to which it is implemented, has the potential to impact ecosystem service productivity, and thus, the net contribution to human wellbeing that flows from Pierce County's forests to the public throughout the region. Table 6 presents ecosystem services that may be directly or indirectly impacted by forest management practices within the practice categories.

TABLE 6 FOREST MANAGEMENT PRACTICES AND ECOSYSTEM SERVICES

ECOSYSTEM SERVICES BY FORESTRY PRACTICE	RIPARIAN AND WETLANDS ZONE MANAGEMENT	ROADS, TRAILS, AND LANDINGS	HARVEST AND POST-HARVEST
PROVISIONING			
Food			
Medicinal Resources			
Ornamental Resources			
Energy and Raw Materials		●	●
Water Storage	○		
REGULATING			
Air Quality			●
Biological Control		●	
Climate Stability	○		●
Disaster Risk Reduction	●	●	
Genetic Transfer		●	●
Soil Formation	●	●	●
Soil Quality	●	●	●
Soil Retention		●	●
Water Quality	●	●	●
Water Supply	○	●	●
Navigation			
SUPPORTING			
Habitat and Nursery	●	●	●
INFORMATION			
Aesthetic Information	○	○	○
Cultural Value			
Recreation and Tourism	○	○	○
Science and Education			

● = DIRECT IMPACT ○ = INDIRECT OR POTENTIAL IMPACT BLANK = UNKNOWN

The following sections include an overview of existing regulations within each forest practice category and the ecosystem services they may impact. Understanding the connections that exist between the current regulatory landscape, the best practices it defines, and the impact of those practices on the ecosystem services that benefit the public more broadly, is a critical first step in determining how to manage Pierce County's forest for net economic and ecological benefits.

WETLAND AND RIPARIAN ZONE MANAGEMENT

When ecologically healthy and functional, riparian forests in western Washington, can provide more than $4,000 in additional ecosystem service value per acre over non-riparian forests. Riparian forests are especially important for reducing the risk of flooding, water capture, supply, and storage, soil retention and water quality, and are often critical fish and wildlife habitat. Aesthetic value and recreation may also be important.

WSDNR divides the state's streams into four categories, according to their scale, cultural and habitat importance, and inter-seasonal permanence. These categories include:

TYPE S STREAMS **Large, named rivers and creeks with year-round flow.** These are important habitat for fish and amphibious species, and providing drinking water for other wildlife.

TYPE F STREAMS **Smaller than Type S but still provide fish and wildlife habitat year-round, but may not be identified on most maps.** Because both Type S and F streams are important fish habitat, forest practices in proximity to these streams focus on retaining trees near surface waters to protect water quality by providing shade, and intercepting erosion and other run-off from nearby slopes, roads, and trails.

TYPE Np STREAMS **Smaller tributaries to Type S or F streams; these also flow year-round, although flows may be sub-surface in the dry season.** These provide habitat for amphibian species, and also protect water quality and habitat downstream.

TYPE Ns STREAMS **Similar to Ns, but their contribution to Type S and F streams are generally sub-surface.** While most management practices are allowed near these subsurface streams, heavy equipment use is prohibited within a 30 foot buffer. This is to prevent soil compaction that might impede subsurface flows.

In addition to riparian forests, wetlands are among the most productive ecosystems in Pierce County, providing critical habitat for aquatic and amphibious species, as well as food and refuge for birds and other wildlife. Wetlands are also important for improving water quality, reducing downstream flooding, and as carbon reservoirs. The state has a classification for wetlands, generally defined as areas of one-quarter acre or more that are covered by open water for at least seven consecutive days between April 1st and October 1st. These classifications include:

TYPE A WETLANDS Larger than 0.5 acres

TYPE B WETLANDS Between 0.25 and 0.5 acres

To protect the ecosystem services produced by streams and wetlands, the WDNR defines Riparian Management Zones (RMZs) and Wetland Management Zones (WMZs), based on stream and wetland type. Depending on other important factors specific to the site in question, including canopy cover, each RMZ and WMZ is divided into a number of "buffer" areas, the most important of which is a Core Zone in which no timber harvesting is allowed. Prohibiting timber harvests within Core Zones prevents soil erosion into surface waters, protecting both soil and water quality. Limiting activities in larger stream and wetland buffers can serve to minimize turbidity and sediment (protecting fish eggs and aquatic plants), provide structural complexity and organic matter crucial to fish and amphibian habitat, maintain shade and regulate stream temperatures, and provide important wildlife habitat. Protecting soils within riparian and wetland zones from compaction also allows precipitation to recharge groundwater tables, and generally reduces the potential for excess runoff to produce localized and downstream flooding. Avoiding compaction can also be important for maintaining and building healthy soils.

ROADS, TRAILS, AND LANDINGS

Riparian areas – especially those with a historical predominance of deciduous trees, such as red alder – tend to have soils richer in organic matter and soil nutrients, with diverse soil biota. However, riparian areas have a higher risk of being impacted by "mass wasting" events, where the upper soils of entire hillsides slide off and fill streams with debris. These events can result from poorly designed and maintained roads, as well as overly aggressive and poorly timed harvests. Thus, the scale, design, and location of road and skid trails, the temporary roads used by loggers move trees, are extremely important when it comes to protecting the valuable ecosystem services provided by riparian areas.

It is this important that any forest owner or manager contending with steep slopes, irregular terrain, clay soils, or evidence of earlier slides consult with a professional forester to ensure the safest way to maintain their riparian forests. Roads and skid trails should also be regularly inspected for cracking, rutting, and poor drainage, especially prior to rainy seasons, after significant storms, and after the Spring thaw. Proper management of roads and skid trails, including the use of crushed rock on road and trail beds, will not only reduce the chances of a "mass wasting" event, but also reduce the rate at which fine sediment enters nearby streams. Fine sediment is synonymous with higher turbidity in a stream which may smother fish eggs, affect aquatic insects, and lead to reduced fish growth rates.

Given the impact of fine sediment on the quality of a stream, Washington state has specific requirements for the appropriate size and location of stream crossings. According to these requirements, roads over fish-bearing streams must allow for fish passage at all life states, limit erosion, and be designed to withstand a 100-year flood event. Stream crossing should be checked regularly for erosion, blockages, and/or failure. Persons planning to install or replace crossings over most Type S or F streams must submit a formal proposal to the WSDNR for a review period of up to 30-days. This is to ensure that water quality and aquatic habitat are protected to a reasonable degree.

Similarly, landings, the cleared areas where logs are brought to await transport for processing, should never be located in drainage channels, WMZs, core or inner RMZs, or on steep, unstable slopes; to limit erosion and impacts on soil quality, it is also important to avoid constructing landings during periods of heavy rain. Because the productivity of riparian ecosystems, the ability to produce timber, provide habitat, and store carbon, is tied to the quantity and quality of surface soils, special care must be taken to minimize impacts to these soils. All secondary benefits of riparian areas, including biodiversity, disaster risk reduction, water capture and supply, and aesthetic value, are ultimately derived from healthy and stable soils, capable of absorbing heavy precipitation, and gradually releasing it for downstream needs.

HARVESTS AND POST-HARVEST MANAGEMENT

Nearly all private forests within Pierce County are managed primarily for timber. To ensure long-term forest productivity, while maintaining the many other benefits provided by forest lands, several safeguards are in place, such as the prohibition on timber cutting within 50 feet of surface waters, with limited exceptions for stream crossing and yarding corridors. While the width of inner and outer buffers within RMZs vary by site class and stream width, the "desired stand condition" is an average basal area (the area occupied by tree stems at chest height) of 325 ft2 per acre 140 years after harvest.[6] Thinning is allowed of smaller, sub-canopy trees within inner RMZs, starting from the outmost edge of the inner zone. By reducing competition for soil nutrients, water, and sunlight, thinning can allow more mature trees to grow stronger and faster, improving both timber quality and quantity. Focusing on trees furthest from surface waters further protects water quality and aquatic habitat. By limiting the degree to which RMZs are thinned, habitat quality is maintained, with the additional benefit of retaining significant reservoirs of carbon as growing trees.

Even following commercial timber harvests, it is important to retain trees and downed logs. WDNR defines these as "Wildlife Reserve" and "Green Recruitment" trees (WRT and GRT, respectively), and each supports important ecosystem functions. WRT include standing trees (living and dead), as well as downed logs, which provide important wildlife habitat – more than 100 species of amphibians, mammals, and birds depend on logs for nesting, overwintering refugia, foraging, and food storage. It is recommended that unstable trees (i.e., those with structural deformities or damage, which may be less valuable for timber) be retained in areas where they are less likely to be disturbed. In this way, lower-grade trees can continue to provide valuable ecosystem services (e.g., habitat, soil retention, carbon storage), while posing little risk to landowners or their guests. The Forest Practices Board requires retention of at least three standing WRT and two downed logs per acre, following management activities (including harvest). In addition, at least two GRT should be left per acre, to facilitate natural reseeding of harvested areas. The retention of both WRT and GRT, while not significantly reducing the total harvestable timber, help to promote wildlife habitat and other important non-timber ecosystem functions (e.g., moderating local temperatures by retaining shade trees).

Because the main goal of the Forest Practices Board guidelines for Class I through III forest practices (again, accounting for 99 percent of private forest management in Pierce County) is to manage those private forests for timber, the Board requires at least 190 trees be established within three years of any harvest activity. Trees can be natural regrowth (aided by retention of GRT "seed" trees), or manually replanted, though overplanting is recommended to allow for natural losses. Exceptions are allowed for "established stands," where enough higher-quality trees (including saplings older than one year) are retained following harvest. While land managers may burn post-harvest slash (smaller branches with little value as timber), permits are required. Of course, large-scale burns are likely to affect local air quality, and heighten risk of wildlife. The Board recommends that smaller vegetation be retained for deer browse, but slash piles must be placed above the 100-year floodplain.

Again, while timber is perhaps the most obvious benefit provided by forest ecosystems, riparian forests are especially known for building nutrient-rich soils (and higher productivity, generally), and can strongly affect the quality of aquatic and amphibious habitat. Almost all forests provide important wildlife habitat, but forests also help to stabilize soils and reduce sediment transport down slope and downstream. Finally, healthy forests are important reservoirs of stored carbon, sequestering additional carbon each year of continued growth.

[6] This amounts to an average of 46 trees per acre, with an average diameter of 36 inches.

ADDITIONAL RESOURCES FOR PRIVATELY OWNED FORESTS

FPA established rules for private forest management, but WDNR also accepts alternative plans, provided they provide an equivalent or better level of protection. Many resources, both public and private, are available to landowners who want to manage their forest to maximize not only timber, but also general ecosystem health. Among the oldest private sector approaches is the American Tree Farm System, a 75 year-old network of family forest owners focused on sustaining air and water quality, habitat and forest recreation, while still extracting timber and fiber (i.e., paper) from working forests (ATFS 2018). While the ATFS offers a third-party certification system, their guidelines and standards are available to non-participants providing a valuable source of time-tested knowledge to forest managers (AFTS 2015),.

More recently, the Forest Stewardship Council has set forth standards for sustainable forest management as part of its approach to third-party certification (FSC 2018). FSC principles and guidelines provide measurable targets for assessing environmental, social, and economic benefits of sound forest management practices (FSC 2010). Like the ATFS, FSC resources are freely available to the general public, whether or not forest managers choose to participate in their certification system.

CONCLUSION

NURTURING ECOSYSTEMS AND COMMUNITIES OF WORKING FORESTS

Productive forest ecosystems in Pierce County build and protect soils, absorb rain and snow to recharge groundwater, gradually releasing water for downstream needs while limiting flooding. Forests managed for greater biodiversity, especially riparian forests, provide and protect critical habitat for fish, amphibians, mammals, birds, insects, and invertebrates. Trees convert atmospheric carbon to wood fiber through photosynthesis, while producing oxygen and improving air quality. Even more, forests provide substantial aesthetic value, supporting higher prices for real estate within their view shed, and offering a broad range of recreational opportunities, from hunting and fishing, to hiking, wildlife viewing, and sightseeing.

Earth Economics estimates that the forest ecosystems that exist on privately owned landed in Pierce County provide between $259 million and $942 million in ecosystem service value every year. This valuation establishes the fact that working forests in the county provide a broad range of benefits, supporting the economic and social wellbeing of both forest owners and communities nearby, downstream, and beyond. And while forests tend to be managed for the production of wood and paper products, it is possible, and even necessary, to manage for other ecosystem functions as well.

This is particularly true for areas like Pierce County where privately-owned forest lands are an integral part of the economic, social, and environmental health of the region. Only by understanding the immense value of ecosystem services provided by these lands can local landowners, elected officials, and other stakeholders manage and regulate the stewardship of forest properties to maximize the economic, social, and environmental benefits they provide, benefits on which we all rely.

APPENDIX A. ECOSYSTEM SERVICES

TABLE 7 ECOSYSTEM SERVICES BY DEFINITION

ECOSYSTEM SERVICES BY DEFINITION

PROVISIONING	
Food	Can include crops, fish, game, and/or produce
Medicinal Resources	Can include traditional medicines, pharmaceuticals, and/or assay organisms
Ornamental Resources	Resources for clothing, jewerly, handicrafts, worship, and decoration
Energy and Raw Materials	Can include fuel, fiber, fertilizer, minerals, and/or energy
Water Storage	Amount of surface or ground water held and its capacity to reliably supply water
REGULATING	
Air Quality	Ability to create and maintain clean, breatable air
Biological Control	Pest and/or disease control
Climate Stability	Ability to support a stable climate at global or local levels
Disaster Risk Reduction	Ability to prevent and mitigate natural disasters, including flood, fire, drought, etc.
Genetic Transfer	Includes pollination and/or seed dispersal
Soil Formation	Soil creation for agricultural and/or ecosystem(s) integrity
Soil Quality	Soil quality improvement due to decomposition and pollutant removal
Soil Retention	Ability to retain arable land, slope stability, and coastal integrity
Water Quality	Water quality improvement due to decomposition and pollutant removal
Water Supply	Ability to provide natural irrigation, drainage, supply, flow, and use of water
Navigation	Ability to maintain neccersary water depth for recreational and commercial vessels
SUPPORTING	
Habitat and Nursery	Ability to maintain genetic and biological diversity, and to promote species growth
INFORMATION	
Aesthetic Information	Enjoyment and appreciation of nature through the senses (sight, sound, etc.)
Cultural Value	Use of nature in art, symbols, architecture, and religious/spiritual purposes
Recreation and Tourism	Can include hiking, boating, travel, camping, and more
Science and Education	Use of natural systems for education and scientific research

APPENDIX B.
VALUATION METHODS

The primary studies from which values are drawn employ a range of valuation techniques depending on the specific circumstances, including:

MARKET PRICING The current market value of goods produced within an ecosystem.
e.g., food, timber

REPLACEMENT COST The cost of replacing the services provided by functional natural systems with man-made infrastructure.
e.g., the installation of a levee to replace natural floodplain protection

AVOIDED COST Ecosystem services can help communities avoid harm that would have incurred in the absence of those services.
e.g. flooding reduction by wetlands and riparian buffers

PRODUCTION APPROACHES Ecosystem services which enhance output.
e.g. rain-fed irrigation can increase crop productivity

TRAVEL COST Demand for some ecosystem services may require travel, the cost of which reflects the implicit value of those services.
e.g., recreation and tourism

HEDONIC PRICING Property values vary by proximity to some ecosystem services.
e.g. homes with water views often sell for higher prices than similar homes without such views

CONTINGENT VALUATION Estimates of value based on surveys of the values assigned to certain activities
e.g., willingness-to-pay to protect water quality

The valuation of most ecosystem services is well-understood and straightforward. However, for ecosystem services that are difficult to value, the benefits are often better described qualitatively.

APPENDIX C.
STUDY LIMITATIONS

Valuation exercises have limitations, yet these limitations should not detract from the core finding that ecosystems produce significant economic value for society. Like any economic analysis, the benefit transfer method (BTM) has strengths and weaknesses. Some arguments against benefit transfer include:

- Every ecosystem is unique; per-acre values derived from another location may be of limited relevance to the ecosystems under analysis.

- Even within a single ecosystem, the value per acre depends on the size of the ecosystem; in most cases, as the size decreases, the per-acre value is expected to increase, and vice versa. (In technical terms, the marginal cost per acre is generally expected to increase as the quantity supplied decreases; a single average value is not the same as a range of marginal values).

- Gathering all the information needed to estimate the specific value for every ecosystem within the study area is not currently feasible. Therefore, the full value of all of the shrubland, grassland, et cetera in a large geographic area cannot yet be ascertained. In technical terms, far too few data points are available to construct a realistic demand curve or estimate a demand function.

- The prior studies upon which calculations are based encompass a wide variety of time periods, geographic areas, investigators, and analytic methods. Many of them provide a range of estimated values rather than single-point estimates. The present study preserves this variance; no studies were removed from the database because their estimated values were deemed too high or too low. In addition, only limited sensitivity analyses were performed. This approach is similar to determining an asking price for a piece of land based on the prices of comparable parcels ("comps"): Even though the property being sold is unique, realtors and lenders feel justified in following this procedure to the extent of publicizing a single asking price rather than a price range.

- The objection to the absence of even an imaginary exchange transaction was made in response to the study by Costanza et al. (1997) of the value of all of the world's ecosystems. Even this is not necessary if one recognizes the different purpose of valuation at this scale–a purpose that is more analogous to national income accounting than to estimating exchange values. (Howarth 2002)

This report displays study results in a way that allows one to appreciate the range of values and their distribution. It is clear from inspection of the tables that the final estimates are not precise. However, they are much better estimates than the alternative of assuming that ecosystem services have zero value, or, alternatively, of assuming they have infinite value. Pragmatically, in estimating the value of ecosystem services, it would be better to be approximately right than precisely wrong.

APPENDIX D.
ECOSYSTEM SERVICES VALUATION REFERENCES

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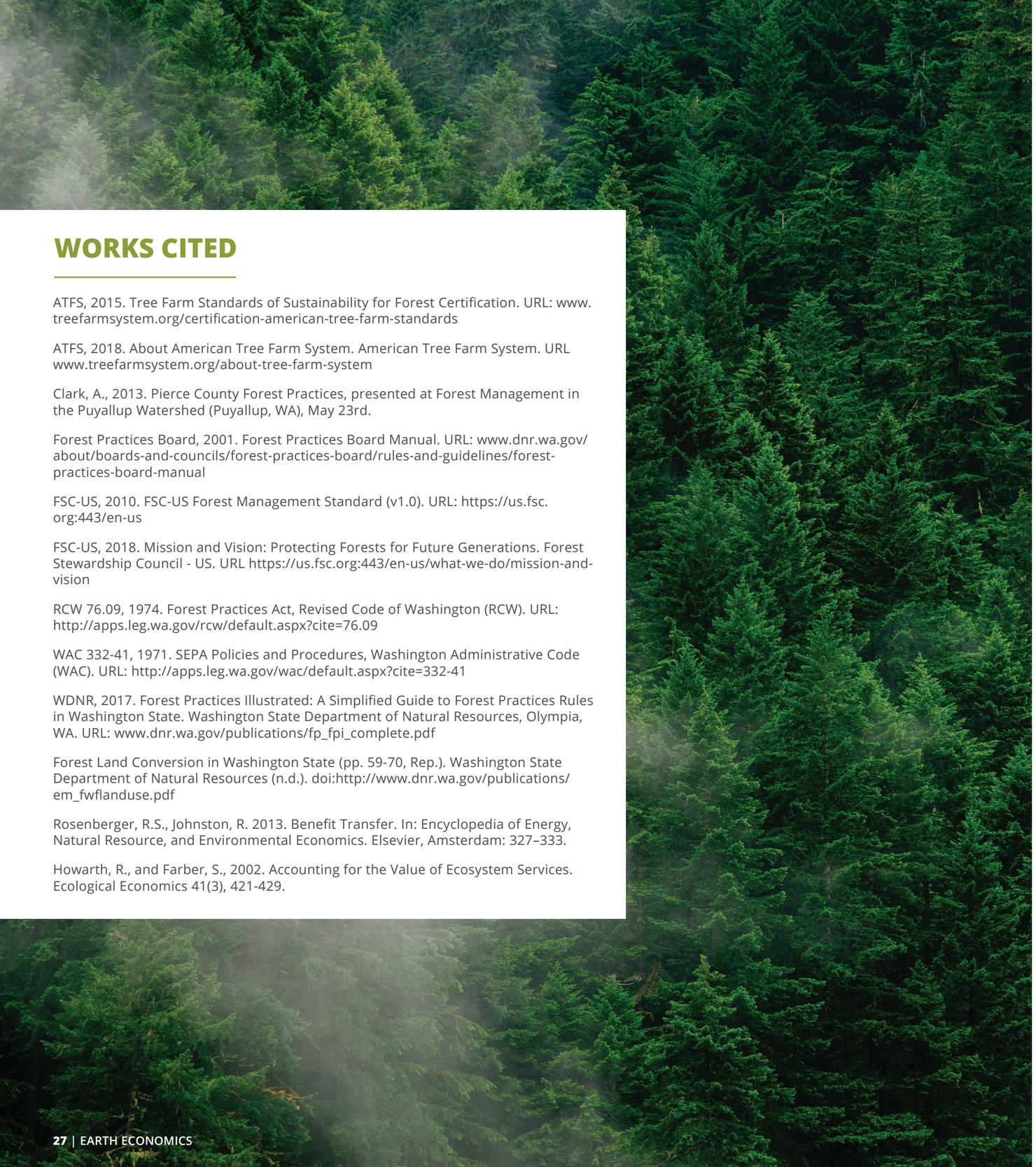

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FOREST MANAGEMENT PRACTICE CLASSES

To acknowledge the diversity of forest types, characteristics, conditions, and land use context, and to allow for diverse landowner goals, the FPA establishes five forest practices classes presented in Table 8 (RCW 76.09.055). Classes IV and IV-General allow for forest conversion to other land uses (e.g., residential, commercial, pasturage), and are regulated by the State Environmental Policy Act (WAC 332-41). Practices which take place outside of urban growth boundaries, and do not permanently convert forests (including commercial timber harvests), fall under classes I through III. These account for 99 percent of the forestry practices in Pierce County (Clark 2013).

TABLE 8 FOREST PRACTICE CLASSES IN WASHINGTON STATE (RCW 76.09.055)

FOREST PRACTICE CLASS	DEFINITION	EXAMPLES
CLASS I	Forest practices that have been determined to have no direct potential for damaging a public resource.	• Culture and harvest of Christmas trees and seedlings • Tree planting and seeding • Any forest practices involving a single landowner where contiguous ownership is less than two acres in size. • Cutting and/or removal of less than five thousand board feet of timber (including live, dead and down material) for personal use (i.e., firewood, fence posts, etc.) in any twelve-month period
CLASS II	Forest practices that are determined to have a less than ordinary potential to damage a public resource and are not conducted within the shorelines of the state.	• Salvage of dead, down, or dying timber if less than forty percent of the total timber volume is removed in any twelve-month period • Any harvest on less than forty acres • Construction of six hundred or more feet of road, provided that the department shall be notified at least two business days before commencement of the construction
CLASS III	Forest practices not listed under Classes I, II, or IV (special and general).	• Aerial application of insecticides or chemicals • Harvesting, road construction, site preparation or aerial application of pesticides on lands which contain cultural, historic or archaeological resources which, at the time the application or notification is filed, have been identified to the department as being of interest to an affected Indian tribe. • The forest practice is on a landowner's ownership of contiguous forest land equal to or greater than twenty acres
CLASS IV (SPECIAL)	Forest practices that have been determined to have potential for a substantial impact on the environment.	• Aerial application of pesticides in a manner identified as having the potential for a substantial impact on the environment • Timber harvest, or construction of roads, landings, gravel pits, rock quarries, or spoil disposal areas, on potentially unstable slopes or landforms • Filling or draining of more than 0.5 acre of a wetland
CLASS IV (GENERAL)	Forest practices that would otherwise be Class I or III, but are conducted within lands meeting a predetermined set of criteria.	• Forest practices that would otherwise be Class III, but are taking place on lands that are not to be reforested because of likelihood of future conversion to urban development • Forest practices (other than those in Class I) on lands that are being converted to another use

EARTH ECONOMICS

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