Ecotrust Forest Management | USDA NRCS

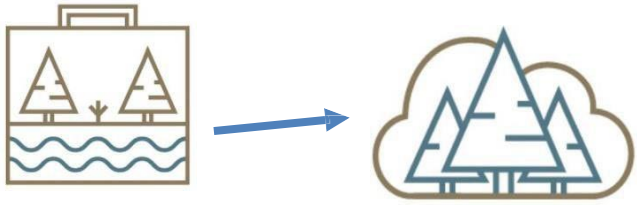
Catalyzing Public, Philanthropic, and Private Capital to Make Impact Investments in Forestland

In 2016, Ecotrust Forest Management (EFM) received a Natural Resources Conservation Services (NRCS) Conservation Innovation Grant to develop a impact investment strategy that could combine private capital at scale with public and philanthropic dollars to achieve measurable forestland productivity and conservation impact goals across different forest types in Oregon and Washington.

Project Highlights

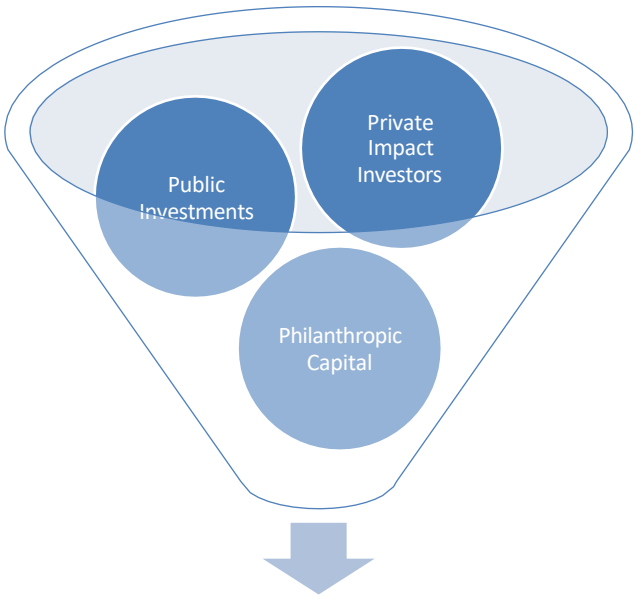
Over the past 18 months EFM interviewed philanthropic partners and private investors to understand the key challenges, perceived risks and opportunities associated with public-private impact investments in forestland. In doing so we developed a financial blueprint for philanthropic lenders and project sponsors to use when contemplating philanthropic investments alongside private capital. Working with impact investors and industry organizations, EFM developed a framework for impact metrics that can be used by public and philanthropic organizations to measure positive social and environmental impact associated with forestland strategies. Finally, EFM also evaluated different alternative end-markets for low-value wood to inform policy makers and investors about the opportunities and challenges of investing in dry-forests of eastern Oregon and Washington. Policy and investment recommendations for public and private investors resulted from this work and will guide much-needed investments in this region. The project helped guide EFM as it navigated the creation and launch of a $75M impact investment vehicle that will invest in western forestland. The Fund launched in May 2018 with $20M in equity and $10M in philanthropic debt commitments and anticipates acquiring 50-100,000 forestland acres across the western U.S.

01 A Public-Private Impact Investment Strategy



The Investment Vehicle

This project aimed create a blueprint for an impact investment vehicle that could combine public, private and philanthropic capital to address forestland challenges in OR and WA. It is widely recognized that there is not sufficient public or philanthropic capital to address our regional natural resource challenges, and that impact investment vehicles are a solution to align private sector capital with public goals and objectives. Private investors surveyed during our project expressed an overwhelming interest in strategies that could provide robust financial outcomes alongside measurable and verifiable impact.



Forestland Impact Investments

Financial Blueprint

Low-Interest, below-market rate debt emerged as the most commonly used philanthropic tool, with wide acceptance among all philanthropic providers who cited its ease of structuring and low-complexity to administer. The role of philanthropic entities providing catalytic, first-loss capital is well established within the impact investment industry and could be a model for public agencies to use in designing targeted subsidies and grant funding programs. EFM developed a financial blueprint for foundations, public agencies and projects sponsors seeking such low-cost debt to complement private capital.

Project Outcomes:

- Recommendations for public-private investments in dry-side forests
- Documents supporting impact investment strategies:
  - Impact Metrics framework for investors
  - Sample term sheet for philanthropic investors
  - Perceived risks of long-term structures

02 An Impact Metric Framework for Forestland Investment

The Importance of Metrics

Public and Philanthropic entities underscored the importance of metrics to measure impact and public value created through their participation. To address this concern, EFM created a framework to measure social/environmental impacts associated with forest restoration activities. The framework identifies the kind of impact anticipated, and the metrics used to measure improvements to forest health, water quality, carbon storage, and economic development.

The Framework

Using industry benchmarks developed by the pioneers of the sector, Global Impact Investment Network (IRIS framework), BLab (B Corp ratings) and impact investor groups (iPar, GIIRS) as a basis, EFM identified 8 key impact categories and within each category specific metrics that define the impact created by a forest management action. Tools like these can be used by philanthropic and public entities to measure positive impacts associated with forestry investments.

Impact Category	Example of Metric	Metric Relevance
Access to Resources	Acres of forestland open to non-motorized public access for activities like hunting, fishing, hiking and recreation.	Improve relationships with local stakeholders in rural communities and increase opportunities to access recreation and forest products.
Climate Change	Increase in above ground carbon absorbed by forestland in a year represented as a % increase over previous year	Absorption of C02 by forests and conversion into organic matter is known to mitigate the effects of climate change.
Equality	Describe active non-timber forest product contracts, or enterprise creation activities, in the current year and if any supported employment with traditionally under-represented, tribes, or individuals from low-income communities.	Job creation among traditionally under-represented communities (e.g. women, Latinos, minority owned businesses) and increases wealth and income among low-income and minority owned enterprises that are reliant on access to natural resources
Employment	Direct Local FTE jobs created and maintained via activities on properties.	Local job creation is possible in rural, natural resource dependent economies via activities and management actions on privately managed forests.
Conservation	Total acres of land with permanently protected land status, via easements or long-term carbon projects.	Local long-term ownership, conservation easements and carbon projects are ways to ensure permanent improvement in the management of assets.
Water	Acres of property in voluntary riparian buffers.	Native fish populations/endangered species are threatened by warming rivers/streams. Forest Management activities and larger voluntary buffers can improve populations through cooler water temperatures and higher oxygen content.
Stewardship	Describe any activities to increase diversity of species or age class via targeted harvests or re-plantings	Increased diversity of species and age class can enable better ecosystem health and function.
Restoration	Number of acres impacted by restoration projects.	Protection of important ecosystem features and habitat on properties can support long-term survival of species. Restoration projects assist in the recovery of an ecosystem that has been degraded, damaged, or destroyed.

03 Recommendations for Public Investments in Dry-side Forests

The Dry-side Challenge

There are millions of acres of forestland on the drier, east side of the Cascades mountain range in Oregon and Washington. This forest type has unique investment challenges, given the more extreme environmental conditions, lower growth rates, and lower-value native species that naturally occur in these drier, more water-stressed regions. The incentives for forestland owners to undertake forest conservation practices (e.g., restoration thinning) are often cost prohibitive, and the markets for the wood products being harvested often do not compensate the landowner enough for undertaking such voluntary activities. This is the exact sort of challenge that impact investment vehicles can be designed to address.

Market Development

EFM piloted a restoration thinning management strategy on a representative east-side property and in the process evaluated the end-markets available to forestland investors. Our experience piloting a restoration strategy and conducting fuels treatment on Desolation Creek shows that investing in dry-side forests in Interior Oregon and Washington, is challenging, and at best a cost-neutral activity, which creates a dearth of private investment in these lands.

Our analysis indicates that well-developed markets for products made from low-value wood, including post and poles that are used in agriculture, torrefied wood which is a replacement for coal in power plants, biochar used as an agricultural supplement, or glued or cross-laminated timber products from small-diameter logs that are also used in Tall Wood Buildings, are necessary to compensate landowners for such restoration-focused activities.

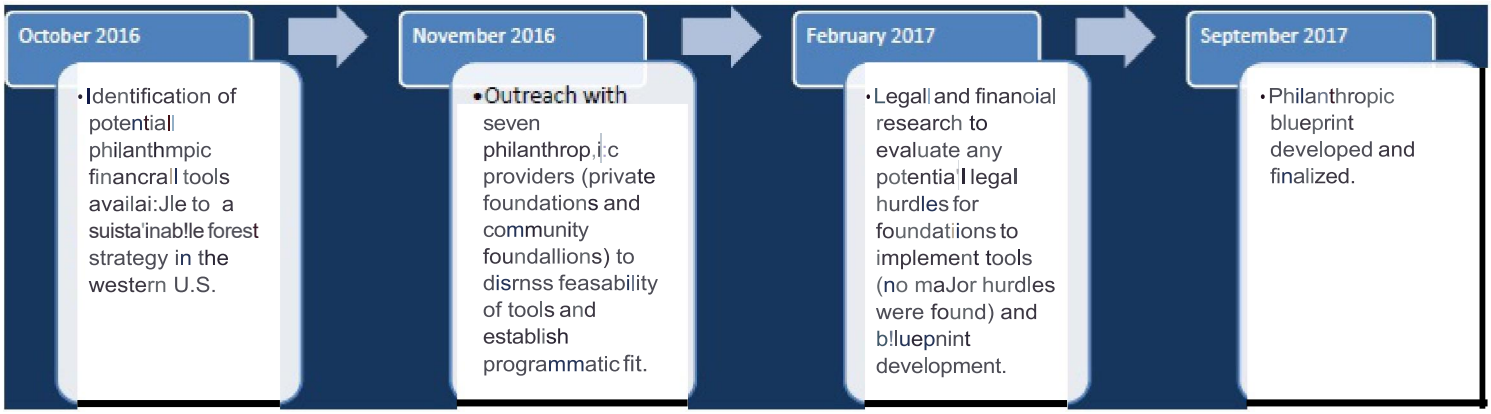
This is especially important given the low value of the wood produced and the long-haul distances required to access mills. Our analysis demonstrates that access to these markets can significantly change the economics of forest thinning on dry-side forests in interior Oregon and Washington, but significant public-private investment in infrastructure and direct cost-support is required to make these restorative activities revenue positive.

The lack of viable and stable end-markets that accept small-diameter wood and the long-haul distances to mills or processing facilities are the main contributors to this challenge. Willing landowners like EFM are further challenged by implementation barriers that include limited contractor capacity and the cost of additional sorting which is required to access non-traditional end-markets.

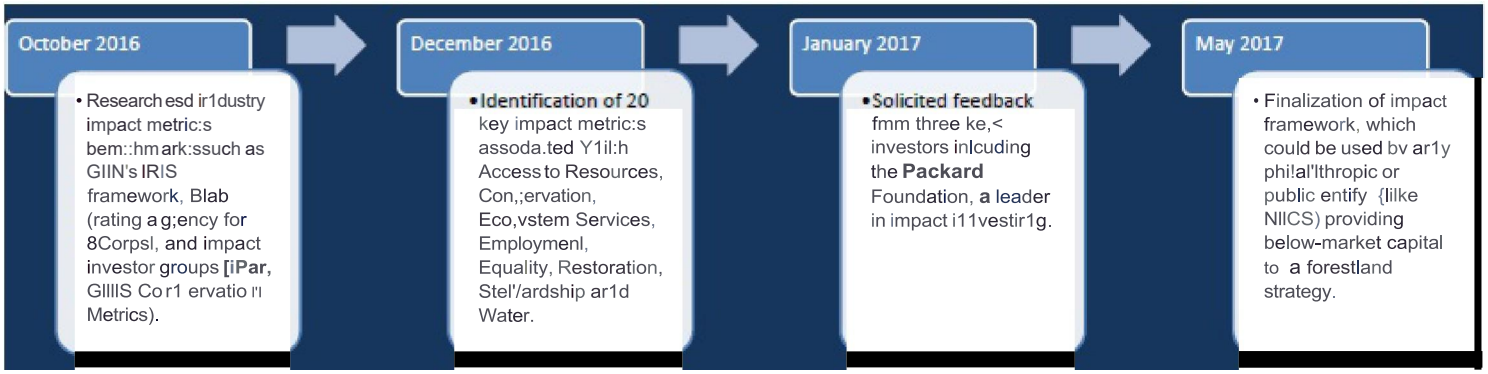
EFM produced a report that details our experience with these challenges, and outlines recommendations for policy makers, philanthropists and impact investors interested in revitalizing our rural communities and their surrounding forestland resources.

04 Methods

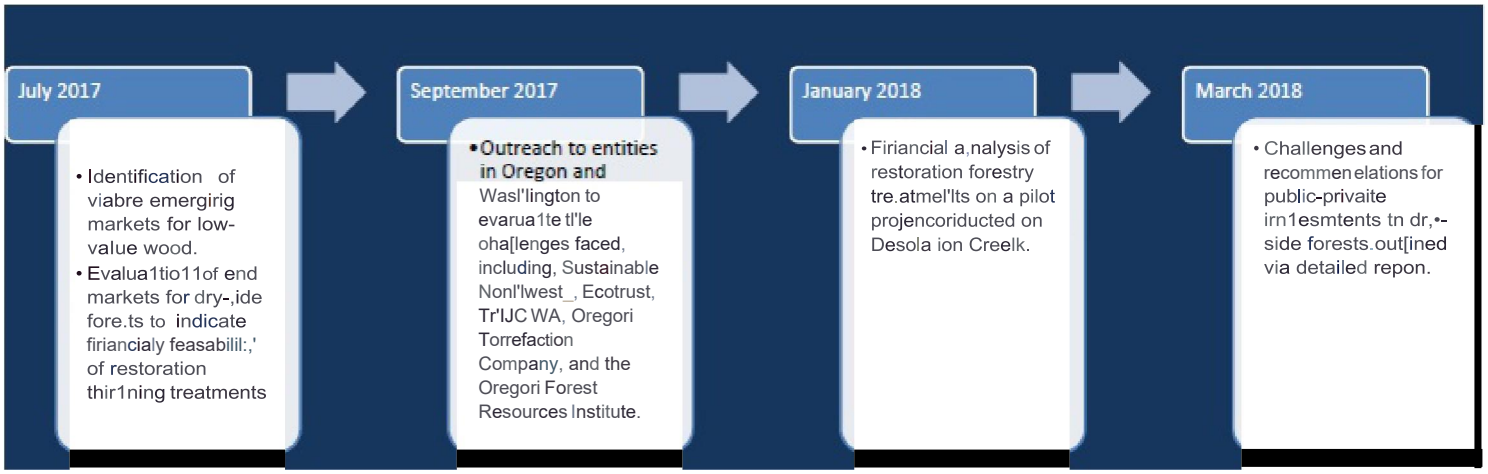
Fund Development



M,etrics Framework



Dry-Side Investment



05 Next Steps

Interior forests

Scale up EFM's pilot restoration forestry program among a larger group of varied landowners in a targeted geography to support restoration activities at a watershed scale across the landscape.

This will require public investments in the supply chain, philanthropic support for land-owners to encourage restoration treatments and market development activities to support viable end-markets for low-value wood.

Future research on cross-laminated timber products and its application to dry side forest species should be prioritized as it could be a very significant driver for restoration activities.

Customization and Use

Customization and use of financial blueprints and impact metrics framework by public agencies to encourage creative impact investment partnerships between private investors and philanthropic entities in different natural resource sectors.

About Us

EFM

Ecotrust Forest Management (EFM) creates compelling investment opportunities at the intersection of working landscapes, conservation, and rural economic development in the western United States. Since our founding in 2004, we have invested over $100M and transitioned more than 77,000 acres of forestland to FSC-certified, ecological management in Oregon, Washington, and California. Our management is certified by the Forest Stewardship Council (FSC) and our forests are managed to produce a full range of goods and services - logs for mills, clean water for communities, carbon sequestration and biodiversity – for the benefit all our stakeholders. Our 11-person team has deep local experience in forestland investment and management, finance, tax credits, and environmental markets. EFM is proud to be a top 50 Impact Fund Manager and among the top 10% of BCorps globally since 2013. Learn more at www.efminvest.com

USDA NRCS

This project was funded through NRCS Conservation Innovation Grants (CIG). CIG is a competitive grant program that stimulates the development and adoption of innovative approaches and technologies for conservation. Through CIG, NRCS partners with public and private entities to accelerate innovation and adopt promising new technology.

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ABOUT ECOTRUST FOREST MANAGEMENT {EFM)

EFM is an investment management company that creates compelling opportunities at the intersection of working landscapes, conservation, and rural economic development in the western United States. Our climate-smart approach aims at improving forest health, species diversity, carbon storage, and water quality, while generating income from a variety of sources including timber harvesting, environmental markets, tax credits, and conservation easements.

ROLE OF PROGRAM RELATED INVESTMENTS {PRIs):

Forests in the western U.S. store over 30 billion metric tons of CO2e, and contribute to reducing ~14 percent of the country's emissions - they are effectively the single largest source of negative emissions in the country. However much of this land is held privately and most private industrial landowners lack financial incentives required to utilize the capacity of their forests to sequester carbon. Limited conservation funding and emerging carbon markets limit the adoption of climate-smart forestry practices to the most motivated landowners.

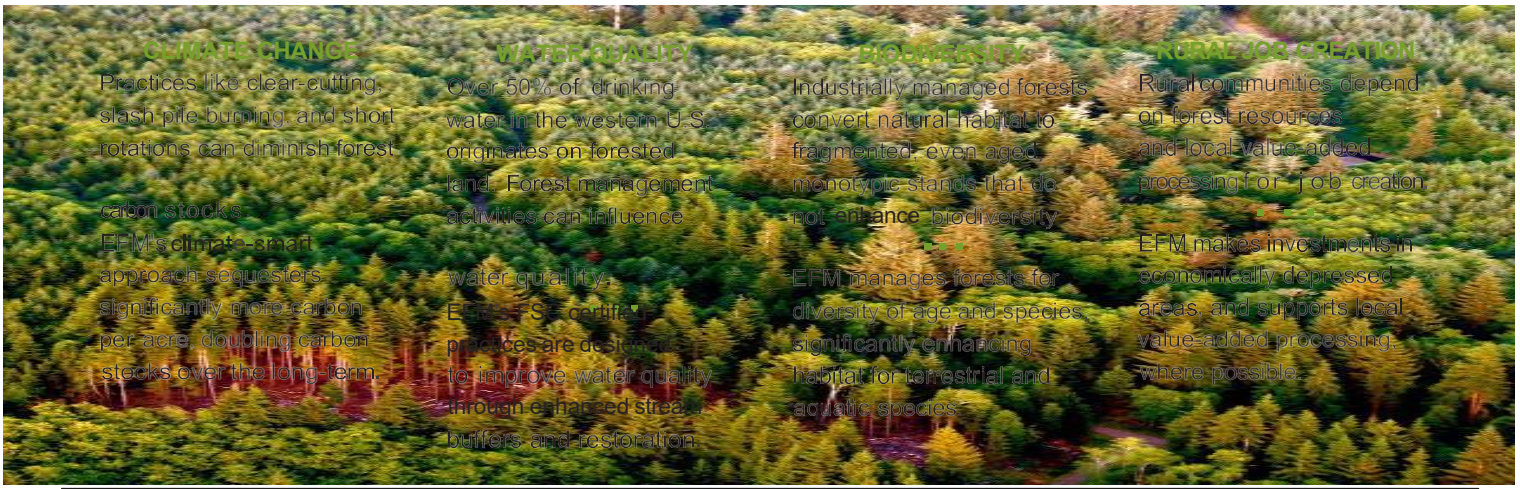
PRis allow Foundations to deploy philanthropic capital efficiently, allowing precious grant dollars to re-cycle while being invested in mission-aligned investment opportunities that return principal (plus modest returns) and create a positive impact. PRis can work alongside private capital and can take the form of low-interest debt, equity, loan guarantees etc.

Ecotrust Forest Management has structured a low-interest senior debt PRI facility that is designed to attract private capital into a $75M Fund that will implement a climate-smart approach to forestland management and investment at scale. The low-interest debt incentivizes the Fund to:

- Adopt FSC management practices that improve water quality, create habitat for wildlife, increase carbon sequestration and support rural employment.
- Transition high-priority forestland properties to long-term, strategic or local owners (like a watershed district, community forest or Tribe) that can permanently steward the improved forest resource.

PRI FACILITY HIGHLIGHTS

- A Senior Debt tranche of $15M, with $10M committed by Packard Foundation, for a 10 year term, at 1%
- Seeking additional $5-lOM to participate in the Fund's PRI facility, either pari-passu with Senior Debt holders, or structured as Junior Debt.



NRCS CONSERVATION INNOVATION GRANT
Deliverable

Grantee Entity Name: Ecotrust Forest Management
Project Title: Catalyzing Public, Philanthropic & Private capital to make impact investments in Forestland
Agreement Number: 69-3A75-17-35
Project Director: Amrita Vatsal
Contact Information Phone Number: 503-467-0801 E-Mail: amrita@ecotrustforests.com
Deliverable Title: Impact Metrics Framework

EFM has created a robust framework for the identification and measurement of the social and environmental impacts associated with improved forest management activities being contemplated by the Fund. This framework was developed for the proposed Fund activities and identifies the metrics used to measure improvements to forest health, water quality, carbon storage, and economic development. This is a key step and crucial pre-condition to attracting philanthropic capital providers and impact investors to invest in a blended capital investment structure

The NRCS could evaluate and utilize the following impact measurement framework and associated impact metrics as best-practice reporting requirements to measure the positive social and environmental impact associated with improved forest management.

EFM Impact Measurement Framework:
EFM undertook a literature review of the existing impact frameworks and metrics that were already published and generally accepted across different sectors and industries. We reviewed the Millennium Ecosystem Assessment and FSC (Forest Stewardship Council) guidance and identified impact themes and associated categories that reflect the positive benefits and impacts that flow from forests to their stakeholders. We mapped the thematic areas and categorization approaches across iPAR and IRIS (an initiative of the Global Impact Investing Network) to arrive at a set of impact themes and categories applicable to forestland impact investment strategies.

Forestland Impact Themes:
We asked: What thematic impact areas do forests and associated investment or management activities largely fall within?

EFM Themes	iPar	IRIS	Comments
People	People	Social Impact	How we impact local people and communities where we work
Planet	Climate	Environment	How we impact the planet and regions outside the places we work (regional and global impact)
Place	Resources	Land Conservation	How we impact the places where we work (local impact)

Forestland Impact Categories:
We asked: What are the specific impact categories that are associated with each impact thematic area?

Theme	**People**
Category	Employment, Equality, Access to Resources,

Theme	**Planet**
Category	Climate

Theme	**Place**
Category	Conservation Restoration, Stewardship, and Water

Impact Category Mapping:

EFM Impact Category	Summary	iPAR Building Block	IRIS
Access to resources	Forests provide opportunities for local access to food, education, energy, water, recreation, and cultural resources.	Access	Access
Equality	Job creation and investment in low-income areas and among traditionally disenfranchised groups including tribal, women, and minorities.	Equality	Equality & Empowerment
Employment	Job creation and maintenance, benefits, training, and ownership opportunities.	Employment	Employment Generation
Conservation	Actions that resulted in the protection and transition of land to a protected status by the organization during the reporting period using a legal mechanism. Protection may be permanent or non-permanent.	Conservation	Protection
Climate	Contribute to climate change mitigation activities via emissions reduction and sequestration.	Climate	Ecosystem Services

Water	Better management of freshwater resources via restoration actions, improvement projects, or via voluntary buffers that result in reduction in chemicals and sedimentation in water and increased filtration.	Rehabilitation	Restoration
Stewardship	Stewardship and use of forests and forest lands that maintains biodiversity, productivity and regeneration capacity and fulfills relevant ecological, economic, and social functions. Land use practices typical of sustainable forestry include minimal and highly controlled clear cutting, replanting with native species, and conservation-oriented management of old growth forests. (Source: FAO)	Production, Conservation	Stewardship
Restoration	Ecological restoration is the process of assisting the recovery of an ecosystem that has been degraded, damaged, or destroyed. An ecosystem has recovered—and is restored—when it contains sufficient biotic and abiotic resources to continue its development without further assistance or subsidy. It will sustain itself structurally and functionally.	Rehabilitation	Restoration

Impact Metrics:

Next we reviewed the impact investment benchmarks developed by the pioneers of the sector, Global Impact Investment Network (we used GIIN's IRIS framework and its Land Conservation Impact Metrics), BLab (the ratings agency for Benefit Corporations) and impact investor frameworks (like the iPar framework). We identified the positive actions that can be under-taken by forest managers to increase the flows and benefits across the various impact categories and identified impact metrics (where available) to measure the impact of these actions. Where metrics were not available, we defined specific metrics to match the impact associated with the forest management activities. We also included space for qualitative impacts as story-telling is a big focus for impact investors. We expect that these impact metrics will be incorporated into the reporting requirements for any philanthropic institution providing below-market capital to the Fund.

1. **Access to Resources**

i) Enable local access to food, education, energy, water, recreation, and cultural resources that forests provide.

(1) Acres of forestland open to non-motorized public access for activities like hunting, fishing, hiking and recreation.

Qualitative: Describe any local community programs or outreach events.

(2) Number of tribes consulted with during year.

Qualitative: Describe any tribal use that occurred on properties.

2. Conservation

i) Actions that resulted in the protection and transition of land to a protected status by the organization during the reporting period using a legal mechanism. Protection may be permanent or non-permanent.
   (1) Total acres of land with permanently protected land status, via easements or long-term contracts (e.g. carbon projects) expressed as a percentage of total ownership.
   (2) Acres transitioned to long term owners in this year, specifically to Tribes, Community Groups, Public Agencies, Conservation groups and protected by virtue of the ownership status, expressed as a percentage of total ownership.

3. Employment

i) Job creation and maintenance, benefits, training, and ownership opportunities.
   (1) Direct local FTE jobs created or maintained via direct investments or contracts entered into by Fund.
   (2) Indirect or imputed local FTE jobs (contracted or hired) created via forest management activities, investments in forest enterprises, or via NTFP contracts. Note: Local is defined as 100 miles from a property

4. Equality

i) Investment and job creation in low-income areas and among traditionally disenfranchised groups including tribal members, women, and minorities.
   (1) Qualitative: Describe the active NTFP (non-timber forest product) contracts or enterprise creation activities in the current year and if any supported employment in low-income areas or among traditionally disenfranchised groups including tribal members, women, and minorities. (e.g. minority owned, tribal, women enterprises)
   (2) Percentage of forestland in economically distressed, low-income communities, as per Federal census.

5. Restoration

i) Assisting the recovery of an ecosystem that has been degraded, damaged, or destroyed. An ecosystem has recovered—and is restored—when it contains sufficient biotic and abiotic resources to continue its development without further assistance. It will sustain itself structurally and functionally.
   (1) Number of upland or riparian restoration projects and current status (i.e. whether initiated, on-going, or completed).
      (a) Qualitative: Describe upland or riparian restoration projects, such as species habitat creation, species surveys completed during the year.
   (2) Total funding that the projects have received in this year and cumulatively, including both direct and indirect funding via intermediaries.
   (3) Number, name, and status of focal species (rare, threatened, or endangered) benefiting from restoration activities in the year.

6. Stewardship

i) Stewardship and use of forests and forest lands that maintains biodiversity, productivity and regeneration capacity and fulfills relevant ecological, economic and social functions. Typical land use practices include minimal and highly controlled clear cutting, replanting with native species, no aerial spraying of herbicide, and conservation-oriented management of older forests.
   (1) Number of mills/facilities supplied by forests in current year.
   (2) Number of seedlings of under-represented species planted during year.
   (3) Percentage of cumulative reforested acres that are reforested with a mix of species.
      (a) Qualitative: Describe any activities undertaken to increase diversity of species or age class via targeted harvests or re-plantings.
   (4) Percent increase of standing timber volume (MBF) over prior year inventory. (i.e. growth)
   (5) Describe third-party certifications held by the organization that are related to its business processes and practices and that are valid as of the end of the reporting period.
   (6) Percentage of ownership that is FSC certified.
   (7) Percentage of ownership that is certified under another program.

7. Climate

i) Contribution to climate change mitigation activities via emissions reduction and sequestration.
   (1) Above ground carbon tons over and above baseline (cumulative and per net acre) stored in forestland across all properties.
   (2) Number and Type of carbon credits or offsets issued or sold during reporting period.
   (3) Calculate % of revenue that (rolling 3 year average after investment period) that is derived from ecosystem service sales including conservation easements.

8. Water

i) Better management of freshwater resources via restoration actions, improvement projects, or via voluntary buffers that result in reduction in chemicals and sedimentation in water and increased filtration.
   (1) Miles of fish-bearing streams that are buffered beyond required State Forest Practices Act.
   (2) Acre-Feet of legal water rights owned.
   (3) Acre-Feet of water rights relinquished or sold to increase in-stream flow.
      (a) Qualitative: Actions undertaken to increase water efficiency or conservation.
   (4) Acres of forestland owned in a domestic watershed (both ground and surface).
   (5) Miles of streams controlled in a domestic watershed (ground and surface).
      (a) Qualitative: Describe any activities by EFM that helped improve water quality in domestic watersheds like roads decommissioned, culverts fixed etc.

NRCS Conservation Innovation Grant 2016-2018

Catalyzing Public, Philanthropic and Private Capital to make Impact Investments in Forestland

Task Group 3 Deliverable: Addressing Dry-Forest Challenges: A feasibility study of alternative wood markets and recommendations for attracting private investment

Goal: Dry-Forest Investment Strategy Development: *To develop a strategy that can attract private capital to address the forest management challenges faced by forestland owners in drier, interior forests of the western United States.*

Objective: *Building on our pilot investment at Desolation Creek, we will aim to address the opportunities and constraints to accessing emerging markets for low-value wood (e.g. post & poles, biofuel, bio-char).*

Objective: *To share with and learn from similar efforts at new market development for low-value wood being undertaken across the western United States.*

1.0 CHALLENGES OF INVESTING IN DRY-FORESTS OF THE INTERIOR WEST

EFM's work has focused primarily on the coastal, temperate rainforests of the Pacific Northwest region. However, there are millions of acres of forestland on the drier, east side of the Cascades mountain range in Oregon and Washington, and throughout the Interior West. This forest type has unique conservation challenges, given the more extreme environmental conditions, including more frequent and intense fires, lower growth rates, and lower-value native species that occur in these drier, more water-stressed regions. Particularly challenging is the overstocking of small trees (typically lodgepole and grand fir) resulting from decades of removal of more valuable species such as ponderosa pine, Douglas-fir, and larch, the subsequent lack of active forest management after removal of the large, valuable trees, and fire suppression at the landscape scale. The incentives for forestland owners to undertake forest conservation practices (e.g., restoration thinning) are often cost prohibitive, and the markets for the wood products being harvested often do not cover the costs for undertaking such voluntary activities. Given slower growth rates and higher conifer species diversity, the amount of biomass per species per acre is not consistent with the current trend towards large, highly-automated mills that require high volumes of logs and a highly uniform log. Given lower biomass density, the haul rates to source a high-efficiency mill produce unacceptable fiber procurement costs. As a result, fiber processing capacity is limited, which lowers the expected returns from timber harvesting and thus the investment returns from forestland ownership. The lack of mills becomes a vicious cycle, with restoration costs (i.e. removal of smaller-diameter, suppressed trees) becoming prohibitive because of the long haul costs to processing centers, which then contributes to further stagnation of dense, suppressed stands and increased high severity fire risk. Alternatively, landowners are forced to remove the remaining large, healthy and fire-resistant trees to finance the removal of the lower-value stems. These challenges impose a huge social cost on our rural communities and more broadly on the rest of the State. Forest fires are a big risk in these kinds of forest conditions, and the threat to private and public lands looms large every fire season.

Goals and Objectives

To better understand these challenges, EFM made a pilot investment in a dry, mixed conifer forest in 2014 through the acquisition of 13,000 acres in Desolation Creek, a sub-watershed of the North Fork of the John Day, in Grant County, OR (see figure 1). During this grant period, EFM undertook a harvest on about 7,000 acres, with the objective of removing stressed, overcrowded, low-value trees so that growth is concentrated on appropriately spaced trees to favor the largest, healthiest trees and diversity of species. With the support of the CIG grant EFM evaluated the feasibility of various alternate wood markets (including firewood, post & poles and torrified wood) and the following is a summary of our findings and recommendations for attracting private investment into dry-side forests. We did market research via interviews with potential buyers of low-value wood, interviews with intermediaries, and wood campuses tours in other regions of the western United States.

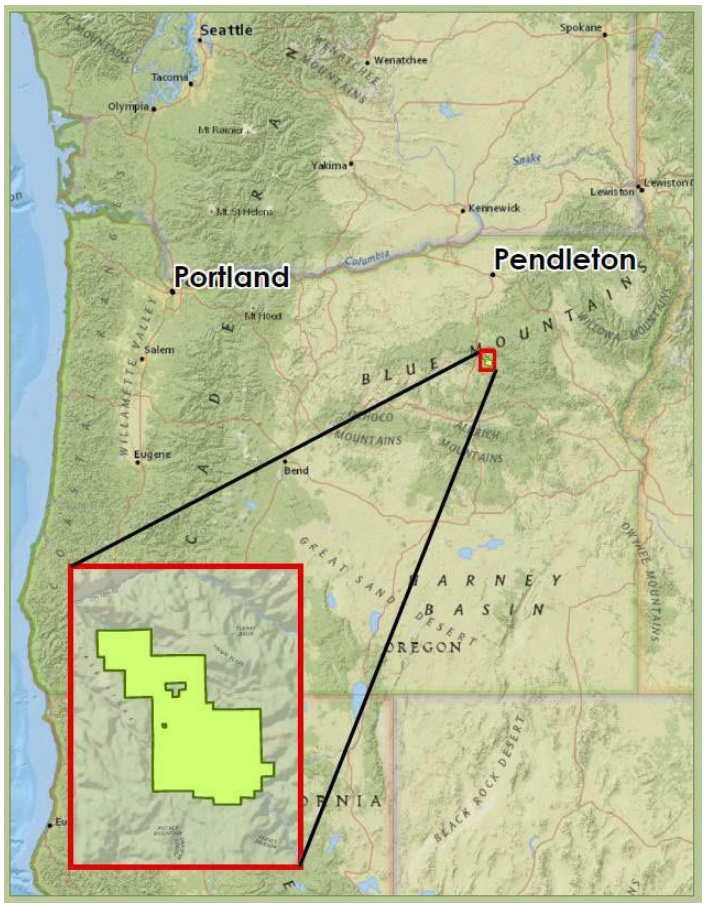


Figure 1- Desolation Creek Property Location Map

Our report outlining our findings is organized as follows:

2.1 : End-market Identification & Feasibility Analysis: Identification of the existing commercial and emerging markets for low-value wood around our pilot project.

2.2 : Financial Analysis: An analysis of their revenue potential and the economics of logging contracts, volume requirements, and arrangements with intermediaries required to sell product into these markets.

2.3 : Operating and Implementation Challenges: A discussion of the operational and execution challenges associates with undertaking the forest management activities at scale.

3.0: Recommendations and Conclusions: A synthesis of the lessons learned from market analysis, financial analysis, and operational analysis.

2.0 DESOLATION CREEK: PROPERTY DESCRIPTION

For this case study, we used EFM's 13,000-acre Desolation Creek property located in north-central Grant County of northeast Oregon as the subject property. The property is representative of the millions of acres of 'dry-forest' that occur across eastern Oregon and Washington and was chosen as the subject for this study given the availability of detailed forest inventory data available to EFM.

The Desolation Creek ownership is situated approximately 10 miles south of Ukiah, Oregon in the Central Blue Mountains. This ownership is an inholding, surrounded by the North Fork John Day Ranger District and the Umatilla National Forest, and represents the largest private holding within the 70,000-acre Desolation Creek watershed, which drains into the highly ecologically significant North Fork of the John Day River.

Figure 2: A forest stand on Desolation Creek that has not yet been thinned

The property is a mixed conifer forest currently containing 44.5 MMBF (3.3 MBF per acre) with a species mix of 40% Douglas-fir/western larch, 40% ponderosa pine, 12% lodgepole pine and the remaining 8% in other conifers and hardwoods. The property has an average site index of 54 (Site Class V) and is modeled to grow between 3%-4% per year. Forests on the property have been heavily harvested by previous owners, who removed the larger trees, and now contains primarily young and small trees with marginal commercial value. The topography is mostly gradually sloping with steep terrain along parts of Desolation Creek with elevations ranging from 3,050 to 5,100 feet.

2.1 END MARKET IDENTIFICATION & FEASIBILITY:

For the purposes of this case study, EFM evaluated a variety of end markets for wood including traditional sawlog and chip markets as well as emerging nontraditional markets such as torrefaction, firewood, biofuel, and post and poles to determine if a restoration thinning harvest regime would be economically viable. Both domestic and export sawlog markets were considered in our analysis.

Traditional Markets

a. Construction and Building End-Markets:

There are five domestic mills (four sawmills and a plywood facility) within reasonable proximity (90 miles) to the property and a log export facility within 110 miles. Domestic sawlog markets typically require trees that are large enough to have a six-inch top-end diameter, while export market require a larger tree that has an eight-inch top-end diameter. Both domestic and export sawlog markets produce products for construction and building end-markets. Douglas-fir and western larch are the preferred species for traditional sawlog markets. Other tree species, including ponderosa pine, grand fir and spruce can be sold, but have lower demand and therefore command a lower price. Current prices were obtained from nearby mills within a reasonable haul distance from the property as of May 2018.

Species	Market	Spec Dia (")	Length (')	Price	Unit
DF	Export	8"+	36	$ 710	MBF
DF/WL	Sawlog	6"+	16	$ 425	MBF
GF/WL/ES	Export	8"+	36	$ 620	MBF
GF/WL	Sawlog	6"+	16	$ 340	MBF
PP/LP	Export	8"+	36	$ 605	MBF
LP/ES	Sawlog	6"+	16	$ 300	MBF
PP	Sawlog	6-11"	16	$ 265	MBF
PP	Sawlog	12-18"	16	$ 335	MBF
PP	Sawlog	19"+	16	$ 375	MBF
All	Chip	3"+	16	$ 38	Ton
LP	Poles	4"+	18	$ 115	Ton
All	Torrefaction	3"+	16	$ 25	Ton

Table 1: Product specifications/price by market and species for the logs from the Desolation Creek property. *Note: Export log prices are based on Westside scaling standards which produce 10-20% less volume compared to the same logs scaled using Eastside rules (all other sawlogs reported in Table 1).*

b. Chip Markets

Smaller trees are traditionally sold into chip markets and used in manufacturing paper products. There are two pulp mills within 200 miles distance to the property, a chipping operation within 130 miles distance that barges material to westside pulp mills, and a wood pellet/fuel brick facility within 60 miles.

Non-traditional Markets:

We explored markets both for fuel and post and pole. The attractiveness of these markets for a land-owner is that they accept a variety of species as well as smaller dimensions down to a three-inch top-end diameter, thus creating a market for otherwise often low-value wood.

a. Hop poles

Hop production in the Pacific Northwest has been steadily increasing (U.S. hop acreage has increased 79.5% since 2012 with 95% of production occurring in the Pacific Northwest). Tapping these markets is not always as straightforward as selling logs to mills, but the small log dimensions of this product are ideally suited to forest restoration.

b. Torrefaction products

Torrefaction products are used as an alternative energy source, with their main appeal being that they are a drop-in replacement for coal.

We had a particular interest in torrefaction, given the efforts of the Oregon Torrefaction Company to build a torrefaction facility in John Day, about 50 miles from the Desolation Creek property. Facility development plans and testing were occurring during this grant period and are continuing. The Oregon Torrefaction Company is planning a commercial scale facility that will produce advanced, solid biofuel. The facility will be located on the Malheur Lumber Company site in John Day, OR.

The facility is being developed by the Oregon Torrefaction Company, an alliance among the U.S. Endowment for Forestry and Communities in partnership with Ochoco Lumber and the Bonneville Environmental Foundation and supported with funding from the USDA Forest Service. The Oregon Torrefaction facility is expected to have a production capacity of 50,000 tons per year. A potential end user is PGE's Boardman Generating Station, the last remaining coal-powered plant in Oregon and the subject of considerable efforts by the environmental community to lessen the plant's generation of greenhouse gases. Material from this new facility will potentially be used as a drop-in replacement for coal at the Boardman Generating Station in Boardman, OR. Also being explored are exports to Asian markets.

The facility is projected to utilize approximately 130,000 green tons of biomass each year. The biomass will be sourced primarily from small diameter and low-value material that is generated as a result of the restoration activities on the Malheur National Forest under a 10-year stewardship contract. Additional biomass will be sourced from private landowners and mill residuals, and EFM entered into conversations early in the process to source material from its planned forest restoration activities.

c. Bio-char

We also briefly explored the potential for biochar production on site, consulting with U.S. Forest Service biochar expert Jim Archuleta and interviewing a nonprofit forestland owner testing biochar production. While intriguing, we concluded that neither the mobile biochar units nor the market were sufficiently advanced to support commercial activities at Desolation Creek at this time.

d. Biofuel

Also, intriguing was providing woody biomass for biofuel. During the grant period, there were two potential biofuel producers contemplating commercial-scale production in the vicinity of Desolation Creek. Neither of those projects has moved forward at this time.

e. CLT or Cross-Laminated Timber

A promising market is glued or cross-laminated timber (CLT) products from small-diameter logs that are used in tall wood buildings. However currently, CLT uses larger dimension lumber and is focused mainly on Douglas-fir and is hence not yet relevant for our purposes and has not been explored further in this report.

2.2 FINANCIAL ANALYSIS

A financial analysis was conducted to evaluate if the sale of wood to various end-markets would be profitable. There are two primary costs associated with wood product harvesting, logging, and hauling. Logging, which is sometimes referred as "On-Board-Truck" (OBT) costs is the act of cutting the trees, bringing them to a centralized landing area, removing limbs and cutting into desired log lengths, and loading the cut material onto a truck. Hauling is the act of driving a loaded truck from the forest to a mill. Trucking cost estimates are based on the time it takes the log truck to load, get to the mill, unload and return empty to the job site.

For the purposes of this analysis, logging costs were set at a constant of $250 per MBF (thousand board feet) or $28 per ton (Note: MBF are based on logs, not lumber). These are market rates for ground-based harvesting based upon recent timberland appraisals. Ground-based harvesting methods are often referred to as tractor or skidder-based logging methods. Smaller material can be more difficult and time consuming to handle, therefore sometimes becoming more expensive to log than larger diameter materials. Harvesting on steeper ground also causes harvest costs to rise. However, for this analysis, we held the logging costs constant in order to focus on distance to markets as a potential barrier to timberland investments on the eastside, rather than variability in logging costs based upon log size, volume removed, or distance to landing.

Haul cost were calculated based on trucking rate of $100 per hour an

d assuming average load sizes of 4,000 MBF or 30 tons per load.

UNIT	Haul Distance (Miles) 10	Haul Distance (Miles) 50	Haul Distance (Miles) 100	Haul Distance (Miles) 150
Haul Cost ($) / MBF	$ 60	$ 100	$ 150	$ 200
Haul Cost ($) / Ton	$ 8	$ 14	$ 20	$ 27

Table 2: Estimated Haul Cost by Unit and Distance

We interviewed a number of log buyers and researched the potential revenue for all the products being evaluated. The following table summarizes the results. It was no surprise that traditional sawlog markets yielded the greatest profitability to the subject property. Given the current strong export pricing, export markets for the highly desirable species of Douglas-fir created the greatest net revenue return, despite being a longer haul than domestic mills. Export markets for ponderosa pine and other mixed conifer also provided a higher profitability than domestic mills at the time of this study.

Species	Market	Spec Dia(")	Length(')	Price	Unit	Haul (Miles) 1-way	Net Revenue
DF	Export	8"+	36	$ 710	MBF	110	$300
DF/WL	Sawlog	6"+	16	$ 425	MBF	73	$52
GF/WL/ES	Export	8"+	36	$ 620	MBF	110	$210
GF/WL	Sawlog	6"+	16	$ 340	MBF	73	($33)
PP/LP	Export	8"+	36	$ 605	MBF	110	$195
LP/ES	Sawlog	6"+	16	$ 300	MBF	73	($73)
PP	Sawlog	6-11"	16	$ 265	MBF	50	($85)
PP	Sawlog	12-18"	16	$ 335	MBF	50	($15)
PP	Sawlog	19"+	16	$ 375	MBF	50	$25
All	Chip	3"+	16	$ 38	Ton	100	($11)
LP	Poles	4"+	18	$ 115	Ton	150	$64
All	Torrefaction	3"+	16	$ 25	Ton	70	($19)

Table 03: Subject property net revenue estimates by species and market (net loss in red)

For the subject property, poles, large ponderosa pine sawlogs, Douglas-fir/western larch sawlogs and export sawlog markets provide opportunities for net revenue generation. The other products are relatively low value but could break even or generate net revenue if haul distances were reduced, or delivered price increased, or if the cost of getting the material (tree tops) to the landing was being subsidized by removing more valuable logs. With current prices, the torrefaction market results in a net loss to the subject property. Currently, the pole market presents the greatest potential opportunity to be profitable within the non-traditional markets. This includes poles used within agriculture sector to grow hops.

While sawlog markets provide profitability, the reality is that many eastside, dry-forest properties lack sawlog-sized trees in volumes sufficient to remove without further reducing stand quality. Many properties are overstocked with small diameter wood and these crowded stands are at the greatest risk for forest health issues and catastrophic fire. Creating profitable markets for small diameter wood is essential to improve the health and reducing fire risk, but one would need to decrease haul distances to markets (i.e. by establishing well-distributed processing facilities), subsidize costs or increase delivered product pricing. Innovation in log harvesting and processing to bring those costs down is another possibility to improve the economics of eastside forest restoration projects. Limiting handling of low value material is absolutely essential. In periods when chip markets are high, and sawlog markets weak some operators have found it most efficient to chip all material, thus reducing costs.

2.3 OPERATING AND IMPLEMENTATION CHALLENGES

EFM interviewed loggers, forest managers, biomass facilities of various kinds under consideration, and conducted site visits at local area mills, including the nearby sawmill and pellet mill (and potential new torrefaction facility). EFM also visited integrated wood campuses, such as that of Wallowa Resources, which includes log sorting capacity, pole peelers, a chipper, and firewood processing. Intrigued by the idea of a “wood campus” where small-diameter logs can find multiple solutions depending on log characteristics and market conditions, the EFM team visited two other examples of integrated processing facilities for low-value wood, one in Oregon and the other in northern California. The advantage of these integrated centers is the ability to minimize sorting at the landing and to transport the low-value material only once to the processing center where it can be converted to more valuable material in a one-step process. Given the low margins, any proposed value-added activity needs to significantly minimize sorting and handling,

We also pursued approaches to in-forest processing, again with the notion of minimizing handling and transport and moving production as close to the source as possible, via “spoke and hub” approaches where mobile processing is combined with stationary processing at a regional center, and where there are potential economies of scale in sourcing, marketing, accounting and financing, and sales. In-forest production increases the value/volume ratio, allowing efficient transport to secondary processing or end-markets. Instead of transporting logs to mills for chipping, logs were felled in the fall and winter at Desolation, allowed to dry for 3-6 months, and then yarded to landings where a mobile chipper could be run efficiently to process the previously felled and dried logs. Exposing the vulnerability of limited processing centers, the two proximate pulp mills purchasing chips were both shuttered in 2017, leaving us with material on the ground for an additional year. The felled material will be processed in 2018, but not without having increased the potential risk of fire intensity and deterioration of material.

While a portion of the logs qualified for higher value post and pole markets, we learned firsthand the challenges and costs imposed by additional sorting. We explored bringing in a mobile peeler to produce poles for agricultural markets, which was a significantly higher-value product than chips, but the sorting costs and the complexity of two different operators in the same landing challenged the viability of the larger operation, and we had to proceed with a chip-only operation.

Figure 3: A forest stand on Desolation Creek, post-thinning treatment

Learning from this experience, we contracted with a local operator in our second year of operation, who had a smaller investment in equipment. With lower capital costs, he had greater flexibility and was able to invest more in labor for handling and sorting and to produce logs for multiple markets. However, these local contractors are often hard to find. EFM solicited six different logging contractors unsuccessfully before finding the two arrangements described above. In addition to the small number of contractors generally, the increased incidence of fires reduces contractor availability even further. During fire season it is hard to hold on to contractors given the demand for their services on fire crews. Given that much of eastern Oregon and Washington already have a short operating season due to access issues in the winter with snow, spring with thawing conditions, followed by shutdowns during fire season, losing contractors during the short operating season is very damaging. As a result of these factors, EFM was not able to log at Desolation during 2017. Operations have since resumed.

Reflecting the fragility of trying to pair a particular property or treatment with a buyer, while Desolation Creek is well situated in relative proximity to the proposed Torrefaction mill, the timing is off. EFM is attempting to get the property “fuel risk reduced” (i.e. thinning of a majority of stands, fuel break established on vulnerable perimeters) as soon as possible to reduce fire risk and to accelerate transition

of stands to the desired future condition. By the time the new Torrefaction facility is up and running, it is likely that EFM will have completed its thinning program. It is important to create a landscape-scale, systematic approach to restoration incentives and processing and to invest in a well-distributed network of fiber processing.

3.0 CONCLUSIONS: RECOMMENDATIONS FOR ATTRACTING PRIVATE INVESTMENT INTO DRY-SIDE FORESTS

Preliminary analysis indicates that value-added markets for products made from low-value wood, including post and poles that are used in agriculture, torrified wood which is a replacement for coal in power plants, biochar used as an agricultural supplement, or glued or cross-laminated timber (CLT) products from small-diameter logs that are also used in tall wood buildings, are necessary to compensate landowners for restoration-focused thinning activities. This is especially important given the low value of the wood produced and the long-haul distances required, as described above. Our analysis on Desolation Creek shows how important access to these markets can be as they significantly change the economics of forest thinning on dry-side forests in eastern Oregon and Washington and can make these restorative activities revenue positive.

Enticing investment into dry mixed-conifer forests will be challenging and will require a mix of private, public and philanthropic resources to share in appropriate risk-reduction. Despite the challenges, creating incentives for dry forest restoration is absolutely essential for the long-term health of both forests and rural communities.

As is evidenced in this report, the paucity of forestland transactions in dry, mixed conifer forests, and the contrast between the historic and current distribution of processing facilities, illustrate that market forces are currently insufficient to stimulate the necessary level of forest restoration. Unlike the productive forests west of the Cascades, the mill infrastructure of the Interior West has not fully transitioned from cutting large logs from older forests to the new challenge of efficiently processing small logs. The transition from large logs to the ever-smaller logs of managed plantations was made possible on the westside forests by the economics of greater forest productivity, shorter distances to end markets, lumber processing innovations, and more efficient transportation networks. In the Interior West, the accumulated wealth of centuries of forest growth supported the first generation of mills, but now that this wealth has been significantly diminished, there is not sufficient return to command mill investment in most markets.

In evaluating the cost and effectiveness of the solutions below and the level of public investment required, it is important for policy makers to consider the direct relationship between fire-prone forest conditions and the incidence of fire, which are now costing over $2B annually in fire-fighting costs alone. Our analysis does not consider the impacts on human health, the market value of the biomass, or the contribution of greenhouse gases from forest fires to accelerating climate change.

Below are some recommendations for stimulating greater investment resources in the dry mixed conifer forests of the Interior West, particularly in Oregon and Washington:

1. **Direct public stimulus for investments in forest restoration or in processing facilities focused on biomass that is not currently being accepted at domestic sawlog facilities or export facilities.** This

stimulus can be in the form of tax credits, subsidies, price supports, or other mechanisms that can go either to the landowner or to processing intermediaries who want to expand small-wood processing facilities. In assessing the return on public dollars, incorporate the cost on health, fire-fighting etc. Direct public funding to priority regions, especially in areas with a high proportion of WUI (Wildlife Urban Interface), a high incidence of fire, where fire suppression costs are particularly high, or where there is reliance on surrounding forests for water provision, recreation or other economically and ecologically significant values.

2. **Implement these public investments at a landscape scale within priority regions for the best results.** Current forest restoration tools for landowners are available at the property scale, but forest fires happen at the landscape scale. Forest landowners that carefully thin their forest, establish fuel breaks, and other best practices are still at the mercy of the condition of the surrounding forest. We recommend targeting the financial incentives in priority watersheds, with selection of projects based on a landscape-wide plan, landowner willingness, and connectivity among restored properties.
    - Prioritize and expand funding for NRCS programs, and other federal programs focused on forest health, for precommercial thinning, shaded fuel breaks, and other forest health activities to the prioritized landscapes. Make aggregation of activities at a landscape-scale a factor for selection and funding availability and use Good Neighbor Authority to create cross-agency partnerships.
    - Streamline federal permitting/funding for prioritized landscapes. Stewardship contracts are a great start, but even a 10 year contract may be insufficient for the level of investment needed for a new processing facility. In addition, the award of a stewardship contract should prioritize supply to processing facilities that are working in cooperation with landscape-scale restoration plans.
    - Monitor incidence of fire, fire severity, and fire suppression costs in prioritized versus non-prioritized landscapes to evaluate the impact and effectiveness of the approach.

3. **Incentives must be structured across land-owner and operator type:** The incentives provided must be relevant to private industrial, private nonindustrial, federal, state, and county forests, and must be evaluated to work across multiple ownership types, or alternatively and perhaps more appropriately, different types of incentives should be designed specifically for each landowner type (federal, tribal, state, county, industrial private, nonindustrial private). Incentives should be designed that can be implemented both by the landowner and by the operator. In particular, an operator-based approach could potentially be implemented across landowners and landowner types, providing efficiency at the landscape scale, and stimulating a much-needed restoration industry.

4. **Public and philanthropic entities need to collaborate to entice private and experienced market actors to establish mills, interim processing facilities and distribution networks at the appropriate scale**

    Private investment favors very large sawmills and biomass facilities, as economies of scale resulting from automation and private financing mechanisms push the facilities to ever-larger size. Large, highly automated facilities require a large supply of very homogeneous product – similar size and species. These qualities are inconsistent with what is needed for effective dry, mixed conifer forest

restoration, which requires a flexible facility with multiple products, appropriately scaled for the efficient haul distances for a variety of products (chips, post and poles, biochar, and so on) and that can process the variety of species and diameters from forests that are managed using uneven-aged management techniques. There has been minimal public and philanthropic financing in mill infrastructure to date given the high financial risk, large amount of capital, and technical knowledge required. Public agencies like NRCS with technical knowledge should partner with philanthropic entities to direct resources efficiently. Public entities could include educational institutions like universities, who should be engaged to research new products using small-diameter wood (e.g. CLT products from pine species).

5. **Investigate hub-and-spoke approaches to reduce costs:** A "hub and spoke" approach is where mobile processing equipment is combined with stationary processing at a regional wood campus, where there are potential economies of scale in sourcing, marketing, accounting and financing, and sales. Wood could be sorted, peeled, or chipped on the landing with mobile equipment and a higher value product could be transported to a regional processing center to be converted into an end-product like a post-and-pole for hops, or torrified wood for power plants. The advantage of these integrated centers is the ability to transport the higher-value material to the processing center where it can be converted to more valuable material in a one-step process. Given the low margins, any proposed value-added activity needs to significantly minimize sorting and handling.

Our experience piloting a restoration strategy and conducting fuels treatment on Desolation Creek shows that investing in dry-side forests in Interior Oregon and Washington, is challenging, and at best a cost-neutral activity, which creates a dearth of private investment in these lands. The lack of viable and stable end-markets that accept small-diameter wood and the long haul distances to mills or processing facilities are the main contributors to this challenge. Willing landowners like EFM are further challenged by implementation barriers that include limited contractor capacity and the cost of additional sorting which is required to access non-traditional end-markets.

In summary, the opportunity to significantly address climate change, reduce wild-fire risk, improve human health and increase rural prosperity via public-private investments in interior-forests cannot be overlooked. There are potential solutions like the ones that have been outlined above that require further coordinated analysis and research. None of these solutions are possible without carefully coordinated public and philanthropic resources that are targeted at high priority landscapes that can be selected strategically. Public and philanthropic resources must be coordinated and be structured to lower risk and create price support mechanisms that are key to attracting private investment.