Assessing the Economic Benefits of Conservation Stewardship Investments in the Blackfoot Watershed

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Blackfoot CHALLENGE
Better Rural Communities through Collaborative Conservation

Yale SCHOOL OF THE ENVIRONMENT

Ucross High Plains Stewardship

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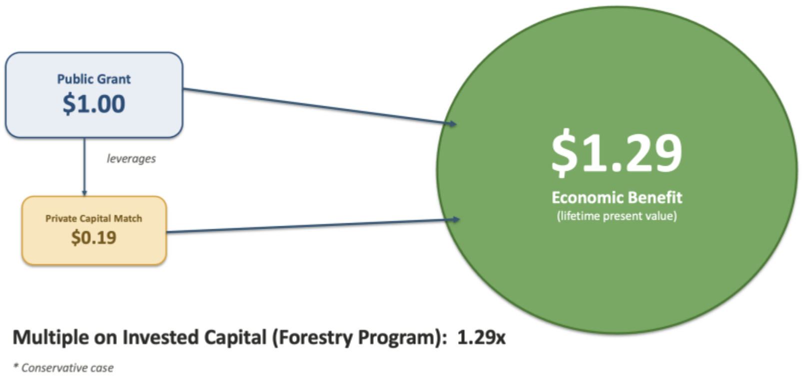
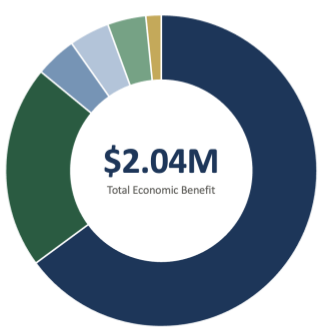
Between 2019 and 2025, the Blackfoot Challenge deployed approximately $1.59 million of public grant capital across five forestry awards to treat roughly 1,853 acres in the Blackfoot watershed through mechanical thinning and prescribed fire. **Every dollar of public capital mobilized an additional $0.19 of private match and generated an estimated $1.29 of lifetime present-value economic benefit**.



Approximately 70% of the program's economic benefit flows through job creation; the remainder accrues as avoided wildfire damages to standing timber, public suppression budgets, and ecosystem services.



COMPONENT	% TOTAL
Job Creation (Contractual)	65.1%
Avoided Timber Loss	21.1%
BC Salary (Job Benefits)	4.3%
Timber Revenue	4.2%
Avoided Non-timber Loss	4.0%
Avoided Suppression	1.6%

Water Program

Blackfoot Challenge's Water Program provides drought mitigation resources to irrigators including a drought response plan, technical guidance, riparian restoration work, and recreational stewardship. The benefits of these program activities can be grouped into three categories: irrigation, recreation, and ecosystem services. The summary results for each category are as follows.

- Irrigation
    - Agriculture is a major industry in the Blackfoot watershed and drought threatens the water supple needed for adequate irrigation
    - For every 10 jobs on farms and ranches, an additional 10 jobs are created regionally
    - For every dollar of value added by farmers, an additional $2.22 is created in other sectors
    - Blackfoot Challenge’s drought response plan avoids $2.5 million of lost income for producers annually
- Recreation
    - Blackfoot Challenge’s drought response plan and restoration work helps maintain in-stream flows and water quality
    - Angling is the most important recreational use of the Blackfoot River, with 83,000 angling days in 2023
    - A 1% decrease in angling days will decrease spending in the region by $360,000 annually
- Ecosystem Services
    - Riparian restoration efforts help enhance ecosystem services in the region
    - Ecosystem services include erosion control, climate regulation, nutrient cycling, water cycling, recreation, and cultural identity
    - Ecosystem services in the Blackfoot watershed are valued at $2-3.5 million over the period from 1991-2021

Introduction

The Blackfoot Challenge (BC) is a globally recognized leader in cooperative conservation and is based in Western Montana's Blackfoot watershed. While officially incorporated as an NGO in 1993, BC's origins date back to the early work of visionary landowners in the 1970s who saw opportunities to conserve and manage land, water, and wildlife in a more holistic way.

BC's long-standing efforts in collaborative conservation have been founded on the premise that building partnerships between private landowners, NGOS, and state and federal agencies produces tangible conservation gains that benefit the public good. The work of BC has generated significant conservation impacts for grizzly bears, wolves, native fisheries, forests, grasslands, and watershed resilience in the face of climate change. In addition to the positive ecological benefits provided by BC in places like the Blackfoot watershed, economic activity derived from conservation can have direct benefits to communities.

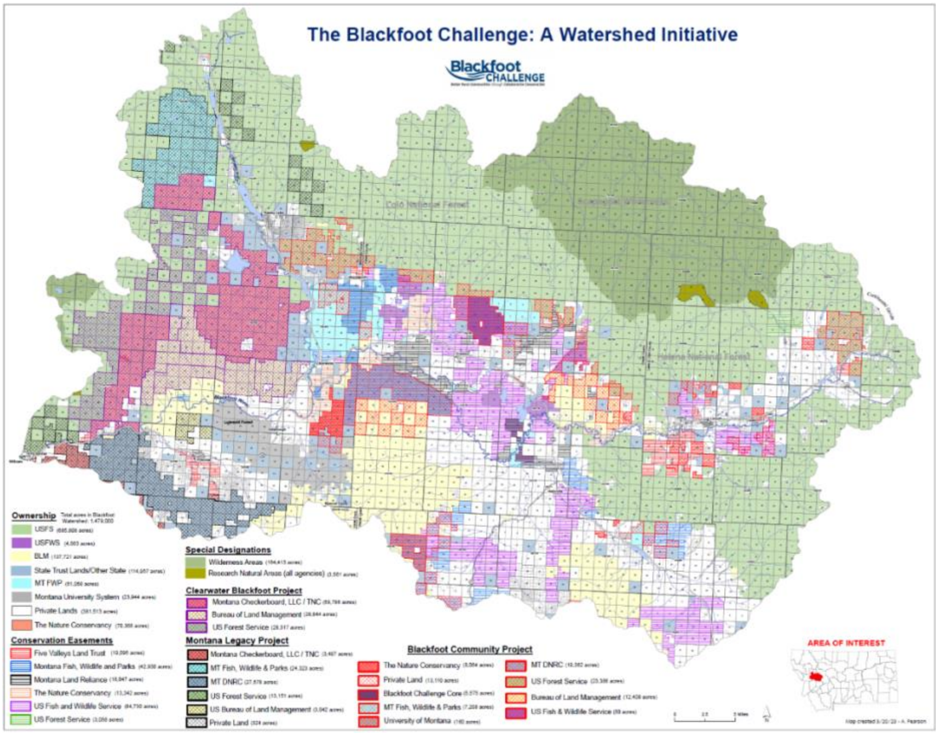
These benefits are often not directly visible, which means they are often undervalued. The purpose of this report is to offer a case study that quantifies the economic benefits of public investments that come from state and federal sources. This analysis represents a data-driven example that quantifies the economic ripple effects of public investments in a rural western landscape. Specifically, this report values the public investments in BC's Forestry and Water Programs during 2020-2025.

In addition to providing an economic analysis, this report also offers a methodological template that other conservation organizations can use or build off to estimate the economic benefits of their own actions. This analysis and methodology can be further refined and/or updated with additional or new data in the future.

Background

BC works at the landscape scale across public and private lands in the Blackfoot River Watershed. The 1.5 million acres watershed incorporates parts of Missoula, Powell, and Lewis and Clark Counties. The watershed has a mosaic of landowners, including U.S. Forest Service (USFS), U.S. Fish and Wildlife Service (USFWS), Bureau of Land Management (BLM), Montana Fish, Wildlife, and Parks (MT FWP), Montana University System, state trust lands, The Nature Conservancy, and private landowners. Many of these parcels are in a checkerboard of alternating public and private ownerships, a holdover from nineteenth century railroad land grants (Figure 1).[1]

Figure 1. Land ownership in the Blackfoot watershed



Source: The Blackfoot Challenge

By working at the landscape scale and across ownerships, BC has been able to serve as an organization that has brought people together and facilitated respectful conversations for nearly three decades. This has generated bottom-up solutions embedded in public and private partnerships. Noteworthy conservation successes include: 1.3 million acres of land permanently protected from development, creation of a 5,600 acre community-owned and managed forest, restoration of native trout habitat, a drought response plan to maintain in-stream flows in the Blackfoot River, conservation of grizzly bear and wolf populations through conflict reduction, restoration of native trumpeter swans, and improvements to native grasslands and soil health across hundreds of working ranches.

BC groups its conservation priorities into nine programs: birds, water, wildlife, forestry, land stewardship, recreation, vegetation, science, and education. For this study, we focused on two of these nine programs: forestry and water. These are two of the most robust programs which engage with some of the region's most important industries.

[1] The Blackfoot Challenge (2026). "Blackfoot Community Conservation Area." https://www.blackfootchallenge.org/what-we-do/blackfoot-community-conservation-area/

Forestry Program

Forests cover more than 80% of the Blackfoot watershed. Lower elevations support ponderosa pine (*Pinus ponderosa*), lodgepole pine (*Pinus contorta*), Douglas-fir (*Pseudotsuga menziesii*), and western larch (*Larix occidentalis*), while subalpine fir (*Abies lasiocarpa*) and Engelmann spruce (*Picea engelmannii*) dominate mid- and upper-elevations. These are fire-adapted forests where historically, low-intensity fires burned through lower-elevation stands every 10 to 40 years, clearing litter and leaving behind mature, fire-resistant trees[2]. A century of fire suppression and intensive logging has disrupted that cycle, producing overgrown stands that are vulnerable to large, high-severity wildfires[3]. At the same time, residential development has extended a Wildland-Urban Interface (WUI) deep into the forest, putting homes, communities, and lives at risk.[4]

BC's Forestry Program works with private landowners to restore forest health and reduce wildfire risk near homes and communities. The major three programs in forestry are 1) Fuels Reduction Program 2) Prescribed Fire 3) Forest Health. Statistically, Forestry Program has treated more than 2,100 forested private acres to date, averaging roughly 400 acres per year[5].

The Fuels Reduction Program is a partnership among BC, local fire departments, state and federal agencies, and private landowners that provides landowners technical assistance and cost-share grants that cover up to half of the fuel reduction treatment cost, including practices like thinning and pruning trees, chipping, and biomass removal. Since the inception of BC's Forestry Committee in 2008 to the present, approximately 110 landowners have received funding for fuel reduction, 21 local contractors had been supported, and the program treated [6] forested acres each year. Established in 2017, the Prescribed Fire Program complements mechanical fuels reduction by reintroducing low-intensity fire onto treated stands, which specifically supports piling and burning thinning slash, broadcast burning understory, and coordinating multi-agency burns through the Montana Prescribed Fire Council. The Forest Health program focuses on restoring forest

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[2] Blackfoot Challenge, *Stewardship Guide*, "Forestry & Fire—By the numbers in the Blackfoot watershed," p. 20. https://blackfootchallenge.org/stewardship-guide
Blackfoot Challenge, *Stewardship Guide*, "Forestry & Fire—By the numbers in the Blackfoot watershed," p. 20. https://blackfootchallenge.org/stewardship-guide
[4] Blackfoot Challenge, *Stewardship Guide*, "Forestry & Fire," pp. 19–24. https://blackfootchallenge.org/stewardship-guide
[5] Blackfoot Challenge Forestry Program https://www.blackfootchallenge.org/what-we-do/forestry/
[6] Blackfoot Challenge, *Stewardship Guide*, "Forestry & Fire—By the numbers in the Blackfoot watershed," p. 20 (figures as of 2020). https://blackfootchallenge.org/stewardship-guide

stand structure and resilience to insect, disease, and climate change on lands that have been fire-excluded for a century.

Residents in Montana have been experiencing frequent wildfire events of different scales, and to suppress the wildfire, the state government funded over $30 millions in wildfire suppression projects in 2024[7] and this number is expected to reach $50 – 70 millions for 2025[8]. Rising suppression costs have, in turn, motivated public and private investment in wildfire treatment programs of the kind described above. Among public funders, the Bureau of Land Management (BLM) and the Montana Department of Natural Resources and Conservation (DNRC) are leading grantors supporting prescribed fire, mechanical thinning, and related fuels-reduction work across the state.

Recent Wildfire History (2014-2024) in the Blackfoot Watershed

From 2015 through 2024, Montana averaged just over 2,000 wildfire starts per year in a fairly stable band of roughly 1,300 to 2,600 fires annually. Two seasons, 2017 and 2021, produced roughly two thirds of the decade's cumulative footprint, while six of the ten years burned under 200,000 acres each.

The 2017 season alone accounted for three large in wildfires (Alice Creek, Liberty, and Rice Ridge) totaling roughly 213,000 acres, with Rice Ridge's 155,900 acres standing as the single largest event on record in the watershed; a decade earlier the 2007 Jocko Lakes Fire (about 36,400 acres) had come within a mile of the community of Seeley Lake.

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[7] The state of Montana & Funding Wildfire Suppression p.7 https://archive.legmt.gov/content/Publications/fiscal/2025-Biennium/Special-Topics/Wildfire/Wildfire-Suppression-Funding-Presentation-Aug2024.pdf

[8] Daily Montana "State on hook for up to $70 million in fire suppression costs this season" https://dailymontanan.com/2025/11/21/state-on-hook-for-up-to-70-million-in-fire-suppression-costs-this-season/

Figure 2: Montana wildfire activity, 2015-2024

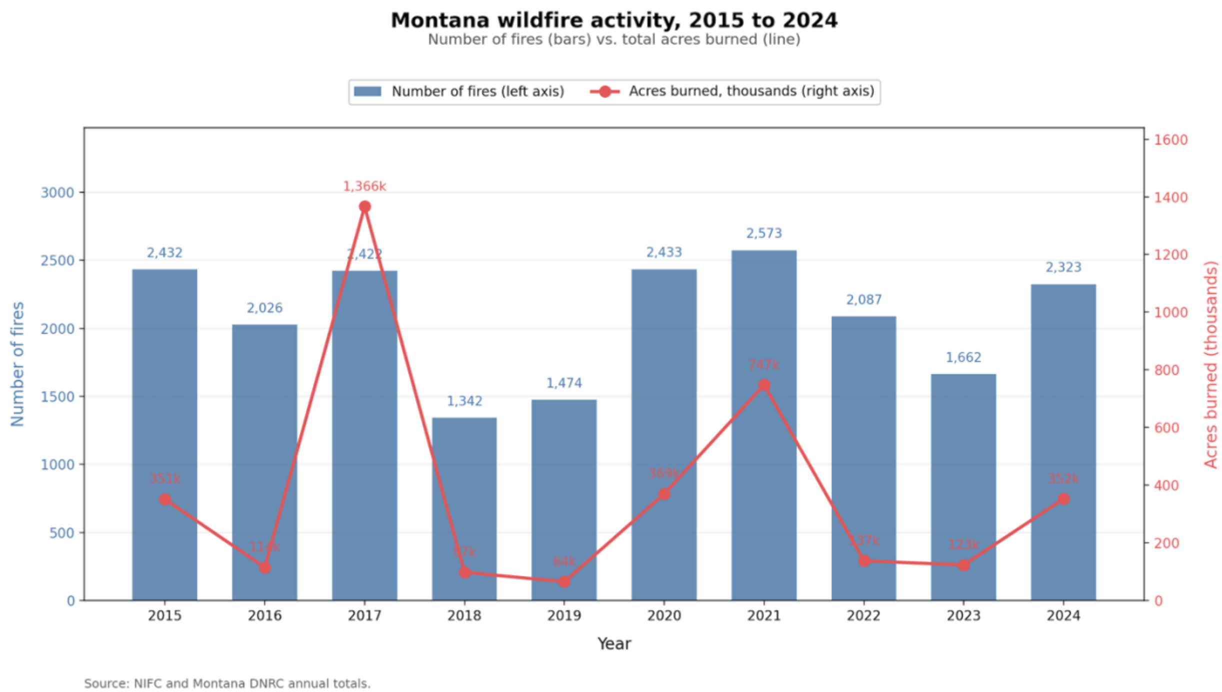
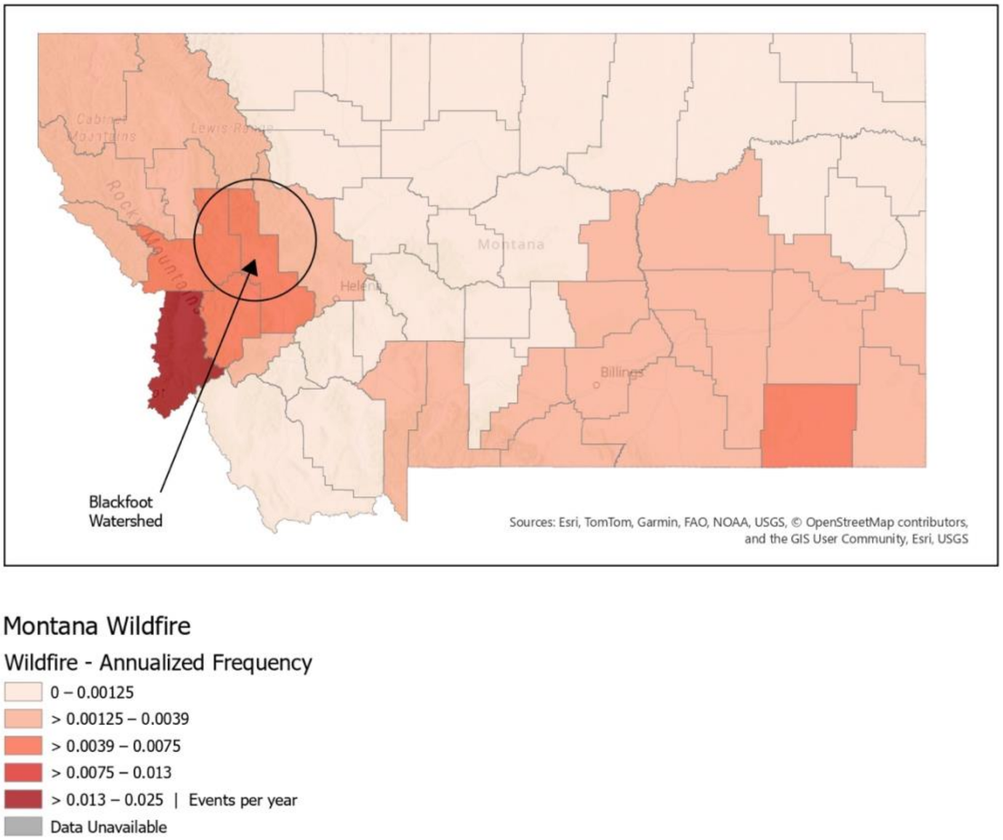


Table 1: Recent wildfires in Blackfoot watershed

Year	Fire	Acres burned	Location	Character
2017	Liberty	≈36,000	Seeley Lake	Mixed severity; threatened Seeley Lake community and forested WUI
2017	Alice Creek	≈29,000	Headwaters above Lincoln	Mixed severity; long-duration summer fire on Helena–Lewis & Clark NF
2017	Liberty	≈28,000	Upper Gold Creek / lower Blackfoot	Mixed severity; mosaic of burned and unburned patches
2017	Rice Ridge	≈160,000	Clearwater River drainage (Seeley Lake area)	Largest fire of the past 30 years to touch the broader watershed; mixed-severity mosaic
2023	Colt	≈7000	About 15 mi NW of Seeley Lake, Lolo NF	Low to moderate severity with localized high severity pockets; lightning ignition

Source: MTBS (Monitoring Trends in Burn Severity

Figure 3: Montana Wildfire Annualized Frequency, 2025



Blackfoot Watershed (circled in Figure 3) falling within the 0.0075–0.013 wildfire events per year class, which is equivalent to a per-location annual burn probability of 0.75%–1.3%, or a fire return interval of roughly 75–130 years. This places the watershed in an elevated-risk regime, well above the eastern Montana baseline (<0.125%) but below the Bitterroot Range peak immediately to the southwest (1.3%–2.5%).

The 0.75%–1.3% figure may appear low relative to Montana's around 2,000 reported wildfire ignitions per year, but the two metrics measure fundamentally different things. The FEMA NRI annualized frequency is derived from FSim Monte Carlo simulation, which can be simply understood as the total acres of land burned over total size of Montana. In 2024, 352,491[9] acres of land burned, and it is equivalent to 0.37% wildfire annualized frequency, which is close to the Montana state average.

[9] Live Montana Fire Map and Tracker. https://www.frontlinewildfire.com/montana-wildfire-map/

Forestry Grants Portfolio, 2019–Present

Before quantifying the economic benefits of BC's conservation efforts in the Forestry Program, it is useful to describe BC's grant portfolio that funded the conservation. During 2019-2025, BC's Forestry Program has been financed through a variety of federal and state cost-share awards that directly paid for mechanical thinning, hand piling, and prescribed fire private forested lands in the watershed. This assessment focuses on five awards: two Bureau of Land Management Community Assistance agreements (L19AC00056 and L24AC00644) and three Montana Department of Natural Resources and Conservation awards (Community Wildfire Defense CWD-23-003, Forest Action Plan ACT-24-002, and Western States Fire Managers WSF-23-005) (Table 2). Four additional awards that the Program held during this window are omitted from the acres-on-the-ground accounting because they funded training, outreach, or prescribed-fire capacity-building rather than per-acre treatment: the Resources Legacy Fund grant that underwrites the Montana Prescribed Fire Council, and three TNC-administered subawards (Fire Learning Network, Blackfoot-Valley FLN, and Promoting Fire-adapted Communities). These capacity grants are essential program infrastructure but do not integrate cleanly onto the per-acre benefit framework used in the following section, so they sit outside Table 2 and the figures that follow it.

Table 2: Forestry Grants Portfolio — duration, grant amount, match, and acres treated (five awards financing direct treatment, 2019–present)

Grant / Agreement	Source	Duration	Grant Amount	Match	Treated Acres
BLM L19AC00056	BLM (Community Assistance)	Aug 2019 – Aug 2024	$596,090	$66,746	541 (closed)
BLM L24AC00644	BLM (Community Assistance)	Apr 2024 – Mar 2029	$272,407	None required	162.4 (ongoing)
DNRC CWD-23-003	DNRC / USFS (Community Wildfire Defense)	Nov 2023 – Nov 2026	$1,433,300	$360,000	1,311 (ongoing)
DNRC ACT-24-002	DNRC (Forest Action Plan)	May 2024 – Apr 2026	$200,000	$50,000	128 (ongoing)
DNRC WSF-23-005	DNRC (Western States Fire Managers)	Jul 2023 – Jun 2025	$155,000	$38,750	245 (closed)

Grant / Agreement	Source	Duration	Grant Amount	Match	Treated Acres
Total (treating grants)	**—**	**2019–2029**	**$2,656,797**	**$515,496**	**~2,387**

Sources: Blackfoot Challenge Forestry Tracking Sheet (grant-level tabs and All_Yearly_Stats); BLM L19AC00056 Final Report workbook and BLM L24AC00644 quarterly reports (TREATMENTS tab); DNRC ACT-24-002, CWD-23-003, and WSF-23-005 agreements; BLM L24AC00644 original agreement and Amendment 1. "Target" acres reflect grant-proposal targets (BLM L19AC00056 had no acres target in its scope of work); "Treated" acres are unique project footprint reported through quarterly or final performance reports.

BC's Forestry Program has a portfolio of $3.17 million awarded grants and landowners' match. State dollars from DNRC dominate the portfolio (about 56% of total funding), with the Community Wildfire Defense award alone accounting for 45% of the total and serving as the program's primary engine through 2024. Federal BLM support covers about 27% of the portfolio, and non-federal match, raised primarily from private landowner, accounts for the remaining 16% of project value.

Across 2019–2025, the program has treated roughly 2,387 acres of land through five federal and state grants, with an additional 321 acres remaining on still-active awards. Noticeably, Blackfoot Challenge managed to treat around 1,300 acres of land in 2024. Activity is highly uneven across years, reflecting the natural lifecycle of individual grants and a recent shift toward larger, more concentrated awards. From 2019 through 2023, the BLM L19AC00056 award carried the program almost single-handedly at a modest 60–150 acres per year. The steep increase of acres treated is contributed to DNRC Community Wildfire Defense (CWD-23-003) delivered roughly 935 acres in a single year.

Table 3: Forested Land Treatment Example

Project ID	Acres	Mechanical								Fire	
Ex: Landowners Last Name, Lot #, Subdivision Name, Address, etc.	*Summation of acres on all activities performed*	Thinning	Hand Pile	Lop and Scatter	Chipping	Crushing	Machine Pile	Mastication or Mowing	Biomass Removal	Hand Pile Burn	Other
ex: Jones Property	30	10			10				10		

Each treated parcel is reported under one or more action types within two broad categories. Mechanical treatments include thinning, hand and machine piling, lop and scatter, chipping, biomass removal, crushing, and mastication or mowing. Fire treatments include hand-pile burning and broadcast prescribed burning. A single parcel often receives multiple actions, which is why "acres treated" and "action-acres" can differ. For example, BC used a BLM grant to treat 10 acres on the Jones Property, as illustrated by Table 3 above, applying three actions to the same 10 acres of land: thinning, then chipping, then biomass removal. This counts as 10 acres treated (the size of the land under treatment) but 30 action-acres (10 acres × 3 actions). Statistically, in terms of the category of the actions that are taken on the lands, the portfolio leans heavily toward mechanical treatment, which accounts for roughly 76% of cumulative action-acres.

Figure 4: Acres treated by calendar year and grant, 2019–2025, with remaining (target-minus-actual) acres on still-active grants

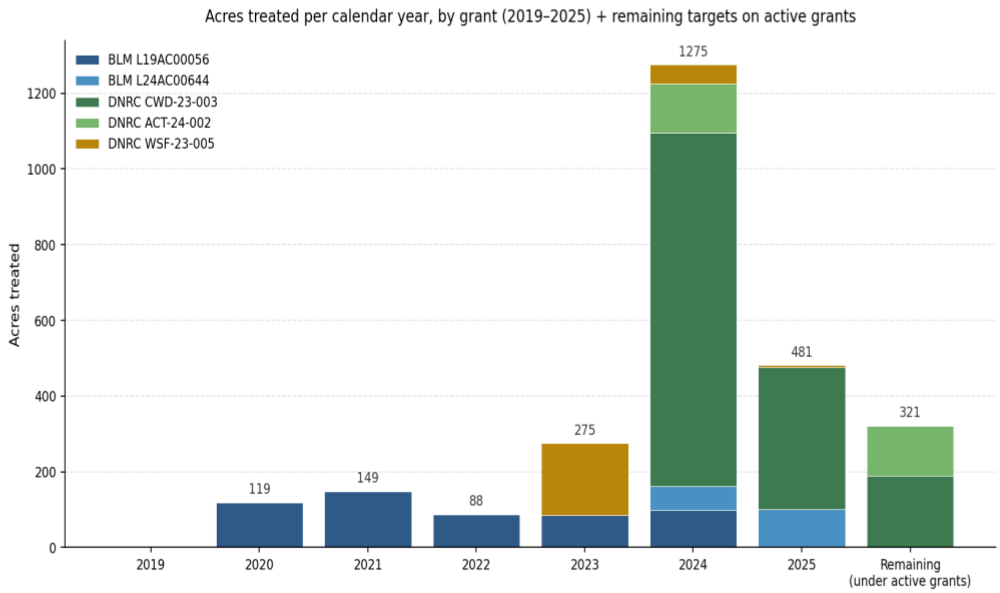
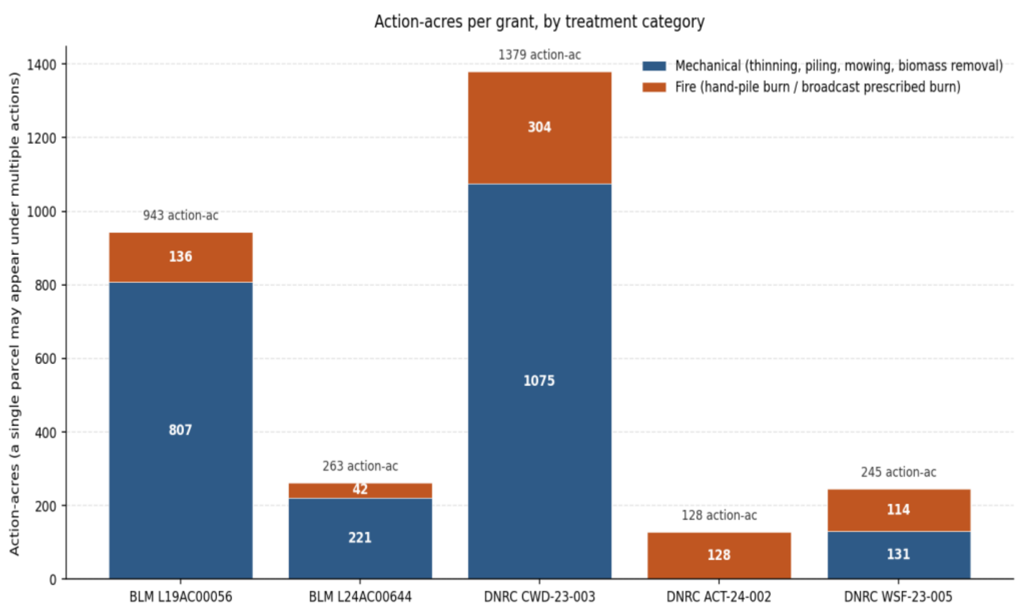


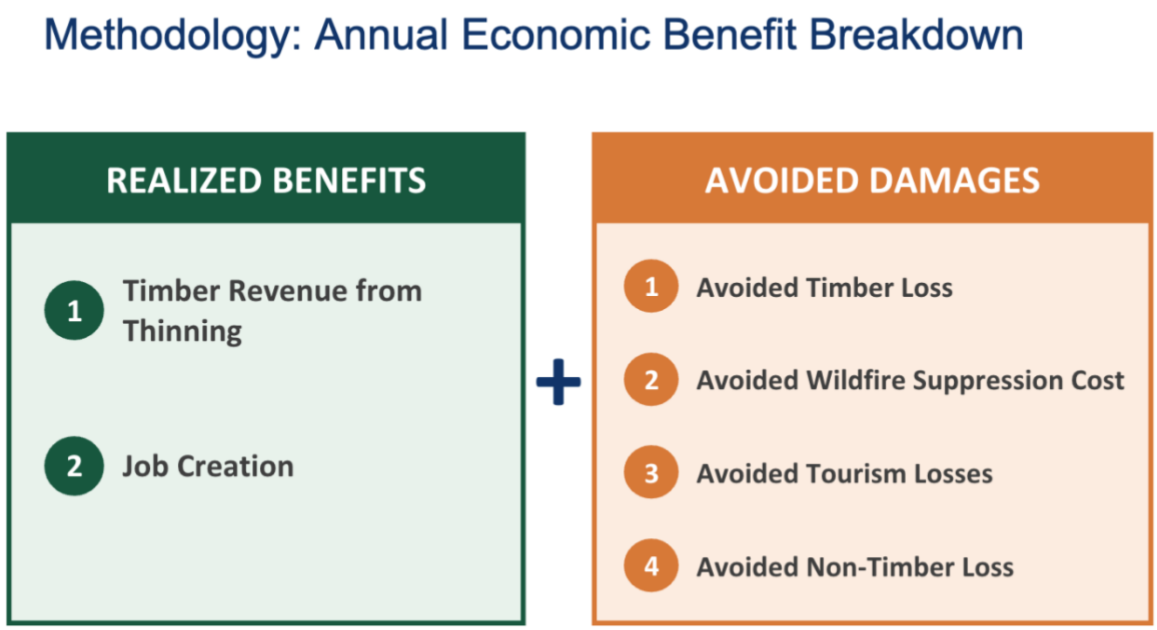
Figure 5: Action-acres per grant by treatment category (mechanical thinning / hand piling vs. prescribed fire). An "action-acre" counts each pass across an acre as a separate tally—a parcel that was thinned and then machine-piled contributes twice



Modeling the Economic Benefits of Forestry Grants

To quantify the economic benefits of these public-private investments in the BC Forestry Program, we built an economic benefit model adapted from Mason et al. (2013), who quantified the net benefits of mechanical fuels treatments across the western United States.[10] The model converts each grant's reported acres treated, treatment type, and contractor and labor spending into a present-value estimate of six benefit streams: (1) timber revenue from thinned stands, (2) avoided timber losses had the treated stand burned, (3) avoided wildfire suppression costs, (4) avoided recreation and tourism losses, (5) avoided non-timber losses (property, ecosystem services, public health), and (6) jobs and contractor income supported by the grant. Taken together, this provides a holistic means for quantifying the overall benefits from investments in wildfire mitigation using public and private funds.

Figure 6: Annual Economic Benefit Breakdown



The total annual economic benefit of each forestry grant breaks down into two categories: realized benefits and avoided damages. Realized benefits are the money that flows into the local economy in the year the work happens, regardless of whether a wildfire ever occurs.

[10] Mason, C. L., Lippke, B. R., Zobrist, K. W., Bloxton, T. D., Ceder, K. R., Comnick, J. M., McCarter, J. B., & Rogers, H. K. (2013). "Quantifying the net economic benefits of mechanical wildfire hazard treatments on timberlands of the western United States." *Forest Policy and Economics*. https://www.sciencedirect.com/science/article/pii/S1389934112000408

These include (1) timber revenue from the trees harvested during thinning operations and (6) jobs and contractor pay supported by the grant. Think of these as the certain, "in-hand" benefits. Even if the next decade is unusually wet and no fire ever comes near the treated parcel, these benefits have already been realized.

Avoided damages are different; they are the losses that would have occurred had a wildfire burned through the parcel, multiplied by the annual probability of that fire actually happening (λ). These include (2) avoided timber losses on the stand itself, (3) avoided suppression costs that state government would have paid to fight the fire, (4) avoided recreation and tourism losses from smoke and trail closures, and (5) avoided non-timber losses including damage to homes, ecosystem services like clean water, and public health impacts from smoke. Because we don't know whether a fire will actually happen, we scale this entire bucket by λ, which is the chance of a fire in any given year.

Figure 7: Total Economic Benefit Calculation Methodology

2 **Total Economic Benefit of the Grant**

Sum the discounted annual benefits across the grant's lifespan.

Total Economic Benefit = Net Present Value (NPV)

sum of all discounted annual benefits, year 1 through year T

Formal notation

$$\mathbf{NPV} = \sum_{t=1}^{T} \text{Benefit}_t \cdot \textit{discounting factor}_t$$

After calculating the annual economic benefit of one forestry grant for a single year, we could arrive at total economic benefit of the grant by adding up the annual benefit within the tenor of the grant and apply a discounting factor to account for the time value of money (Figure 7).

Assumptions

Forest coverage within the Blackfoot watershed is assumed to be 80%, consistent with the Blackfoot Challenge *Stewardship Guide*. Stand volume, tree density, and species composition estimates were taken from the U.S. Forest Service Rocky Mountain Research

Station's *Montana Forests 2020 FIA Snapshot*, which reports 11.8 billion live trees on 26.35 million acres of forest land (447.8 trees per acre) and a standing volume of 52.1 billion cubic feet (1,976 ft^3/acre), with species shares of 23.0% lodgepole pine, 21.2% Douglas-fir, and 20.5% subalpine fir. As Top 3 timber types account for around 70% of the total population, and condition on the fact that the market price for these timbers is not significantly different, I choose to rescale three shares to sum to 1 (35.6% lodgepole, 32.8% Douglas-fir, 31.7% subalpine fir) and used to weight timber prices throughout the model. Thinning is assumed to leave a residual spacing of 10 feet between trees, corresponding to 435.6 trees per acre (√ (43,560 ft^2/ac ÷ $spacing^2$)); the implied removal is 12.23 trees per acre. Every removed tree is assumed merchantable.

We worked with Samuel Scott, a Forest Economist at University of Montana's Bureau of Business and Economic Research (BBER), to come up with two reasonable approximations for stumpage price of thinned timbers. In accordance with BBER assumptions, the average stumpage price across species is around $20.4/MBF, and $163.2/MBF if we use DNRC Trust sales in the area[11]. The huge difference between these two numbers is due to extremely different hauling price, contract cost, and logging cost. Sensitivity analysis on these two different cases, denoted as base case and upper case in the economic model. Besides, the salvage recovery share is 15%, so the fraction of standing timber value actually lost when a stand burn is k = 0.85.

Another key assumption we make to avoid mistakenly modeling the extremely complicated and fluctuating dynamics of wildfire spread is that a wildfire on any one treated acre only spreads within that acre. Consequently, each type of avoided damages is equivalent to the number of acres treated multiplied by the per-unit avoided damage of that category. For instance, to calculate avoided timber loss, we multiply total acres treated by the average stumpage value of timber on one acre of land

Avoided suppression cost is derived from the past-10-year (2012–2021) average of state-only Montana wildfire suppression cost per acre burned, per the Montana Legislative Fiscal Division's *Wildfire Suppression* brief[12]. For non-timber losses, the ecosystem-service and public-health portion of N_t is priced using Mason et al. (2013), who estimate non-timber avoided wildfire damages of $495 per hectare base case and $1,485 per hectare upside (Forest Policy and Economics, Table 4); applying the hectare-to-acre conversion (2.471 ac/ha) gives $200.32/ac and $600.97/ac respectively. These two numbers are regarded as base case and upper case in the sensitivity analysis.

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[11] Due to the limitation of data, we assume same stumpage price across tree species. This is not a materially influential assumption since the sawlog prices across species are similar

[12] Montana Legislative Fiscal Division, Wildfire Suppression brief, updated September 2022.

Job benefits are measured directly from grant disbursement records. Spending on employing third-party contractor to conduct wildfire treatment work, which is recorded as contractual spending in BC's balance sheet, is the primary contributor to the job creation benefit of the program. Besides, Salary of Blackfoot Challenge employees recorded on the forestry program's balance sheet is another source of job benefit.

Three model-wide parameters close out the parameterization. Annualized wildfire frequency, or wildfire occurrence probability, λ is set to 1.3% according to 2025 FEMA (Federal Emergency Management Agency) data with 3% as the upper case. A 1.3% annualized wildfire frequency implies that, on average, any given acre in the Blackfoot Watershed burns once every 76 years, which is an extremely conservative estimate at first glance. This figure may seem unrealistic given that thousands of acres burn each year in the watershed, but the nuance lies in how annualized wildfire frequency is defined. The metric measures the probability of wildfire occurring on any arbitrary acre within the target area, typically approximated as the annual acreage burned divided by the total area of the watershed. The 1.3%–3% range becomes intuitive when we divide the average annual burned area (~70,000 acres) by the total Blackfoot Watershed area (~1.5 million acres), which yields a value at roughly that scale

To calculate net present value (NPV) of BC's investments, we set real discount rate *r* equal to 4%, which is applied to future avoided losses, consistent with standard federal cost-benefit practice. The benefit-matrix scoping assumption is that only thinning generates direct timber revenue; every other mechanical action (hand pile, lop and scatter, chipping, crushing, machine pile, mastication/mowing, biomass removal) and every prescribed-fire action (hand pile burn, broadcast burn) contributes only to the avoided damages and job benefit streams.

Last but not least, regarding the persistence of wildfire treatment effects, the theoretically appropriate analytical horizon would span at least several decades, as a single prescribed burn can provide ecosystem services to a forest over a long-time scale. To facilitate economic quantification, however, we assume that treatment effects persist for five years following the conclusion of the grant period. Drawing on Prestemon et al. (2010) and Mercer et al. (2007)[13], and adjusting downward to maintain a conservative estimate, we assume that treatment effectiveness is 75% in the first post-treatment year and decays to 28% by the fifth year. Avoided damages are the only benefit category to which this

[13] T. Davis, Jamie Peeler, Joseph Fargione, Ryan D. Haugo, Kerry L. Metlen, Marcos D. Robles, and Travis Woolley, "Tamm Review: A Meta-Analysis of Thinning, Prescribed Fire, and Wildfire Effects on Subsequent Wildfire Severity in Conifer Dominated Forests of the Western US," *Forest Ecology and Management*.

temporal decay is applied; all other categories are treated as one-time effects realized in the year of treatment.

Results

The five forestry grants modeled in this study collectively raised approximately $2,656,797 of state and federal public capital to target treating roughly 2,400 acres of forest in the Blackfoot watershed since 2019. Considering some of the grants are still on going, we merely focus on accounting for the impact of invested capital ($1.59 million dollars as of 2025).

Economic Benefit Achieved by Investing in $1 of Public Capital in Blackfoot Challenge's Forestry Projects

Applying the economic model framework described in the preceding section across the five grants, these treatments are estimated to generate $2.05 million[14] in lifetime present-value economic benefits at a 4% discount rate, equivalent to a portfolio multiple on invested capital (MOIC) of 1.29x. In plain terms, every public dollar entrusted to BC returned an estimated $1.29 of measurable economic value to the region. Returns varied modestly across grants, ranging from 1.16x on BLM L19AC00056 to 1.84x on DNRC ACT-24-002, with the three intermediate grants clustering tightly between 1.25x and 1.49x. The dispersion in MOIC across grants is driven less by award size than by treatment mix and is a direct consequence of two structural features of the model: the per-acre benefit profile of each treatment type and its relative unit cost. On the benefit side, thinning and prescribed fire produce similar per-acre economic value in our framework, because both reduce future wildfire damages by the same modeled amount; the only material difference is that thinning generates direct timber revenue at the time of treatment, whereas prescribed fire does not. On the cost side, however, mechanical thinning carries a substantially higher per-acre cost than prescribed fire. As a result, prescribed-fire-heavy grants such as DNRC ACT-24-002 deliver a higher return per public dollar deployed, while thinning-heavy grants such as BLM L19AC00056 deliver a lower percentage return.

Figure 8: Economic Benefit Multiple of Invested Capital (MOIC) on Five Major Grants, 2019-2025

[14] all the results are uppercase scenario in the economic model

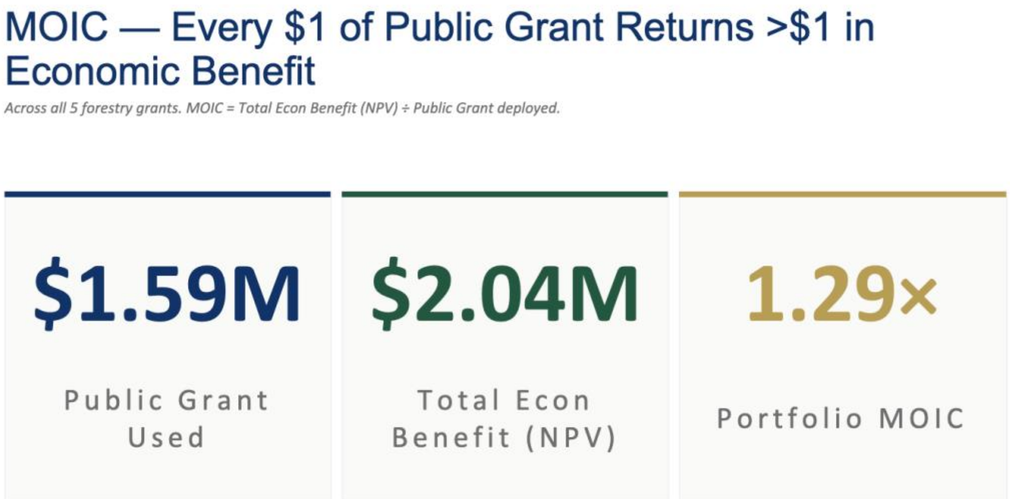
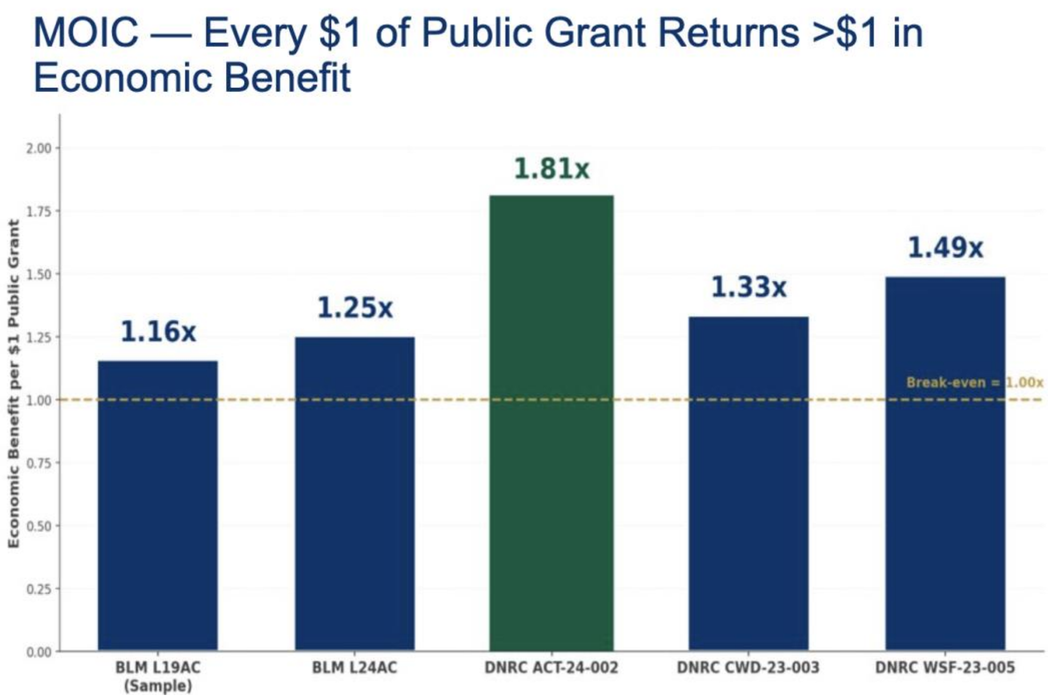


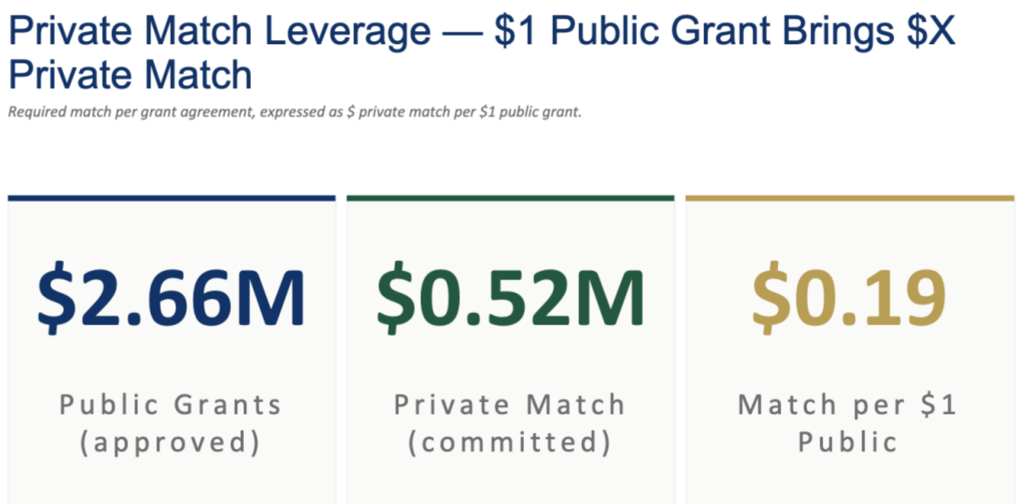
Figure 9: Economic Benefit MOIC for each Grant, 2019-2025



Private Capital Match for each $1 of Public Capital Invested in Blackfoot Challenge's Forestry Projects

The common approach for BC to incorporate private capital into forestry projects is the required landowner's match proportion of each grant. Across the five grants in the portfolio, federal and state agencies committed approximately $2.66 million in public capital, and there is a total of $515,496 of private match from landowners was formally pledged. Statistically, across the major five grants, a portfolio match ratio of $0.19 of private capital for every $1 of public capital, or 16.2% of total project cost.

Figure 10: Private Capital Match for BC's Major Public Grants, 2019-2025

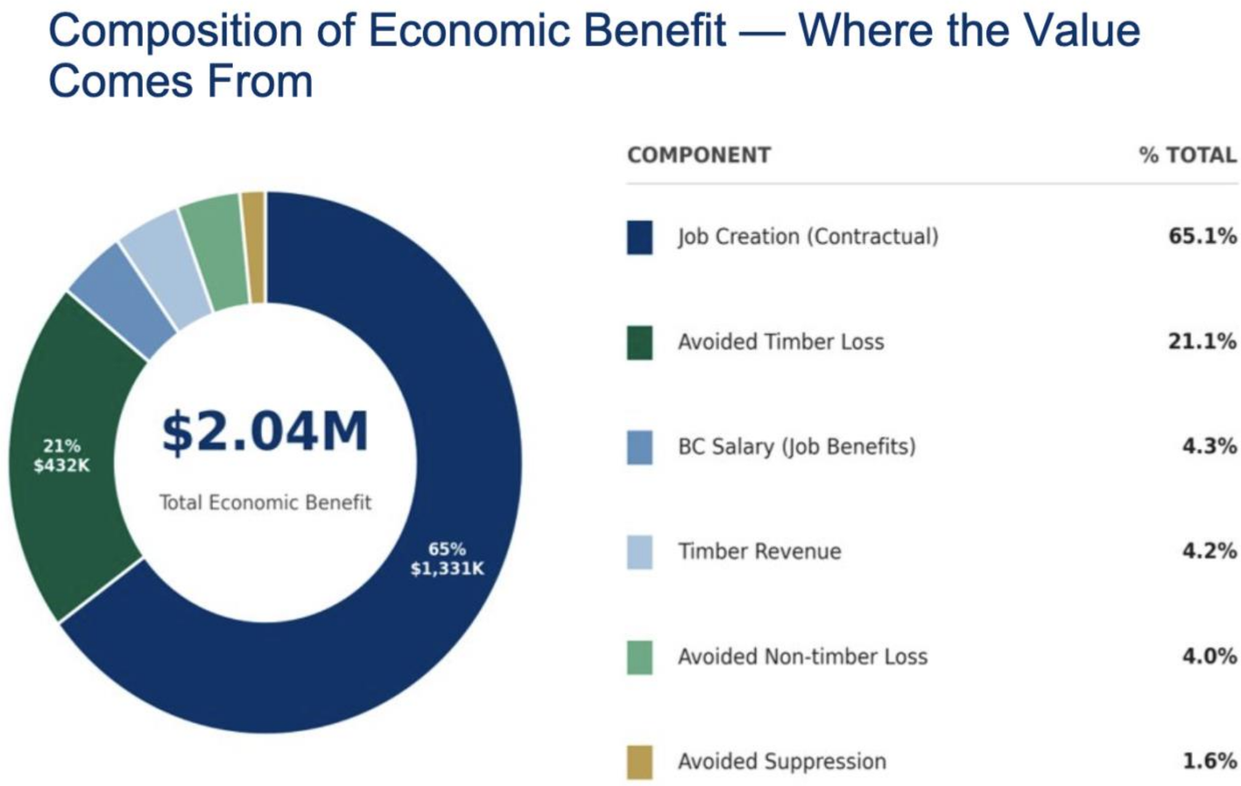


The match composition varies materially by funder. The three DNRC awards each carry the standard 20% non-federal match required under Montana's Forest Action Plan funding mechanisms ($360,000 on CWD-23-003, $50,000 on ACT-24-002, and $38,750 on WSF-23-005). The two BLM awards diverge: BLM L19AC00056 carried a modest 10.1% non-federal share ($66,746 against $596,090), while BLM L24AC00644 was structured without a formal match requirement.

Composition of on average $1.29 Economic Benefit Generated for $1 of Public Grant Investment

Approximately 70% of the portfolio's lifetime value (about $1.42 million) is generated through job creation, including contractor payments to local forestry crews and salary of BC staff. A further 21% (about $433,000) is attributable to avoided timber loss, that is, standing merchantable timber that fuels reduction shields from probabilistic future wildfire. Avoided non-timber damages, health losses of citizen and ecosystem services, contribute roughly 4% ($74,000), and avoided wildfire-suppression expenditures borne by state and federal agencies account for another 1.5% ($30,000). Direct timber revenue from harvest sales contributes the residual 4% (about $88,000).

Figure 11: Composition of an Average of 1.29x Economic Benefit



Discussion

Limitations of our Economic Model & Future Studies

The model's principal structural limitation is its treatment of wildfire spread: each treated parcel is modeled as a closed system, with any assumed ignition confined to a single acre and no allowance made for cross-parcel spillovers. Because the bulk of the economic benefit of fuels reduction work accrues precisely through such spillovers, the avoided-damage estimates reported above are best understood as a conservative floor rather than a central estimate. The model also limits the ripple effect of wildfire treatment to five years, even though some literature suggests the ripple effect could extend across ten years and, for prescribed-fire interactions with subsequent thinning, considerably longer. Another limitation of the model is that we apply a uniform wildfire effectiveness multiplier to all treatments; after talking to Cindy, the wildfire project manager of Blackfoot Challenge program, we learn that the probability of post treatment ignition differs materially across mechanical thinning, prescribed fire, and the sequential application of both, with combined treatments producing the most durable risk reduction. Moreover, our economic model only captures the most direct economic benefits of forestry projects while others are omitted. For instance, future studies should focus on modeling avoided structural property loss in the wildland-urban interface, non-sawlog forest-product revenue, the net carbon balance of treatment, and recreation[15], and biodiversity-habitat benefits. Last but not least, field interviews with landowners during our site visit in the watershed further indicated that the model overstates the merchantable share of timber generated by thinning operations, since not all thinned material is of sawlog quality or accessible to mill-bound transport, and the realized stumpage revenue per acre is typically lower than the model's assumed unit value.

A second class of limitations relates to the data usage. Stand-level forestry density was approximated using statewide Montana averages in the absence of parcel-level inventory data for the Blackfoot watershed; stumpage prices were assumed identical across tree species, a simplification driven by the unavailability of a disaggregated price series; and non-timber avoided-damage values were transferred from Mason et al. (2013), which were estimated for the western United States in aggregate rather than for this specific landscape. Finally, the discount rate of 4% and the wildfire-effectiveness multiplier of 75% are applied as point estimates throughout, without explicit treatment of parameter uncertainty.

Few directions for future research we think would materially strengthen the framework: integration of a physically grounded wildfire-spread simulation calibrated to Blackfoot-specific fuel loads, topography, and the historical distribution of fire sizes in the watershed; estimation of treatment-specific effectiveness coefficients that differentiate mechanical thinning, prescribed fire, and combined treatments; extension of the treatment-persistence horizon from five years to a literature-consistent ten-to-hundred-year decay schedule, paired with a sensitivity analysis on the discount rate and the wildfire-occurrence rate.

Potential to Incorporate Various Types of Private Capital into Forestry Projects

The average 1:0.19 ratio of private match per public dollar that the present land conservation public grant structure achieves is a significant institutional accomplishment for Blackfoot Challenge. The source of that match, however, is single: it comes entirely from individual landowners. Given the cash flow potential and impact investing characteristics of certain forestry projects, BC could plausibly broaden the private-capital base supporting future projects. Consider a representative mechanical thinning project.

[15] Our research suggests that there is no statistically significant correlation between tourism loss and wildfire events

Under the current model, BC covers roughly 84% of project cost through public grant capital, with the participating landowner contributing the remaining 16%. This project is expected to a direct cash flow from stumpage revenue, and a longer-horizon stream of avoided wildfire damages and ecosystem-service benefits captured by the economic model presented above. Both attributes, a pure cash component and a measurable conservation impact narrative, are precisely the features that institutional impact funds, ESG-oriented private equity, and conservation aligned philanthropy actively seek for. Therefore, forestry program has huge potential to be well structured as a typical project finance transaction to attract more private capital. Below is a hypothetical example of how we could structure a forestry project as a common project finance transaction to attract money from private equity firms and philanthropic entities. Consider a typical $200,000 mechanical thinning project assumed to generate $20,000 in stumpage revenue at harvest and, at the portfolio average MOIC of 1.29x, approximately $232,000 in present-value economic benefit. Under the conventional way of funding this project, it is a mix of $180,000 public capital and $20,000 landowner match, and the stumpage accrues to the landowner and the contribution breaks even. However, we could restructure the project to leverage PE and philanthropic capital to increase return for each party. Hypothetically, Blackfoot Challenge reaches an agreement with landowner to pledge $5,000 of expected stumpage revenue as a contractual yield to a private equity investor, attracting a $50,000 commitment with an effective 10% cash-on-cash return and this's forestry project's impact-investing nature; the resulting credibility also might be able to attract $40,000 of mission-aligned philanthropic capital, reducing the required public grant to $100,000 and the landowner contribution to $10,000. The landowner retains $15,000 of stumpage, which earns his/her $50,000 profit compared to zero in the conventional case; also, the economic-benefit multiple on invested capital for Blackfoot challenges will rise to 2.3x. Though the figures above are illustrative rather than empirically calibrated, it helps demonstrate that forestry projects, like mechanical thinning projects, possess the potential to attract various non-landowner private capital.

Water Program

Water is a critical resource in the Blackfoot watershed. It is used for irrigation, recreation, tourism, drinking water, and is the basis for the healthy ecosystems that make this region unique. The value of water comes from the many ways people benefit from a steady predictable supply. Since 2000, droughts have started earlier and lasted longer and have threatened that steady water supply.[16] BC is engaged in drought resilience and watershed restoration activities that will help mitigate drought effects and allow locals and visitors alike to continue to benefit from this critical resource.

Drought Response

In 2000, BC established the Blackfoot Drought Plan which implemented a voluntary drought response effort in the watershed. The Plan is based on the premise of "shared sacrifice for shared benefit," where participants cooperatively reduce water use to limit negative impacts on fish and share a limited water supply. Drought response has been implemented in 17 of the 26 years that the plan has been in action.

Two in-stream flow rights exist on the Blackfoot River for the purposes of protecting fisheries: the Murphy Right and the Milltown Right. The Murphy Right is co-owned by Montana Fish, Wildlife, and Parks (MT FWP) and the Confederated Salish and Kootenai Tribes (CSKT). It protects "blue-ribbon" fisheries like the Blackfoot River by establishing a minimum in-stream flow of 700 cubic feet per second (cfs) with a priority date of 1971. The Milltown Right was previously an in-stream hydropower right, but in 2015, was transferred to co-ownership by MT FWP and CSKT. The Milltown Right also requires a minimum in-stream flow of 700 cfs during the summer months, but its earlier priority date (1904) means more irrigators are junior and must comply with a call, a legal requirement where junior water rights holders must discontinue use if there is insufficient water availability for all senior rights.[17]

Of the 3,500 surface water rights in the Blackfoot watershed, 373 surface water irrigation rights are junior to the Milltown and Murphy Rights and an additional 205 rights with other uses are junior to the Murphy Right.[18] A major component of the drought plan is that MT FWP and CSKT have agreed that when flows are between 500 and 700 cfs, users participating in the voluntary drought response plan will be shielded from a call on their

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[16] The Blackfoot Challenge. (2026). "2025 Drought Season Summary Presentation". https://www.blackfootchallenge.org/resource/2025-drought-season-summary-presentation/
[17] The Blackfoot Challenge. (2026). "Blackfoot Drought Response Plan". https://www.blackfootchallenge.org/resource/blackfoot-drought-response-plan/
[18] Domestic and stock water is typically not included.

junior water rights. Below 500 cfs, all junior users, including plan participants, are called "unless they can show a reduction in the use of senior water that is equal to the amount of junior water use – called a water trade."[19]

BC is key in communicating and advocating for water users in this region. Drought affects not only irrigators, but also anglers and angling businesses as fishing restrictions may also be set in place. BC maintains a roster of water uses, anglers, and businesses and takes on the responsibility of contacting them when flow and temperature marks are triggered. They ensure community members are aware of upcoming restrictions and have a plan in place. In addition, they manage the critical individual drought response plans which shield junior water users from MT FWP and CSKT calls.

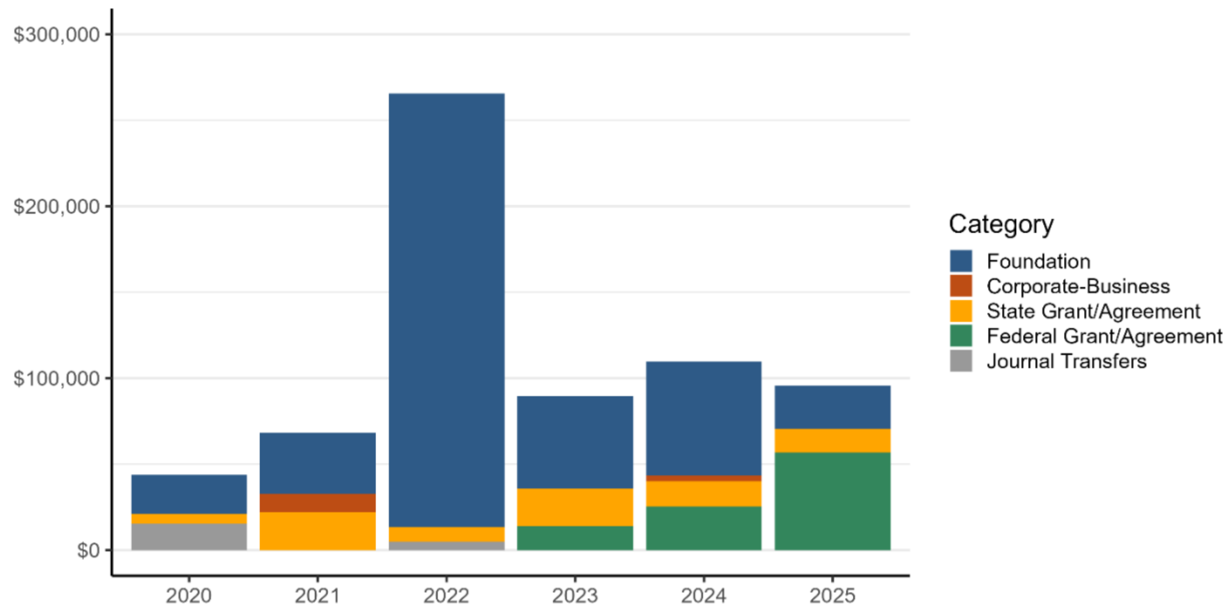
BC's efforts to keep more water in the river while maintaining community cohesion can be grouped into three benefits: irrigation, recreation, and ecosystem services. The following sections quantify each of these benefits.

Program Funding and Expenditures

In recognition of the growing threat of climate change and drought in the region, BC has expanded their water program significantly since 2023. Revenues (Figure 12) steadily increased during 2020-2024, from $44,000 in 2020 to $110,000 in 2024, with an anomalously high foundation-based donation in 2022. From 2020 to 2024, foundations are the largest source of revenue, followed by state grants and agreements from MT FWP and DNRC. In 2023, 2024, and 2025, federal grants from the Bureau of Land Management, Bureau of Reclamation, and Natural Resource Conservation Service were executed. These federal grants represent a growing proportion of funding to the water program.

Figure 12. Water program revenue by source

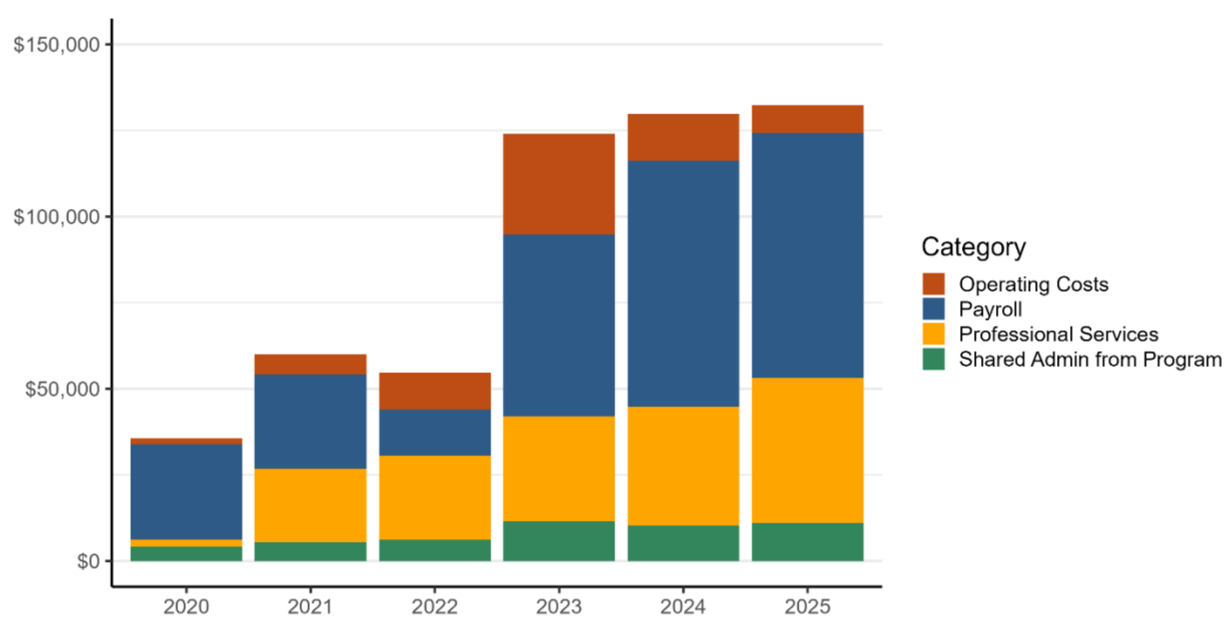
[19] The Blackfoot Challenge. (2024). Blackfoot Drought Plan Fact Sheet.



Source: The Blackfoot Challenge (2025)

Expenditures (Figure 12) also shifted over time to reflect higher budgets and an expanded program. The program spent $36,000 in 2020 and $132,000 in 2024. Roughly one-third of their annual spending goes to contractors who assist with restoration projects. From 2023 to 2025, wages made up the highest portion of expenditures, reflecting the hiring of a full-time water program steward and the overall expansion of the program.

Figure 13. Water program expenditures by source



Source: The Blackfoot Challenge (2025)

The funding sources and expenditures reflect how the water program is expanding its regional impact, particularly since 2023. It is projected to continue to grow and increase investments in long-term stream health and drought management.

Irrigation

BC collaborates with private landowners, specifically farmers and ranchers, to minimize the impact of drought restrictions on their operations' revenue. Drought often results in decreased revenue, decreased employment, and less value added to the regional economy. BC alleviates these impacts by mediating water supply amongst users. Their individual drought response plans are the reason enrolled users can continue to use water when the river flow is below 700 cfs. We estimate the avoided cost of implementing drought plans for junior water users at $139 per acre of irrigated farmland. Other benefits include increased employment, greater value added to the regional economy, and decreased hardship and conflict over limited resources.

BC also works to alleviate drought conditions by helping landowners complete restoration projects along streams. These restoration projects help mitigate channel bank erosion and the ensuing loss of pastureland. Many of these projects are opportunities to collaborate with state and federal agencies and other non-profits.

Agriculture is a foundational sector of the economy in the Blackfoot watershed, with hay production and cattle ranching being particularly prominent.

The Blackfoot watershed is located within a subset of Missoula, Powell, and Lewis and Clark Counties and irrigated acreage in the watershed is estimated to be 35,555 acres (27% of the tri-county irrigated acreage total).[20] Much of the land in the watershed is used for cattle ranching, pastureland, haying meadows, and barley production. Across the tri-county region, the average farm size is 1,493 acres. Seventy percent of these farms primarily raise livestock and the remaining 30% primarily grow crops. Table 4 summarizes farm and ranch characteristics in the region.

Table 4. Farm and ranch characteristics by county during 2022). The black bold values represent total acres per category and the blue bold values represent the average acres for the category in 2022.

[20] The Blackfoot Challenge. (2026). Personal Communication with Clancy Jandreau. April 27, 2026.

	Missoula County	Powell County	Lewis and Clark County	Total/Average
Farms	606	245	595	**1,446**
Acres of Farmland	339,770	549,429	996,169	**1,885,368**
Avg Farm Size (acres)	561	2,243	1,674	**1,493**
Proportion Crop	39%	16%	35%	**30%**
Proportion Livestock	61%	84%	65%	**70%**
Acres Irrigated	18,635	65,135	47,709	**131,479**
Proportion of Farmland Irrigated	5%	12%	5%	**7%**

Source: USDA NASS (2022)

Agricultural productivity is deeply tied to water availability. Drought threatens the economic output of the Blackfoot watershed.

While only 7% of all farmland in this region is irrigated, this represents the most productive and highest-revenue-generating land in the area.[21] Montana has a semi-arid climate, and this region historically averages seven inches of rain during the growing season.[22] To produce enough hay and provide enough water for their cattle, ranchers supplement season precipitation with irrigation. BC's soil scientist has estimated average potential crop water use for hay in the Blackfoot to be 25.25 inches of water per year.[23] This drops to 17 inches for a cool year, and up to 35.6 inches for a hot year. Potential crop water use has also increased over the years. Local NRCS irrigation guides from the 1980s list crop water use for hay as only 15 inches, when today it is 25-33 inches depending on weather.[24]

As drought becomes a regular annual occurrence, more irrigation will be demanded to grow crops and raise cattle. At the same time, drought means less water in rivers and the triggering of the Milltown and Murphy Rights. Increasing demand is coincident with decreasing supply, which leads irrigators to a conundrum; how should they use their limited water? Some sacrifice some fields and focus on fully irrigating only the best fields. Others irrigate all fields less than what is ideal. Decreased precipitation and higher temperatures lead to drier soils and vegetation, erosion issues, and less water. This in turn reduces crop yield in the short term and decreases the amount of arable land in the long term. Farmers and ranchers face financial hardship, elevated levels of stress, mental health issues, and conflict over water. [25] Some may face losing their agribusiness entirely.

[21] Lonsdale, W. R., Cross, W. F., Dalby, C. E., Meloy, S. E., Schwend, A. C. (2020). "Evaluating Irrigation Efficiency: Toward a Sustainable Water Future for Montana". Montana University System Water Center, Montana State University. https://www.montanawatercenter.org/irrigated

[22] Dutton, B. (2025). "Annual Report 2025". *Blackfoot Challenge Irrigation Scheduling Program. https://www.blackfootchallenge.org/resource/2025-annual-irrigation-summary-report/*

[23] Ibid.

[24] Personal communication with Clancy Jandreau, April 29, 2026.

[25] National Drought Mitigation Center. (n.d.). "Reasons to Prepare". University of Nebraska-Lincoln. https://drought.unl.edu/scenarioguide/DroughtPlanning/ReasonstoPrepare.aspx

Users who hold junior water rights (junior users) are at higher risk as they are the first group required to reduce or cease irrigation due to a call.

The avoided loss of revenue from participating in a drought plan is $139 per irrigated hay/alfalfa acre per year.

To estimate the value of BC's drought management program, we compared hay production in three scenarios:

- Normal season irrigation
- Drought season irrigation with drought plan (reduction in irrigation)
- Drought season irrigation without drought plan (cessation of irrigation)

Using historical averages for hay water use and precipitation, we estimated that in a "normal" non-drought year, farmers would irrigate 18.25 inches of water over the season and produce 5.6 tons of hay per acre (assuming a productivity of 4.5 inches of irrigation per ton of hay).[26] In a drought year, a farmer with junior water rights with a drought plan who reduced irrigation by 50% in August and September would only irrigate 13.93 inches and only produce 4.7 tons of hay per acre. Without a drought plan, that same farmer would be forced to cease irrigation in August and September. They would only use 9.6 inches over the season and only produce 3.7 tons of hay per acre.

We calculate the avoided cost of having a drought plan as:

$$Avoided\ Cost = \frac{Avoided\ Water\ Loss}{Hay\ Production\ Efficiency} \times\ Price\ of\ Hay\ \times Junior\ Irrigated\ Acreage$$

Where avoided water loss is the difference in water used with a plan versus water used without a plan (4.3" water per season), hay production efficiency is 4.5" water per ton of hay, and the market price of hay/alfalfa is $145 per ton. By participating in BC's drought program, the model farmer would grow 0.96 tons of hay per acre they otherwise could not. At a market price of $145 per ton, we estimate this at $139 per irrigated acre per year. We were unable to estimate the proportion of land owned by junior users, and this is an opportunity for BC to collect more data. However, if we assume junior users own 50% of the watershed's irrigated acreage, we estimate this total value as $2.5 million revenue per year across the entire watershed.

A $139 per acre annual loss of revenue for a junior user can sum to a potentially huge income cut. As drought stresses resources, ranchers are likely to see lower incomes as they sell fewer products. They may also see increased expenses of securing water and

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[26] Dutton, B. (2025). Irrigation, Crops, and Soils Report 2025.; Bauder, J. (n.d.). "Making a Ton of Hay!". Montana State University. https://waterquality.montana.edu/farm-ranch/irrigation/alfalfa/making_ton.html

other nutrients. Both will decrease their net cash farm income. In a "do-nothing" scenario, farms stand to operate even closer to the margin, and potentially even go into debt. Table 5 summarizes per farm average income for each of the counties in the watershed.

Table 5. Average farm income by county (2022)

	Missoula County	Powell County	Lewis and Clark County	Average
Total Income	**$ 55,479**	**$ 209,564**	**$ 155,464**	**$ 140,169**
Market value of products sold	$ 24,252	$ 157,748	$ 94,470	**$ 92,157**
Farm-related Income	$ 21,872	$ 31,165	$ 18,935	**$ 23,991**
Government payments	$ 9,355	$ 20,651	$ 42,059	**$ 24,022**
Total Production Expenses	**$ 36,189**	**$ 137,000**	**$ 93,948**	**$ 89,046**
Net Cash Farm Income	**$ (5,798)**	**$ 40,810**	**$ 12,712**	**$ 15,908**

Source: USDA NASS (2022)

The average regional farm has an annual income of $92,000 and production expenses amounting to $89,000. The average net income is almost $16,000. Note that these numbers vary greatly across the three counties. Powell County has fewer, larger farms than Lewis and Clark and Missoula County, suggesting farmers and ranchers in Powell County may benefit from economies of scale. In Missoula County, where the average farm size is only 562 acres, the loss of income may impact farmers the hardest.

Drought mitigation will avoid reductions to farm-related income, local job losses, and decreased industry contributions to GDP.

BC's drought response coordination has implications for both individual farm-related incomes as well as ripple effects on the wider economy.

In the long term, farms and ranches could be forced to downsize or even close. This means fewer employment opportunities, less value added, and fewer ripple effects into the regional economy. Table 6 shows the economic impacts of farm and ranch activity that the region stands to lose.

Table 6. Economic impacts of farm and ranch activity by county (2021)

	Missoula County	Powell County	Lewis and Clark County	Total/Average
Total Employment	**1,546**	**789**	**1,272**	**3,607**
Direct employment	577	477	777	1,831
Employment in businesses supporting agriculture production*	577	279	328	1,184
Employment in other related businesses**	392	33	167	592
Employment as % of County Labor Force	**2%**	**27%**	**4%**	**11%**
Every 10 jobs on farms and ranches create X additional jobs	**17**	**7**	**6**	**10**
Value Added	**$ 28,900,000**	**$ 29,000,000**	**$ 48,500,000**	**$ 106,400,000**
Direct contribution to GDP of farm and ranch	$ 5,800,000	$ 14,200,000	$ 18,600,000	$ 38,600,000
Contribution to GDP of businesses supporting agriculture production*	$ 17,300,000	$ 12,900,000	$ 18,700,000	$ 48,900,000
Contribution to GDP of other related businesses**	$ 5,800,000	$ 2,000,000	$ 11,300,000	$ 19,100,000
Value Added as % of County GDP	**1%**	**14%**	**1%**	**5%**
Each $ contributes additional $X in other sectors	**$ 4.00**	**$ 1.04**	**$ 1.62**	**$ 2.22**

Source: Montana State University (2021)

*Notes: * Includes feed and fertilizer distributors; ** Includes grocery and drugstores.*

Employment represents not only people who work directly on the farm and ranch, but those employed in related fields. In total, the agriculture sector in these three counties employs over 3,500 people, either directly or indirectly (Table 6). A loss of agribusiness would in turn decrease demand for related products, also affecting their employment. This would particularly affect Powell County, where agriculture-related employment represents nearly one-third of the labor force. However, Missoula County farm employment has the largest ripple effect on job creation. Every ten jobs on farms and ranches in Missoula County create seventeen additional jobs regionally. This large effect is because the city of Missoula is an economic hub for western Montana.[27]

Value added represents the difference between the market value of a product (i.e., cattle and other farm products) and the sum of its constituents (e.g., hay, etc.). Again, these contributions are both from the farm or ranch itself as well as other related businesses. In total, the agriculture sector in these three counties creates $106 million in value added, either directly or indirectly. Each dollar contributes an average additional $2.22 of value in other sectors as well.

Recreation

The Blackfoot watershed is known for its scenic beauty and opportunities for trout fishing and other river-based recreation. Recreation is a form of tourism which attracts visitors to the area who spend money in the local economy. BC's river restoration work has maintained 50-75 cfs of flow in-stream and has increased trout abundance by 0.28 trout per meter.[28] The avoided cost of a decrease in recreation and associated spending depends on the elasticity of recreation demand to temperature and fish abundance. One study estimates drought associated changes in spending for cold-water fisheries at $50,000 to $100,000 annually. Maintaining intact landscapes with quality natural resources ensures that people continue to invest in the Blackfoot watershed.

The Blackfoot River is a legendary fly-fishing location and a key recreational attraction to visitors. Visitation has increased over the years, particularly since 2020.

The Blackfoot watershed is part of Montana's Crown of the Continent ecosystem, one of the most intact wild regions of North America. Its pristine condition means the area is a prime location for recreation opportunities such as fishing, camping, and hiking.

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[27] Haynes, G., Schumacher, J., and Peterson, J. (2021). "Economic Impact of Agriculture – Missoula County". Montana State University Extension. https://www.montana.edu/extension/agimpact/reports/missoula.pdf
[28] Pierce, R., Podner, C., & Carim, K. (2013). Response of wild trout to stream restoration over two decades in the Blackfoot River basin, Montana. Transactions of the American Fisheries Society, 142(1), 68-81.

Recreation and recreation-based tourism make up a large proportion of visits to the watershed and the Blackfoot River itself is one of Montana's most popular rivers.[29]

The Blackfoot River Recreation Corridor includes opportunities for whitewater rafting, kayaking, tubing, fishing, canoeing, and camping. It is home to eleven native fish species, including the bull trout and western slope cutthroat trout. There are more than 30 publicly owned or managed fishing access sites along the mainstem of the Blackfoot River and 8 float-in campsites.[30]

Warming stream temperatures increase stress on fish and as their suitable habitat shrinks, they must migrate to colder reaches. Anglers face fishing restrictions and potential crowding in the future.

The Blackfoot watershed experienced back-to-back record-breaking droughts in 2024 and 2025, and 2025 was the warmest year on record for the western continental United States.[31] A continued warming trend will likely lead to both a loss of revenue and increasing costs for the watershed communities. When temperatures increase, fish move upstream in search of cooler conditions, or if hindered, will die from a lack of oxygen.[32] If in-stream temperatures reach 71 degrees Fahrenheit for three consecutive days, MT FWP issues "hoot owl" fishing restrictions, prohibiting fishing from 2pm to midnight each day. These restrictions were issued most recently in 2015, 2016, 2024, and 2025. In some cases, reaches or whole tributaries may be closed entirely until conditions improve. These restrictions, while extremely important to maintaining fish survival and ecosystem health, reduce fishing opportunities for anglers and directly lead to a loss of revenue for the local economy. If fish seek refuge in cooler upstream areas permanently, fishing-based recreation will see a decreasing trend in this area over time.

Warming rivers also are likely to increase costs to the region. When rivers increase in temperature, the hypoxic conditions can trigger the algal blooms. While water quality is generally high in the Blackfoot watershed, some areas adjacent to agriculture and grazing

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[29] Montana Fish, Wildlife, and Parks. (2010). "Blackfoot River Recreation Management Plan". https://fwp.mt.gov/binaries/content/assets/fwp/activities/river-recreation/blackfoot-river-recreation-management-plan.pdf

[30] Montana State Parks. (2026). "Blackfoot River Corridor, MT – Campground Details". https://montanastateparks.reserveamerica.com/camping/blackfoot-river-corridor/r/campgroundDetails.do?contractCode=MT&parkId=632300

[31] The Blackfoot Challenge. (2026). "2025 Drought Season Summary Presentation".

[32] Whitlock C, Cross W, Maxwell B, Silverman N, Wade AA. 2017. "2017 Montana Climate Assessment". Montana State University and University of Montana, Montana Institute on Ecosystems. https://montanaclimate.org/chapter/water

pastures can suffer some impairments.[33] Nevada Creek in particular has had water quality and dewatering issues. Controlling the growth of algae and other water quality issues involves time and effort which each have a cost associated with them.

BC's restoration projects create diverse riparian habitats and maintain adequate in-stream flows to alleviate drought related stress on fish.

In recognition of the importance of native trout fisheries, BC and their partners have worked for decades to improve conditions for migration, reproduction, and rearing. The Blackfoot Community Conservation Area and conservation easements on private land improved habitat connectivity and avoided the impact of overdevelopment on fisheries.[34] They have also partnered with BLM, the Big Blackfoot Chapter of Trout Unlimited, MT FWP, USFWS and others on multiple stream restoration projects in the Nevada Creek drainage.

In 2008, the Montana Department of Environmental Quality established total maximum daily loads (TMDLs) that addressed issues related to temperature, sediment, nutrients, and metals along Nevada Creek. BC helped with multiple stages of this project, including stakeholder outreach, hosting meetings, and providing their expertise and knowledge of the area.[35] In addition, their long-term work with ranchers to establish rotational grazing and fence off riparian pastures helped mitigate future issues related to water quality. BC also collaborated with irrigators to conserve in-stream flows and keep temperatures cold enough for migratory bull trout. Finally, their restoration work to pilot test beaver dam mimicry projects, stabilize channel banks, and maintain riparian vegetation all helped to improve water quality. A 2012 study examined how BC's river restoration efforts increased wild trout abundance on 18 tributaries of the Blackfoot River.[36] The study found that three years post-treatment, abundance had increased from 0.19 trout per linear stream meter to 0.47 trout per meter.

BC is also a steward for recreation opportunities in the region. They coordinated a volunteer program which connected with visitors and collected data on use and impact. They have also hosted community meetings to help gain and share perspectives on recreation by both local community members and user groups.[37]

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[33] Montana Fish, Wildlife, and Parks. (2023). "Statewide Fisheries Management Plan 2023-2026 – Blackfoot River Drainage". https://fwp.mt.gov/binaries/content/assets/fwp/conservation/fisheries-management/statewide-fisheries-management-plan-2023-2026/2.07_blackfoot-river-drainage.pdf
[34] Ibid.
[35] Montana DEQ and EPA Region 8. (2014). "Middle Blackfoot – Nevada TMDL and Water Quality Improvement Plan Addendum. https://deq.mt.gov/files/water/wqpb/CWAIC/TMDL/C03-TMDL-02a-a.pdf
[36] Pierce, R., Podner, C., & Carim, K. (2013). Response of wild trout to stream restoration over two decades in the Blackfoot River basin, Montana. Transactions of the American Fisheries Society, 142(1), 68-81.
[37] The Blackfoot Challenge. (2026). Recreation Research. https://www.blackfootchallenge.org/what-we-do/recreation-stewardship/recreation-research-data/

The avoided loss of revenue from one percent fewer decreased angling trips to the region is $360,000 per year.

The benefits to BC's restoration work can be quantified based on avoided losses to recreation. We can calculate the direct lost value as:

$$Avoided\ Cost = (Change\ in\ Trips\ \times \$119.59)_{resident} + (Change\ in\ Trips\ \times \$926.67)_{nonresident}$$

Where the change in trips reflects how visitation trends change as a result of improved water quality and quantity, and the daily spending is the average daily expenditures per trip.

While recreation on the Blackfoot River comes in many forms, we focus here on the value from angling. Angling, particularly for trout, is the hallmark activity of the region and has the most data available. MT FWP estimated that the Blackfoot River saw 83,000 angling days in 2023.[38] We attribute 50,722 days to residents and 32,277 days to nonresidents.[39] A MT FWP study calculated that resident anglers in Montana spent an average of $119.59 per day on related expenses, compared to $926.67 per day for nonresident anglers (2026 dollars).[40] Note that these values are different for residents compared to nonresidents; residents make up 61% of Blackfoot River trips, but nonresidents spend many times more per day for their trip. Furthermore, nonresidents are more elastic to changes in river quality; they may choose to travel elsewhere for a vacation whereas residents will continue to frequent the same local reaches.

Boaters and anglers must pay for food, fuel, equipment, fishing licenses, and use fees. Nonresident visitors must also pay for transportation and lodging. Commercial users must pay guide fees. Finally, anyone recreating on state land owned by MT FWP must purchase a conservation license. These costs all circulate in the local, regional, and state economy and provide jobs and income to local residents.

Data on how angling trips change as a result of more abundant fish and potentially higher catch rates is not currently available for the Blackfoot River. However, if we assume a 1% decrease in angling visitation due to poor stream quality, the avoided cost would equal $360,000 per year. A 2022 study of socioeconomic responses to climate change in Montana's fisheries found that under A1B climate scenarios, cold-water habitat losses

[38] Uthe, P. (2025). "Blackfoot Hoot Owl Discussion". Presentation to BC Drought Committee. Blackfoot Fisheries Biologist, Montana Fish, Wildlife, and Parks.
[39] Oschell, C. (2022). "Blackfoot Data." Presentation to the Blackfoot Challenge Water Committee. Montana Fish, Wildlife, and Parks
[40] Lewis, M.S., & King, Z. (2014). Statewide Estimates of Resident and Nonresident Hunter & Angler Expenditures in Montana (2014).

would lead to $50,000 to $100,000 in decreased spending along the Blackfoot River's mainstem.[41]

River-based recreation provides value in the form of local jobs, incomes, and expenditures.

Commercial service providers like guides and outfitters are an important piece of the recreation economy. The Institute for Tourism and Recreation Research (ITRR) at the University of Montana completed a study which found that in 2017 boating (rafting, floating, canoeing, kayaking) was the most popular outfitted activity in Montana with 283,600 clients served, followed by fishing with 160,400 clients served. [42] Activities involving guides and outfitters have a much higher impact on the regional economy; not only do the visitors themselves have direct and indirect economic impacts, but their guides do as well. The fishing industry contributes two jobs in every thousand to the Crown of the Continent region.[43]

ITRR also completed an analysis of nonresident traveler expenditures and their corresponding economic contributions.[44] In Missoula County, nonresident spending totaled $502 million in 2024. Of that, $24 million (5%) was from guide and outfitter related spending, $12 million (2%) was from licenses and entrance fees, and $6 million (1%) was from campground and RV park fees. These three categories are directly related to recreation. Other important categories include spending on lodging, restaurants, groceries, car rentals, and gasoline. The $502 million of nonresident spending in Missoula County directly supported $409 million in economic activity in the region through jobs and immediate spending, and a further $286 million in indirect economic activity (i.e., supply chain impacts). While this total economic contribution cannot be purely attributed to recreation-based tourism, the tourism industry is a major draw for visitors. An estimated 13.2 million people traveled to Montana in 2025, and outdoor recreation related businesses accounted for 4.6% of GDP in 2023 (third highest in the country).[45] A decrease in recreation quality would likely result in a decrease in nonresident economic spending, ultimately impacting the amount of nonresident money input into the economy. We do not

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[41] Cline, T. J., Muhlfeld, C. C., Kovach, R., Al-Chokhachy, R., Schmetterling, D., Whited, D., & Lynch, A. J. (2022). Socioeconomic resilience to climatic extremes in a freshwater fishery. Science Advances, 8(36).
[42] Grau, K. (2025). "Economic Contribution of 2023/2024 Averaged Nonresident Travel Spending in Montana Travel Regions and Counties. Institute for Tourism and Recreation Research, University of Montana. https://scholarworks.umt.edu/cgi/viewcontent.cgi?article=1376&context=itrr_pubs
[43] Rasker, R. (2011). The Effects of Climate Change on Downhill Skiing and Recreational Fishing in the Crown of the Continent. Headwaters Economics.
[44] Grau, K. (2025).
[45] Montana Institute for Tourism and Recreation Research. (2025). "Nonresident Visitation Estimates". University of Montana. https://itrrdashboard.com/; US Bureau of Economic Analysis (2023). "State Outdoor Recreation Value Added as a Percent of State GDP".

report Lewis and Clark and Powell County data here due to their relatively small economic contribution to river-based tourism in the Blackfoot watershed.

BC's projects have helped the Blackfoot watershed avoid costs associated with a loss of this important recreational resource. A decrease in river quality would lead to lost revenue from guide fees, float-in campsites, and spending in the community on food, lodging, and supplies. This will have a ripple effect in the broader regional economy, decreasing jobs, labor income, and secondary business' contributions to regional GDP. By balancing recreation demand, fisheries management, and the needs of private landowners, BC allows recreators to continue to enjoy blue ribbon fishing, and guides and outfitters to maintain their livelihoods on the river.

Ecosystem Services

BC's mission is to care for both rural communities as well as the land and wildlife around them. Much of the conservation work they do aims to restore ecosystems and their functions. These programs do not directly benefit a specific landowner, angler, or resident, but their effects still benefit the community as a whole. Investment in healthy rivers and watersheds creates a class of benefits known as "ecosystem services." We estimate the restoration efforts from 1991 to 2021 resulted in ecosystem service benefits valued at $2 to $3.5 million.

BC undertook many actions that improve overall ecosystem health in the watershed.

- ***In-stream Flows.*** The voluntary drought response program described above outlines how BC coordinates efforts to keep more water in streams and tributaries. These voluntary irrigation measures conserve 50 to 75 cfs each year.
- ***Riparian and Wetland Enhancements.*** Staff and partners work with willing landowners to enhance riparian and wetland habitats for improved ecosystem function and servicing. Projects include restoring floodplain connectivity, improving in-stream aquatic habitat, installing beaver mimicry structures, and reducing channel incision and excessive erosion.
- ***Soil Health Research.*** The Soil Health Work Group hosts an annual soil moisture monitoring program for participating landowners which provides them with daily data. It has also partnered with The Nature Conservancy to test the effectiveness of biochar as soil health amendment to improve soil moisture holding capacity.
- ***Riparian Grazing Management.*** Staff are working with landowners to build a myriad of grazing improvements, including riparian fencing, stock water gaps, off-stream stock tanks, and rotational grazing on upland pastures. These actions will

help stabilize channel banks, establish riparian vegetation, and reduce nutrient overload.

These actions create benefits which braid together to improve the overall health of the Blackfoot watershed.

Ecosystem services are "positive benefits that wildlife and ecosystems provide to people."

Ecosystem services include wildlife habitat, biodiversity, clean air, clean water, climate regulation, nutrient cycling, and even cultural values for residents.[46] As a relatively pristine natural environment, the Blackfoot watershed provides many of these benefits to its communities. Table 7 describes different categories of services and how they show up in the Blackfoot.

Table 7. Ecosystem Services in the Blackfoot watershed

Category	Definition	Examples in Blackfoot watershed
Provisioning Services	Material or energy products obtained from an ecosystem	• Crops and forage • Livestock • Water • Fuel and energy • Mineral resources
Regulating Services	Benefits from the moderation of ecosystem processes	• Pollination • Water quality • Air quality • Erosion control • Carbon sequestration • Climate regulation
Supporting Services	Services that maintain fundamental ecosystem processes	• Photosynthesis • Nutrient cycling • Water cycling • Soil creation
Cultural Services	Non-material benefits provided to human society and culture	• Recreation and tourism • Landscape aesthetics and inspiration • Cultural identity and spiritual connection

Source: Warziniack, T., Lawson, M., Dante-Wood, S.K. (2018)

The water program impacts all of these by working to increase the quantity and quality of water available for both humans and wildlife. However, pressures on mountain landscapes threaten all these services. The restoration efforts of BC help to balance the economic benefits of tourism, agriculture, and development with the benefits of maintaining healthy ecosystems.

[46] National Wildlife Federation. (n.d.). "Ecosystem Services". https://www.nwf.org/Educational-Resources/Wildlife-Guide/Understanding-Conservation/Ecosystem-Services

Ecosystem services are estimated using the willingness to pay model. In the Blackfoot watershed, WTP is $7.97 to $14.19 value per household per mile of riparian habitat restored.

Many of these benefits are not directly quantifiable because they are not bought and sold in a market like cattle or a camping permit. Instead, the value of restoration efforts can be valued using nonmarket valuation methods. While there are many different techniques, they all try to determine the willingness to pay (WTP). WTP is the theoretical maximum price a consumer is willing to pay for a good or service.[47] In this case, it is the value to consumers for a marginal improvement in ecosystem health.

The more accurate estimation of WTP for ecosystem restoration in the Blackfoot watershed would require a tailored survey sent to regional households asking them a series of questions about different restoration scenarios. In lieu of this, we reviewed existing literature on WTP studies in other locations and made a best estimate of how that value would translate to our study area.

We reviewed eleven studies ranging from 1983 to 2009. The studies all took place in the United States and primarily focused on the benefits of increased in-stream flows to the overall riparian ecosystem. The studies used either a contingent valuation or dichotomous choice method, which require respondents to accept or reject a specified "bid" for a change.[48] The result is a dollar amount per household per mile or hectare improved. Of the eleven studies, we narrowed down five which best matched the conditions and ecosystem of the Blackfoot watershed. These studies were the closest match for land use, geographic location, and the actual value measured (i.e., in-stream flows and ecosystem preservation). From there, we chose the highest and lowest estimated WTP (accounting for inflation) as our range.

There are several limitations of transferring contingent valuation and discrete choice models to a different ecosystem, including what benefits are included, differences in location, proposed restoration activities, demographics or participants, and cultural differences. The high range value is from a study on the Middle Rio Grande where water scarcity may increase the value of water compared to the Blackfoot watershed. Furthermore, some of these studies are 30 years old; preferences change over time, and a growing recognition of the value of ecosystem services may mean these values

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[47] Stobierski, T. (2020). "Willingness to Pay: What It Is & How to Calculate. *Harvard Business School*. https://online.hbs.edu/blog/post/willingness-to-pay

[48] Contingent valuation directly asks respondents to declare a dollar amount, whereas discrete choice models ask respondents to pick between alternatives that each cost varying amounts.

underestimate WTP. Ultimately, we chose the best possible range of values given the existing literature.

The following formula shows how the WTP value from the literature was applied to the Blackfoot watershed:

$$Total\ WTP = WTP \times\ Households\ \times Miles\ Restored$$

The result is an estimate of $7.97 to $14.19 value per household per mile of riparian habitat restored. There are an estimated 6,281 households in the study area. Therefore, using the lowest and highest estimated WTP value it is estimated that the Blackfoot watershed is valued at $50,000-$89,000 per mile restored.

The Big Blackfoot Chapter of Trout (BBCTU) frequently collaborated with BC on restoration projects. Their data show that from 1991 to 2021, BBCTU and their regional partners completed 111 restoration projects on 40.3 miles of streams in the Blackfoot watershed.[49] Using the Total WTP equation above, we estimate these restoration efforts resulted in ecosystem service benefits valued at $2 to $3.5 million.

Conclusion

Across the five grants modeled, BC's forestry program translated roughly $1.59 million of public capital into an estimated $2.05 million of lifetime present-value economic benefits, a 1.29x return on every public dollar deployed. The bulk of that value flows to the watershed through contractor and staff payrolls; the remainder accrues as avoided wildfire damages to timber, suppression budgets, and ecosystem services. Given that the model treats each acre as an isolated parcel and omits several monetizable benefit categories, this figure is best understood as a conservative lower bound on the program's true social return.

BC's water program has benefits to agriculture, recreation, and ecosystem services. These benefits include avoided costs associated with drought and contributions to regional employment, labor income, value added, and spending. The water program translates to roughly $139 per acre of annual revenue for junior users, $360,000 in annual spending for anglers, and $2 to $3.5 million in ecosystem services over the last twenty years.

In addition to project-specific benefits related to the forestry program, water program, and others, BC brings value to the region through their role as a convener of many different stakeholders. They coordinate discussions between private landowners, state and federal

[49] Personal communication with Clancy Jandreau. April 29, 2026

agencies, and other non-profits to help maximize the investments these groups make into their watershed. As a non-profit, BC is uniquely positioned to facilitate public-private partnerships in the area. Their long history of stewardship in the region brings groups together and minimizes friction from competing priorities.

Appendix A: Forestry Program Methodology

A.1 Economic Model Setup

To quantify the economic benefits of public-private investments in the BC Forestry Program, we built an economic benefit model adapted from Mason et al. (2013)[50], who quantified the net benefits of mechanical fuels treatments across the western United States. The model converts each grant's reported acres treated, treatment type, and contractor and labor spending into a present-value estimate of six benefit streams: (1) timber revenue from thinned stands, (2) avoided timber losses had the treated stand burned, (3) avoided wildfire suppression costs, (3) avoided non-timber losses (property, ecosystem services, public health), and (5) jobs and contractor income supported by the grant. Taken together, this provides a holistic means for quantifying the overall benefits from investments in wildfire mitigation using public and private funds.

For each grant year *t*, the per-year benefit and net present value are computed as follows,

$$EB_t = (PV_{\text{Treated},\,t} + JB_t + \lambda \cdot [PV_{\text{untreated},\,t} \cdot k + S_t + N_t]) \cdot (1+r)^{-t}$$

$$NPV = \sum_{t=0}^{T} EB_t$$

Symbol	Definition	Unit	Data source
PV_ Treated$_t$	Timber revenue from thinned stumpage	$/yr	Calculated through Samuel Scott's stumpage pricing model, who is a researcher at University of Montana Bureau of Business and Economic Research
λ	Annualized wildfire frequency	—	2025 FEMA (Federal Emergency Management Agency) data
PV_ untreated	Per-acre standing timber value lost if the	$/acre	Stumpage Price from Samuel Scott model × FIA species composition (Montana FIA 2020 Snapshot).

[50] [10] Mason, C. L., Lippke, B. R., Zobrist, K. W., Bloxton, T. D., Ceder, K. R., Comnick, J. M., McCarter, J. B., & Rogers, H. K. (2013). "Quantifying the net economic benefits of mechanical wildfire hazard treatments on timberlands of the western United States." *Forest Policy and Economics*. https://www.sciencedirect.com/science/article/pii/S1389934112000408

	stand had burned.		
k	Salvage discount factor	%	85%, taken from Mason et al. (2013).
S_t	Avoided wildfire suppression cost.	$/acre	Montana Legislative Fiscal Division, Wildfire Suppression brief, updated September 2022. [51]
N_t	Avoided non-timber losses	$/acre	Mason et al. (2013)
JB_t	Contractor spend plus Blackfoot Challenge staff time.	$/year	Blackfoot Challenge quarterly grant reports + Statement of Activity.
r	Real discount rate on future avoided losses.	%	4%
t	Years since treatment.	yrs	Grant calendar information from Blackfoot Challenge + 5-year ripple effect

A.2 Model Specification

For each grant year *t*, the per-year economic benefit and the lifetime net present value are computed according to the formula above. The first two terms inside the outer parentheses, *PV*_Treated_t and *JB_t*, capture deterministic flows realized in the year of treatment: direct timber revenue from material harvested during thinning, and labor income paid to contractors and Blackfoot Challenge staff. The bracketed expression captures the expected-loss component of the calculation — the per-acre value of timber, suppression cost, and non-timber damages that an untreated wildfire would otherwise impose on the parcel — and is scaled by the annual wildfire-occurrence probability λ so that benefits are not claimed in years in which the stand would not have burned. Within the bracket, *PV_untreated_t* × *k* values the standing commercial timber that would have been lost net of the salvage fraction recoverable from a burned stand, *S_t* captures the avoided per-acre wildfire suppression cost that would have been borne by state and federal agencies, and *N_t* aggregates the avoided non-timber damages spanning ecosystem

[51] https://archive.legmt.gov/content/Publications/fiscal/leg_reference/Brochures/Wildfire-2022.pdf

services and public-health endpoints. The composite expression is then discounted by $(1 + r)^{-t}$ to translate future avoided losses into present-value terms at a real discount rate of $r = 4\%$. The lifetime net present value of a treated parcel is the sum of these discounted per-year benefits over the post-treatment analytical horizon $t = 0, 1, \ldots, T$.

Appendix B: Water Program Methodology

B1. Irrigation Benefits

$$Avoided\ Cost = \frac{Avoided\ Water\ Loss}{Hay\ Production\ Efficiency} \times\ Price\ of\ Hay\ \times Junior\ Irrigated\ Acreage$$

Irrigation Regime: BC's soil scientist publishes an annual "Irrigation, Crops, and Soils Report" detailing weekly rainfall and high, low, and average long term hay water. We summed the weekly precipitation and average long term hay water to determine how much water was needed per month and what fraction of that came from precipitation. The remainder was assumed to come from irrigation (hay water use – precipitation = irrigation). Thus, we assume that average long term hay water use is 25.25" per acre per season, and 7" comes from precipitation. The remaining 18.25" comes from irrigation, though that amount is not uniform throughout the season. The most irrigation is needed in July and August when precipitation is at its lowest and evapotranspiration is high. Full calculations can be found in the accompanying spreadsheet.

Avoided Water Loss: Assumed at 4.3 inches of water. This is the difference in irrigation comparing a drought plan with a no drought plan scenario. We assume that in a drought year, irrigation restrictions will kick in during August and September. We assume irrigation will proceed as normal from May to July. If an irrigator has a drought plan, we assume their water use will be 50% of normal in August and September. If an irrigator does not have a drought plan, we assume their water use will be 0 in August and September. In summary, we assume a normal irrigation season will use 18.25" per acre, a drought season with a plan will use 13.93" per acre, and a drought season with no plan will use 9.60" per acre. The effect of the drought plan is the difference (13.93" - 9.60" = 4.32"). Our main assumptions are related to the amount irrigated per month and the effect of drought on the timing and amount of water not used. More data collection would provide a more accurate value.

Hay Production Efficiency: Assumed at 4.5 inches of water per ton of alfalfa produced. This assumption was referenced in several articles from Montana State University- that "each ton of alfalfa hay requires 4 to 5 inches of water." We chose the median value in this range for simplicity. Barry Dutton, BC's soil scientist, agreed this value was a reasonable assumption. However, this range depends on the relative climate, soil health, and watering regime of the land. A more accurate value would be specific to the watershed.

Price of Hay: Assumed at $145 per ton. Value is from 2025 National Agricultural Statistics Service's State Agriculture Overview for Montana. The price per unit for "Hay, Alfalfa" was used to represent the mix of crops for which irrigation is primarily used. We assume all irrigation is used for this hay, alfalfa mix. A more accurate value could be determined by getting more accurate information on how much of each crop is produced in the watershed.

Junior Irrigated Acreage: Assumed at half the total irrigated acreage of the watershed (17,777 acres). A more accurate value could be determined by getting the true acreage owned by junior users. Since rights are called on in order of seniority, a chart showing how much acreage is progressively affected by calls on water rights would be useful.

B2. Recreation Benefits

$$Avoided\ Cost = (Change\ in\ Trips\ \times \$119.59)_{resident} + (Change\ in\ Trips\ \times \$926.67)_{nonresident}$$

Trips: A report from the MT FWP Blackfoot River Recreation Program Manager reported the number of angling days on the Blackfoot River as 83,000 in 2023. MT FWP data from 2007 used in a Headwaters Economics report was used to determine the ratio of resident to nonresident anglers on the Blackfoot River. The ratio was 61% resident and 39% nonresident when combining activity on lakes and streams. We assume this ratio has not changed and applied it to the angler days in the Blackfoot watershed to get the local angling days split by residents and nonresidents. Note that there are several different studies of angling days in Montana and the Blackfoot River. Each was published in a different year and includes different survey methods, so one's results will vary depending on which study is used. A more accurate value could be determined by getting a more up to date ratio for resident versus nonresident visitation, and total visitation days. Further, recreation benefits should expand to include other types of recreation including boating, camping, and hiking.

Spending: A 2014 study by Lewis and King provided statewide estimates of resident and nonresident angler expenditures per year. These values were scaled up to 2026 dollars using the US BLS CPI Inflation Calculator.

B3. Ecosystem Services Benefits

$$Total\ WTP = WTP \times\ Households\ \times Miles\ Restored$$

WTP: Estimated at $7.97-$14.19 per household per mile. Lower bound comes from Holmes et. al (2004), a study on the Little Tennessee River in North Carolina. Upper bound comes from Weber and Stewart (2009), a study on the Middle Rio Grande near Albuquerque, New Mexico. Both values were scaled up to 2026 dollars using the US BLS

CPI Inflation Calculator. Full literature review can be found in the accompanying spreadsheet.

Households: We used household data from the 2023 5-year American Community Survey (ACS). We used a spatial join to determine which census tracts overlapped the watershed polygon. ACS variable B11012: Households by Type provided the number of households in the watershed.

Miles Restored: BC's partners at the Big Blackfoot Chapter of Trout Unlimited provided an estimate of 40.3 miles of river restored in the watershed from 1991 to 2021. As such, we were forced to provide an estimate for this entire period rather an on an annual basis. As the Water Program continues to collect more data on restoration, they will be able to plug that number in to get a more accurate estimate of ecosystem services.