



Pilot Hill



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Valuing Latent Attributes of a Recreation and Wildlife Habitat Management Area

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College of Business
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and Economic Analysis

The Center for Business and Economic Analysis (CBEA) at the University of Wyoming (UWyo) supports the economic growth and diversification of Wyoming's economy through applied economic and business analytics for communities, industries, and entrepreneurs. The center was established in 2019 as a unit within the College of Business. CBEA is a member of the Association for University Business and Economic Research (AUBER).

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Abstract

Conserving and restoring wildlife habitat is increasingly prioritized as economies focus on sustainable development. Through a household survey that sampled over 1,000 households, we use contingent valuation and conjoint analysis to estimate the non-market value of a recreation and wildlife habitat management area (WHMA) of more than 7,000 acres. Using the more conservative contingent valuation estimates, the average valuation for this WHMA was \$9.43 per household per visit, which aggregates to an overall regional economic benefit of \$4.27 million per year. Households also reported preferring the current WHMA plan with trails more than 2:1 over leaving the area as open space or using it for other economic development projects. Survey respondents indicate that the two most important attributes of this WHMA are protecting the area from residential development and connecting the adjacent city to National Forest and state recreation lands.

Keywords: non-market valuation; policymaking; public lands; connectivity

Introduction

The restoration and conservation of ecosystems are fundamental aspects of sustainable development globally, especially in the current era marked by the challenges of climate change (Cao *et al.*, 2021). As societies strive toward more sustainable practices, the valuation of non-market goods, such as recreational and wildlife habitat areas, plays a pivotal role in informing policy decisions by providing assessments in monetary terms that can be compared to outside options.

This paper presents findings using a combination of contingent valuation and choice experiments applied to survey results involving over 1,000 households. The study not only estimates the monetary value associated with visits to the wildlife habitat management area (WHMA) but also explores public preferences and perceptions regarding the area's management and potential alternative uses. Discrete-choice survey methods have been a common tool to help policymakers make conservation decisions for natural resources (e.g., Cook *et al.* (2018) and O'Connor *et al.* (2020)).

We begin by introducing the Pilot Hill WHMA (Pilot Hill, hereafter) which consists of more than 7,000 acres connecting an adjacent city to over 65,000 acres of National Forest and state recreation lands. Then, we introduce the survey design and fielding process, after which we discuss contingent valuation and choice experiment results. The paper concludes with a synthesis of findings.

In sum, this paper contributes to the literature on the economic valuation and management of wildlife habitats, providing empirical evidence of the significant value associated with designating WHMAs. In fact, based on conservative estimates from contingent valuation, the WHMA is associated with an average household valuation of \$9.43 per visit, translating to an annual regional economic benefit of approximately \$4.27 million. Additionally, households expressed a strong preference for the current WHMA plan featuring trails, with a ratio exceeding 2:1 compared to leaving the area as open space or utilizing it for other economic

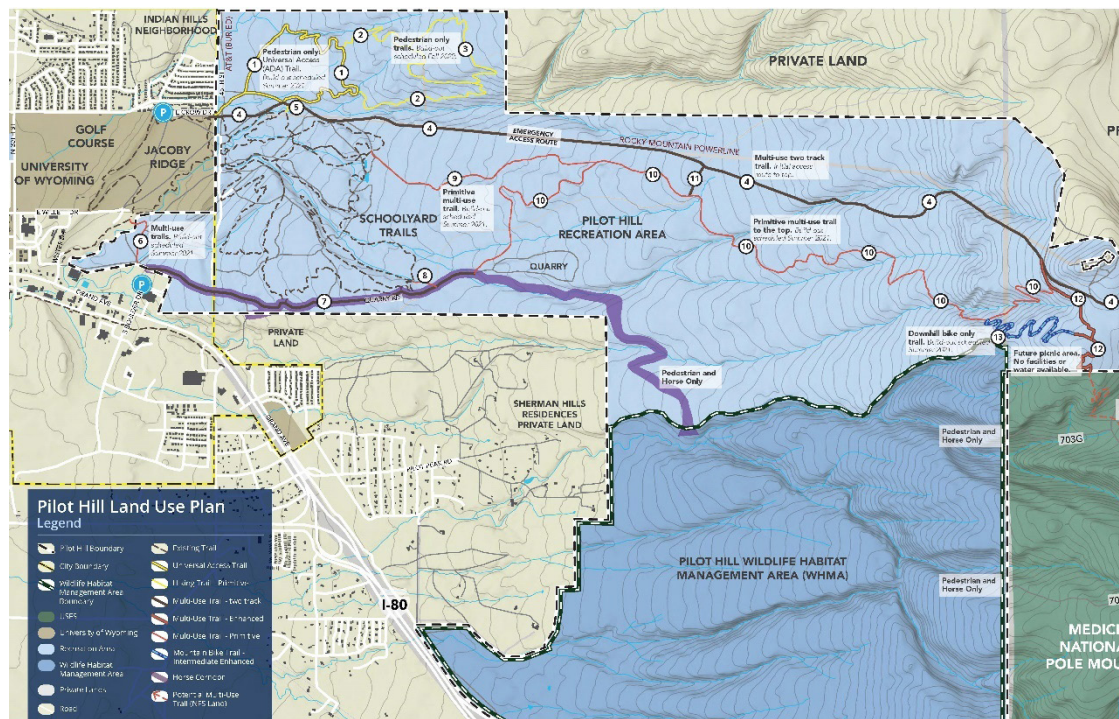
purposes. Survey responses highlight the critical attributes of the WHMA, emphasizing the importance of protecting it from residential development and establishing connections to nearby National Forest and state recreation lands. Understanding these preferences is crucial for informing future management decisions aimed at optimizing the societal and economic benefits of WHMAs.

Background on Pilot Hill

Pilot Hill consists of more than 7,000 acres connecting neighborhoods in the City of Laramie, Wyoming (WY) to over 65,000 acres of National Forest Lands in the Laramie Mountain Range. Notably, Pilot Hill overlies the Casper Aquifer, a unique geologic feature that naturally filters rain and snow to provide a primary drinking water source for residents and visitors to Albany County, WY, where the City of Laramie is located. Restricting development in the aquifer recharge zone is key to protecting the City of Laramie's water source since if the aquifer recharge zone becomes contaminated, the city would need to construct a costly water treatment facility. Thus, these acres that encompass Pilot Hill, immediately adjacent to Laramie, create a unique community resource that prevents future development in this area, thus, protecting the Casper Aquifer, and conserving wildlife habitat.

Further, Pilot Hill is divided into two sections: a WHMA (3,076 acres) on the southern section with limited trail development and a Recreation Corridor (4,010 acres) with many miles of recreational trails. See Figure 1 for a map of the proposed area. The project's ecosystem varies from low to high elevation areas and includes many species such as elk, moose, mule deer, and pronghorn antelope. In addition, the Office of the Wyoming State Archaeologist found 158 prehistoric and historic archaeological sites within the project area.

Figure 1. Pilot Hill Recreation and Wildlife Habitat Management Area Map



Note: See <https://pilothis.org/> for a larger version of the map.

The project's Recreation Corridor was mapped while carefully accounting for the need to protect aquifer, wildlife, and archeological sites. This corridor also avoids Radio towers for Wyoming Public Media/University of Wyoming, Townsquare Media, and Laramie Mountain Broadcasting as well as powerlines owned by Rocky Mountain Power. Instead, it uses several existing roads previously used for agricultural purposes. In total, 43.9 miles of trails are planned across the project area, a mix of multi-use, hiking-only, and biking-only trails. Two ADA accessible trails are planned to allow those with disabilities to also enjoy the project area and its recreational opportunities. In addition, a horse access corridor is planned to support horseback riding. In sum, most trails are multi-use trails (27.1 miles), most of which would be open to all user types (mountain bikers, hikers, and horseback riders). The network also includes 5.9 miles of hiking-only trails and 10.9 miles of biking-only trails. The trails in this plan provide desired connectivity to Pilot Peak and the Pole Mountain Unit of the Medicine Bow National Forest.

Moreover, Pilot Hill supports public access to open spaces for educational opportunities. The project area encourages student visits ranging from elementary school classes learning about aquifers to University of Wyoming students conducting scientific research on migration patterns of wildlife. Particularly, Albany County educators can develop curricula to utilize Pilot Hill for research and site-based learning activities.

Principally, Pilot Hill is a result of a collaborative effort by Albany County citizens, the University of Wyoming, and the Wyoming Office of State Lands and Investments, where thousands of acres of private land were preserved in July 2020 through an exchange with a private company. Currently, the project area includes lands owned by several different landowners. To illustrate, the University of Wyoming owns 1,233 acres close to and within the City of Laramie while the Bureau of Land Management (BLM) owns 480 acres that are under consideration for lease, and the remaining land is Wyoming State Trust Lands and under a lease to Albany County.

Survey Development

The purpose of the household survey is to estimate the economic value of Pilot Hill and its attributes. The challenge in conducting this estimation is that, unlike many goods and services traded in an economy, Pilot Hill, and its attributes are non-market goods. This means there is no market price to rely on when estimating economic value. However, economists have used methods such as travel costs (i.e., estimating value based on the willingness of households to pay the cost of travel to use the good or service) and hypothetical valuation estimates through surveys, to capture the value of non-market goods and services (Champ *et al.* 2003; Haab and McConnell 2002).

Since Pilot Hill is not fully developed and open to the public, we chose the latter method. More specifically, we chose two non-market valuation techniques: a contingent valuation survey and a choice experiment. Contingent valuation is a survey methodology for estimating maximum willingness to pay (WTP) for a non-market good or service. Choice experiments estimate the value of specific attributes of an environmental or public good or service. These methods have also been applied in disciplines outside of economics. For

example, choice experiments have been used in marketing to value specific attributes of a new good before it enters the marketplace.

To apply contingent valuation and choice experiment methods, we conducted a household survey. The goal was to achieve a minimum of 500 completed online surveys using a survey instrument we developed. First, we ran two separate focus groups to help with survey design. The first was focused on the community and was completed on June 28, 2021. The full transcript of the community focus group is available in Appendix A. The second effort was focused on a group of experts in various fields that helped us better understand aspects of the Pilot Hill development such as aquifer protection, wildlife habitat, hiking/biking trails, and educational opportunities, to name a few. The experts' focus group was completed on June 21, 2021, with the full transcript available in Appendix B.

After the focus groups, we tested the online survey on WYSAC's WyoSpeaks panel. The mission of WyoSpeaks is to give voice to Wyoming citizens on important issues facing our state and make public policy more responsive to the opinions of our citizens. The WyoSpeaks survey panel uses probability-based sampling methods to monitor the perspectives of Wyoming citizens through online surveys. Over the course of a year, WYSAC conducts state-wide telephone surveys where all Wyoming residents have an equal probability of selection. During these surveys, respondents are given the opportunity to join the WyoSpeaks panel of Wyoming citizens. The only way to be added to the WyoSpeaks panel is through this random selection process. Our survey was fielded to all 655 WyoSpeaks panel members who reside in Albany and Laramie Counties, WY and 224 respondents completed the test version of the survey. When accounting for valid email addresses and eligible respondents, this results on a simple response rate of 36 percent. We then examined the comments of the respondents and determined that no further changes to the survey were necessary.

We next turn to the sampling design for the household survey where the focus was on households from likely users of Pilot Hill that reside in Southeastern Wyoming, Western Nebraska, and Northern Colorado. Therefore, we mailed 10,000 letters to households in the sampling region. The expected response rate was approximately 5% based on similar studies administered by the Wyoming Survey & Analysis Center (WYSAC). To increase response rates, we purchased 10,000 postal stamps and sent the introductory letter with actual mailing stamps rather than standard permit imprints (Harrison et al., 2002). WYSAC also entered all respondents that completed the survey into a raffle to win an iPad. A copy of the introductory letter (see Appendix C) and the full household survey (see Appendix D) is included at the end of this paper.

The sampling design had 50% of the letters sent to randomly selected households in Albany County, WY where the City of Laramie is located. The other 50% were sent equally to the other five sampling regions: (1) Cheyenne, WY including Laramie, Platt and Goshen Counties; (2) Rawlins, WY including Carbon County; (3) Casper, WY including Natrona County; (4) Western Nebraska including Scottsbluff, Banner and Kimball Counties; and (5) Northern Colorado including Larimer and Weld Counties.

The survey included four sections: (1) background information about Pilot Hill, (2) opening questions about outdoor recreation, expected future use of Pilot Hill, (3) household economic valuation questions, and (4) sociodemographic questions. The total number of completed surveys (including the WyoSpeaks panel) is 1,017 with descriptive statistics shown below in Table 1.

Table 1. Descriptive Statistics for Survey Questions (N = 1,017)

Variable Name	Definition	Mean	Min	Max
Final Survey	Final Survey	78%		
Some Outdoors	Outdoor activities a few times per month or yr.	63%	0	1
Frequent Outdoors	Outdoor activities a few times per week or daily	27%	0	1
Aware	Aware of PH before the survey	56%	0	1
Some PH Usage	Expect to use PH between 1 and 10 times per yr.	55%	0	1
Frequent PH Usage	Expect to use PH more than 10 times per year.	22%	0	1
Environment	Favor environment over economic development	77%	0	1
Young	Between 18 and 34 years old	35%	0	1
Middle Age	Between 35 and 64 years old	44%	0	1
Old	Between 65 and 75+ years old	21%	0	1
Parent	Parents of a child aged 17 years old or younger	24%	0	1
HH Size	Number in household including the respondent	2.42	1	15
Female	Identify as female	57%	0	1
High School	High School is highest level of education	6%	0	1
College	College is highest level of education	61%	0	1
Professional	Professional or Doctoral degrees	32%	0	1
Hispanic	Identify as Hispanic, Latino/a or Spanish origin	8%	0	1
White	Identify themselves as white	97%	0	1
Black	Identify themselves as black	1%	0	1
Native American	Identify as Native American	3%	0	1
Asian	Identify as Asian	3%	0	1
Income	Annual household income from all sources	\$78.3k	\$5k	\$200k
Albany, WY	Reside in Albany County, WY	65%	0	1
Cheyenne, WY	Reside in Laramie, Platte or Goshen County, WY	21%	0	1
Casper, WY	Reside in Natrona County, WY	3%	0	1
Rawlins, WY	Reside in Carbon County, WY	5%	0	1
Colorado	Reside in Larimer or Weld County, CO	3%	0	1
Nebraska	Reside in Scottsbluff, Banner, Kimball Co. NE	3%	0	1

We highlight three features of Table 1. First, the respondents answering the survey are disproportionately highly educated with 32% of the respondents having a professional or graduate degree. Nationally, only 13.1% of people 25 and older have a professional or graduate degree, but we do note that 28% in Albany County, WY have a professional or graduate degree. Second, the majority of respondents prefer protection of

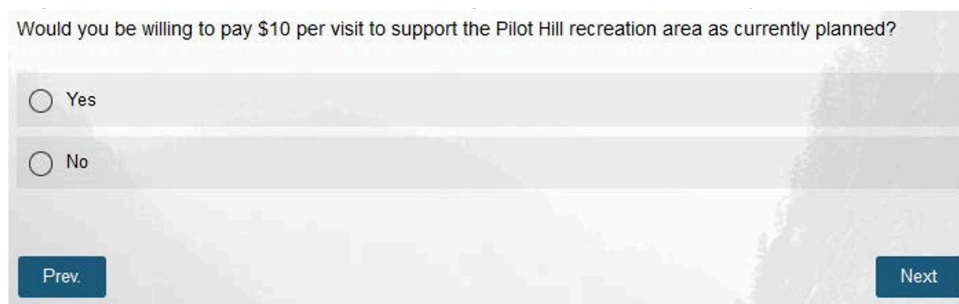
the environment over economic development (77% vs. 23%). Third, despite targeting 50% of respondents from Albany County, WY, the final sample composition had nearly two-thirds of the respondents being from Albany County. Next, we turn to the economic non-market valuation estimates.

Non-market Valuation of Pilot Hill and its Attributes

4.1. CONTINGENT VALUATION

We start with estimation of the double-bounded dichotomous choice (DBDC) model. The recommended method for eliciting maximum willingness to pay (WTP) for a non-market good or service is to present the respondent with a take-it-or-leave-it bid. Below in Figure 2, we show a screen shot of the contingent valuation question from the online survey.

Figure 2. Screenshot of the Contingent Valuation Survey Question

The image is a screenshot of a survey question. At the top, the text reads: "Would you be willing to pay \$10 per visit to support the Pilot Hill recreation area as currently planned?". Below this text are two radio button options: "Yes" and "No". At the bottom of the form, there are two buttons: "Prev." on the left and "Next" on the right. The background of the form is a light gray with a faint image of a mountain landscape.

Previous research has found the “take-it-or-leave-it” cognitive task of the respondent is simpler than an open-ended WTP question (Bishop and Heberlein, 2019). However, since the “take-it-or-leave-it” response does not sufficiently narrow down the WTP, we ask a follow-up question that reduces the bid by 50% if the respondent says “No” to the initial question and increases the bid by 100% if the respondent says “Yes” to the initial question. This allows us to bracket the respondent’s maximum WTP without placing a large burden on the respondent. The initial bids are randomized to households from the set of values per visit for users or a one-time donated value for non-users. To clarify, if the respondent indicated earlier in the survey that they were likely to use Pilot Hill in the future, they were categorized as a user and shown a bid per visit. Otherwise, if the respondent indicated they would not use Pilot Hill, the questions framed the bid as one-time donation. The breakdown of the responses is shown in Table 2.

Table 2. Breakdown of Contingent Valuation Responses for the Current Pilot Hill Plan

Responses to DBDC Questions	Percentage of Responses
“yes - yes”	10%
“yes - no”	26%
“no - yes”	22%
“no - no”	42%

Notes. DBCD = Double-Bounded Discrete Choice

The results from Table 2 show that most respondents say “No” to both bids and only 10% of respondents say “Yes” to both randomized bids. Next, we briefly discuss the model for maximum WTP. Maximum WTP for the current Pilot Hill plan is represented by the following equation:

$$WPT_i^* = X_i\beta + \varepsilon_i \quad (1)$$

where WPT_i^* is the latent maximum willingness to pay for Pilot Hill for respondent i , X_i is a vector of explanatory variables, β_i is a vector of coefficient estimates, and ε_i is an error term. Given the responses from the dichotomous-choice WTP questions, the model is estimated using maximum likelihood methods and the results are reported in Table 4. Note that the coefficients obtained directly from maximum likelihood estimation are not the β values in equation (1). A simple transformation is necessary to put the coefficient in dollar units.

Table 3. Double-Bounded Discrete-Choice Contingent Valuation Estimates (N = 883)

Variable Name	Transformed Coefficients ('s)	Standard Errors
Intercept	1.0180	1.0155
Final Survey	0.5835	0.2040
Aware	-1.8527*	0.1624
Some PH Usage	4.6029***	0.1802
Frequent PH Usage	1.0522	0.2318
Environment	5.1889***	0.1652
Young	3.9508**	0.2060
Middle Age	2.4285*	0.1894
Parent	0.9603	0.1923
HH Size	-0.3671	0.0631
Female	1.5112*	0.1311
High School	-2.6692	0.3128

College	-1.7975*	0.1485
Hispanic	1.4069	0.2659
White	1.3151	0.3559
Log(Income)	-0.1780	0.0809
Cheyenne, WY	4.4161***	0.2283
Casper, WY	2.4202	0.3879
Rawlins, WY	0.7336	0.3447
Colorado	6.0667**	0.3759
Nebraska	3.1740	0.3921
BID	-0.1452***	0.0063

Notes: Standard errors from the untransformed coefficients

*Significance codes: 0.01 '***', 0.05 '**', 0.1 '*'*

Logistic Log-likelihood: -1080.40, AIC: 2204.805, BIC: 2310.038

Table 3 shows the coefficient estimates for equation (1). Coefficients with positive signs are associated with a higher WTP for Pilot Hill while coefficients with a negative sign are associated with a lower WTP for Pilot Hill. Respondents with a statistically significantly higher value for Pilot Hill:

- are female
- prefer the environment over economic development
- plan to moderately use the recreation area
- are young
- have a professional or graduate degree, and
- are from Laramie, Platte or Goshen counties, WY as well as Northern Colorado.

Respondents with a statistically significantly lower value for Pilot Hill:

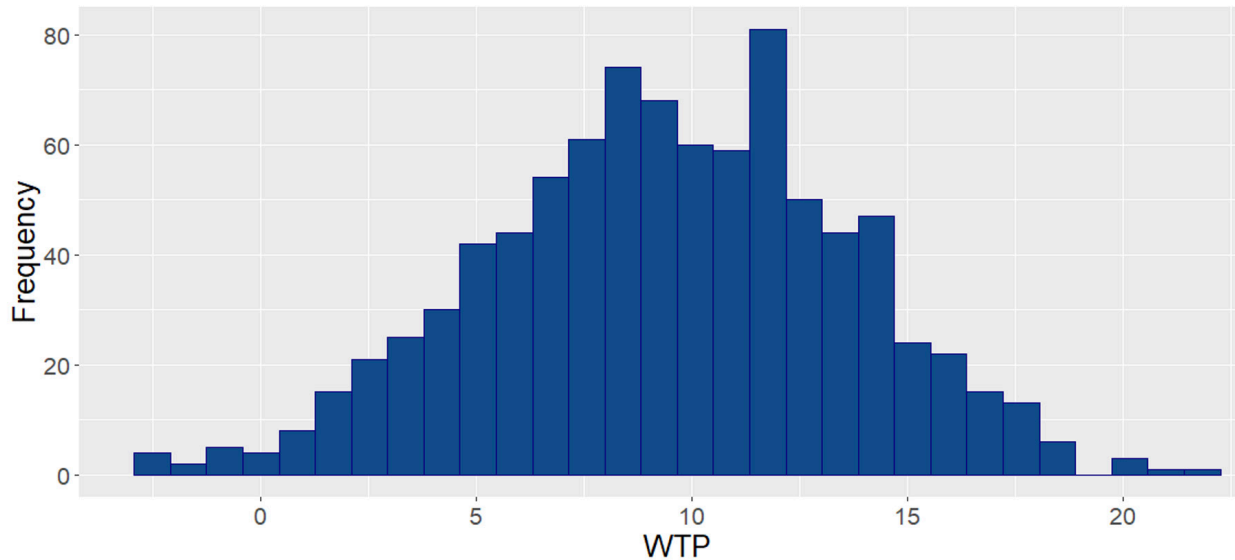
- are those already aware of Pilot Hill, and
- those receiving a higher donation/fee initial bid.

Table 4. Mean WTP from the Contingent Valuation Estimates

Category	Mean WTP	Sample Size (N)
All respondents	\$9.43	883
Pilot Hill Users	\$9.93	687
Pilot Hill Non-Users	\$7.68	196

Using equation (1), we then estimate a maximum WTP for Pilot Hill based on the respondent's characteristics. Figure 3 shows the distribution of WTP values across all 883 respondents that answered the WTP questions.

Figure 3. Distribution of Estimated Maximum WTP Values for Pilot Hill (N = 883)



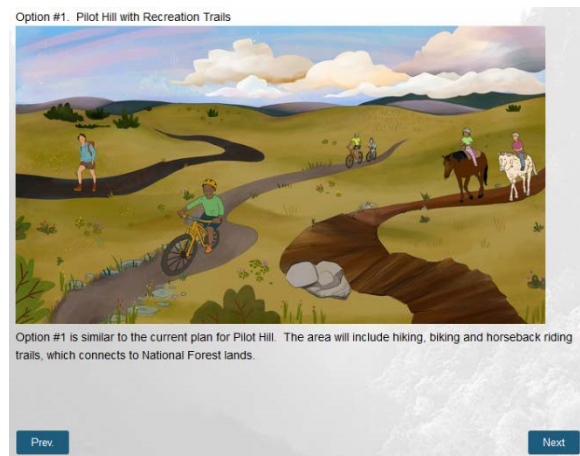
The mean WTP across all respondents is \$9.43 per visit or annual donation and slightly lower for those who said they would use the Pilot Hill recreation in the future. The hypothetical cost of Pilot Hill was posed as a daily visitation fee, so a lower valuation for the respondents that expect to pay multiple times is in line with economic theory.

4.2. CHOICE EXPERIMENT

The survey also included a choice experiment which presented respondents with three different options for Pilot Hill. Option #1 was similar to the current development plan for Pilot Hill. It offered multi-use trails for hikers, bikers, and horseback riders. Option #2 was a hypothetical scenario whereby Pilot Hill is left as open space without trails and human use. Option #3 was a hypothetical scenario whereby the lease to Pilot Hill is terminated and the area is returned to the state of Wyoming. The area could then be used to provide an economic return to the citizens of Wyoming through residential development, mining, or wind turbines, among other possible options. Each scenario was clearly explained and accompanied by an artist's rendering so the respondent can more easily distinguish and recall the options. A snapshot of the three scenarios is shown in Figure 4.

Figure 4. Choice Experiment Scenarios (Trails, Open Space, and Economic Development)

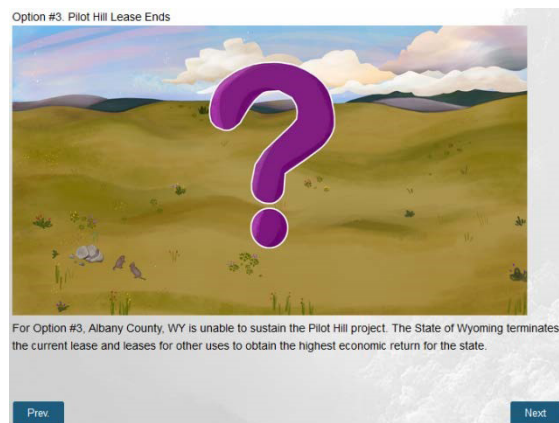
Option #1. Recreation Trails



Option #2. Open Space



Option #3. Economic Development



Three Choices with Costs

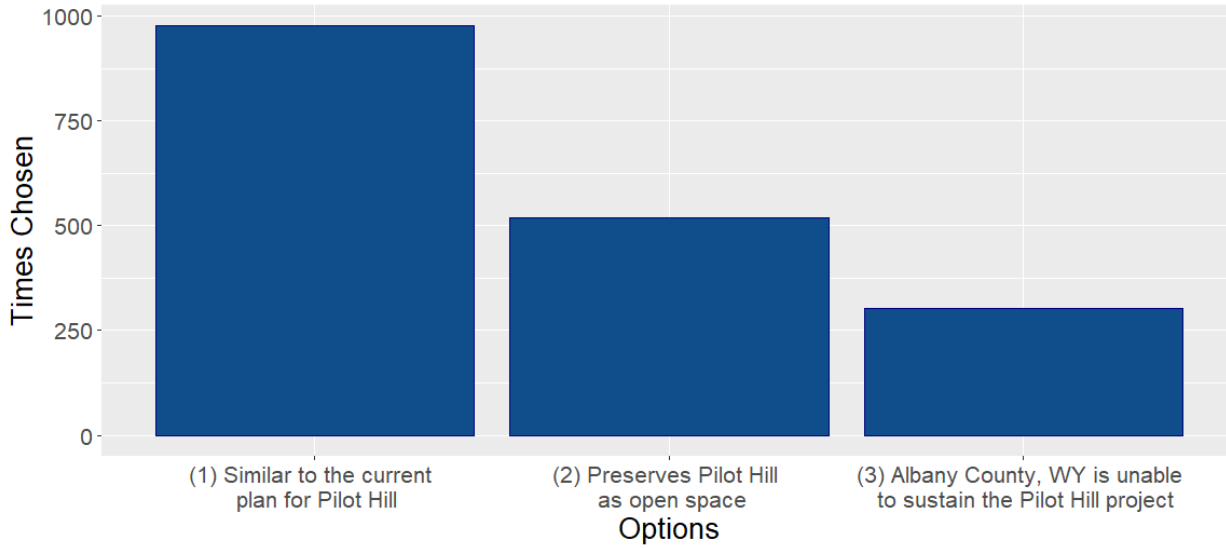
Now please select which one of the three options you prefer.

Option #1 Pilot Hill with Recreation Trails	Option #2 Pilot Hill as Open Space	Option #3 Pilot Hill Lease Ends
This option involves a fee of \$20 per visit.	This option involves a donation of \$15.	This option involves no fee or donation.
<input type="radio"/>	<input type="radio"/>	<input type="radio"/>

Options #1 and #2 also included a randomized cost to the respondent. For Option #1, the cost was either presented as a fee per visit (if the respondent indicated they were likely to use Pilot Hill in the future) or a one-time donation (if the respondent indicated they would not use Pilot Hill). The cost exhibited was drawn randomly from . There was no cost associated with Option #3.

Figure 5 shows the distribution of choices for all 997 respondents. Most respondent were presented with two instances of choice, each with different randomized costs. The total number of choices was 1,809. The total number of choices was less than twice the number of respondents because the randomly selected fees were such that a second-choice scenario was not necessary. For example, if the lowest cost of \$5 was selected for Options #1 and #2 and the respondent chose Option #3, there was no reason to give the respondent a second choice with higher costs.

Figure 5. Respondent Choices (Option #1 Trails; Option #2 Open Space; Option #3 Econ Dev)



Note: The categories along the horizontal axis (from left to right) are: (1) Similar to the current plan for Pilot Hill. The area will include hiking, biking and horseback riding trails, which connects to National Forest lands; (2) Preserve Pilot Hill as open space with no recreation trails; (3) Albany County, WY is unable to sustain the Pilot Hill project. The State of Wyoming terminates the current lease and leases for other uses to obtain the highest economic return for the state.

The most preferred option in the choice experiment, irrespective of cost, was Option #1 with a trail system (Bowker *et al.*, 2007) and connectivity to National Forest and state lands. This option was chosen more than the other two options combined. Option #3 of returning the land to the state of Wyoming to obtain the highest economic return was the least frequent choice, although we note it was chosen approximately 17% of the time.

The primary advantage of a choice experiment is that it allows for estimation of the dollar value for Pilot Hill attributes. Thus, we estimate a conditional logit model for the three choices in Figure 3 where the choices are indexed by $j=\{0,1,2\}$ and households are indexed by $i=1,\dots,N$. We specify that $j=1$ is economic development (baseline choice), $j=0$ is trails, and is $j=2$ open space. The latent random utility equation is:

$$y_{i,j}^* = z_{i,j}y + w_i\delta_j + \varepsilon_{i,j} \quad (2)$$

where $y_{i,j}^*$ can be interpreted as the latent utility of choice j for household i , and $\varepsilon_{i,j}$ is a stochastic error term assumed to have a Type 1 extreme value distribution. The term $z_{i,j}$ represents attributes that vary by household and choice, while captures attributes that vary only by household but not across choices. Since $\delta_0=\delta_1=\delta_2$ in our experiment, the term $w_i\delta_j$ drops out of the analysis (Wooldridge, 2002), and the estimating equations simplify to

$$y_{i,0}^* = y_0 + y_3price_{i,0} + \varepsilon_{i,0} \quad (3.1)$$

$$y_{i,1}^* = y_1 + y_3 price_{i,1} + \varepsilon_{i,1} \quad (3.2)$$

$$y_{i,2}^* = y_2 + y_3 price_{i,2} + \varepsilon_{i,2} \quad (3.3)$$

where γ_0 , γ_1 and γ_2 , and are the alternative-specific constants (ASCs). As shown in Hanley, Mourato, and Wright (2001), the maximum willingness to pay (WTP) for the j^{th} choice can be derived as the ratio of ASC and the coefficient on price:

$$WTP_j = -y_j/y_3 \quad (4)$$

To estimate the *marginal* value of each attribute requires a survey design whereby attribute levels are randomly varied across choices. This was not the approach taken in this study. In this study, respondents were instead presented with three fixed bundles of hypothetical attributes for Pilot Hill with an associated cost and asked to choose the preferred option. Using equation (4), we were able to estimate the maximum *total* WTP for each attribute bundle. Results are available in Table 5.

Table 5. Choice Experiment Estimates (N = 1,798)

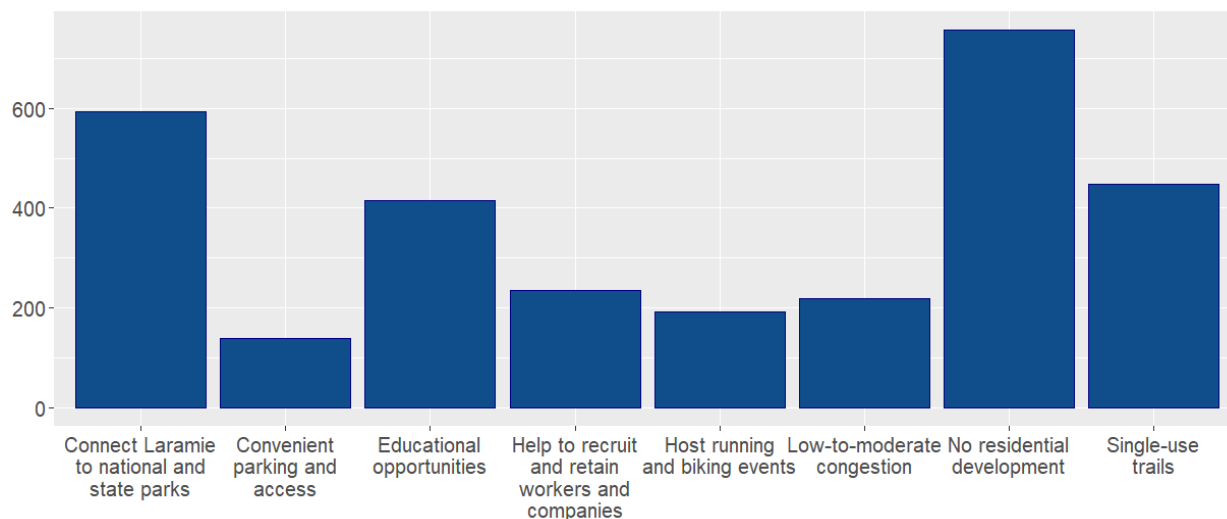
Variable Name	Coefficients ('s)	Standard Errors
Trails ASC	1.405***	0.111
Open Space ASC	0.748***	0.108
Econ Develop.	N/A	N/A
Price	-0.017***	0.006
Trails WTP	\$84.53	
Open Space WTP	\$45.02	

Notes: ASC = Alternative-specific constant

*Significance codes: 0.01 '***', 0.05 '**', 0.1 '*'*

In addition to the choice experiment, we asked respondents to choose the three most preferred attributes of Pilot Hill. The results of the attribute ranking are shown below in Figure 6. The most preferred attributes for Pilot Hill (in order) were: (1) protecting the area from residential development, (2) connecting Laramie to National Forest and state recreational lands, and (3) single-use trails.

Figure 6. Number of Times a Pilot Hill Attribute was Chosen as Most Important



Note: The categories along the horizontal axis (from left to right) are: (1) Ability to host running and biking events that bring visitors to Albany County, WY; (2) Connecting Laramie, WY to National Forest and state recreation lands; (3) Convenient parking and access for various transportation modes; (4) Educational opportunities for K12/UW students and the general public; (5) Help to recruit and retain workers and companies through improved outdoor amenities; (6) Low-to-moderate congestion with no more than 5 users on each trail; (7) No residential development protecting the aquifer, wildlife habitat, and open space; and (8) Single-use trails that are exclusive to type of user (i.e., hikers, bikers, and horse riders).

4.3. REGIONAL ECONOMIC ESTIMATES

Next, we extrapolate the household-level economic value estimates to calculate a total regional economic value of Pilot Hill. To do this, we take a conservative approach and adjust household WTP down by a factor of 3 to account for hypothetical bias (Loomis, 2010). Stated preference surveys have been shown to often elicit higher WTP values than are estimated in revealed preference situations. The adjusted household value from the contingent valuation analysis is then multiplied by the number of households to calculate the total economic value of Pilot Hill in each region. The estimated economic value for households is a weighted average accounting for the distribution of users (per trip value \times number of expected trips) and non-users (estimated donation level). Table 6 below shows the calculations and the total regional economic value of Pilot Hill.

The total regional economic value for Pilot Hill is \$4.27 million per year. This is a conservative estimate since we used an aggressive adjustment factor for hypothetical bias. We do note, however, that selection bias is a possibility in that some individuals who did not complete the survey, for example due to time constraints or attitude toward Pilot Hill, may have a systematically lower WTP for Pilot Hill. Others that were aware of Pilot Hill or plan to use it frequently, may be more likely to participate in the survey. We did not attempt to correct for this potential bias.

Table 6. Calculations for Regional Economic Valuation of Pilot Hill

Regions	No. of Households	Avg. Value (\$) per HH w/ Hypothetical Bias	Adjusted Avg. Value (\$) per HH	Regional Valuation (\$)
Albany, WY	15,944	\$74.13	\$24.71	\$395,212
Rawlins, WY	6,204	\$36.00	\$12.00	\$74,448
Casper, WY	32,799	\$27.21	\$9.07	\$297,487
Cheyenne, WY	48,920	\$43.20	\$14.40	\$704,448
Northern CO	241,692	\$32.58	\$10.86	\$2,624,775
Western NE	16,572	\$31.61	\$10.54	\$174,614
Total	362,131			\$4,270,984

Notes: The average Pilot Hill estimated value is a weighted average of non-users (\$7.68 donation), moderate users (5 visits per year, \$11.30 per visit, \$56.51 per year), and frequent users (20 visits per year, \$6.57 per visit, \$131.40 per year). The weights are based on the proportion of the sample that are non-users, moderate users who plan to use Pilot Hill between 1-10 times per year, and frequent users who plan to use Pilot Hill more than 10 times per year.

Conclusion and Discussion

In this paper, we estimate the regional value of the Pilot Hill Recreation and WHMA in Southeast Wyoming. Pilot Hill is unique since it connects the community of Laramie, WY to over 65,000 acres of national forest lands. In estimating the non-market valuation of Pilot Hill, we administered a household survey designed to elicit respondents' maximum WTP. Two different non-market valuation techniques were utilized in the survey – contingent valuation and choice experiments. The two methodologies, while very different in their approach, are both designed to elicit the economic value of Pilot Hill and its attributes.

The mean willingness to pay per household from the contingent valuation analysis is \$9.43 per visit or donation. The mean willingness to pay per household for the current plan of hiking/biking/horseback trails is \$84.53 per visit or donation, almost nine times larger. The contingent valuation design led to a lower willingness to pay for multiple reasons, including that many households may have already been aware that Pilot Hill and its trail system were free of charge. This could explain why over 40% of respondents answered “no” to both WTP questions shown in the contingent valuation portion of the survey. In addition, note that the contingent valuation design was not setup as a referendum between trails or housing development, which many respondents ranked as an attribute to be avoided. In the choice experiment, there was not an opportunity to express a strong aversion to housing development on Pilot Hill without either choosing trails or open space and paying the fee. It is not clear which WTP estimate better captures household preferences, but in line with convention, the more conservative estimate from the contingent valuation design might be more suitable to inform policy.

The one-time cost of the Pilot Hill land purchase was \$10.5 million (Aadland *et al.*, 2021). Our annual economic benefit estimate to the region is \$4.27 million. Using a social discount rate of 4%, the present value of the Pilot Hill project over a five-year period is \$19.77 million, which is nearly double the economic cost. This paper adds to the literature providing support to economic development strategies that pursue the restoration and conservation of ecosystems (Khalaf *et al.*, 2021).

References

- Aadland, D., Khalaf, C., & Zapata-Moran, I. (2021). *Examining the Regional Economic Impact of the Pilot Hill Project and a Valuation of its Latent Attributes*. Laramie, WY: Center for Business and Economic Analysis (CBEA). Prepared for Pilot Hill Inc. Retrieved from <https://www.uwyo.edu/cbea/files/documents/pilothillreport2021.pdf>.
- Bishop, R.C., and T.A. Heberlein. (2019). "The contingent valuation method." *Economic Valuation of Natural Resources*. Routledge, 81-104.
- Bowker, J. M., J.C. Bergstrom, and J. Gill. (2007). "Estimating the economic value and impacts of recreational trails: a case study of the Virginia Creeper Rail Trail." *Tourism Economics*, 13(2): 241-260.
- Cao, S., Z. Liu, W. Li, and J. Xian. (2021). "Balancing ecological conservation with socioeconomic development." *Ambio*, 50(5), 1117-1122.
- Champ, P.A., Boyle, K.J. and Brown, T.C. eds. (2003). *A primer on nonmarket valuation* (Vol. 3). Dordrecht: Kluwer Academic Publishers.
- Cook, D., K. Eiriksdottir, B. Davidsdottir, and D.M. Kristofersson. (2018). "The contingent valuation study of Heidmork, Iceland – Willingness to pay for preservation." *Journal of Environmental Management*, 126-138.
- Deller, S.C., T. Tsung-Hsiu, and D. Marcouiller. (2001). "The role of amenities and quality of life in rural economic growth." *American Journal of Agricultural Economics*, 83, 352–365.
- Haab, T.C. and McConnell, K.E. (2002). *Valuing environmental and natural resources: The econometrics of non-market valuation*. Edward Elgar Publishing.
- Hanley, N., S. Mourato, and R.E. Wright (2001). "Choice modelling approaches: a superior alternative for environmental valuation?" *Journal of Economic Surveys*, 15(3), 435-462.
- Harrison, R.A., D. Holt, and P. J. Elton (2002). "Do postage-stamps increase response rates to postal surveys? A randomized controlled trial." *International Journal of Epidemiology*, 31(4), 872-874.
- Khalaf, C., G. Michaud, and G.J. Jolley (2022). "Toward a new rural typology: Mapping resources, opportunities, and challenges." *Economic Development Quarterly*, 36(3), 276-293.
- Loomis, John (2010). "What Can Meta Analysis tell us About Hypothetical Bias in Stated Preference Valuation Studies." Unpublished manuscript.

O'Connor, E., Hynes, S., and Chen W. (2020). "Estimating the non-market benefit of deep-sea ecosystem restoration: Evidence from a contingent valuation study of the Dohrn Canyon in the Bay of Naples." *Journal of Environmental Management*, 275, 111180.

Wooldridge, Jeffery M. (2002). *Econometric Analysis of Cross Section and Panel Data*. The MIT Press, Cambridge, MA.

Appendix A. Community Focus Group Interview Script

Objectives of Interview

- Determine if language is understandable for the possible respondents.
- Determine if the levels and the payment vehicle is credible.
- Determine if the information provided is sufficient.

Script

Welcome and explanation of the purpose.

“Hello, thank you for coming today. My name is David Aadland and I’m here with Irene Zapata Moran. We are with the Center for Business and Economic Analysis at the University of Wyoming. We are designing a survey to measure how much people like you value outdoor recreational spaces such as Pilot Hill. The purpose of this initial session is to gather information that will help us develop a final survey for Pilot Hill. Specifically, we are interested in whether the potential survey questions are understandable, and the scenarios we will be describing are credible. First, we are going to play a video that introduces the Pilot Hill project. Then we will continue with a brief discussion.

[Play video]

Questions

Opening questions:

1. Please tell us your name and your favorite outdoor activity.
2. What features do you think a recreational area such as Pilot Hill should have?

Questions about hiking/biking trails:

3. Do you plan to use the hiking/biking trails at Pilot Hill?
4. Do you think it is important to have separate trails for hiking and separate trails for biking?
5. If you were to use Pilot Hill trails, how important is the number of people on the trail? How many people would you need to meet during a day hike or bike ride before you considered the trail crowded?

Questions about open space protection (aquifer protection and wildlife habitat conservation):

6. When you hear the words “aquifer protection”, what comes to mind?
7. When you hear the words “wildlife habitat conservation”, what comes to mind?

Baseline without the Pilot Hill Project. The Pilot Hill project is an effort to limit the residential development in the open space that connects Laramie to Pole Mountain. Without the Pilot Hill project, it is presumed that the open space would have been subject to residential development. This development would have resulted in a loss of wildlife habitat and potentially contaminated the aquifer.

8. Is the baseline level of development understandable?
9. If I say that the Pilot Hill project will provide 50% more aquifer protection than the baseline scenario, does that make sense to you?
10. If I say that Pilot Hill project will provide 50% more habitat conservation than the baseline scenario, does that make sense to you?

Questions about educational opportunities:

11. When you hear the words “educational opportunities” provided by Pilot Hill, what comes to mind?

Questions about the payment vehicle:

12. Currently, visitors and residents do not pay to use the Pilot Hill recreations area. There are no plans to charge residents or visitors. Hypothetically, if projects like Pilot Hill were to request payment, do these methods sound reasonable?
 - An entrance fee of \$3 - \$5 per day?
 - An annual donation of \$20 - \$40 dollars?

Thanks for your willingness to participate in this session. Do you have any final questions or comments?”

Appendix B. Expert Focus Group Interview Script

Objectives

- Address appropriate language for the attributes and levels.
- Define the possible hypothetical levels in each attribute.

Script

Welcome and purpose of the focus group.

“Thank you for joining us today. My name is David Aadland and I’m here with Irene Zapata Moran. We are with the Center for Business and Economic Analysis at the University of Wyoming. We are designing a survey to measure how much people value outdoor recreational spaces such as Pilot Hill. The purpose of this initial session is to determine the appropriate language and levels for each attribute. A brief introduction of Pilot Hill project is explained in the following video.

[Play video]

The attributes that are important to the Pilot Hill organization are:

- The number of trails, types of use of the trails (multi-use or exclusive), and trail congestion.
- Habitat conservation.
- Aquifer protection.
- Educational opportunities.
- Connectivity to Pole Mountain recreation area.
- Preserving open space and wildness.
- Accommodating non-motorized modes of transportation on site.

Next, we will share the focus group script we will be using for community members and are asking your opinion of the questions.

Questions for community members and experts.

Opening questions:

1. Please tell us your name and your favorite outdoor activity.
2. What features do you think a recreational area such as Pilot Hill should have?

Questions about hiking/biking trails:

3. Do you plan to use the hiking/biking trails at Pilot Hill?

4. Do you think it is important to have separate trails for hiking and separate trails for biking?
5. If you were to use Pilot Hill trails, how important is the number of people on the trail?
6. How many people would you need to meet, say for an hour-long hike, before you considered the trail crowded?
7. Do you think the number of people you meet on the trail is a good measure of congestion?

Questions about aquifer protection:

8. When you hear the words “aquifer protection”, what comes to mind?
9. If I say that the Pilot Hill project will provide XX% more aquifer protection (manner and levels defined after experts focus group), does that make sense to you?
10. What is the best way to describe aquifer protection and how can it be measured: the area protected, water quality improvement, etc.?
11. What levels of protection are realistic?

Questions about wildlife habitat conservation:

12. When you hear the words “wildlife habitat conservation”, what comes to mind?
13. If I say that Pilot Hill project will provide XX% more habitat conservation (manner and levels defined after experts focus group), does that make sense to you?
14. What is the best way to describe habitat conservation and how can it be measured:
15. number of species protected, the size of the area protected, etc.?
16. What levels of conservation are realistic?

Questions about educational opportunities:

17. When you hear the words “educational opportunities” provided by Pilot Hill, what comes to mind?
18. What types of educational opportunities for Pilot Hill are or will be available?
19. What levels are realistic?

Questions about the payment vehicle:

20. Currently, visitors and residents do not pay to use the Pilot Hill recreations area. There are no plans to charge residents or visitors. Hypothetically, if projects like Pilot Hill were to request payment, do these methods sound reasonable?
 - An entrance fee of \$3 - \$5 per day?
 - An annual donation of \$20 to \$40 dollars?
 - An increase in local taxes of \$10 per year.

Thanks for your willingness to participate in this session. Do you have any final questions or comments?”

Appendix C. Introductory Letter to Households



Wyoming Survey & Analysis Center
UNIVERSITY OF WYOMING



College of Business
Center for Business
and Economic Analysis

September 10th, 2021 Address block

Dear <city> Resident,

Your household address was randomly selected to participate in a study developed by the

University of Wyoming's Center for Business and Economic Analysis (CBEA) and the Pilot Hill Committee in Laramie, WY. The purpose of this study is to perform an economic analysis regarding the use of the Pilot Hill recreation area outside Laramie, WY. Everyone who completes will be entered in a drawing for a new iPad, to be drawn in early October.

The survey should take approximately 8 minutes or less. You don't have to answer any questions you don't want to, and you can end the survey at any time. We hope that you will take a few minutes to help us out with this vital project, regardless of if you have ever heard of Pilot Hill.

To access the online survey, please visit: <http://wysac.uwyo.edu/pilothill> and enter your household's unique passcode (case sensitive): <code>

Or, you may use your mobile phone to scan the QR code on the bottom of this letter.

Your participation in this survey is voluntary. Refusal to participate will not affect any benefits to which you are otherwise entitled. You may skip any question that you do not want to answer. All of your responses will be kept confidential.

For more information about the survey or if you have any trouble accessing the online survey, you may contact me directly via email (harnisch@uwyo.edu).

Sincerely,

Brian Harnisch
Senior Research Scientist
Wyoming Survey & Analysis Center (WYSAC)
University of Wyoming

Appendix D. Household Survey



Wyoming Survey & Analysis Center
UNIVERSITY OF WYOMING



College of Business
Center for Business
and Economic Analysis

Thank you for agreeing to participate in the survey. The survey is designed by the Center for Business and Economic Analysis (CBEA) at the University of Wyoming on behalf of the Pilot Hill committee. We are interested in responses from people like you, people in Albany County and in the surrounding region. The survey should take approximately 8 minutes or less. You don't have to answer any questions you don't want to, and you can end the survey at any time. We hope that you will take a few minutes to help us out with this vital project, regardless of where you live or if you have ever heard of Pilot Hill.

Press 'Next' to continue.

Next

Background

The Pilot Hill Recreation and Wildlife Habitat Management Area is just east of Laramie, WY and provides sweeping scenic vistas, important wildlife habitat, and interesting natural features – from deep ravines to limestone cliffs and conifer forests. This entire area overlies a key portion of the Casper Aquifer recharge area, a unique geologic feature that naturally filters rain and snow to provide a primary drinking water source for residents and visitors to Albany County, WY.

For more than a century this area served as a working landscape for the Warren Livestock Company. In the fall of 2020, the property was sold to the State and the University of Wyoming and leased to Albany County with an agreed upon intent of maintaining the land as open space, providing wildlife habitat protection and non-motorized recreational access for the benefit of all of southeastern Wyoming.

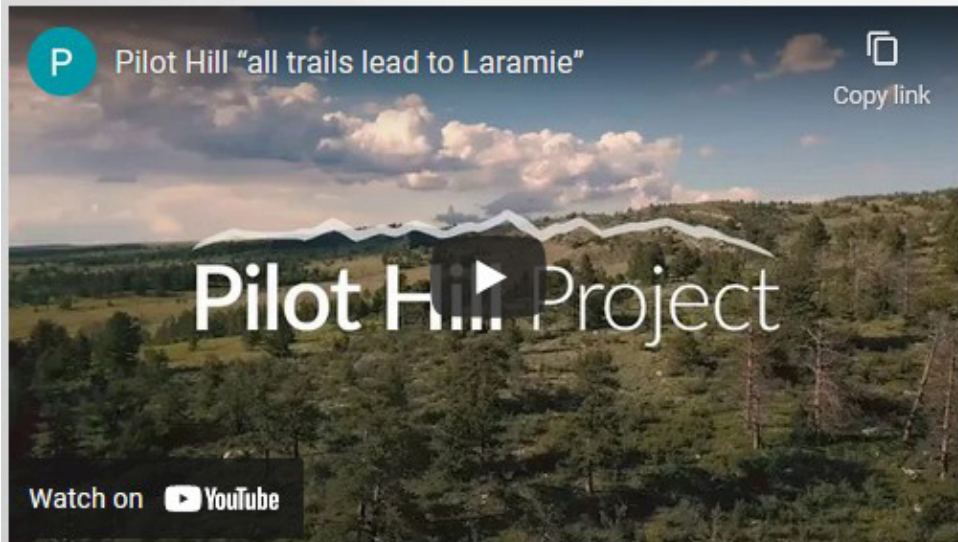
Prev.

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Background (con't)

Pilot Hill connects Laramie neighborhoods to almost eleven square miles of open space in the foothills and to over 65,000 additional acres of National Forest Lands in the Laramie Range. Protecting the area from residential development, Pilot Hill preserves a unique landscape, helps to protect an important aquifer resource, and provides open space for recreation, education, and wildlife habitat.

We hope you will take a minute to watch the informational video below for more information about Pilot Hill. You may also [click here to see a map of the area](#). (.pdf will open in a new tab or window - close that window to return to this screen).



How frequently do you hike, run, bike, or horseback ride in the outdoors?

- ☐ Never
- ☐ A few times per year
- ☐ A few times per month
- ☐ A few times per week
- ☐ Daily

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Next

Before this survey, were you aware of the Pilot Hill recreation area in Albany County, WY?

☐ Yes

☐ No

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Next

How many times per year do you expect to use the Pilot Hill recreation area?

☐ Not at all

☐ 1-2 times

☐ 3-10 times

☐ 11-50 times

☐ More than 50 times

Prev.

Next

In general, which do you feel is more important to the region:

☐ Economic Development

☐ Environmental Protection

Prev.

Next

When answering the next question, please treat your response as if you were making a real decision that requires a payment and reduces your budget available for other items such as housing, transportation, food, etc. Also, keep in mind there are no current plans to actually charge users of Pilot Hill recreation area.

Would you be willing to pay \$20 per visit to support the Pilot Hill recreation area as currently planned?

☐ Yes

☐ No

Next

Would you be willing to pay \$10 per visit to support the Pilot Hill recreation area as currently planned?

☐ Yes

☐ No

Prev.

Next

Please choose the **three** most important features of the Pilot Hill recreation area.

- ☐ Connecting Laramie, WY to National Forest and state recreation lands.
- ☐ Single-use trails that are exclusive to type of user (i.e., hikers, bikers, and horse riders).
- ☐ Low-to-moderate congestion with no more than 5 users on each trail.
- ☐ No residential development protecting the aquifer, wildlife habitat, and open space.
- ☐ Educational opportunities for K-12/UW students and the general public.
- ☐ Convenient parking and access for various transportation modes.
- ☐ Ability to host running and biking events that bring visitors to Albany County, WY.
- ☐ Help to recruit and retain workers and companies through improved outdoor amenities.

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Next

Next, we are going to ask you to choose between three **hypothetical** combinations of features for Pilot Hill. You will see three different scenarios, and we are asking you to choose one of the three combinations for each scenarios.

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Next

Option #1. Pilot Hill with Recreation Trails



Option #1 is similar to the current plan for Pilot Hill. The area will include hiking, biking and horseback riding trails, which connects to National Forest lands.

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Option #2. Pilot Hill as Open Space



Option #2 preserves Pilot Hill as open space with no recreation trails.

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Option #3. Pilot Hill Lease Ends



For Option #3, Albany County, WY is unable to sustain the Pilot Hill project. The State of Wyoming terminates the current lease and leases for other uses to obtain the highest economic return for the state.

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Now please select which one of the three options you prefer.

Option #1
Pilot Hill with Recreation Trails

This option involves a fee of
\$20 per visit.

☐

Option #2
Pilot Hill as Open Space

This option involves a donation
of **\$15**.

☐

Option #3
Pilot Hill Lease Ends

This option involves no fee or
donation.

☐[Prev.](#)[Next](#)

Again, please select which one of the three options you prefer given the new values below.

Option #1
Pilot Hill with Recreation Trails

This option involves a fee of
\$20 per visit.

☐

Option #2
Pilot Hill as Open Space

This option involves a donation
of **\$20**.

☐

Option #3
Pilot Hill Lease Ends

This option involves no fee or
donation.

☐

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Next

Finally, we have just a few questions about you and your household to make sure our survey is representative.

What is your age?

☐ 18-24

☐ 25-34

☐ 35-44

☐ 45-54

☐ 55-64

☐ 65-74

☐ 75+

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Are you a parent of a child aged 17 years old or younger?

☐ Yes

☐ No

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Including yourself, how many members live in your household?

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What is your gender?

☐ Male

☐ Female

☐ Other (specify):

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What is the highest level of education you have completed or the highest degree you have attained?

- ☐ 12th grade or less
- ☐ High school diploma or GED
- ☐ Some college, no degree
- ☐ Certificate, diploma, or associate degree: Occupational, Tech., Vocational Progrm
- ☐ Associate degree: Academic program
- ☐ Bachelor's degree
- ☐ Master's degree
- ☐ Professional or Doctoral degree (e.g.: PhD, Md, Dds, Edd, Jd, MBA, etc.)

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Are you Hispanic, Latino/a, or Spanish origin?

- ☐ Yes
- ☐ No

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Next

Which one or more of the following would you say is your race?

- ☐ White
- ☐ Black or African American
- ☐ American Indian or Alaska Native
- ☐ Asian
- ☐ Native Hawaiian or Other Pacific Islander

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Is your annual household income from all sources -

- ☐ Less than \$10,000
- ☐ \$10,000 to less than \$15,000
- ☐ \$15,000 to less than \$20,000
- ☐ \$20,000 to less than \$25,000
- ☐ \$25,000 to less than \$35,000
- ☐ \$35,000 to less than \$50,000
- ☐ \$50,000 to less than \$75,000
- ☐ \$75,000 to less than \$100,000
- ☐ \$100,000 to less than \$150,000
- ☐ \$150,000 to less than \$200,000
- ☐ \$200,000 or more
- ☐ Don't know/not sure

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Next

What is the ZIP postal code where you live?

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