Riverside Ranch – Pitkin County
Methodology for Landscape Performance Benefits

Environmental

Sequesters 43 tons of carbon annually in the 453 trees on the property, approximately the same amount of CO2 released by burning 4,372 gallons of gasoline.

All the trees on site were counted. There are Ponderosa Pine, Narrowleaf Cottonwood, Quaking Aspen, Colorado Blue Spruce, Globe Willow, Douglas Fir and Lombardy Poplar on site. A random sampling of approximately one-third of the trees (30.68%) was measured (DBH at 4.5 ft from ground. http://fennerschool-associated.anu.edu.au/mensuration/dob.htm#bh).

These measurements were entered into the tree benefit calculator (http://www.treebenefits.com/calculator/). The values were averaged and extrapolated to represent all the trees on site.

The aggregate amount of atmospheric carbon reduction was 85,592 lb. 85,592 lb / 2,000 lb per ton = 42.796 tons.

The amount of carbon dioxide released by burning a gallon of gasoline was found here: (http://www.epa.gov/cleanenergy/energy-resources/refs.html), which is 0.00892 metric tons per gallon of gasoline.

0.00892 metric tons = 19.67 lbs per gallon of gas. This is confirmed by the 19.64 lbs CO2 per gallon of gas reported from the U.S. Energy Information Administration (http://www.eia.gov/tools/faqs/faq.cfm?id=307&t=11).

43 tons = 86000 lbs. 86000 / 19.67 = 4372.14 gallons of gasoline.

Limitation

1) The tree survey did not measure each individual tree but rather a sampling of approximately 1/3 of the trees. A survey that took into account the exact DBH of each tree would likely prove more accurate.

Provides suitable habitat for two trout species through a series of created ponds and wetlands. Water quality testing showed temperature, pH, and alkalinity to be within suitable ranges.

The landscape architect worked with an aquatic consultant to create a riparian system to provide year-round trout habitat. Three ponds and one-third of a mile of stream course were created. Lake aeration, a bacterial injection system, vegetation cover, dead tree trunks, weirs and other structures were added to facilitate the function of rainbow trout and brown trout habitats.

Many factors are important for creating a successful trout habitat. Data were obtained by performing on-site analysis and also by taking water samples which were tested at the Utah Water Research Laboratory. On a visit to the site on June 19, 2013, water temperature, alkalinity, pH and hardness were measured in six different locations using an aquarium thermometer and test strips. Testing locations are shown in Figure 1 and correspond with inlet and outlet of each pond.

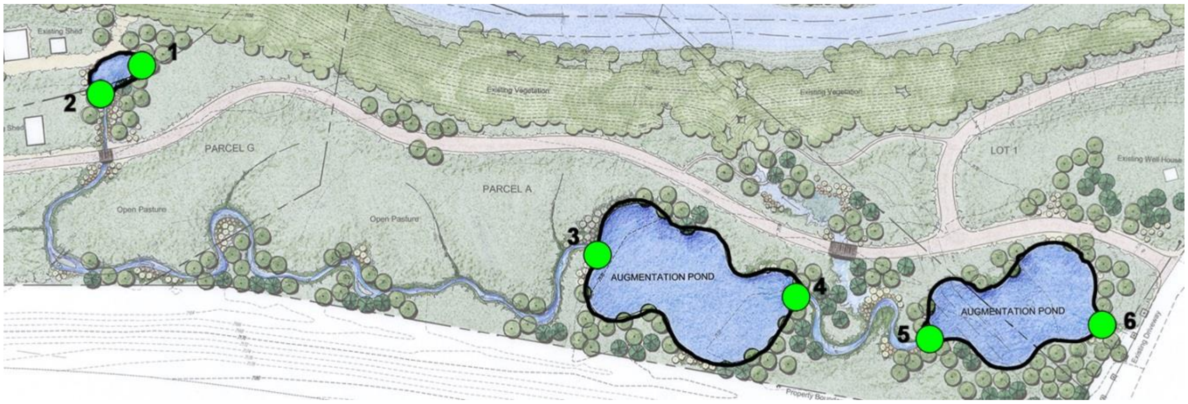

Figure 1. Water quality sample locations at Riverside Ranch.

Measurements were taken from the furthest downstream position first, working upstream, to ensure the disturbed pond bottom did not impact water quality tests. The results are presented in Table 2.

Table 2. Water quality test results

Location	TSS (mg/L)	Temperature (F)	pH	Alkalinity (ppm)	Hardness	Time of sampling
1	5	69.50	7.4	80	168.01	12:53 pm
2	12	68.00	7.5	80	167.69	1:01 pm
3	3	66.00	7.7	100	162.63	1:09 pm
4	2	66.00	7.6	80	125.51	1:15 pm
5	3	66.00	7.6	70	162.51	1:19 pm
6	1	66.00	7.5	90	165.11	1:30 pm

These results can be compared with recommended levels seen in Table 3. A comparison reveals that all samples were within suitable ranges.

Table 3. Suitable water quality parameters for trout. Adapted from (Boren, Baker, Cowley, & Hurd, 2003)

Parameter	Level
pH	6.5-8.5

Alkalinity	10-400 ppm
Hardness	>20 ppm
Dissolved Oxygen	5-12 ppm
TSS	<25 mg/L

Water temperature is one of the most critical factors for trout survival. Research indicates that rainbow trout survive in temperatures ranging from 33-78 degrees Fahrenheit, with optimum growth occurring between 50-55 degrees. Brown trout survive in 33-72 degrees Fahrenheit with optimum growth between 48-55 degrees Fahrenheit (Boren, Baker, Cowley, & Hurd, 2003). While the temperatures were outside the optimum range, all temperatures were within the suitable range. It is important to note that the samples were taken near the edge of the pond, in shallow water which represents the worst case scenario. Also, water temperature increased two degrees over the length of the stream course, suggesting that these shallow waters have a significant impact on raising the water temperature.

In addition to the tests above, researchers on-site were able to visually confirm the presence of trout in each of the ponds, a further indication of the success of the design to provide adequate habitat to sustain the fish.

Limitations:

1) The data gathered represents a single sample on a sunny June day. More samples on other dates would need to be tested to give a better idea of year-round suitability.
2) The aquarium test strips used did not have very precise scales and some judgment was left to researchers.

Stores all water rights volumes, 3.25 acre-ft, on-site, which can be released to augment the nearby Roaring Fork River when needed. This is equivalent to 1.5 Olympic-size swimming pools.

Many areas in the western United States govern water use to ensure that upstream users do not infringe on the rights of downstream users by allowing landowners the access to and use of certain volumes of water commonly referred to as water rights. In Colorado, a water right gives you right to use water; it does not let you own the actual drops of water. In addition, referred to as the Prior Appropriation Law, individuals who used the water first have the senior rights to the use of the water. If you do not use your water rights, (and for a "beneficial use"), you lose your rights to the water. http://www.coloradotu.org/ctucoldwater/wp-content/uploads/2011/09/Basic-Water-Law-Simplified.pdf

Riverside Ranch has ample water rights, but is required to store this water on site or risk losing the privilege of its use which could result in a lack of water for irrigation or other purposes that may arise in the future. In addition, an easement was placed on the ranch requiring that water for surrounding properties be stored on site as well. This easement necessitated the storage of up to 2.5 acre feet of water on site. Original submissions of impoundment permits to the Office of the State Engineer Division of Water Resources by the landscape architect states the capacity of each pond as follows:

Pond #1: 0.15 acre feet
Pond #2: 1.6 acre feet
Pond #3: 1.5 acre feet
Total volume = 0.15 + 1.6 + 1.5 = 3.25 acre feet

An Olympic swimming pool (164 ft X 82 ft X 6.6 ft) holds 2,500 cubic meters of water. 3.25 acre feet = 4,008.8 cubic meters. 4,008.8 / 2,500 = 1.6

Reuses nearly 8,000 cubic yards, or 95%, of material excavated from ponds to re-contour the site, obviating the need to import fill and saving on disposal, purchasing, and transportation costs.

Roger Neal of High Country Engineering performed the cut and fill calculations through two different methods.

Method 1, the grid method: applying a five-foot grid system over the site to calculate the volume.
Method 2. the composite, or triangulation network method: triangulating lines between contours to calculate the volume.

Table 1. Cut and fill analysis using two methods (Source: High Country Engineering, 2002)

Method	Cut (yds)	Fill (yds)	Net(yds)
1. Grid	7,832	7,441	391 (cut)
2. Composite	7,858	7,516	342 (cut)
Average	7,845	7,478.50	366.5 (cut)

366.5 / 7,845 = 0.0467 or 4.6%. 100 – 4.6 = 95.4% of the cut was reused on site.

Limitations

1) These calculations were based on the difference between existing and finished contours and may not include detailed volumes of topsoil displacement.
2) The numbers reflect the average of the two methods used to calculate cut and fill and thus are close approximations rather than exact figures.

Prevented 42 cubic yards of asphalt from entering the local landfill by using a recycled asphalt paving mix to create the access driveways.

The total length of the driveways was assessed using AutoCAD construction files. Dimensions of the driveway were determined to be 1,512.81 ft in length and 12 ft wide. A construction detail obtained from the landscape architect indicates the depth of asphalt is 3 in. In Colorado, maximum allowable recycled asphalt pavement used in mixes cannot exceed 25%. (http://www.co-asphalt.com/documents/RAP_Brochure_all.pdf)

1,512.81 X 12 = 18,153.72 sf
18,153 X .25 ft = 4538.25 cu ft of total asphalt
4538 X 25% = 1134.5 cu ft of recycled asphalt = 42.02 cu yd

Limitation

1) It is unknown the actual amount of recycled materials used in the mix for the driveway, so the maximum recycled materials allowed was used in our calculations, which could be inaccurate. However, the highest percentage allowable was used because of the likelihood that the contractor wanted to reduce costs. As the following graph indicates, materials consume the majority of production costs associated with laying asphalt.

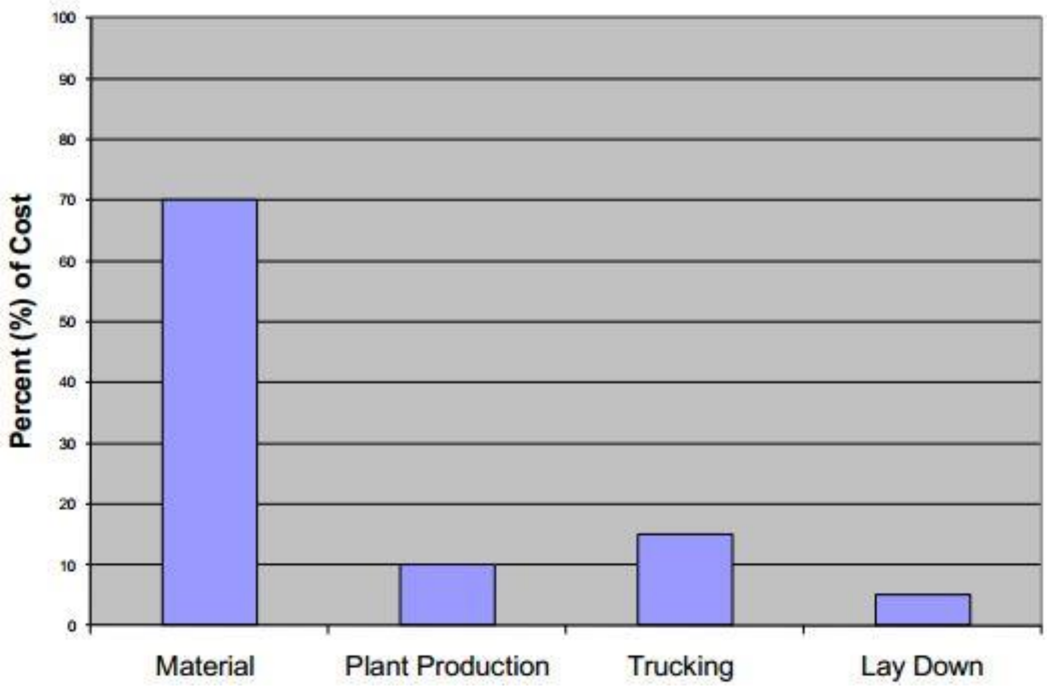

Figure 2, Estimated asphalt production cost categories.
(http://www.fhwa.dot.gov/publications/research/infrastructure/pavements/11021/11021.pdf

Prevented over 430 cubic feet of wood from entering the local landfill by purchasing reclaimed wood instead of new lumber to reconstruct the facades on the historic buildings. This was estimated to reduce greenhouse gas emissions by 10 metric tons of carbon dioxide equivalent.

The square footage of the facades for all five historic structures was determined using a combination of AutoCAD drawings, on site observations and photographs of the property. The square footage of each façade was found to be:

Farmhouse: 1,262.42 sf
Shed #1: 369.93 sf
Caretaker Unit: 817 sf (Note: Shed #2 is known as the Caretaker Unit).
Shed #3: 500.5 sf
Shed #4: 493.62 sf

The total square footage of the facades is 1,262.42 + 369.93 + 817 +500.5 + 493.62 = 3,443.47 sf.

The facades were built with 2" X 4" pieces of lumber which have an actual thickness of 1.5" (or 0.125 ft).
0.125 X 3,443.47 = 430.43 cu ft of wood were used in the façade construction.

The average weight for pine timber used in construction was obtained from the American Wood Council (available from http://www.awc.org/pdf/WSDD/wsdd.pdf, page 9). The weight for Western White Pine is 27.2 lbs/cu ft. The volume of the wood is 430.43 cu ft and the total weight is 11,707.798 lb, or 5.85 tons.

Using the EPA's Waste Reduction Model (WARM) calculator (http://epa.gov/epawaste/conserve/tools/warm/Warm_Form.html), the effect of recycling the 5.85

tons of wood compared to transportation to the local landfill (local landfill is 13.9 miles from the site on Highway 82 in Snowmass Village, Colorado) and subsequent decay was assessed. It was found that approximately 10 metric tons of carbon dioxide equivalent were saved.

Limitations

1) The method above took into account only lumber used in the construction of the building facades, not any of the materials needed to restore the interior of any of the structures.
2) Weight for lumber can vary immensely due to many factors including wood density, age, moisture content, etc. This method used a standard for wood weight that may vary from the actual weight of the wood used.
3) The WARM calculator produces an environmental value on the wood that has been recycled but does not produce such a value for the wood that the team was able to avoid purchasing by using recycled lumber.

Social

Rehabilitated five historic structures along Highway 82 in Pitkin County, including one eligible for the National Register of Historic Places. Only 6 historic sites are on the National Register along this highway, the area's major thoroughfare.

The main house contains significant historical and architectural value. Built in 1887 of timbers that had been transported over Independence Pass by its original owner, Arthur B. Foster, the homestead was developed into a successful ranching operation. Jeremie J. Gerbaz, another prominent citizen of Pitkin County and former County Commissioner, constable for the district and school board member, purchased the property in 1898 and continued farming it until his death in 1947. Known as one of the earliest homesteads in the Roaring Fork Valley, the house has been quite well preserved, with only the porch removed from the north wall. It stands as a prime example of the late Victorian architectural style typical of residences of the successful ranchers in this area.

Eligibility for the National Register of Historic Places is indicated on the Historic Building Inventory Record submitted to the Colorado Historical Society Office of Archaeology and Historic Preservation (Project Name: Pitkin Reconnaissance Survey, 1999, SHF#98-02-084). This record indicates that research performed to determine the significance of the structures included an interview with Jeremie J. Gerbaz's grandson. Suzannah Reid, AIA, a Pitkin County Historic Preservation Officer, concurs that the main house is eligible for the National Register. The now uninhabited structure was restored in a manner consistent with the Secretary of the Interior Standards for Rehabilitation, preserving its eligibility for the National Register.

Because of the site's location next to a major thoroughfare, Highway 82, the structures are identifiable historic features for citizens of Pitkin County. They are landmarks that represent the agricultural heritage of this valley and each building embodies a separate, but integral piece of this history. GIS data were obtained from the National Park Service, U.S. Department of the Interior, National Register of Historic Places (http://nrhp.focus.nps.gov/natreg/docs/Download.html) that locates historic structures and sites. Data were last updated in 2007. Along Highway 82 through Pitkin County, there are six historic structures and sites along this road listed on the National Register.

Limitation

1) Eligible historic sites and structures are not indicated in the GIS data, so there is a likelihood

that other eligible sites exist.

Cost Comparison Methodology

By limiting turf grass to just 0.57 acres or 11% of the total site area, the homeowners save an estimated $9,485 in annual maintenance costs compared to if the entire site were conventional lawn. This figure includes labor, fuel, and fertilizer costs.

A large portion of the site is covered in grass. 5.39 acres of this is non-mowed, non-fertilized native grass, and 0.57 acres is mowed, fertilized turf-grass. To compare annual maintenance costs associated with each type of grass, we used a method developed by Rosenberg et al (2011).Their method uses a spreadsheet they developed with approximations for maintaining specific aspects of a landscape.

Our method calculated the savings as a what-if scenario. Essentially, if all the 5.39 acres that are native grasses were instead planted as turf-grass, how much annual maintenance would be required? Our comparison analyzed the maintenance needs of all the grass as if it were all high-maintenance turf-grass. Then, the maintenance needs of only the 0.57 acres were calculated and the difference between the costs to maintain the two areas was determined. This result is the savings that are realized.

Factors that were considered in the comparison are fuel for equipment needed to mow and trim the lawn; fertilizer to maintain the turf-grass; and labor to perform all of the aforementioned maintenance activities.

The model assumptions include:

Hourly labor rate: $40.00
Cost of fuel / gallon: $4.67 (July 21, 2013 cost in Aspen, CO)
Cost of fertilizer/lb: $0.30
Size of mower used: 52-72” gasoline engine
Size of trimmer: Gasoline-oil engine
Conventional Maintenance (vs. intense maintenance)

Outputs of the model indicate that annual maintenance costs for the 5.39 acres if it were turf-grass would be $10,789; to maintain the 0.57 acres of turf grass annually requires $1,304.

$10,789 - $1,304= $9485
$9485 / $10,789 = 88% annual savings in maintenance by using native grasses

Limitation

1) The model was developed and intended for use in Utah, thus costs and maintenance needs will be different in Colorado. Rates will also obviously fluctuate with different maintenance regimes, equipment used and products used. Because these factors are the same in each scenario, it is still effective in showing an approximation for the percentage of savings that can be realized by using native grasses.

References

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