After the Fire: Contour Log Felling to Stabilize Hillslopes

Querencia in Action: Landowner Guide

Trees, shrubs, wildflowers, and grasses play many roles in New Mexico's forest ecosystems. On the forest floor, lateral roots spread outwards holding on to soil particles and stabilizing sediment movement while vertical roots allow water to infiltrate downwards. Leaves in the upper canopy act like tiny umbrellas, interrupting the intensity of rain drops plummeting towards the forest floor. Severe forest fires can consume plant and organic material leaving behind bare and even hydrophobic soil, or soil that repels water. As water collects and flows across a burned hillslope, it gathers ever increasing speed causing potentially catastrophic flooding and erosion. The goal of many post-fire restoration approaches is to slow down and spread out water to prevent destruction downstream. It may seem like a huge feat to restore your land, but you likely have many materials on hand that can be used to build restoration structures, such as rocks, brush, and even charred trees.

Contour Log Felling

Contour log felling is a method of placing logs in shallow trenches along the land's contour to slow water running downhill and trap sediment. Contour lines indicate a constant elevation, like lines on a topographic map (Figure 1). All surfaces on one contour line are level to one another. Water traveling downslope on a treated area is forced to meander back and forth between an alternating, zig-zag pattern of placed logs (Figure 2). This treatment can increase water infiltration into the soil, stabilize and retain loose soil, and create macro sites for vegetation recovery.

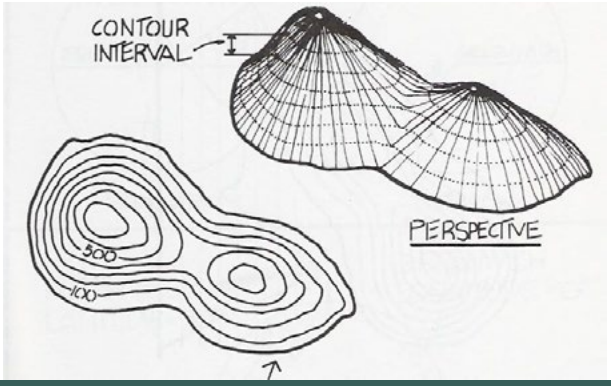

Figure 1. Examples of contour lines (Altmann et al., 2022).

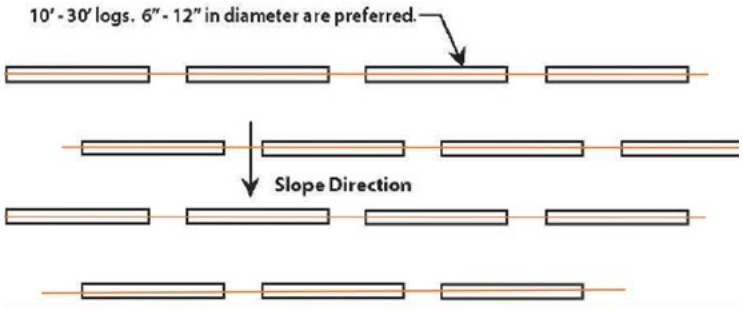

Figure 2. Theoretical log terracing pattern. Orange represents contour lines (Adapted from Barkley, Y., n.d., University of Idaho).

Contour felling can be expensive (contracting may cost as much as $40-1,200/acre) and can require experienced labor (especially in cutting charred and/or dead trees) and fairly accurate log placement. These cost considerations should be evaluated along with studies that show that in the first post-fire year and in light rainfall events (<1.8" per hour), contour log felling reduced erosion rates by 50-70%. However, inaccurate placement (2-5 degrees off contour) can reduce how efficiently sediment is trapped by 20%. Because contour felling is difficult to implement over large areas, the US Forest Service no longer endorses this method. Other land managers, like Santa Clara Pueblo, have reported great success when logs are properly placed and secured. Generally, this treatment has a lifetime of about 1-2 years, post completion. Once sediment builds up behind the structures, each log has "done its job." Additionally, contour felling can use up some "waste" material by utilizing excess charred logs on the landscape.

Santa Clara Tribe Utilizes Contour Log Felling

Between 1998-2011, three separate fires burned about 80% of the Santa Clara Pueblo's forested lands with an estimated $250M in damages to infrastructure. Erosion and flooding after the 2011 Las Conchas Fire desecrated the sacred Santa Clara Canyon and Creek, subsequently instigating innovative collaborations with several tribal, federal, state, private industry, and non-governmental organizations to restore the landscape. Integrating the tribe's traditional ecological knowledge with the Army Corps of Engineers' "Engineering with Nature" principles, the management teams utilized natural materials to maximize local resources and limit the input of foreign materials. When the canyon's volcanic soil lacked the boulders needed for erosion control structures, the tribe turned to burned timber to create contour log felling treatments. In 2022, Santa Clara Pueblo shared their expertise by leading contour felling workshops for the communities impacted by the Hermit's Peak/Calf Canyon Fire. Since 2014, Santa Clara Pueblo and their partners have built 5,300 structures in 26 tributaries that provide successful, locally sourced erosion and flooding controls.

Materials:

- Experienced labor
- Clinometer*
- A-frame, site level, or laser level
- Pin flags
- DBH tape (Diameter at Breast Height tape is a tool that quickly measures tree diameters)
- Logs to size (10-30 ft tall; 6-12 inches diameter)

- Chainsaw
- Handsaws or folding saws/ loppers
- Hard rakes
- Shovels
- Hazel hoes or mattocks, pick axes
- Stakes at 12-16" long (as needed)
- 100' vinyl tape
- Personal Protective Equipment (PPE)
- Weed free seeds (optional)
- Weed free mulch (optional)

* Low tech tools and techniques (See Notes)

Installation:

1. Locate moderate to severely burned sites (Table 1).

Table 1. Fire severity classes and descriptions (Oregon State University Extension, n.d.)	
Low Severity	Most trees survive with scorch evidence. Most organic matter on soil top is intact and little consumption or charring of twigs and down logs is evident.
Moderate Severity	Most trees have been killed or are severely scorched and retain most of their needles. Some organic matter on soil top is consumed. Twigs may be consumed and downed logs are deeply charred.
High Severity	Nearly all trees are killed and have no needles. Nearly all organic matter, twigs, and logs have been consumed and soil may be damaged or altered.

2. Measure the slope using a clinometer* to determine if it is between 20 - 60% slope.
3. Practice your ability to walk a contour using an A-frame (see page 5). Like most things, identifying a contour line gets easier with practice. The steeper the slope, the more critical it is to get it right. A site level or laser level can also be used to identify the approximate cross slope alignment. Mark contour lines on slope using pin flags.
4. Estimate the tree height (must provide logs 10-30 ft tall). Measure with DBH Tape* or estimate the diameter for most of the tree (each log at 6-12"). Preferentially select trees upslope of the contour line so they can be felled and rolled downhill.
5. Fell appropriate trees near the contour line, leaving stumps at 12" high for bracing the logs.
6. Cut logs to 10-30 ft.
7. Remove tree limbs so log can lie flat on ground (limbs and slash can be spread above and below the log structure).
8. Dig a shallow trench for the entire length of the log, or parts of it, to maximize ground contact. It is imperative that logs lie flat with complete ground contact.
9. Place the log in the trench and backfill with trenched soil to prevent water from cutting under the log (Figure 3).

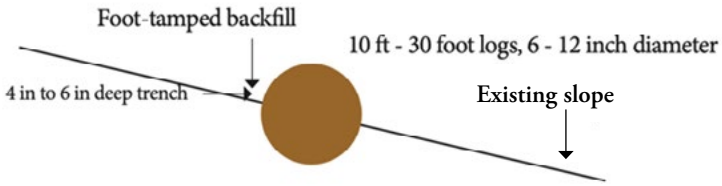

Figure 3. Typical log and bedding detail (NRCS, 2017).

10. Drive sturdy stakes, use large rocks or brace logs against cut stumps to secure logs from potential rolling (Figure 4).

Figure 4. Example of stakes, stump, and backfilling for contour log felling (Coalition for Upper South Platte, 2015).

11. You may create berms made of piled soil at the ends of the log to increase soil storage capacity. This is especially useful on steeper slopes or lower down on a hillslope.

12. Seeding and mulching immediately behind/upstream of the structure can create ground cover, capture debris and moisture, and stabilize soil (optional).

13. Work across contour (see Table 2 for spacing) and down slope by repeating process in burn scar area to create a bricklayer like patterning.

Table 2. Recommended spacing for contour slope treatments (Altmann et al., 2022).

Slope Steepness (percent)	Burn Intensity	
	Moderate	Severe
	Spacing (feet)	
10 - 20%	60	40
20 - 50%	30	20
> 50%	15	10

Notes

- Low Tech tools and techniques:
  - DBH tape: A low-tech option to measure tree diameter involves the use of a string, tape measure, and some simple math. Wrap a string around a tree at breast height to measure diameter (DBH), and pull it tight—make sure the string is level all around the tree. Hold the end of the string against the tree with one hand, and use the other hand to hold the location on the string that matches up with the end of the string after it has been wrapped around the tree. Use a tape measure to measure the number of inches of string that went around the tree (the circumference), divide that number by 3.14 (pi), and the result will be the tree diameter. The same technique can be done by using a flexible tape measure and noting the number of inches around the tree directly from the tape measure and then dividing by 3.14. If you are trying to locate fixed DBH trees, such as 6" to 12" you can take the string, measure a length and find after doing the math the spot that equals 6" DBH and mark it with a sharpie and one line. Repeat for 12" using two lines.
  - Clinometer: A great video using cheap and easy materials or your smart phone. https://www.youtube.com/watch?v=yxpYmcP7RsQ&ab_channel=GROWObservatory
- Start from the top of area and work downwards.
- Be aware of dead or weakened trees when working in the area and wear appropriate PPE.
- Please consider consulting with experts in the post-fire treatment profession who can provide perspective, insight, guidance, and advice in this ever-evolving field of practice.
- Contour felling on rocky or uneven ground is very difficult to implement properly; contour felling is only effective when properly implemented.

References

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Credits

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Marking contour lines

-From the Sustainable Agriculture Extension Manual for Eastern and Southern Africa
echocommunity.org

Requirements

- Two straight wooden poles (1.5-2 m long), and one straight pole (1-1.5 m long).
- String, hammer, nails, pencil.
- Stones or pegs.

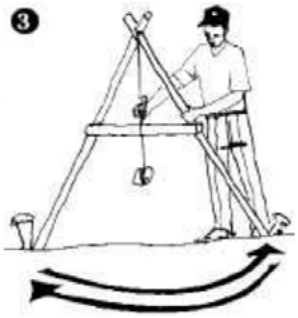
Making the A-frame

1. Use the poles and nails to make a frame in the shape of an "A" **(Picture 1)**.

2. Tie one end of the string to the top of the "A".

3. Tie the stone to the other end of the string, so it hangs down just below the horizontal crossbar of the "A".

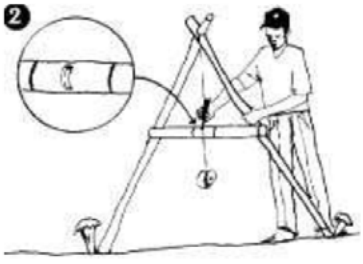
Calibrating the A-frame



4. Stand the A-frame upright on reasonably level ground. Mark on the ground where the two legs stand.

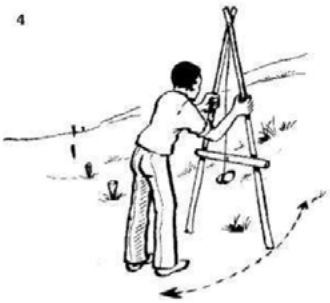
5. Hold the A-frame still, and use the pencil to mark lightly on the crossbar where the string crosses it **(Picture 2)**.

6. Turn the A-frame round, so that each leg stands exactly where the other had stood.



7. Make a second light mark on the crossbar where the string crosses it.

8. The two marks on the crossbar should be fairly close together. Halfway between them shows where the string would cross if the A-frame were standing on exactly level ground. Make a heavy pencil mark or notch the bar with a knife at this point **(Picture 3)**.



To use the A-frame, it is "walked" across the slope, making sure that the two legs are level each time by checking if the string crosses the horizontal bar at the calibrated point. If not, the forward leg is moved until the string shows the frame is level. The position of the legs on the ground is marked with pegs or stones, and then the frame is pivoted around to mark a new point on the slope.

The line of pegs or stones will mark a contour line: they will all be at the same height on the slope.

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