Aspen Stand Water Development for Wildlife

William E. Rice

HARVESTING WATER FROM ASPEN STANDS FOR WILDLIFE USE

William E. Rice, Bureau of Land Management, 200 S. Oakley Highway, Burley, ID. 83318.

ABSTRACT:

A new technology has been developed to obtain water from aspen (*Populus tremuloides*) stands for wildlife use. This paper presents the four year study results of this technology and provides site, vegetative and soils criteria for evaluating aspen stands for possible water harvesting. The advantages, limitations, and costs of this water collection and storage system compared to traditional guzzlers are discussed.

INTRODUCTION:

Semiarid rangelands in the West are poor water producers and the potential for evapotranspiration substantially exceeds precipitation (Hibbert 1983). As a result, unbound (free) water is often lacking over wide areas during the summer season. Increasing and prolonging the availability of water in these areas can increase the carrying capacity for many species of wildlife (Yoakum and Dasmann 1971).

Aspen (*Populus tremuloides*) stands have characteristics that make them suitable for water harvesting. Aspen stands receive 16 inches or more precipitation annually and usually coincide with sites receiving heavy snow accumulations. Unlike coniferous trees that hold snow in the canopy and lose much of the water to evaporation, most snow in aspen stands is deposited on the ground. As a result, mature aspen stands generally yield about 42% of the total water received as surface runoff and groundwater recharge (Figure 1; DeByle 1985a).

In areas prone to windblown snow, accumulations can be increased in aspen stands by the strategic cutting of small patches within the stand. Small openings are effective snow traps, accumulating 33% more snow and evaporation is 30% slower in these openings than elsewhere in the stand (DeByle 1985a). Troendle and Meimen (1984) reported increasing water yield over 50% by creating snow traps. Replacing the trees and understory shrubs with herbaceous vegetation also significantly reduces evapotranspiration losses (Hibbert 1983). Consequently, the net water yield can be increased significantly through manipulation.

Knowledge of these relationships and methods of harvesting water have been previously used primarily for the purpose of augmenting water yield from watersheds for off-site use (Hibbert, 1983). Snow management practices have been used to develop on-site surface water for livestock but they involved snow fences or manipulation of sagebrush vegetation (Sturges and Tabler 1981). To my knowledge, no one has reported developing on-site water by intercepting and storing seasonally excess subsurface water. In the fall of 1989, I attempted to determine the feasibility of developing water for wildlife use from aspen stands.

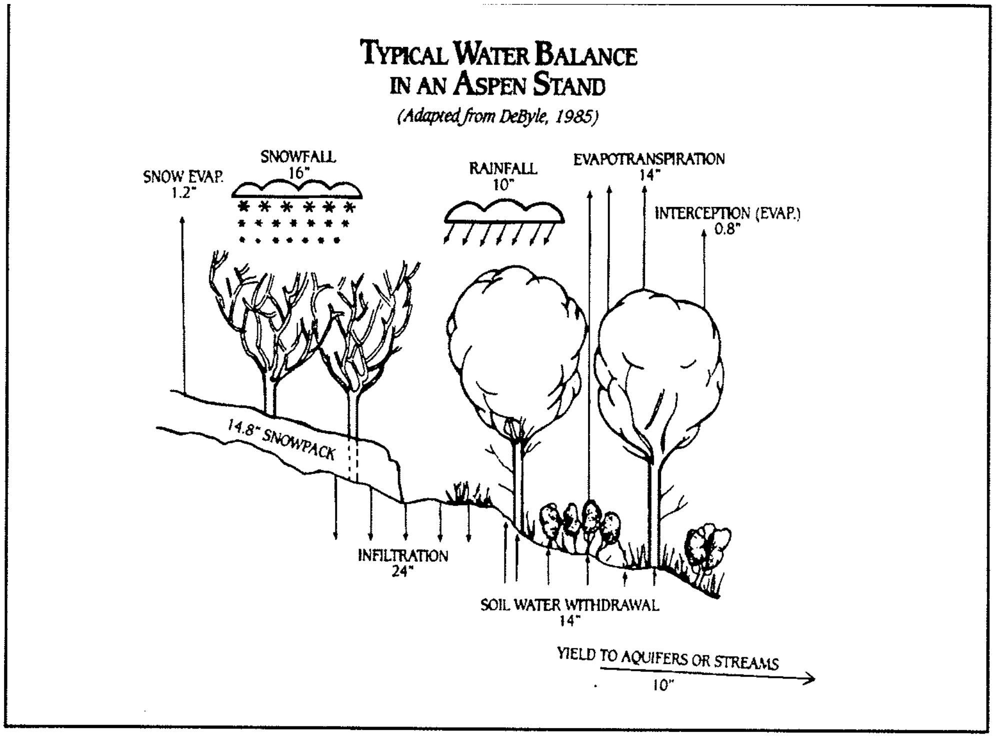


Figure 1. Water balance in a typical western aspen stand (DeByle 1985a).

STUDY AREA:

The study area is located in southeastern Idaho in the Sublett Mountain Range. Water harvesters were installed at two sites. One was located in Trail Canyon (6,500 feet elevation), about 27 miles south of Rockland and nine miles west of Holbrook, Idaho (Site # 1). The other (Site #2) is located about seven miles northwest of the first site in Crazy Canyon (6,200 feet elevation). Climate, geology, soils and vegetation were similar at both sites.

Temperatures range from over 100 degrees Fahrenheit in the summer to minus 30 degrees Fahrenheit during the winter. The majority of the precipitation occurs from late fall to late spring. From mid-June through September little precipitation occurs and is usually limited to occasional isolated thundershowers. Average annual precipitation at Snowville, Utah, the nearest climatic station, is 11.2 inches. Precipitation at the two sites is probably 8 to 10 inches greater due to elevation influences.

The precipitation year 1988-89 was the third year of a drought that continued through 1991-92. Precipitation at Snowville, Utah, was 26% below normal for 1988-89 and forty percent below normal for 1989-90, 1990-91, and 1991-92. The geology of the area consists of undifferentiated upper Paleozoic sediments. The soils are mostly gravelly loams and are quite well drained. As a result, perennial springs and streams are few and far between.

Vegetation in the study area is dominated by sagebrush communities, with lesser amounts of Utah juniper (*Juniperus osteosperma*) and mountain shrub communities. Aspen stands generally occur as stringers along drainages and in isolated patches on the lee sides of ridges where snow accumulates.

Common understory shrubs in the two aspen stands selected for development consisted of mountain lover (*Pachistima myrsinites*), willow (*Salix* spp.), Wood's rose (*Rosa woodsii*), chokecherry (*Prunus virginiana*), and shinyleaf ceanothus (*Ceanothus velutinus*). Common herbaceous species included Great Basin wildrye (*Elymus cinereus*), Nevada bluegrass (*Poa* spp.), sticky geranium (*Geranium viscossissimum*), and nettleleaf horsemint (*Agastache urticifolia*).

METHODS:

Soil samples were taken from 15 aspen stands using a soil auger. The purpose of samples was to determine presence and depth to moist soil and other indicators of water in the soil. Initially, samples were taken along the elevational gradient from the upper to lower parts of stands. This effort was abandoned when it was determined that rocky, shallow soils were regularly encountered near the surface at the upper parts of the stands. The deepest soils were found where the trees were well developed and vigorous in the middle and lower parts of the stand.

Development of Site # 1 took place in early fall, 1989. Aspen and understory shrubs were completely cut and removed from a small area (20 feet by 40 feet) within the aspen stand. At the downhill end of the opening, a pit was dug by hand measuring seven feet long, four feet wide, and six feet deep.

From the downhill end of the pit, a horizontal narrow trench was dug to the point where it intercepted the natural slope (Figure 2).

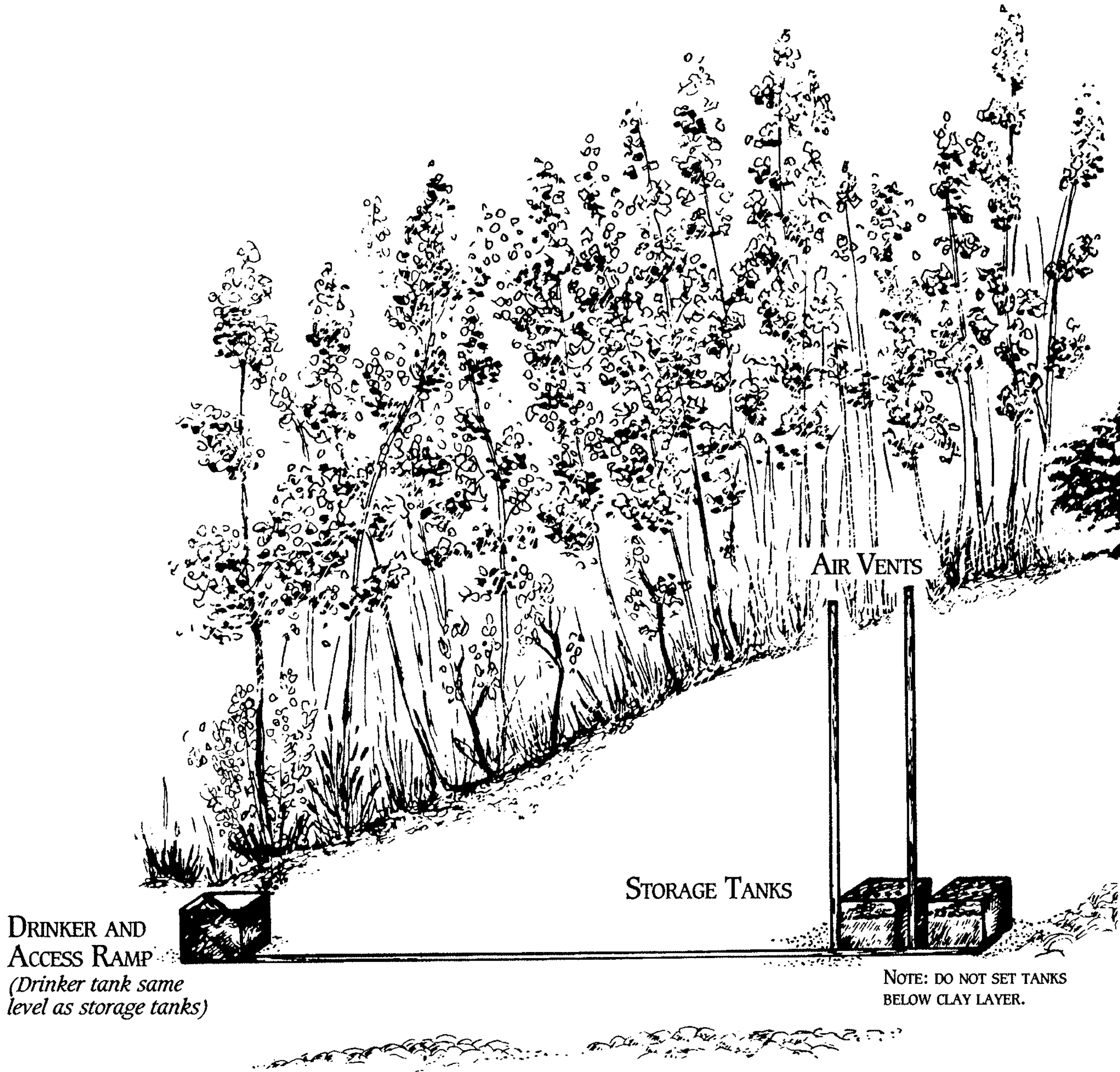
The bottom, downhill and side walls of the pit were lined with 6mm plastic sheeting to trap water in the pit. Three 55 gallon plastic barrels were placed in the pit, lying on their sides. The barrels were plumbed so that they were all linked to a common outlet. The system was vented to prevent air lock. A hose was installed from the outlet, through a shut off valve, to a small wildlife drinker (Figure 2). Total storage capacity equaled about 160 gallons.

Once the barrels were in place, and plumbing complete, the pit was partially back-filled up to the top of the barrels. The top surfaces of the barrels were then perforated with numerous quarter inch holes. Filter cloth was then placed over the top of the barrels to prevent soil from entering the water system and the remainder of the pit was back-filled with the available soil.

The valve allowing water to flow to the wildlife drinker was closed to enable later determination of the amount of water collected.

Previously cut aspen trees were placed over the collecting pit and piled around the guzzler to discourage livestock use.

Site #2 was developed in October 1991. Aspen and understory shrubs were removed from an area measuring 50 feet by 100 feet. A backhoe was used to dig the pit to a depth of 12 feet. Two 200 gallon surplus fire pumper tanks were installed and linked with 1 1/4" plastic pipe to a 140 gallon guzzler. Total storage capacity equaled 540 gallons. The other aspects of this installation were similar to the development at Site #1 except that the disturbed area was seeded with a grass seed mix and no valve was installed at the guzzler.



Construction Notes

1. Line the bottom, downhill sides of the pit with 6mm black plastic sheeting.
2. Perforate the tops of tanks with numerous perforations.
3. Cover tank perforations with filter cloth.
4. If gravel is available, cover filter cloth with 6" of gravel before backfilling the pit.

Figure 2. Water harvester construction diagram.

RESULTS:

Moist soils were present at all 15 sites tested. However, no water ever collected in the holes in any of the samples up to a depth of 11 feet.

Vegetation present at the sites provided good clues to the presence and depth of moist soils. Sites with Great Basin wild rye and willow present in the understory had soil moisture within four to eight feet of the surface. When these species were absent, moist soils were not found until at least nine feet. The depth to moist soils also seemed to be related to the vigor of the aspen stand. Aspen stands that had mature aspen foliage present from the top to more than half way down the trees as well as numerous aspen sprouts in the understory had moist soils closer to the surface.

Within the study area most aspen stands sampled that displayed the vegetative features indicative of moist soil close to the surface were located in the upper ends of south-east facing draws.

Moist soils were present within four feet of the surface at Site #1 (developed in 1989) and within six feet at Site #2 (developed in 1991). Also numerous striations of oxidized iron and magnesium in the soil samples indicated a high frequency of wetness of the site.

Site # 1 was checked for the first time August 8, 1990, 10 months after development. At that time, the system was drained of 90 gallons. After draining, the valve was closed. During the next visit in early October, another 20 gallons of water was removed from the system. Although I could not be certain that the system had drained completely during the first visit (an air block could have occurred), it was encouraging to find that a total of 110 gallons was present in a year that had only 40% of normal precipitation.

Site # 1 was revisited in June 1991. At that time, all barrels were full (160 gallons).

Site #2 was visited for the first time since installation on May 6, 1992. As was the case with Site #1, precipitation since installation was well below normal. In spite of this, a total of 270 gallons of water was present in the system. Water was still present in the system in late May but was not measured. No water was available at an August 5, 1992, visit but wet soil in the bottom of the drinker indicated that it had been available in the recent past.

Site #2 was visited in April 21, 1993, after normal winter precipitation. At that time the system was full (540 gallons). A revisit on April 28, 1993 revealed that the system contained 32 gallons less than the April 21 visit. Numerous deer tracks were evident at the guzzler. On May 7, 1993, the system was once again completely full. As measured from a rain collection can at the site, 1.4 inches of water had accumulated since the April 21 visit.

The cost of the test system (Site #1) was $1,700 ($1,500 labor; $200 materials). Development cost for Site #2 was about $2,000. Since the storage tanks were surplus, no cost was incurred with them other than transportation.

DISCUSSION:

There are a large number of aspen community types in the intermountain west occurring on many different types of sites (Mueggler, 1988). Not all may be suitable for water harvesting. In the study area, the two aspen stands that were developed had the following characteristics:

1. Aspen trees were vigorous with foliage present more than halfway down from the top.

2. Aspen sprouts were common in the understory.

3. Great basin wild rye was present in the area of the pit.

4. Willow was present in the understory.

5. Soils were deep (at least six feet), contained a high clay content and had little rock.

6. In late summer, moist soils were within six feet of the surface.

7. The stands were located just below the crests of ridges (i.e. in areas of windblown snow deposition.) and had southeast aspects.

Some or all of these site criteria may not be suitable for other areas. For example, Tew (1967), working in central Utah, determined that aspen stands with a north exposure had the deepest soils and the greatest water yield compared with other exposures. Therefore, until these site criteria are confirmed for other areas, checking relative soil moisture levels among stands may be the surest way to select good potential sites. Perhaps evaluating the depth of snow remaining in aspen stands during late spring or early summer would also be a good way to judge sites.

Clearing the aspen and understory shrubs above the collection/storage tanks was done to:

1. Increase snow collection at the site.

2. Reduce the amount of evaporation of snow.

3. Reduce the amount of evapotranspiration by woody vegetation, and;

4. Increase available water for collection.

Aspen stands are prime habitat for many wildlife species (DeByle 1985b). Extensive removal of aspen and understory shrubs can have deleterious impacts to a number of species. Other resources and aesthetic values can also be negatively affected. The risk of mass wasting, erosion, changes in peak flow, flooding and reduced water quality can all be increased by such activity.

The scale of removal has a large bearing on the extent of impacts. Johnson (1984) concluded based on the results of his and the research of others that removal of less than 20% of a stand has undetectable impacts to the watershed and water quality. The amount of aspen and shrubs removed at the two sites developed was minor in comparison to the size of the stand. At both Site #1 and Site # 2 less than one percent of the stand was cut. Damage to wildlife food and cover was considered negligible as was aesthetic impacts. From outside the aspen stand there was no visible sign of disturbance. When seen from a distance of about 1/4 mile, the cut areas appeared as natural openings.

Because of the previously discussed potential impacts to wildlife, watershed and aesthetics, the potential to develop large quantities of water using this method are limited and unadvisable. The volume will never be enough for cattle and should only be considered for wildlife. I estimate that the most that can be collected is in the range 1,000 - 5,000 gallons. Efforts to increase beyond these levels would likely require the removal of too much aspen to meet present environmental standards.

After cutting mature aspen, dense suckering of aspen sprouts should be expected. These suckers use less water than mature trees but the differences diminish over time. Within 10-15 years, the sprout stand may consume as much water as the parent trees did (Tew 1967; Hibbert 1983; Debyle, 1985a). To continue the benefits of water yield, some type of control program may be needed at periodic intervals of 5-10 years. Possibly the seeding of herbaceous vegetation during the first fall after development may help to suppress aspen recovery and extend the useful life of the treatment.

The cost of developing water harvesters in comparison with conventual guzzlers is likely to be lower. With the water harvester, the need for a collection apron is eliminated. Likewise, the maintenance costs of the harvester are likely to be lower than conventual guzzlers although the need to periodically remove brush and trees from the collection area may reduce or eliminate the savings. I believe the harvester is less likely to have system failure from leaves and other material clogging the system. Certainly, vandalism problems should be reduced with the harvester. Depending on the materials used, the useful life of the water harvester can potentially be much longer than conventual guzzlers.

From an aesthetic point of view, the water harvester is much less noticeable than conventional guzzlers with their generally highly visible collection aprons.

The system installed at Site #1 was totally experimental. It was developed simply to test the idea. The development at Site #2 was also experimental although it approached operational size and capacity. Both systems successfully captured excess water. Nevertheless, this technology should not be considered fully developed. Some additional investigation is needed to determine the optimum depth to place the collection/storage tanks. Depth may not be important. The water available to the system may be restricted to that which is directly above the collection surface. If it turns out that depth is not important, then the potential costs for development and maintenance of these systems would be reduced significantly.

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