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Surface runoff plot design for use in watershed research

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Abstract

A micro-watershed design is presented for use in watershed research projects. The plot size is 5 m (1 × 5 m) and uses low cost materials for construction. This plot size is suitable for surface flow and soil erosion research projects conducted where space is limiting and may be used either for monitoring natural or simulated rainfall events. Similar plots were used in research conducted on the Hall Ranch of the Eastern Oregon Agricultural Research Center, Union, Ore.

Many micro-watershed plot sizes have been used in the history of rangeland hydrology. The large (3.7 m × 18.3 m) USLE plots have been used in open shrub and grass lands (e.g., Johnson and Gordon 1986) and in some forest clear cut applications (Hart 1984). This size of watershed plot usually must be in close proximity to a road for transport of building materials and simulated rainfall equipment (if it is used). Heede (1987) argued that the proper area of a micro-watershed in selectively cut forests in Arizona is one with naturally defined topographic boundaries. Unfortunately, many logging and/or grazing research projects are not conducted in units that lend themselves to such subdivision.

An alternative to the above size is a smaller plot of 1 × 5 m (5 m^2) (Fig. 1). Plots of this size were used in a research project conducted in a selectively cut ponderosa pine forest in the foothills of the Wallowa Mountains in northeastern Oregon (Williams 1988). In this study, the 5-m^2 plot maximized understory vegetation representation, sample size, and efficient use of the study area. The 5-m length may be inadequate for surface flow to develop from natural rainfall events onto forest soils. This size plot will be adequately covered by a single 3 nozzle modula of the programmable rainfall simulator developed by Meyer and Harmon (1979) and Neibling et al. (1981). Depending on site conditions, the possibility exists to expand this area without a considerable amount of extra work. The watershed plot design is a scaled-down simplified version of plots used by the Agricultural Research Service (ARS) at Pendleton, Ore., for surface flow and sediment studies conducted on cultivated fields (Mutchler 1963, Zuzel et al. 1982).

Watershed Plot Design

A 5-cm steel round-bar template is used to maintain a constant area and slope. It is placed on the hillside and the slope within it is measured with a clinometer. Position of the plot is determined by moving the template until both the top and bottom are level with the contour of the hillside.

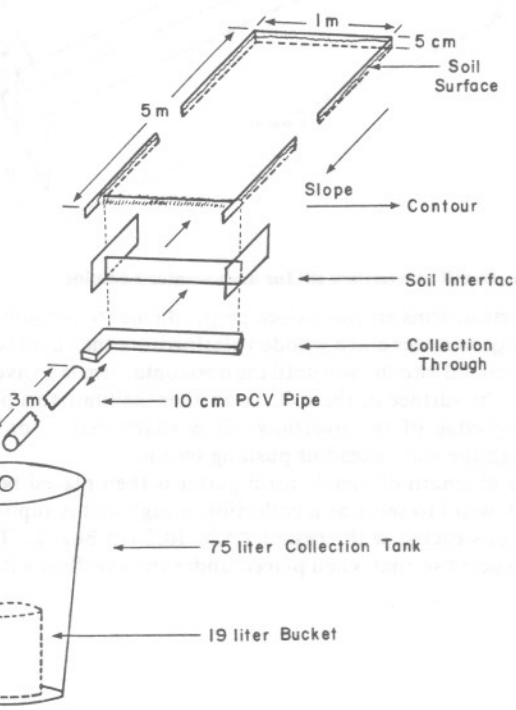

Fig. 1. Layout of micro-watershed plot.

The plot is delineated by borders constructed with preservative treated 2.5 × 10.2-cm fir and larch boards. These are buried approximately 5 cm below the surface of the soil, with approximately 5 cm left above the surface. The boards are held in place on the inside of the plot by a straight cut face in the soil. The cut face and space for the board is made by using a 1 m × 15 cm piece of 4.8 mm flat steel with a sharpened edge used as a knife to make 2 parallel cuts approximately 2.5 cm apart in the earth. A hook-knife device made from a 2.5 cm wide piece of steel is then used to cut off any roots between the soil faces and lift the soil out. This produces a relatively straight and undisturbed face. Surveyor stakes are then driven into the ground to hold the boards in place. If the board

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does not press firmly against the soil in the plot, a tighter fit can be obtained by wedging additional stakes between the first stake and the board. Excess soil from excavations for the collection trough, pipe, and collections tank is then tamped in as back-fill on the outside of the plot to insure stability and prevent rill development.

At the bottom of each plot a overflow sill is driven into the ground (Fig. 2). The overflow sill is constructed from 14 gauge sheet metal and resembles a 3 dimensional "H" placed on the ground. The horizontal arm follows the contour of the hillside and

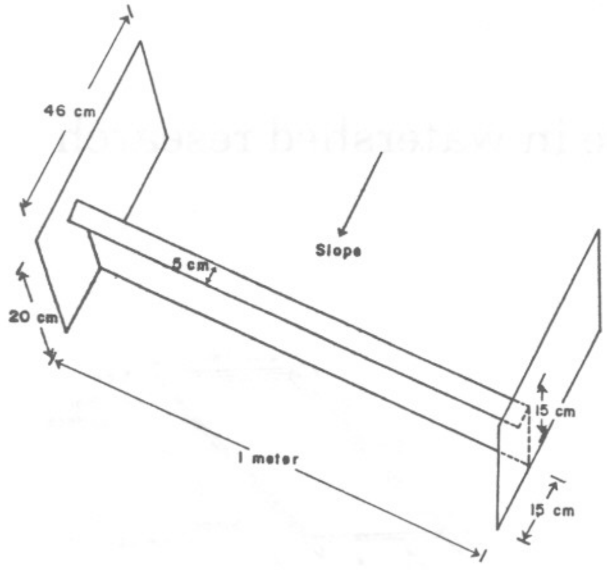

Fig. 2. Detail of overflow sill for micro-watershed plot.

the vertical arms are positioned perpendicular to the slope contour. A sledge hammer and a wooden platform are then used to drive the overflow sill into the soil until the horizontal arm is an average 5 cm below the surface of the soil. To further facilitate this process the leading edge of the overflow sill is sharpened in order to cut through the soil instead of pushing into it.

A 1 m length of metal storm gutter is then placed beneath the overflow sill to serve as a collection trough and is supported by a box constructed with treated 2.5 × 10.2-cm boards. The box is constructed so that when placed under the overflow sill the gutter has a 2.5% slope along the contour of the hillside. A cover constructed of treated 2.5 × 30.5-cm boards prevents rainfall from directly falling into the trough. The space between the cover and the soil above the overflow sill is about 5 cm. Hardware cloth with a 60.4-cm mesh covers this opening to prevent the gutter from filling with pine needles and grass and to discourage curious rodents.

The trough empties into a 10 cm diameter polyvinyl chloride (PVC) storm drain pipe which extends down hill 3 m to a 75 liter garbage can used for the collection tank. The end of this pipe is also covered with 0.64-cm mesh hardware cloth to further prevent rodents from falling into and drowning in the collection bucket. The PVC pipe and collection tank are then buried for protection and to insulate samples against freezing temperatures. A 19-liter collection bucket is placed inside the collection tank. The bucket is easily removed to measure and sample surface flow. The gutter, PVC pipe, and collection tank are all protected from large herbivore trampling by a 3-strand barbed-wire fence.

A. 1.25 m length of PVC pipe with a cap glued onto the end of it is wired on a fence post to collect rainfall at the plot. Each collection bucket and rain gage is charged with anti-freeze and mineral oil to prevent freezing or evaporation.

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