NATURAL RESOURCES CONSERVATION SERVICE
CONSERVATION PRACTICE STANDARD
OREGON

WATER-HARVESTING CATCHMENT

(No.)

CODE 636

DEFINITION

A facility for collecting and storing precipitation.

PURPOSE

This practice may be applied as part of a conservation management system to support one or more of the following:

* Provide water for livestock.
* Provide water for fish and wildlife.
* Provide water for recreation or other purposes.
* Improve livestock or wildlife distribution.

CONDITIONS WHERE PRACTICE APPLIES

This practice applies to preparation of a watershed with membranes of rubber, plastic, fiberglass, metal, etc., or soil treatments of asphalt, cement, wax, or sodium salt to increase runoff. It can also include collection of runoff from high runoff areas such as rock outcrops or existing paved areas by construction of simple curbs or diversion ditches. The collected water is delivered by pipeline to a water storage tank.

This practice applies to areas where there is a need for primary or supplemental beneficial water. The contributing area must have a potential to furnish the quantity and quality of water required for the intended use.

FEDERAL, STATE, AND LOCAL LAWS

Design and construction activities shall comply with all federal, state and local laws, rules and regulations governing pollution abatement, health and safety. According to the Oregon Building Code Division ***"only roof surfaces may be used for harvesting rainwater."***

The owner or operator shall be responsible for securing all required permits or approvals and for performing in accordance with such laws and regulations.

CRITERIA

Each water-harvesting catchment must be designed according to a plan suited to water requirements and site conditions. The following points shall be considered in designing water-harvesting catchments:

1. Quality and quantity of water required for the planned use.
2. Probability of filling the storage area or basin.
3. Area of apron needed for the required water yield.
4. Materials and method required to insure that the apron is smooth and impervious. Earth, treated earth, wax, rubber, plastic, asphalt, concrete, steel, and other such suitable materials are acceptable for this purpose.
5. Provisions for diverting foreign runoff from the catchment area to prevent damage and excessive sedimentation.
6. Provisions for protecting the apron from damage by runoff in excess of that needed to maintain the design capacity of the conveyance system. An overflow pipe or an emergency spillway can be used.
7. Need for a sediment trap between the apron and the storage basin.
8. A storage basin that is adequate in size, impermeability, and durability for the required water. Earth basins and tanks of steel, concrete, Butyl rubber and similar facilities are acceptable. Earth dams must have at least 1 foot of freeboard above design high water. All storage basins must be protected from 10-year frequency, 24-hour duration storms. An overflow device must be installed in all storage basins.
9. Need for evaporation represents, such as rock filling and floating covers.

Conservation practice standards are reviewed periodically and updated if needed. To obtain the current version of this standard, contact your Natural Resources Conservation Service State Office or visit the Field Office Technical Guide.

10. Adequate protection to prevent damage from weather, animals, vandals, wildlife, and traffic. Fencing may be necessary.
11. Provisions for maintaining the apron, the conveyance system, the overflow device, and the storage basin.

Catchment apron

The apron consists of a cleared, grubbed, compacted, sterilized, and sealed area to provide runoff at the efficiency desired. Floodwater shall be diverted away from the apron by a ditch or dike located above or along the side of the apron. The apron shall be designed with a berm around its perimeter approximately 6 inches high to direct collected runoff. The downstream berm shall be a maximum of 2 feet high.

Concrete and grouted rock curbs, or a ditch excavated in earth or rock shall be designed to direct water from existing natural rock outcrop aprons or paved areas to a storage tank(s). The ditch excavated in earth or rock shall be sealed if necessary.

Location of catchment aprons

The following items shall be considered when locating catchment aprons:

Locate in areas of highest precipitation. Generally, the landowner/operator has a good knowledge of storm patterns. Also refer to local rainfall records (where available).

Locate in drift areas if snowmelt is significant, but locate on southern exposure to melt snow.

Wax catchments located at higher elevations should have southern exposure.

Wax catchment aprons shall be located in areas of sandy soils (SM. or coarser). They are not recommended on finer soils where frost heave or cracking problems exist or on soils with high gypsum content. However, initial and replacement costs should be considered in site selections. Rocky or gravely areas for wax, asphalt, or concrete type catchment aprons should be avoided unless a smooth, firm soil surface can be prepared. Areas with large rocks should be avoided for all types of catchments.

Wind frequently damages membrane type catchment aprons; therefore, they should be located in areas protected from the wind. Locate in forested areas where possible, so trees will act as a windbreak. Avoid locating catchments in areas with abruptly changing slopes leeward and down hill from the strongest prevailing wind direction. For example, do not locate a catchment on a south exposure subject to strong northerly winds.

Where protection from wind cannot be provided by trees or other obstacles, cover rubber, plastic, etc. membranes with at least a 2 inch thickness of poorly graded 1 to 1-1/2 inch sized aggregate (containing no fines). Aggregate coverings also protect membrane materials from physical damage by deer, antelope or other wildlife and UV light.

Catchments shall be located such that the slope in the direction of sheet flow is not steeper than 8 percent nor flatter than 3 percent. Ideally the catchment slope should be 3 to 5 percent. Some membrane type catchment aprons (asphalt-fabric, reinforced plastic, artificial rubber, sheet metal, concrete) can be installed on up to 10 percent slopes. Slopes steeper than 8 percent create an erosion problem on wax aprons. Slopes flatter than 3 percent tend to reduce runoff efficiency because of water retention.

Length of catchment aprons

Catchment aprons using membrane or soil treatments can have apron lengths up to 500 feet.

Maximum length of wax aprons in the direction of sheet flow shall be determined from Table 1.

Table 1. Maximum length of wax aprons

Percent slope	3	4	5	6	7	8
Maximum apron length in feet	100	84	66	50	34	20

Water requirements

A water harvesting system must supply the quantity and seasonal distribution of water required. Table 2 gives estimates of the daily water requirements of various animals and birds. In hot, dry areas values can be greater.

Table 2. Estimates of daily drinking water requirements and spacing of facilities for various animals and birds.

Animals/ birds	Gallons per day	Spacing in miles
Cattle	12	1/2 - 1
Dairy Cows	25	1/2 - 1
Horses	12	1/2 - 1
Sheep	1.5	1/2 - 1
Goats	1.5	1/2 - 1
Hogs	2	
Poultry	0.33	
Mule Deer	2	1 - 2
Antelope	2	2 - 3
Elk	8	1 - 3
Wild turkey	500/flock/year	
Quail	750/covey/year	
Doves	5/facility/day	
Songbirds	2/facility/day	

Size of catchment apron and Storage Facility

The size of catchment apron and storage facility required will depend upon the grazing system and periods of precipitation. In most instances a smaller catchment and storage facility can be used if the period of maximum water use follows the period of maximum rainfall. A larger system is needed if the period of maximum water use occurs during or following periods of low rainfall.

Catchment apron size can be approximated by the equations:

$$A \text{ (acres)} = \frac{0.000037\,(R)}{(P)\,(E)} \qquad \text{(Equation 1)}$$

$$A \text{ (sq yds)} = \frac{0.18\,(R)}{(P)\,(E)} \qquad \text{(Equation 2)}$$

Where:

A = Area of catchment apron
R = Total water requirement (gallons)
P = Rainfall (inches)
E = Catchment efficiency (See Table 2)

Total water requirement R can be determined by: using Table 2 or ARS Handbook No. 600 “Handbook of Water Harvesting”. An estimate of daily drinking water requirements for various animals is shown in Table 2. Catchment apron efficiencies are shown in Table 3. Total water requirement R is the product of the daily animal need, the number of animals, and the number of days in the grazing period. This period can be seasonal or annual.

Rainfall P can either be average monthly (for seasonal computation) or average annual precipitation (for annual computation). See Section I of the Field Office Technical Guide to determine average annual and average monthly precipitation for the appropriate weather station in Oregon.

Any losses from seepage or evaporation must be included as part of the total water requirement. Generally, the average monthly water requirement, plus a safety factor, can be used as an approximation of storage tank size for short periods of water use (1 to 3 months). For longer periods, assume that the tank(s) will fill twice and that storage tank volume can be estimated as one half the total annual water requirement.

To determine the optimum size of catchment apron and storage, the method used in ARS Handbook No 600 shall be used. Runoff and storage are calculated for each month. In this method the first approximation of runoff and storage data is computed by Equation 2.

Water in storage is then calculated by Equation 3.

$$S = R + Sp - U \qquad \text{(Equation 3)}$$

Where:

S = Water in storage at end of month, in gallons
Sp = Storage from previous month, in gallons
U = Water use during month, in gallons
R = Catchment runoff, in gallons

Catchment apron Efficiencies

Approximate catchment apron efficiencies are shown in Table 3.

Table 3. Approximate Catchment Apron Efficiencies

Material	Percent
Asphalt - fabric	95
Steel	95
Wax	75
Soil cement	75
Sodium Salt	75
Rock outcrop (sandstone)	30
Rock outcrop (basalt)	40 - 60[1]
Latex - asphalt	85
Asphalt - fiberglass	90
Gravel covered membrane	85
Asphalt/Concrete paving	60 - 85[1]

[1] Depending upon cracks

Sediment

Sediment from the catchment apron area shall be collected in a basin or trap immediately upstream of the outlet pipe or in a sediment trap structure along the pipeline. Sediment shall be removed as a scheduled maintenance item.

Catchment apron outlet and spillway

Catchments shall be protected from a 10- year frequency, 24-hour duration storm runoff event. This storm can be handled entirely by the outlet pipe, or by the outlet pipe and a spillway.

Water shall be delivered from the apron to the storage tank in an outlet pipe having trash protection on the upstream end. Generally, an elevated outlet pipe is preferred instead of a buried outlet pipe unless the pipe is aesthetically unacceptable or will be subject to vandalism. Buried pipes are subject to freezing, particularly at the sediment trap. If used, buried pipes shall be protected from freezing.

Typically a 12 inch diameter helical corrugated metal or welded steel pipe with water-tight joints is used for the outlet pipe. The pipe can be supported on a compacted earth mound or on bents. Height will vary from the ground surface at the apron to the height of the top of the storage tank at the downstream end. Because storm runoff is the source of water, the outlet pipe shall have a capacity to deliver peak runoff from the apron from a 10-year frequency, 24-hour duration rainfall event. The outlet pipe entrance shall be set low enough to provide sufficient pipeline entrance head.

An emergency spillway shall be used to protect catchment facilities from anticipated storm runoff volumes in excess of outlet pipe capacity, and in case outlet components become partially blocked with debris.

Storage tank

Water storage tanks shall be used to store runoff water until used by livestock and wildlife. Tanks shall have sufficient storage capacity to accomplish the intended purpose. An evaporation barrier shall be used in open top tanks.

Storage tanks can be constructed of steel with a concrete floor, or steel, fiberglass, and plastic on concrete foundations or bents. Properly designed pressure treated wood or steel foundations and bents can also be used. When exposed to sunlight, plastic and fiberglass tanks shall include or be painted with appropriate ultra violet (UV) protection.

Flow rate in discharge pipelines to water troughs or other drinking facilities shall be float controlled.

Evaporation suppression

Evaporation barriers shall be installed in open top storage tanks to reduce evaporation. A floating foam rubber cover appears to be the most effective with the least maintenance. Other options are plastic sheets supported by floats, swimming pool covers, and mineral (cooking) oil. Petroleum products (i.e. motor oil) shall not be used.

Protection

Fencing shall be used to protect the catchment apron (except rock aprons) from trampling by livestock and wildlife. Fencing shall enclose all components subject to damage by animals. The fence shall be located on the top or at the toe of the apron berm. Animals shall be prevented from falling into the storage tank by placing the top of the tank a minimum of 3 feet above the ground surface.

Fencing shall be a minimum of 48 inches high, consisting of:

Cattle	30” woven + 2 barbed wires, or at least 4 barbed wires
Sheep	30” woven + 3 barbed wires, or at least 7 barbed wires
Deer	48” woven wire

Fencing shall be installed in accordance with the Standard and Specification for Fencing (Code 382).

CONSIDERATIONS

Water Quantity

1. Effects of intercepting precipitation on surface and ground water. Factors include changes in evaporation, timing of releases from the catchment, and the impact of surface water decreases versus ground water.

Water Quality

1. Potential improvement in surface water quality resulting from flow reduction's contribution to reducing erosion and sediment yield. Consider the size of the

harvest area and the impact of associated structures, such as sediment traps.

2. Effects of reduced dilution water on water quality factor such as dissolved substances, waste assimilation capacity, and dissolved oxygen.
3. Effects of loss of ground water dilution and the reduction of input of dissolved salts and chemicals on ground water quality.

PLANS AND SPECIFICATIONS

Plans and specifications for water-harvesting catchments shall be in keeping with this standard and shall describe the requirements for installing the practice to achieve its intended purpose.

OPERATION AND MAINTENANCE

An Operation and Maintenance plan must be prepared for use by the land owner or operator responsible for water-harvesting catchment operation and maintenance. The plan should provide specific instructions for operating and maintaining catchments to insure they function properly. Minimum requirements to be addressed in the Operation and Maintenance Plan are:

1. Repair or replace damaged components.
2. Insure all lap joints and edges are properly sealed to prevent wind from gaining access under membrane type catchments. Make uniform by rearranging or replace aggregate covering materials when needed.
3. Apply asphalt emulsion seal coats on asphalt fabric catchments at regular 3 - 5 year intervals or at shorter intervals if required.
4. Seal cracks in concrete, asphalt, and rock catchment aprons.
5. Restrict and control damaging plant growth.

REFERENCES

USDA NRCS, National Engineering Field Handbook, Chapters 2 and 3.

ARS Handbook No. 600, “Handbook of Water Harvesting”.

USDA NRCS, Standard Drawings Handbook - Oregon.