WILDLIFE MANAGEMENT TECHNIQUES MANUAL

Fourth Edition: Revised

Edited by: Sanford D. Schemnitz Professor, Department Head New Mexico State University

Illustrated by: Larry Toschik Phoenix, AZ

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WATER DEVELOPMENTS

The amount, availability, and presence of water throughout the year can be improved for purposes of increasing wildlife numbers or expanding the use of habitat. Water can be "removed" to reduce animal numbers and feeding in areas where they are undesired. Frequently water is developed for various other uses than specifically for wildlife. For one 11-year rangeland rehabilitation program in a 96- by 282-km area of southeastern Oregon, 1,600 water developments were completed primarily for the needs of domestic livestock (Heady and Bartolome 1977). When these uses are properly planned, water also can provide benefits to wildlife. Consequently, the habitat manager should be familiar with the various techniques for development of water including natural springs, seeps, and water holes; and man-made structures such as reservoirs, "guzzlers," and wells.

Water Holes

Water holes are open water storage basins, either natural or artificial. Water is such a basic requirement to wildlife in some areas that water holes are often the hub of wildlife activities; therefore, they should be designed and maintained to be usable for all species of wild animals.

Natural water holes are often found in playas and rocky areas where runoff waters are accumulated in a depression. At times such holes can be improved by deepening the catchment or by trenching runoff waters directly to the basin. In the Southwest, cement embankments have been added to large, flat rock surfaces, thereby channeling water to a nearby hole. Storage has been increased by raising the lowest level of the basin's edge.

Man-made structures can be adapted to provide water holes for wildlife. Examples are the side basins on pipelines as illustrated in Fig. 20.20. One such pipeline development in Nevada provided 3 new water holes along a 24-km stretch which formerly had no natural waters for chukar partridge (U.S. Bureau of Land Management 1964). Similar structures have been used in New Mexico (Bird 1977).

Springs and Seeps

No 2 springs are alike as to developmental needs; however, there are several different planning techniques that can be applied. Before a spring or seep is developed, the reliability and quantity of its flow should be checked. Generally, it is necessary to install a protective box to catch and store the water. Sometimes it is advisable to provide large capacity storage at sites where waterflow is intermittent so that stored water will be available after the spring or seep quits flowing. These waters should be dug out of firm ground, hardpan, or rock to obtain maximum flow. The source, whether one or several, should be conducted to a collection basin and thence piped to a trough. It is usually necessary and desirable to fence the water source and collection basin from human or livestock use.

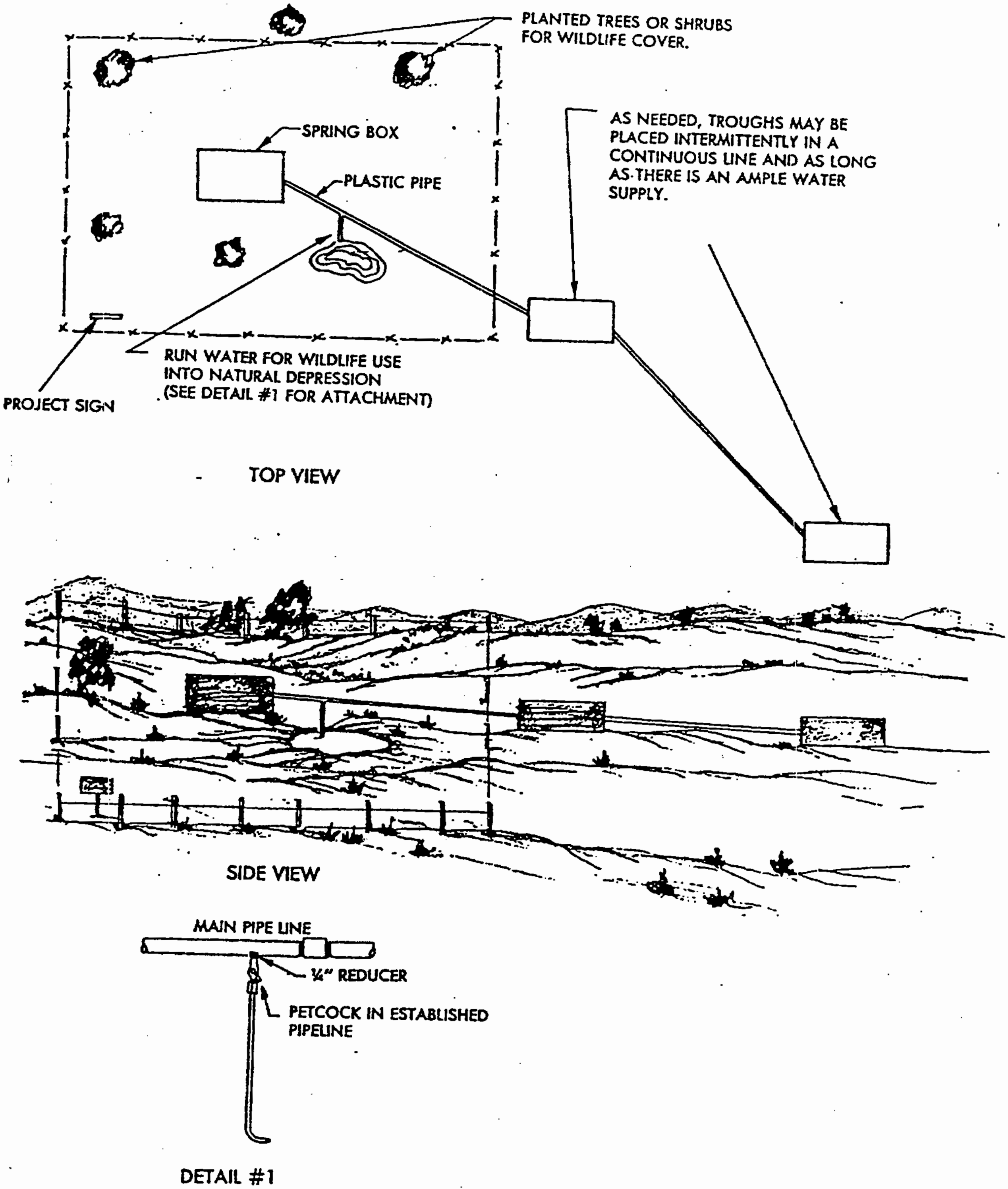

Fig. 20.20. Water developments for many uses can be modified for the benefit of wildlife. This drawing of a spring improvement for livestock in Nevada included a side basin installation for chukars. (Nevada State Office, U.S. Bureau of Land Management.)

In the central and western U.S., many springs are found in canyon bottoms and when developed often become a maintenance problem due to storm flood damage. Flood damage can be reduced for canyon bottom projects by burying a short length of perforated asphalt soil pipe in packed gravel at the water source from which the water is piped to a basin out of the canyon bottom. This technique allows storm water to flow over the buried source of spring water without damage to the development work (Weaver et al. 1959).

For wildlife water developments, plastic pipe is usually preferred to galvanized iron pipe since it is lighter and easier to transport and lay. The pipe should be buried deep enough to escape damage by freezing, trampling by livestock, or washing out during floods. The pipe should also be laid to grade, in order to avoid air blocks.

The development of a spring is not just a simple matter of collecting a maximum flow of water and making it available. The development should be planned to achieve a purpose with a minimum of detrimental effects. Spring developments planned primarily for wildlife use, as well as those planned for other purposes, should do the following:

1. Provide at least 1 escape route to and from the water. Take advantage of the natural terrain and vegetation where possible.
2. Provide an alternate escape route where feasible.
3. Fence water developments from livestock. Fences can serve the purposes of preserving the water source and protecting food and cover needed for small species of wildlife. Protective fences should be negotiable by wildlife except where trampling or wallowing by big game will damage the spring source. Fence posts should be pointed to discourage perching by avian predators.
4. Provide safety from wildlife drowning by construction of gentle basin slopes or ramps in tanks (see Figs. 20.27, 28, 29.)
5. Maintain or provide adequate cover around the watering area, either by saving the natural cover or by plantings and brush piles.
6. Provide, where applicable, an information sign to inform the public as to the purpose of the development.
7. Provide water developments of sufficient capacity to supply water at all seasons of the year during which it is needed for wild animals.
8. Provide public access to water by piping it outside of fenced water developments. Where shy animals are involved, pipe water for human consumption some distance from wildlife water. For example, it is recommended that sustained camping be discouraged within 0.8-km radius of water used by desert bighorn sheep.

Many habitats in the Southwest have no form of permanent water. Such areas provide minimal use for bighorn sheep (McQuivey 1978) and other wildlife. Recognizing this limiting habitat component, the California and Nevada Wildlife Agencies have been working for years to improve intermittent springs and seeps. Sometimes these waters provide such low quantities that they are measured as "teaspoons" per hour compared to the more common measurement of "gallons" per hour. Often, seeps can be detected only by moist soil. Even with such little natural water, some of these seeps have been developed to fill a 18.9-l (5-gallon) or 37.8-l (10-gallon) container. Bighorns have been seen to wait their turn for such available drinking water (C. Hansen pers. comm.). Figure 20.21 illustrates desert bighorn sheep using a spring development.

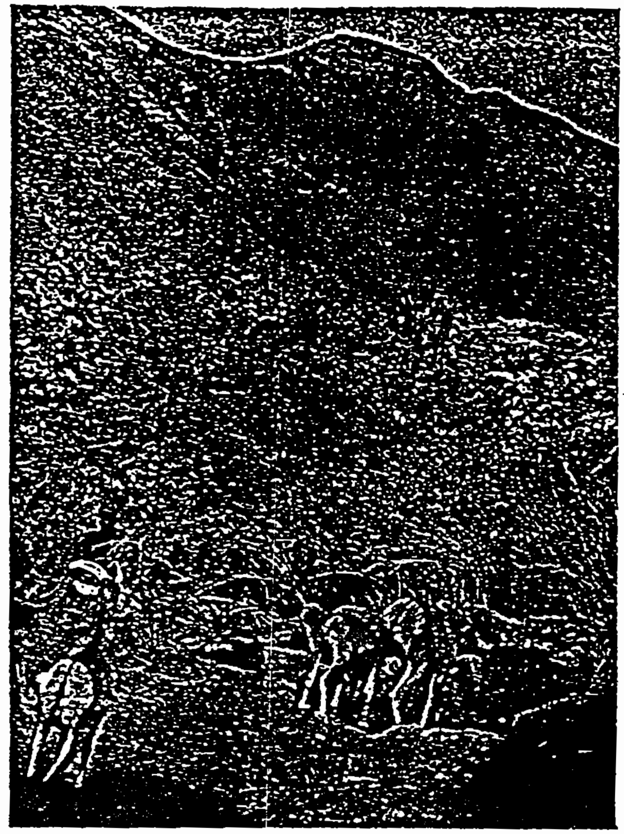

Fig. 20.21. Desert bighorn sheep at a developed spring on the Desert National Game Range in Nevada. (U.S. Fish and Wildlife Service photo by O. Deming.)

Reservoirs and Small Ponds

The term "reservoir" as used here refers to water impounded behind a dam. It may be formed by building a dam directly across a drainage or by enclosing a depression to one side of a drainage and constructing a diversion ditch into the resulting basin. Reservoirs should be designed to provide maximum storage with a minimum of surface area to reduce evaporation loss. The following are major points to consider in the selection of reservoir sites:

1. The most suitable soils for dams are clays with a fair proportion of sand and gravel (1 part clay to 2 or 3 parts grit). Soils with a high proportion of clay crack badly upon drying and are apt to slip when wet.
2. The watershed above the dam should be large enough to provide sufficient water to fill the reservoir, but not so large that excessive flows will damage the spillway or wash out the dam.
3. The most economical site is one along a natural drainage where the channel is narrow, relatively deep, and the bottom is easily made watertight. The channel grade immediately above the dam should be as flat as possible.
4. Wildlife should have easy access to the water.
5. The dam should be located, if possible, to take advantage of natural spillway sites. Otherwise, an adequate spillway must be incorporated into the development.

The dam site should be surveyed and staked prior to construction. If there is any question as to the suitability of material for dam construction, an examination should be made by a soil scientist. Trees and shrubs should be cleared from the dam site and flooded basin. The foundation area of the dam should be plowed or scarified in the direction of the main axis of the dam so there will be a good bond between the foundation and the fill material. On sites where stability and permeability of the foundation material is questionable, a narrow core trench should be dug lengthwise to the dam, then refilled and packed with damp clay soil. Where suitable material is available above the dam, it should be obtained there so the borrow pit will become part of the reservoir and add depth to the impoundment. General specifications for the construction of dams should include these items:

1. The base thickness of the dam must be equal to or greater than 4½ times the height plus the crest thickness. The slopes of the dam should be 2½:1 on the upstream face and 2:1 on the downstream face.

2. Minimum width of the top of all dams should be 3.1 m.

3. The fill of the dam should be carried at least 10% higher than the required height to allow for settling.

4. Freeboard (depth from the top of the dam to the high-water mark when the spillway is carrying the estimated peak runoff) should not be less than 61 cm. The spillway should be designed to handle double the largest known volume of runoff and should be constructed at a level which will prevent the water from ever rising higher than within 61 cm of the top of the dam. A natural spillway is preferred. It should have a broad, relatively flat cross section, take the water out well above the fill, and re-enter the main channel some distance downstream from the fill. When a spillway is built, it should be wide, flat-bottomed, and protected from washing by riprapping (facing with rocks). The entrance should be wide and smooth and the grade of the spillway channel mild so the water will flow through without cutting (Hamilton and Jepson 1940).

New reservoirs usually do not hold water satisfactorily for several months. It may be necessary to spread bentonite over the bottom and sides of the basin and face of the dam to "seal" the impoundment so it will hold water. Samples of soil from the reservoir, the dam material, and the bentonite can be laboratory tested to determine how much bentonite should be applied. Another method of sealing reservoirs to prevent excessive loss of water is to line the basin with polyethylene (U.S. Bureau of Land Management 1966). After the basin has been made, it is covered with plastic sheets, then 15.2 to 20.3 cm of dirt rolled evenly over the plastic. Where there is the possibility of damage to the plastic by animals, 30.5 cm of soil must be placed over the liner.

While working in the Southwest, biologists for the U.S. Fish and Wildlife Service found that water-cut canyons offer suitable sites for small concrete dams and reservoirs to provide water for desert bighorn sheep (Halloran and Deming 1956). These small reservoirs were most effective where canyons narrowed down with steep, vertical sides of bedrock. Such arroyos make good construction sites, particularly on east or north facing drainages which provide protection from the sun and reduce evaporation. Dams should be firmly keyed into the bedrock on both sides and bottom. A pipe outlet should be incorporated into the dam. Water loss will be prevented if rock formations are checked from cracks and fissures. Rock sealing is, at times, an important phase of sound construction. Commercial sealers can be quickly applied to the dam after completion. Usually, such canyon dams should be under 12.2 m long and not over 3 or 3.7 m high. During the first several years after construction, the small ponds formed behind the dams will provide water for wildlife. After the reservoir becomes filled with gravel and sand washed in by rain floods, the water soaking into the gravel and sand is stored and protected from excessive evaporation. The stored water is piped through the dam to natural rock basins below or to cement troughs constructed away from the main water course (U.S. Bureau of Land Management 1964).

Small ponds can often be constructed quickly and efficiently for wildlife needs. Their small size and strategic distribution provide not only an animal's water requirements but add new diversity to habitats. One example is an area that was devoid of natural surface waters. Then an unsuccessful agricultural experiment left an uncapped artesian well. Wildlife managers channeled water from the well to a small excavated pond which now services over 155 different species of wild mammals, birds, fishes, and amphibians. It can be said that in this case, man created a new environmental niche which in turn provided a richer habitat for endemic wildlife.

Water Catchments

During the past [illegible] decades, there have been several types of self-filling watering devices designed for the use of wildlife. Probably the greatest numbers have been constructed for primary use by quail. However, many of these structures have been built specifically to benefit other wild animals, including antelope, bighorn sheep, deer, sage grouse, and turkeys. The California Department of Fish and Game (Glading 1947, Leopold 1977) constructed over 2,000 catchments for quail between 1943 and 1974. Since so many of these devices were installed for upland game birds (Galliformes) they have been referred to as "Gallinaceous Guzzlers" or recently, just "Guzzlers."

GUZZLERS

The guzzler is a permanent, self-filling water catchment similar to a cistern. The whole structure is so simple there is very little that can get out of order, and so a minimum of maintenance is required. Essentially, the guzzler installation consists of a watertight tank set in the ground which is filled by a rain-collecting apron. This apron collects rainwater and drains it into a tank where it is stored for use by wildlife. Where the device is intended for watering birds or small animals, they may enter the covered tank through an open end and walk down a sloping ramp to the water level. If the birds and other animals drink directly from the storage tank, all floating valves or other mechanical devices that are subject to failure are eliminated (see Fig. 20.22).

The most important step in the installation of a guzzler is locating an adequate site for its placement. A guzzler should not be placed in a wash or gully where it may collect silt or sand, or be damaged by flood waters.

Fig. 20.22. Water catchments for small wildlife species have been constructed in the western states. They have been an important factor in increasing suitable habitat (U.S. Bureau of Land Management photo by Ed Smith).

The size of the water-collecting apron should be proportioned so that the cistern will need no water source other than rainfall to fill it. Since the cost of digging the hole for the cistern is one of the largest expenditures, a site should be chosen where digging is comparatively easy. The tank should be placed with its open end away from the prevailing wind and, if possible, facing in a northerly direction in order that a minimum of sunlight will enter the tank. Such placement will cut down the growth of algae, temperature of water, and evaporation.

The cisterns used for guzzlers usually are made of either concrete or plastic. Occasionally steel tanks are used. The plastic guzzler is a prefabricated tank constructed of fiber glass impregnated with a plastic resin. If the construction site is a long distance from a source of washed aggregate, or if labor costs are high, the plastic guzzlers offer savings in transportation and labor costs.

With concrete guzzlers, only washed gravel aggregates should be used for construction; otherwise the concrete may start to disintegrate after 5 or 10 years. Tanks made of steel are used for guzzlers in some areas and are reported as giving satisfactory service.

Collecting aprons have been made of many materials. Concrete sealed with bitumul, galvanized metal sheet roofing, glass mat and bitumul, rubber or plastic sheets, asphalt, and plywood have all been used successfully. From the standpoint of maintenance costs, however, durable materials such as concrete or metal have proven most satisfactory.

The size of the water collecting apron or surface needed to fill a guzzler will depend on the size of guzzler and the minimum annual rainfall that can be expected at the construction site. Actually, the size of the needed interception area will prove surprisingly small because nearly 100% of the rainfall is collected. Calculation of the potential yield of the rainfall collection surface can be determined by the following formula:

Surface area in square meters of apron × 9.9 = liters per cm of rainfall. It is important that calculations be made on the basis of the minimum of precipitation expected, rather than the average or maximum, to prevent guzzler failing during drought years. Table 20.3 gives the size of aprons in square feet needed to fill 2271 l, 2649.5 l, 3046.5 l tanks at different minimum rainfall rates

General instructions for installation of a concrete guzzler are summarized as follows:

1. Select the site and clear the apron. Lay out the excavation site for the guzzler. To square the outline, measure diagonally from each rear corner to opposite front corner and adjust stakes until these distances are equal. Excavate the rear portion to required depth and slope ramp at front to ground level. Line excavation with laminated Kraft paper.

2. Assemble reusable plywood forms for inner walls and hang in position with 10.2-cm clearance between forms and walls and floor. Level the forms and pour

Table 20.3. Size of apron needed for 600, 700, and 900 gal "guzzlers."

Minimum Annual Rainfall (inches)	Square Feet of Collecting Surface Required			Apron Dimension in Feet Square			Circular		
	600g.	700g.	900g.	600g.	700g.	900g.	600g.	700g.	900g.
1	965	1,127	1,453	31	34	38	36	38	43
2	482	563	726	22	24	27	25	27	31
3	322	376	485	18	19	22	20	22	25
4	242	282	365	16	17	19	18	19	22
5	192	225	290	14	15	17	16	17	19
6	162	189	243	13	14	15	15	16	18
7	138	161	208	12	13	14	13	14	16
8	121	141	182	11	12	14	12	13	15
9	107	125	161	11	12	13	12	13	14
10	97	113	146	10	11	12	11	12	14
11	87	102	132	9	10	11	10	11	13
12	80	94	121	9	10	11	10	11	12

concrete between forms and walls of excavation. Tamp and vibrate walls. Pour enough concrete to complete floor and ramp. Trowel smooth, allowing 1.3-cm clearance between edge of form and ramp.

3. Remove wall from carriers, assemble reusable roof forms, place in position and cover with 3 thicknesses of Kraft paper. Place dishpan in position for manhole. Cover roof with 7.6 cm of concrete, place 7.6 cm of concrete inside the dishpan. Insert a loop of heavy wire or 0.6-cm reinforcing rod at center of manhole cover to serve as a handle. Provide a 15.2-cm curb at front end of guzzler roof. Pour a 7.6-cm skirt 0.9 m wide in front of guzzler ramp and provide a 15.2-cm trash wall.

4. Outline apron. Excavate a settling basin 45.7 cm in diameter and 20.3 cm deep in front of skirt. Cover entire apron and basin with Kraft paper and pour concrete 7.6 cm thick. Trowel smooth and provide a 15.2-cm trash wall around circumference of apron. Provide a hole of 7.6-cm diameter through trash wall for screened inlet to guzzler. Make holes for 1.3-cm-diameter iron coyote guard at 10.2-cm intervals across front of guzzler. Cover all fresh concrete with paper to ensure proper curing.

5. Allow to set for 24 hr, remove paper and forms, wash inside of guzzler with cement and water. Apply asphalt emulsion to apron. Install coyote guards. Cover roof with 25.4 cm of dirt to stabilize temperature within cistern. If domestic livestock graze the area, fence the entire guzzler against stock so there will be no chance of damage to apron, tank, or lid. When guzzler is constructed after the rainy season, it is best to fill it with water to aid in curing concrete and to develop bird or animal acceptance.

Although incorporating the same general principles as the concrete guzzler described above, the quail guzzler illustrated in Fig. 20.22 is dissimilar in many respects. This illustrates the flexibility and diversity of design that has been characteristic of guzzler development in various regions. The iron roof should have a gentle slope of around 5% for best performance and should be relatively smooth to prevent water from standing on surface. Runoff is caught at the bottom of the aprons and carried in pipes to the storage container.

In some localities the storage tank has been closed at all ends, or a storage bag is used, and the water piped by gravity flow to a small trough (Lauritizen and Thayer 1966). Here the flow is regulated by a float valve. Where such a valve is in use, a regular schedule of maintenance is needed to keep the valve functioning during the season when water is needed. Possibly the greatest value of this design facility is that it directly allows wildlife to use the water in the storage tank. This eliminates additional construction and maintenance costs experienced with additional items such as troughs and float valves.

Although most guzzlers have been constructed for game bird use, their values to big game were well analyzed by Roberts (1977). He researched the literature thoroughly to identify the needs and values for antelope, bighorn sheep, deer, and elk. Roberts' final comment was that water catchment devices for big game are a practical means of increasing wildlife habitat and distribution in arid areas.

Figure 20.23 portrays a guzzler adapted for bighorn sheep. Similar structures have been designed for and used by deer. The catchment provides for a precipitation collecting apron and underground storage tanks. From the storage tanks the water proceeds to a trough with a control valve. The project is designed to use water more efficiently through excess surface exposure causing high evaporation. However, it can require a higher maintenance frequency schedule and has a more limited use value for other species of wildlife.

The installation of precipitation catchment facilities on ranges lacking adequate water has been successful for pronghorns (June 1965, Sundstrom 1968). Figure 20.24 provides specifications for the catchment used. At first, a fence was constructed to control livestock use; however, this was later dismantled when its need was no longer justified. This construction type of catchment was installed in a variety of habitats and was used by deer, elk, sage grouse, doves, rabbits, ground squirrels,

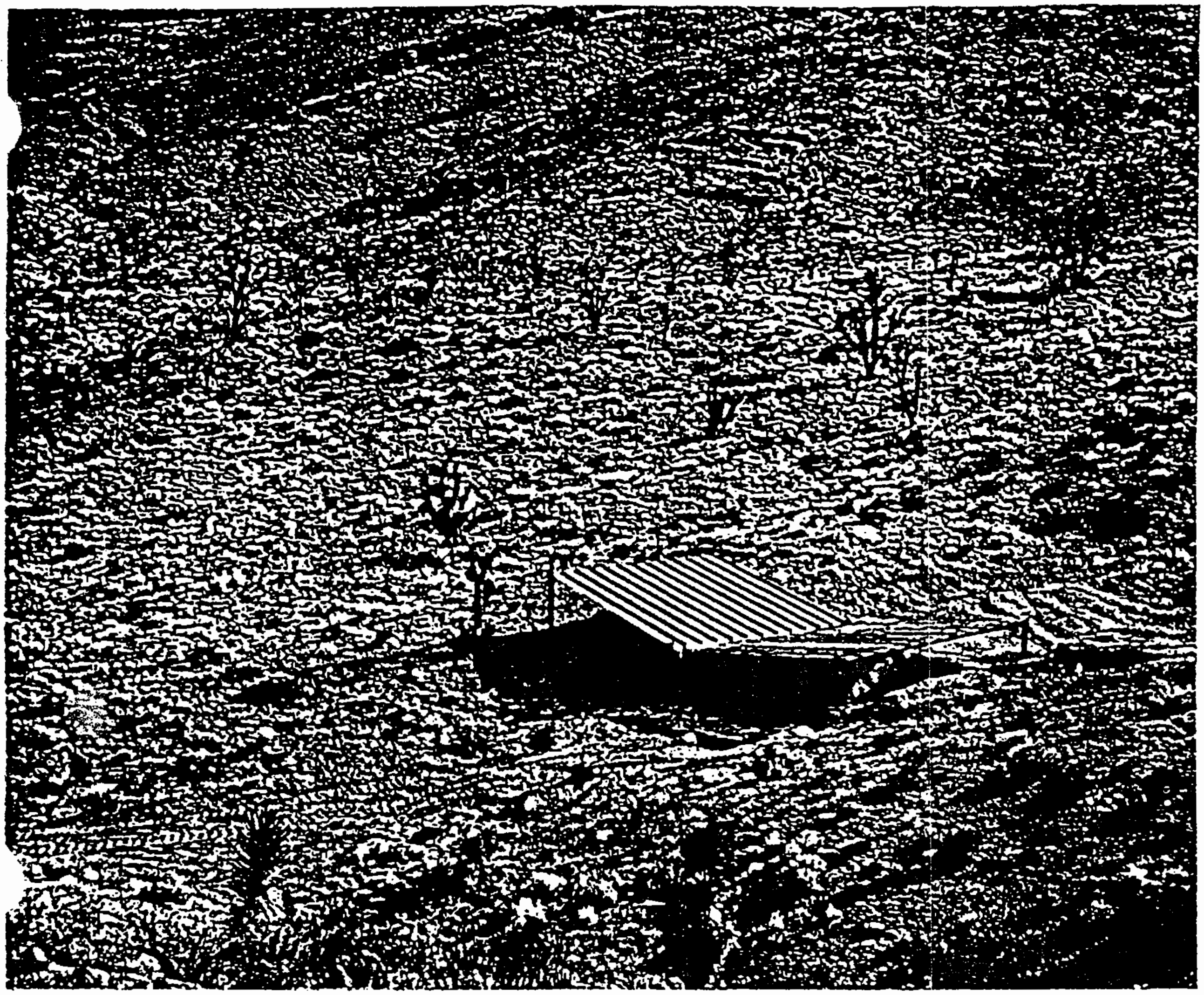

Fig. 20.23. A water catchment constructed in the Southwest on a critical summer range inhabited by desert bighorn sheep. (U.S. Bureau of Land Management photo by Jim Yoakum.)

and many other species of wildlife. Possibly its greatest value is that it provides ready access of water to a tremendous variety of wildlife. Not only was the water used for drinking, but it was used frequently for bathing by songbirds, thereby qualifying as a genuine multiple-use improvement!

DUGOUTS

As cattlemen moved into the West, they constructed large earthen catchment basins to collect water for livestock. These excavations were commonly called "dugouts" by early pioneers and "charcos" by early settlers along the Mexican border. Lately, government agencies have been constructing many of these charco pits on public lands. Deer and antelope frequently make use of such improvements and rely heavily upon their use during critical dry summer months. Bighorn sheep are not frequent users of these projects but do benefit occasionally during seasonal movements to and from their ranges in rocky, mountainous terrain.

Dugouts may be located in almost any type of topography. They are, however, most satisfactory and commonly used in areas of comparatively flat but well-drained terrain. Flat slopes facilitate maximum storage with minimum excavation. A natural pothole or intermittent lake bed is often a good location for a dugout. Dugouts should not be located in wet or muddy areas because of the difficulty for large animals to get to the water.

Fig. 20.25 shows a small rectangular dugout with specifications. For larger dugouts the length, width, or depth may be increased, but the side slopes should be about the same. All sides should be sloped sufficiently to prevent sloughing (usually 2:1 or flatter) and 1 or more relatively flat side slopes (4:1 or flatter) should be provided for livestock or big game entrances (U.S. Bureau of Land Management 1964).

Modified Water Developments and Safety Devices

The habitat manager may construct water developments, such as tanks, troughs, or wells strictly for the

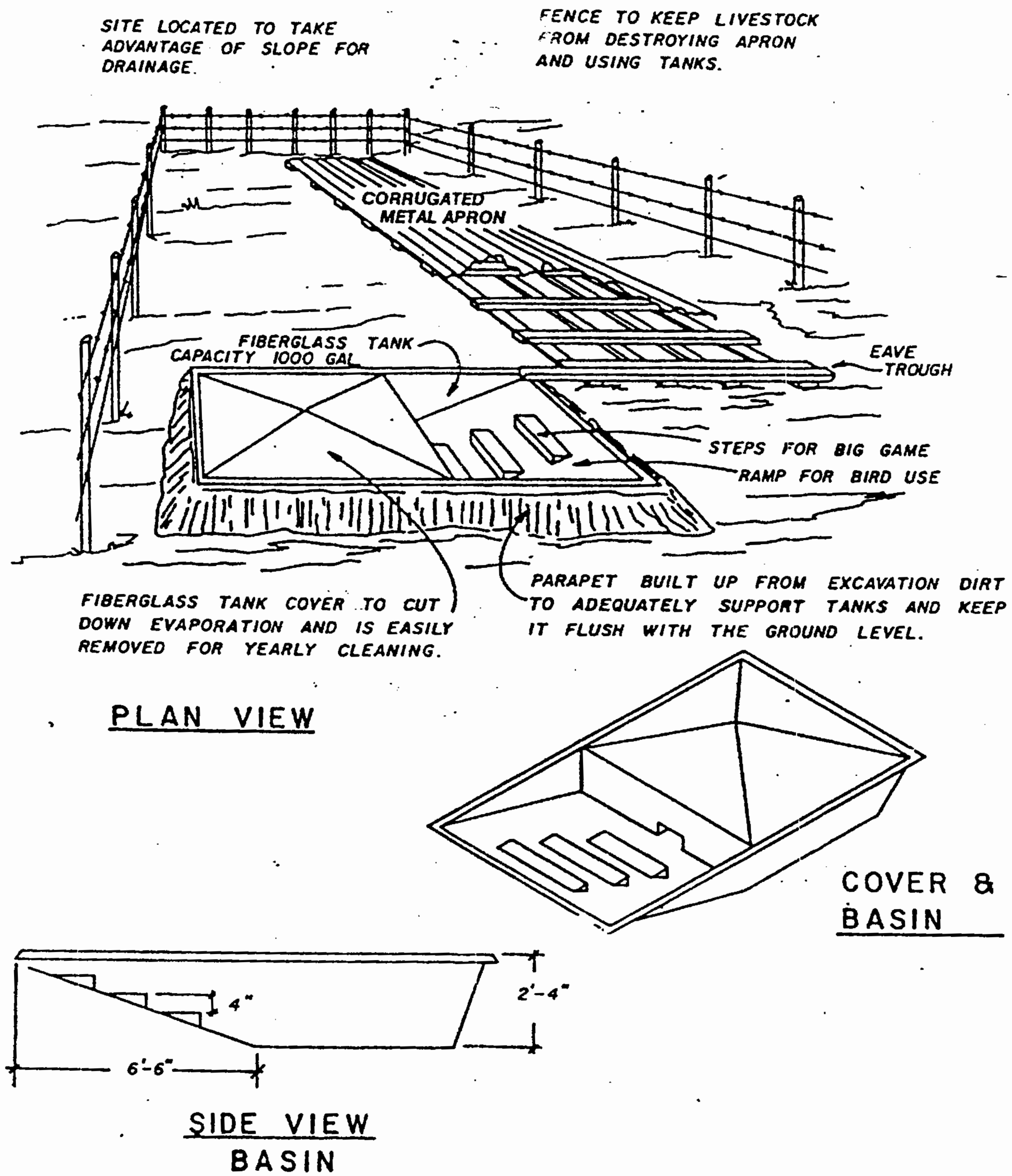

Fig. 20.24. A water catchment designed for antelope use on the Red Desert of Wyoming (adapted from June 1965).

benefit of wildlife. More commonly, water developments will be constructed for other purposes, i.e., for livestock, campground water storage, and fire suppression. Often a slight modification or addition to such developments can be made that will make water available to wildlife. Managers desiring additional information on specifications, plans and construction details for water improvements will find the following sources of value: *Range Improvement Standards Handbook* (U.S. Forest Service 1960), *Engineering Handbook and Construction Manual* (U.S. Bureau of Land Management 1967), and Vallentine's (1971) book: *Range Development and Improvement.*

Where water is scarce in dry environs, wildlife often readily seek and use man-made water improvements. Some of these are designed without proper considerations for wildlife use and, consequently, can become a problem by entrapment and drowning. This is especially true for young animals. The hazard of drowning can be reduced by floats, ramps, or ladders that allow avenues of escape. The best design will incorporate such escape facilities as a part of the improvement.

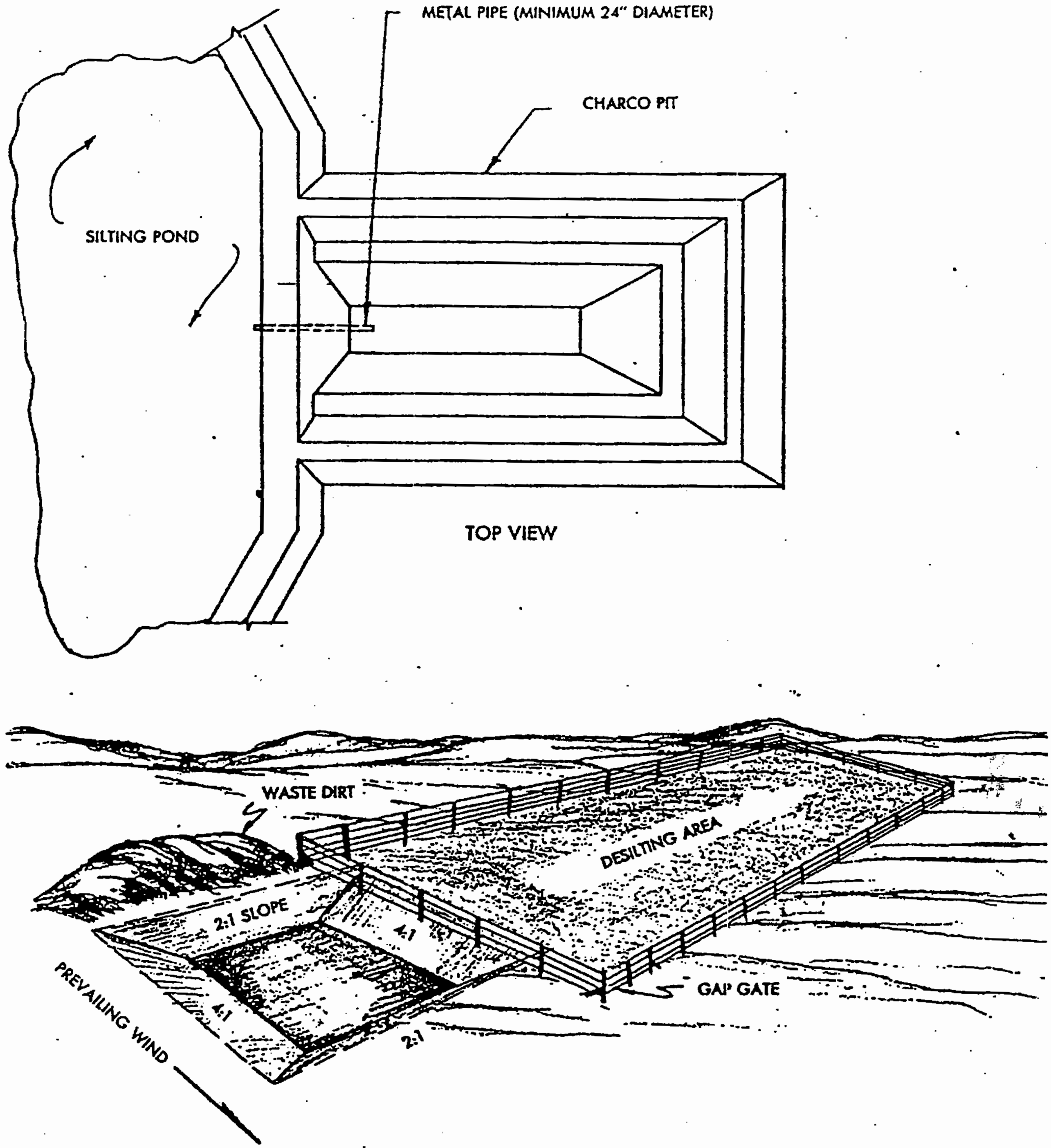

Fig. 20.25. Schematic sketch of a "dugout" or charco pit used in the west for providing water on the ranges for livestock and wildlife. Nevada State Office, U.S. Bureau of Land Management.)

Where this has not been done, it becomes necessary to improvise. Any float, ramp, or ladder placed in a water development should be relatively maintenance free and designed so that it neither interferes with nor can be damaged by livestock. Wilson and Hannans (1977) surveyed the subject of water development for livestock and listed the following guidelines:

1. Rarely are livestock water developments located in areas where terrain and cover conditions promote maximum utilization by wildlife; therefore, separate watering facilities for wildlife should be provided in association with the livestock development.

2. Fencing the wildlife water facility in a manner allowing wildlife use, but excluding livestock, is nearly always necessary to preserve water quality and insure growth of protective cover.

3. Water should be available in all water developments at all times, except in those areas where freezing during the winter could result in damage to the project.

4. Wherever ground-level wildlife drinking facilities are not provided in association with other water developments, the height of livestock troughs or other containers must not exceed 50.8 cm (Fig. 20.26).

5. Consider installing safety barricades in all livestock watering developments to prevent accidental entry and possible drowning (Fig. 20.27).

6. Consider installation of concrete blocks and/or rocks to form escape ramps on all livestock water developments where water depth exceeds 50.8 cm (Fig. 20.27).

7. When the lip of water troughs prohibits small wildlife from the water, construct wildlife ladders which allow the animals access. These ladders can be constructed of expanded metal or rebar and hardware cloth and should be protected by posts or protective fencing (Fig. 20.28).

8. An alternate method of providing small animal access to the water from outside the trough is to construct concrete ramps or rock ramps topped with cement (Fig. 20.28).

9. Large troughs posing survival problems inside the facility need escape ladders. These escape ladders must be constructed to intercept the line of travel around the edge of the tank. They should be attached to the structure by a hinge or bracket. Wildlife escape ladders should have a minimum slope of 30 degrees, but the incline should not exceed 45 degrees. A minimum of 1 ladder should be installed per 9.14 linear m of trough perimeter (Fig. 20.29).

In many livestock rangelands, large open water storage tanks are used which are out of reach for many species of wildlife (except birds and bats). For these developments, a floating wildlife platform should be installed. Figures. 20.30 and 20.31 provide examples of floating ramps.

WETLAND IMPROVEMENTS

Development of Water Areas

Techniques for improving wetlands will vary and are dependent to a large degree on the prior structural development of the area, water quality, water level management, soil, climate, topography, and plant succession. Sometimes wetlands can be manipulated by use of biological and physical forces to develop an improved environment for wildlife.

A biological need should be established before any plans for wetland improvements are made. The chief use or uses of the area should be the prime consideration in judging its potential development, although these uses are also largely determined by the location of the area and physical characteristics. Some areas may best be developed primarily for waterfowl, others for muskrat or other fur production. There will be other areas where these 2 features can be combined. The habitat manager can often use various practices to create interspersion of open water with marshland, interlace ditches and high spoil lands, plant vegetation for food and cover, and thereby create wetlands favorable to ducks and geese, beaver, muskrats, mink and warmwater fishes. For the habitat manager seriously concerned with techniques of preserving, managing, or manipulating wetlands, we recommend the *Techniques Handbook of Waterfowl Habitat Development and Management* published by the Atlantic Waterfowl Council (1972). A sizable portion of this book is devoted to making preliminary evaluations prior to development in order to establish need. There are also sections on improvement techniques, many of which are incorporated in this Chapter.

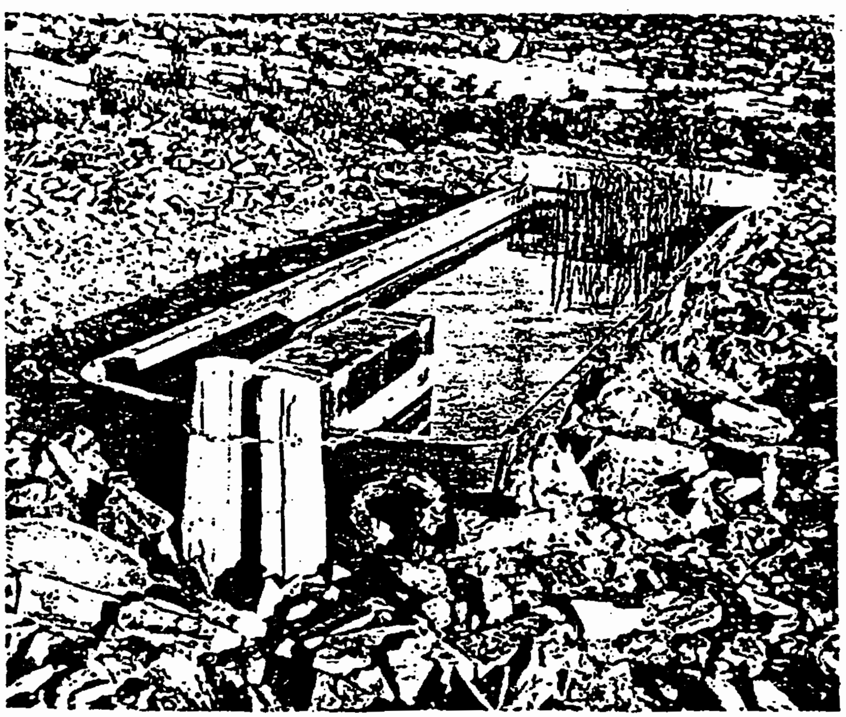

Fig. 20.26. A water trough financed for livestock use; however, a wildlife habitat manager added the following specifications for wildlife requirements: (1) that the trough be placed low to the ground for easy wildlife access, (2) that water be available for wildlife during critical dry seasons even though livestock are not in area, and (3) that an escape ramp (right distance end covered in part by vegetation) be installed for small wildlife. (U.S. Bureau of Land Management photo by Jim Yoakum.)