

**NATURAL RESOURCES CONSERVATION SERVICE
CONSERVATION PRACTICE STANDARD
ARIZONA**

WATERING FACILITY

(No.)

CODE 614

DEFINITION

A permanent or portable device to provide an adequate amount and quality of drinking water for livestock and/or wildlife.

PURPOSE

To provide access to drinking water for livestock and/or wildlife in order to:

- Meet daily water requirements
- Improve animal distribution

CONDITIONS WHERE PRACTICE APPLIES

This practice applies to all land uses where there is a need for new or improved watering facilities for livestock and/or wildlife.

CRITERIA

Conservation Practices shall be designed on an individual basis to meet site conditions and functional requirements. They shall be part of an approved and overall engineering plan for irrigation, drainage, wildlife, recreation, channel improvement, or similar purposes.

Design and implementation of subsidiary components and/or structures shall meet all applicable Natural Resource Conservation Service (NRCS) conservation practice standards. The criteria for the design of any components not specifically addressed in NRCS practice standards or specifications shall be consistent with sound engineering principles and/or manufacturer recommendations.

Laws and Regulations. This practice must conform to all federal, state, tribal, and local laws, rules, or regulations. *Laws and regulations*

of particular concern include those involving water rights, land use, pollution control, property easements, wetlands, preservation of cultural resources, and endangered species.

The owner is responsible for securing necessary permits and water rights, complying with all laws and regulations, and meeting legal requirements applicable to the installation, operation, and maintenance of this practice and associated structures.

Cultural Resources and Wildlife

Habitat. *Impact to cultural resources, wetlands and Federal and state protected species shall be evaluated and avoided or minimized to the extent practicable during planning, design and implementation of this conservation practice in accordance with established National policy, General Manual (GM) Title 420-Part 401; Title 450-Part 401, Title 190-Parts 410.22 and 410.26, National Planning Procedures Handbook (NPPH), National Cultural Resources Procedures Handbook (NCRPH), National Food Security Act Manual (NFSAM), and the National Environmental Compliance Handbook (NECH).*

General Criteria Applicable To All Purposes

Water Quantity. Design watering facilities with adequate capacity and supply to meet the seasonal daily water requirements for the number and species of the livestock and/or wildlife planned to use the facility. Include the storage volume necessary to provide water between periods of replenishment.

<i>Minimum Daily Water Requirements for Livestock (gallons per head per day)</i>	
<i>Cattle</i>	<i>12 to 20</i>
<i>Horses</i>	<i>10 to 15</i>

<i>Dairy Cows (Drinking Only)</i>	<i>15 to 20</i>
<i>Dairy Cows (Drinking & Barn needs)</i>	<i>30 to 35</i>
<i>Hogs</i>	<i>4 to 8</i>
<i>Sheep and Goats</i>	<i>1 to 2</i>

<i>Minimum Daily Water Requirements for Wildlife (gallons per animal per day)</i>	
<i>Mule deer</i>	<i>1-2</i>
<i>Antelope</i>	<i>1-2</i>
<i>Elk</i>	<i>5-8</i>
<i>Quail</i> (gallons/flock/day)	<i>1-2</i>
<i>Wild turkey</i> (gallons/flock/summer)	<i>500</i>
<i>Mourning dove</i> (gallons/flock/day)	<i>2-5</i>
<i>Pheasant</i> (gallons/flock/day)	<i>2-5</i>

For additional information, refer to the National Range and Pasture Handbook for guidance on livestock water quantity and quality requirements. For wildlife, base water quantity and quality requirements on targeted species need. Adequate water should be left for wildlife when livestock are not using the watering facility.

Recommended total storage capacity is 14 days for Windmill and 7 days for Motor or engine driven facilities. If additional water sources or facilities are available (catchments, mud tanks, wells, etc.), total storage capacity may be reduced. Storage reduction is dependent on the type, size and/or seasonal availability of the additional water source and shall be clearly documented in the conservation plan. The minimum storage capacity and recharge time for drinkers shall be 12 hours.

Location. Locate facilities to promote even grazing distribution and reduce grazing pressure on sensitive areas. *The distribution and spacing of facilities shall be based on topography, required travel distance to water and the home range, territory size and distribution of the target species.*

Distribution of stock watering places shall be such that livestock not travel more than one mile nor less than one-half mile between forage and dependable water on gentle slopes. In rough

areas, the greatest distance from forage to water should not exceed one-half mile nor be less than one-quarter mile.

For wildlife only facilities, distribution of facilities shall adhere to the following criteria:

<i>Distance Between Available Water for Wildlife (miles)</i>	
<i>Mule deer</i>	<i>1 to 3</i>
<i>Antelope</i>	<i>2 to 3</i>
<i>Elk</i>	<i>1 to 3</i>
<i>Quail</i>	<i>0.5 to 1</i>
<i>Wild turkey</i>	<i>1 to 2</i>
<i>Mourning dove</i>	<i>3 to 5</i>
<i>Pheasant</i>	<i>0.5 to 1</i>

Facility Design. Design the watering facility to provide adequate access to the animals planned to use the facility. *Facilities shall be protected from livestock or wildlife entering or falling into the tank or drinker by providing water to its full capacity or by other structural measures. No special provisions are required for drinkers less than 2 feet in height.*

Incorporate wildlife escape features into the watering facility design or use a wildlife escape ramp attached to the water facility. *The ramps shall be usable at all water levels possible within the facility and be built to prevent animal passage or entrapment under the ramp. For large watering facilities, multiple ramps shall be used to maintain a maximum ramp spacing of 20-feet. See Arizona Tech Note (TN), AZ-9-2 Biology, "Watering Facility Escape Ladder Design" for minimum design criteria.*

Include design elements to meet the specific needs of the animals that are planned to use the watering facility, both livestock and wildlife.

Protect areas around watering facilities where animal concentrations or overflow from the watering facility will cause resource concerns. Use criteria in NRCS Conservation Practice Standard 561, Heavy Use Area Protection to design the protection.

The site shall be well drained or drainage measures shall be provided as needed. Areas adjacent to the watering facility that will be trampled by livestock and other large animals shall be graded, graveled, paved, or otherwise treated to provide firm footing, eliminate water ponding, and reduce erosion.

Foundation. Install permanent watering facilities on a firm, level foundation that will not settle differentially. Examples of suitable foundation materials are bedrock, compacted gravel, railroad ties, and stable, well compacted native soils. *Clear all trees, brush and rubbish from the foundation area prior to placement of the facility.*

Anchoring. Design and install *all* watering facilities (tanks and troughs of any size) to prevent sliding and overturning by wind and animals, particularly when they are empty. *If possible, the water surface shall be left open or unobstructed, such that no wire or posts cross the water surface.*

For tanks or troughs less than 8 feet in height, anchoring design shall be site specific, adhere to manufacturer recommendations, if any, and may be accomplished, but is not limited to, by any of the following:

- *Concrete or “other” ballast materials, at least 4-inches thick, placed inside the tank or trough (water is not allowed);*
- *Three or more equally spaced posts (steel or wood) welded or bolted to facility and anchored in concrete or buried at least 30 inches into soil, with the tops of the posts at or below the rim of the facility;*
- *(recommended for PE tanks and troughs) Three or more equally spaced, new ¼ inch (minimum) diameter galvanized steel guy wires or cables, with a minimum of 3 galvanized cable clips on each end or splice, secured to the facility with eye-bolts, welded connections or grooves and anchored by concrete blocks, steel plates, railroad ties or earth anchors (manufacturer literature shall be provided in project file); or*
- *(not the preferred alternative) Two cross members of 1 ½ inch diameter (minimum) steel*

pipes or 4”x4” wood posts bolted to three or four equally spaced posts. The posts shall be standard steel posts or a minimum 4-inch diameter juniper, pinion, or pressure treated wood, and shall be set at least 30 inches deep.

All tanks and troughs over 8 feet in height shall have a custom anchor design.

Materials. Design watering facilities and all valves, *exposed pipes* and controls to withstand or be protected from damage by livestock, wildlife, freezing, and ice damage.

Construct watering facilities from durable materials that have a life expectancy that meets or exceeds the planned useful life of the installation. Follow appropriate NRCS design procedures for the material being used or applicable industry standards where NRCS standards do not exist.

Unless otherwise noted, material properties shall be as follows:

- *Black, Galvanized and Corrugated Sheet Steel shall meet ASTM A36 for material quality and ASTM A123 for galvanized coating.*
- *Fiberglass material shall be a commercial grade glass fiber meeting ASTM D3299, D4097 or AWWA D120. Resins shall be orthophthalic or isophthalic polyester, with a glass to resin ratio of 30 to 70, respectively, by weight. Resin shall contain sufficient pigment to inhibit deterioration by ultraviolet rays. New tanks and troughs shall be filament wound or contact molded, while reconstructed tanks may be spray gun or pneumatically applied.*
- *Polyethylene material shall be 100-percent virgin (no recycled materials) conforming to ASTM D1998 and contain sufficient stabilizers to inhibit degradation from ultraviolet rays.*

For facilities that do not meet any of the limitations or criteria included in this standard, shall be individually designed and approved by a registered engineer in the state where the work is to be implemented.

Pipe and Appurtenances. Use the criteria in Arizona Conservation Practice Standard 516,

Pipeline, to design piping associated with the watering facility. Include backflow prevention devices on facilities connected to wells, domestic or municipal water systems (refer to Arizona Conservation Practice 533, Pumping Plant).

All above ground inlet and outlet pipes that are exposed to sunlight, livestock, freezing or other traffic shall be new galvanized steel pipe of adequate size to deliver the needed quantity of water.

In areas of known water quality concerns, copper pipe may be used in lieu of galvanized steel pipe. Copper pipe shall be drawn or “hard” temper, type K or L, and meet ASTM B88.

HDPE pipe may be used for overflow pipe provided the pipe is securely fastened to the watering facility and the pipe meets the material requirements as outlined in Arizona Conservation Practice 516, Pipeline, Surface Installation (160 psi pipe may be used in this application).

All fittings, such as couplers, reducers, bends, tees, risers, valves and appurtenances shall be made of material(s) that are recommended for use with the pipe. All valves shall be brass and of the correct size.

All pipe and appurtenances shall be installed in accordance with manufacturer recommendations. Where manufacturer’s recommendations do not allow steel connections, the manufacturer recommendations shall be followed to complete the facility connection. A flexible coupler (i.e. rubber boot with steel clamps) shall be installed within 6 inches of the manufacturer approved connection to transition to galvanized steel or other approved materials.

An overflow pipe or automatic float shall be installed to provide 2 inches minimum (4 inches maximum) freeboard in the tank or trough. Overflow and outlet pipes must be of a diameter equal to or larger than that of the inlet pipe.

Storage tanks with covered tops shall have an 18 inch diameter (minimum) access manhole installed in the top and will have a drain and an overflow pipe.

Corrosion Protection. *Where corrosion may be an issue on galvanized pipe, threaded connections, fittings or other materials, protective measures shall be applied per Arizona Conservation Practice Standard 430, Irrigation Pipeline.*

Roof. *When a roof is placed over the watering facility to provide shade or evaporation control, the roof shall be designed for site specific snow and wind loads (refer to local or state building code requirements). The roof supports (posts or columns) shall be durable enough to withstand anticipated livestock and wildlife activities. Roofs may be inverted to provide a rainwater catchment area to augment water supplies.*

Fixed steel or floating foam rubber covers can be used in open storage tanks to control evaporation. Galvanized steel roofing can be used on either a wooden or a steel frame to cover an open tank. Floating covers shall be made of low-density, closed cell (EPDM) synthetic rubber a minimum of 3/16 inch thickness for tank diameters up to 20 feet. Holes ½ inch diameter shall be cut through the cover on 4 foot centers to allow water to drain through the cover and air to escape from below. A 1 inch thick rubber ring shall be attached around the edge of the sheet to prevent wind problems. Guy wires shall be tied across the top of the tank to keep floating covers from blowing out of the tank when nearly full of water.

Wildlife Facilities. *Because each facility is unique to species, habitat, topography and climate, watering facilities must be planned for a primary wildlife species and installation adapted to a specific site. Types of facilities include:*

- 1. Rain Traps – impervious catchments with storage tank and drinking facilities.*
- 2. Dugouts and pits supplied by surface runoff, stream diversion or spring flow.*

3. Drinking troughs supplied from a pipeline.

Recommended water storage capacity (tank size) as determined by average annual rainfall:

Average Rainfall (inches)	Capacity Required (gallons)
0 to 8	750
8 or more	500

Recommended apron dimension based on the average annual rainfall for the area and the tank storage capacity.

Circular Apron *		
Average Rainfall (inches)	Apron Radius (ft.) by Storage Size	
	500 gallons	750 gallons
0 to 5	--	14.0
5 to 8	--	12.0
8 to 12	7.0	10.0
12 to 16	7.0	8.0

Rectangular Apron *		
Average Rainfall (inches)	Apron Area (sq.ft.) by Storage Size	
	500 gallons	750 gallons
0 to 5	--	500
5 to 8	--	300
8 to 12	132	200
12 to 16	100	150

* The size can be reduced if used for small mammals and/or birds

Guzzlers. Temporary "guzzlers" can be created by modifying barrels and filling them as needed with water hauled to the site. A fifty-five gallon steel drum can be connected by pipe to a small basin at ground level. Water flow is regulated by atmospheric pressure or a float valve. Barrels should not contain any residue of contaminant harmful to wildlife.

Investigations, Surveys and Design

Criteria. Documentation requirements will be as outlined below, in addition to the documentation requirements of the practice components used in the system.

Make a preliminary site assessment or investigation to determine the location, distribution (pipeline), type of outlets, and tank

or trough sizes. Determine the number of livestock served in each pasture/range, total number in the system, season of use, and number and location of facilities. Additional documentation may include:

1. Water source(s) (i.e., available flow rate, dependability) and water quality in areas of known water quality concerns.
2. Soil or geological investigation to determine soil and/or foundation conditions. Documentation shall include material classification by the Unified Soil Classification System (SM, CL, etc.), texture (silty sand, lean clay, etc.), and corrosion potential (steel pipe), resistivity readings or published data.
3. Verify appropriate state or local laws for permitting and approval requirements and notify landowner of his/her responsibilities.
4. Verification or certification of used materials (if any).

To adequately plan and layout this practice, a detailed topographic survey may be required, that adequately details:

1. Site topography, as needed to show the physical features of the site, including existing features/practices, field elevations, location of any utilities or markers, etc.
2. Determine control elevations and distances. Where applicable, USGS 7.5-minute topographic Quadrangles combined with aerial photography may be used, provided design analysis verifies minimum hydraulic criteria (pressures and flows) are achievable at all locations.
3. If applicable, a permanent benchmark(s) shall be set and described. Preferably, the elevations and coordinates should be based on a local (assumed) or coordinate system (State or grid) and clearly stated on the plan. Datum may be in the form of Northing and Easting coordinates, or Longitude and Latitude.

The design of a practice is the application of Field Office Technical Guide practice standards, practical experience and judgment in the development of a solution to the problem or the objective. All computations and decisions

made during the design of a practice are to be checked by another qualified individual and appropriate notations made. Design computations, calculations or analysis shall meet the following criteria:

1. Calculate design flow based on number of livestock served, days of storage, tank and trough sizes, conveyance capabilities, etc.
2. Determine material type, size, capacity or storage requirements.
3. Fittings and appurtenance (valves, gates, vents, etc.) shall be designed to withstand the maximum hydraulic, including transients, and static pressures.
4. Material estimates (material volume computations), includes estimates of foundation, facilities, fittings and appurtenances, concrete, and vegetative components.
5. Subsidiary and applicable components shall be designed in accordance with applicable conservation practice standards (i.e., pipelines shall meet the requirements of Conservation Practice 516, Pipeline, etc.);

Installation and Basis of Acceptance. For construction that does not meet State, OSHA, or Tribal criteria or requirements where deficient construction materials were used, NRCS may consider a waiver request for approval of construction after it has received a signed and sealed construction and/or material exemption from a licensed engineer. Required exemption shall be for installation of materials that do not meet minimum quality criteria as found in applicable Standards, Specifications, ASTM's, AWWA standards, etc.

Contractors performing work under this practice shall abide by all Federal, State or Tribal laws or criteria, and must be licensed by the state board of technical registers where the work is being implemented.

CONSIDERATIONS

General Considerations Applicable To All Purposes

Design fences associated with the watering facilities to allow safe access and exit for area

wildlife species (*see Arizona conservation practice Standard 382, Fence*). To protect bats and other species that access water by skimming across the surface, fencing material should not extend across the water surface. If fencing or anchoring across the water is necessary it should be made highly visible by avoiding the use of single wire fences and using fencing materials such as posts or by adding streamers or coverings on the fence.

For watering facilities that will be accessible to wildlife, give consideration to the effects the location of the facility will have on target and non-target species. Also consider the effect of introducing a new water source within the ecosystem in the vicinity of the facility. This should include things such as the concentration of grazing, predation, entrapment, drowning, disease transmission, hunting and expansion of the wildlife populations beyond the carrying capacity of available habitat.

Consider the following guidelines for materials commonly used for watering facilities.

Concrete	3000-psi compressive strength
Galvanized Steel	20-gage thickness (<i>minimum</i>)
Polyethylene	Ultraviolet Resistance
Fiberglass	Ultraviolet Resistance

Where water is supplied continuously or under pressure to the watering facility consider the use of automatic water level controls to control the flow of water to the facility and to prevent unnecessary overflows.

Consider the use of animal-activated devices to supply water, such as nose-valves. Freeze-proof drinkers, float boxes, or electric heaters may be used.

Watering facilities often collect debris and algae and should be cleaned on a regular basis. *Fish like goldfish and mosquito fish can be used to control algae and insect larvae, but should not be used near areas with native fish populations. Consult the Arizona Game and Fish Department before stocking these species.* Consider increasing the pipe sizes for inlets and outlets to

reduce the chances of clogging. Maintenance of a watering facility can be made easier by providing a method to completely drain the watering facility.

Steep slopes leading to watering facilities can cause erosion problems from overuse by animals as well as problems with piping and valves from excess pressure. Choose the location of watering facilities to minimize these problems from steep topography

Design alternatives presented to the client should address resource and ecological concerns, economics and acceptable level of risk for design criteria as it relates to hazards to life or property.

Water Quality. *Livestock watering facilities will be located so they do not cause impairment of surface water quality in riparian areas and their associated streams, lakes, cienegas (wet meadows) and springs.*

The following Maximum Water Quality Standards for Livestock are recommended by the State of Arizona.

Maximum Water Quality Standards for Livestock (mg/L)	
Dissolved Aluminum	5.0
Dissolved Arsenic	0.2
Dissolved Boron	1.0
Dissolved Cadmium	0.05
Dissolved Chromium	1.0
Dissolved Cobalt	1.0
Dissolved Copper	0.5
Dissolved Lead	0.05
Total Mercury	0.01
Dissolved Selenium	0.05
Dissolved Vanadium	0.1
Dissolved Zinc	25.0
Radium-226+ Radium-228 (pCi/L)	30
Tritium (pCi/L)	20,000
Total gross alpha* (pCi/L)	15
Nitrate	45

* Total gross alpha (including radium-226, but excluding radon and uranium)

The following maximum recommended level for total dissolved solids (TDS) applies:

- Small animals - 3,000 mg/l,
- Poultry - 5,000 mg/l,
- Other livestock - 7,000 mg/l.

Information on water sampling and testing is available from the Arizona Department of Health Services, Licensure and Certification Program at 602-364-0720 or from the ADHS website at:

<http://www.hs.state.az.us/lab/license/env.htm>.

Steel Rim Tank or Trough with Concrete

Floor. *The minimum wall thickness for steel (Black Sheet, Galvanized Sheet, or Corrugated Sheet) tanks or troughs shall be 12 gauge, irrespective of height and diameter.*

Steel fabrication and concrete foundation shall also meet the following criteria:

- *The bottom 8 inches of the steel wall shall be painted with 2 coats of asphalt primer and embedded a minimum of 4 inches into the concrete base;*
- *Joints may be bolted, riveted, butt-welded, or lap welded (fillet weld on both sides). Welds shall be continuous. Bolted or riveted and lap welded joints shall be over-lapped a minimum 2 inches;*
- *Holes for 3/8 inch or 1/2 inch bolts and/or rivets shall be drilled or punched and spaced 1 1/2 inch or 2 inches, respectively or per manufacturer recommendations.*
- *All welds, bolts, rivets and joints shall be coated with a National Sanitary Foundation (NSF) approved urethane polymer to inhibit water contact.*
- *Concrete beneath steel wall shall be a minimum 12 inches thick and 24 inches wide.*

Minimum reinforcing steel requirements are as follows:

Diameter (feet)	Floor Area (sq.ft.)	Minimum Steel Requirements
Under 12	120	No. 4 on 10 1/2" centers
12 to 20	120 to 320	No. 4 on 10 1/2" centers
20 to 30	320 to 710	No. 4 on 6 1/2" centers
30 to 40	710 to 1,260	No. 4 on 5 1/2" centers

Fiberglass Tanks and Troughs. The wall thickness for new or used fiberglass tanks and troughs shall meet the following minimum requirements:

Height (feet)	Thickness (inch)
Less than 6	1/4
6 to 12	5/16
12 to 16	3/8

The top edge of open tanks or troughs shall be reinforced per manufacturer recommendations, by a steel flange, or other approved method.

Galvanized Steel Tanks and Troughs, Freestanding. The minimum wall thickness for steel (Black Sheet, Galvanized Sheet, or Corrugated Sheet) tanks or troughs shall be 12 gauge, irrespective of height and diameter.

Prefabricated tanks and troughs shall also meet the following criteria:

- Troughs shall have quality joints, flat bottoms coated with asphalt or epoxy and rolled or reinforced rims.
- Joints may be bolted, riveted, butt-welded, or lap welded (fillet weld on both sides). Welds shall be continuous. Bolted or riveted and lap welded joints shall be over-lapped a minimum 2 inches.
- Holes for 3/8 inch or 1/2 inch bolts and/or rivets shall be drilled or punched and spaced 1 1/2 inch or 2 inches, respectively or per manufacturer recommendations.
- All welds, bolts, rivets and joints shall be coated with a National Sanitary Foundation (NSF) approved urethane polymer to inhibit water contact.

Polyethylene Tanks and Troughs. All tanks and troughs shall be new (manufactured within the previous 12 months), suitable for potable water, and carry a five year warranty (minimum) from the manufacturer or supplier from the date of purchase. Tank and trough diameter, height and corresponding wall (material) thickness shall be as specified by the manufacturer, but not less than 3/16 inch.

Partial burial of a PE tank or trough, as a substitute for anchoring requirement, is not permitted. PE tanks specifically manufactured for underground applications may be allowed provided they are installed (buried) per manufacturer recommendations (manufacturer documentation is required for case file).

Used Heavy Equipment Tire Trough. Tires shall be cleaned of any stop-leak material or other chemicals not intended for consumption by livestock or wildlife. Concrete foundation shall be 6 inches thick (minimum), with a 6"x6" mesh, 10 gage wire reinforcement.

Reinforced Concrete Tank and Trough. Minimum reinforcing steel requirements are as follows:

For Tanks or Troughs less than 4-feet in Height		
Diameter (feet)	Wall/Floor Thickness (inches)	Minimum Steel Reinforcement
Under 8	6	No. 3 bar @ 12" O.C.
8 to 14	6	No. 3 bar @ 10" O.C.
14 to 20	6	No. 4 bar @ 10" O.C.

For Tanks or Troughs between 4 to 8-feet in Height		
Diameter (feet)	Wall/Floor Thickness (inches)	Minimum Steel Reinforcement
Under 8	8	No. 4 bar @ 12" O.C.
8 to 14	8	No. 4 bar @ 10" O.C.
14 to 20	8	No. 4 bar @ 8" O.C.

Used Steel (Gasoline) Tanks. The minimum wall thickness of new and used steel storage tanks shall meet the following minimum requirements:

Tank Size (gallons)	New Steel Thickness (inch)	Used Steel Thickness (inch)
0 to 2,000	1/8	1/8
2,000 to 4,000	3/16	1/8
4,000 to 8,000	1/4	3/16
8,000 to 16,000	3/8	1/4

Refurbished (gasoline storage) tanks can be very dangerous to work on, especially welding and

cutting. Tanks shall be refurbished by a commercial tank refurbishing company. They shall be cleaned to bare metal (sand blasted, etc.) and coated with a manufacturer approved coating (epoxy, coal tar, or locally available product) suitable for potable water.

To avoid unnecessary risks and liabilities to both NRCS and its cooperators, the supplier or the commercial tank refurbishing company shall certify that the tanks meet the minimum wall thicknesses, as specified, and are free of hydrocarbon vapors.

PLANS AND SPECIFICATIONS

Use Arizona standard drawings to the extent possible. These may be supplemented by additional drawings or specification notes on the drawings to provide full installation instructions.

Construction plans shall include all components needed for the safe operation of the proposed improvements such as railing, fencing, or warning signs as appropriate. The plans shall address operations near existing utilities, trench excavations and any other items related to construction of the structure that may pose a safety risk to those involved.

General Criteria Applicable To All Purposes

Development of plans and specifications for watering facilities will be guided by the *National Engineering Handbook, Part 650*, the *Engineering Field Handbook, Chapter 5*, and shall be in accordance with the *National Engineering Manual, Parts 541 and 54*. They shall provide the minimum information necessary to install the facility and show site specific details in accordance with this standard. Construction documents shall describe the requirements for applying the practice to achieve its intended use. As a minimum this shall include the following:

- Project location map, including section, township and range, North arrow, cooperator/owner acknowledgement and certification signature blocks, engineering job class (cover sheet).

- References that the owner/cooperator are responsible for all permits, rights-of-way, easements and the contact, coordination and location determination of any existing utilities or clearances (buried utility disclaimer).
- If applicable, a map showing the location of the practice(s) or system in reference to a known or established benchmark or reference point with the location, description and elevation clearly shown. Topographical features and/or controls shall be shown, showing tie in with existing or other planned practices.
- Field surveys and notes, soil investigations or geologic soil boring locations and soil classifications, earthwork or material estimates/quantities (foundation materials or requirements).
- System overview and layout (i.e., location and orientation of practice in relation to existing or planned facilities; identify the water source and type; connections to tanks or facilities; overflow or drain locations; vegetative requirements; construction/installation criteria, including State and Federal [OSHA] safety requirements, etc.).
- Section or detail view of tank or drinker, including material type, thickness, and size (diameter, height, capacity); inlet, outlet and overflow pipes; anchoring system; wildlife escape ramp.
- Appurtenance or fitting details (i.e., valves, air vents, manholes, drain valves, air release valves, pressure relief valves, backflow prevention, etc.) as required, for proper system functionality.
- Construction notes, details or specifications to clarify a component and furnish directions or site specific requirement, i.e. quantities of materials.
- Use Arizona Construction and Material Specifications for each item of work and material, as applicable and available. Additional specifications may need to be written to provide full material and installation instructions. Fill in blanks and add or delete items from the specifications to make them fit the job as needed.

All designs completed by non-NRCS personal shall meet minimum State licensing board

requirements and NRCS requirements and criteria as outlined in the General Manual, the National Engineering Manual (including Arizona Supplements), and the National Engineering Handbook.

ONCE ALL PARTIES HAVE ACCEPTED AND SIGNED THE PLANS AND SPECIFICATIONS, NO CHANGES SHALL BE MADE TO THE DRAWINGS OR SPECIFICATIONS WITHOUT PRIOR APPROVAL OF NRCS.

OPERATION AND MAINTENANCE

General Criteria Applicable To All Purposes

Provide a site and project specific operation and maintenance (O&M) plan for the type of watering facility to be installed to the landowner, cooperator or operator responsible for operation and maintenance and shall be commensurate with the size and complexity of the project. The plan shall document needed actions, including reference to periodic inspections and the prompt repair or replacement of damaged components, and should provide specific instructions for operating and maintaining facilities to ensure they function properly and adequately throughout their expected life. As a minimum, include the following items in the plan:

- a monitoring schedule to ensure maintenance of adequate inflow and outflow;
- checking for leaks and repair as necessary;
- if present, the checking of the automatic water level device to insure proper operation;
- checking to ensure that adjacent areas are protected against erosion;
- if present, checking to ensure the outlet pipe is freely operating and not causing erosion problems;
- A schedule for periodic *flushing and* cleaning of the facility.
- *Checking for corrosion and electrolysis and draining steel tanks and troughs as needed to remove sediment that can cause corrosion;*
- *Checking coatings on metal, fiberglass and plastic tanks and re-coating as needed to maintain effective ultraviolet resistance;*
- *Maintaining wildlife escape ramps;*

- *Maintaining appurtenance features (valves, piping, floats, drains, fences, etc.) in functional and protected conditions;*
- *Eradicate or otherwise remove all rodents or burrowing animals that have or may potentially damage any part of the delivery or application facilities. Immediately repair any damage caused by their activity;*
- *Immediately repair any damage resulting from vandalism, vehicles, livestock or wildlife;*
- *Preparing guidance for winter weather to allow for ice expansion without damage (if applicable);*
- *Checking and maintaining anchorage of freestanding tanks and troughs;*
- *Algae and iron sludge accumulation should be addressed in areas with known water quality problems. Chemicals such as copper sulfate and chlorine can be recommended as needed, as long as local rules and regulations are followed.*
- *Inspect for safety of people or animals using the area near the structure.*
- *Check all timber or lumber sections for decay and other damage, especially, sections in contact with earth or other materials. Promptly repair any damaged sections and apply protective coatings, as needed.*

REFERENCES

- Brigham, William and Stevenson, Craig, 1997, Wildlife Water Catchment Construction in Nevada, Technical Note 397.
- Tsukamoto, George and Stiver, San Juan, 1990, Wildlife water Development, Proceedings of the Wildlife Water Development Symposium, Las Vegas, NV, USDI Bureau of Land Management.
- Yoakum, J. and W.P. Dasmann. 1971. Habitat Manipulation Practices. Ch. 14 in Wildlife Management Techniques, Third Edition. Ed. Robert H. Giles, Jr. Pub. The Wildlife Society. 633 pp.
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