

DEPARTMENT OF THE ARMY PERMIT
Regional Permit 32
Fill Material Placed in Waters of the U.S. for Earthen Flood Detention Dams Designed
as Part of a Regional Watershed Management Plan
in the State of Missouri

Permit Number: CEMVR-OD-P-

Section: 404

Permittee:

POC:

Tel:

Effective Date:

Expiration Date:

Issuing Office:

U.S. Army Corps of Engineers, Rock Island District
Clock Tower Building - P.O. Box 2004
Rock Island, Illinois 61204-2004

You are authorized to perform work in accordance with the terms and conditions specified below.

NOTE: The term "you" and its derivatives, as used in this permit, means the permittee or any future transferee. The term "this office" refers to the appropriate district or division office of the Corps of Engineers having jurisdiction over the permitted activity or the appropriate official of that office acting under the authority of the commanding officer.

Project Description:

Project Location:

in accordance with the plans and drawings attached hereto which are incorporated in and made a part of this permit.

Drawings No. CEMVR-OD-P-

Permit Conditions:

General Conditions:

1. The time limit for completing the work authorized ends on the date specified on page 1. If you find that you need more time to complete the authorized activity, submit your request for a time extension to this office for consideration at least one month before that date is reached.
2. You must maintain the activity authorized by this permit in good condition and in conformance with the terms and conditions of this permit. You are not relieved of this requirement if you abandon the permitted activity, although you may make a good faith transfer to a third party, in compliance with General Condition 4 below. Should you wish to cease to maintain the authorized activity or should you desire to abandon it without a good faith transfer, you must obtain a modification of this permit from this office, which may require restoration of the area.
3. If you discover any previously unknown historic or archaeological remains while accomplishing the activity authorized by this permit, you must immediately notify this office of what you have found. We will initiate the Federal and state coordination required to determine if the remains warrant a recovery effort or if the site is eligible for listing in the National Register of Historic Places.
4. If you sell the property associated with this permit, you must obtain the signature of the new owner in the space provided and forward a copy of the permit to this office to validate the transfer of this authorization.
5. If a conditioned water quality certification has been issued for your project, you must comply with the conditions specified in the certification as special conditions to this permit. For your convenience, a copy of the certification is attached if it contains such conditions. (Condition is not applicable for Section 10 Permits.)
6. You must allow representatives from this office to inspect the authorized activity at any time deemed necessary to ensure that it is being or has been accomplished in accordance with the terms and conditions of your permit.

Special Conditions:

NOTE: This regional permit authorizes discharges of dredged or fill material associated with mechanized land clearing, excavation and other discharges of dredged or fill material below the ordinary high water mark of waters of the United States in conjunction with the construction and required mitigation work of earthen flood detention dams designed as part of a regional watershed management plan and prepared under the authority of the Watershed Protection and Flood Prevention Act, Public Law 83-566, as amended.

1. You must sign and return a "Compliance Certification" after you complete the authorized work and any required mitigation. Your signature will certify that you completed the work in accordance with this permit, including general and specific conditions, and that any required mitigation was completed in accordance with the permit conditions. The "Compliance Certification" may be submitted with the required annual status report (see conditions below).

2. If a contractor will perform any part of the authorized work, you must discuss the terms and conditions of this permit with the contractor before the contractor starts work; and, you must give a copy of this entire permit to the contractor.

3. You must use clean, uncontaminated materials for fill in order to minimize excessive turbidity by leaching of fines, as well as to preclude the entrance of deleterious and/or toxic materials into the waters of the United States by natural runoff or by leaching.

4. You must dispose of excess concrete and wash water from concrete trucks and other concrete mixing equipment in a nonwetland area above the ordinary high water mark and at a location where the concrete and wash water cannot enter the water body or an adjacent wetland area.

5. You must excavate, dredge and/or fill in the watercourse in a manner that will minimize increases in suspended solids and turbidity which may degrade water quality and damage aquatic life outside the immediate area of operation.

6. You must immediately remove and properly dispose of all debris during every phase of the project in order to prevent the accumulation of unsightly, deleterious and/or toxic materials in or near the waterbody.

7. You must not dispose of any construction debris or waste materials below the ordinary high water mark of any water body, in a wetland area, or at any location where the materials could be introduced into the water body or an adjacent wetland as a result of runoff, flooding, wind, or other natural forces.

8. You must store all construction materials, equipment, and/or petroleum products, when not in use, above anticipated high water levels.

9. You must restrict the clearing of timber and other vegetation to the absolute minimum required to accomplish the work.

10. You must not discharge fill or dredged material or excavate below the water surface during the fish spawning seasons, unless a written variance from the Missouri Department of Conservation that no more than minimal impacts will occur to fish populations from the work during normal fish spawning periods. Evidence of coordination with the Missouri Department of Conservation will be included with the authorization.

11. Upon completion of earthwork operations, you must seed, replant or otherwise protect from erosion all fills in the water or on shore, and other areas on shore disturbed during construction. If seeding does not successfully vegetate the disturbed areas by the end of the first growing season, you must implement alternate measures, such as placing riprap or additional vegetative plantings, to protect the disturbed areas from further erosion. You must contact the Rock Island District Regulatory Office prior to beginning work on any additional erosion control measures so that a determination can be made whether further authorization is required.

12. The mitigation plan submitted as a part of the project plans is considered a part of the authorization. The mitigation plan shall be implemented concurrently with the project development.

a. You must exclude agricultural use from all mitigation areas, i.e., use for livestock production, and prohibit any other noncompatible use that would jeopardize the biological integrity of the mitigation areas.

b. You must protect all mitigation areas with a deed restriction, conservation easement, United States Department of Agriculture (USDA) contract restriction or other restrictive agreement formed between the landowner and the USDA. You must provide a copy of the restriction on each mitigation area to the Corps of Engineers at the time that you submit your "Compliance Certificate".

13. The programmatic memorandum of agreement (MOA), or procedural memorandum of agreement (PMOA), or project specific MOA or other documentation signed by the Missouri State Historic Preservation Officer that the proposed work will not affect any property listed on the National Register of Historic Places or listed as eligible for listing on the register will be a part of this permit. The regional permit does not authorize the work to affect any property listed on the National Register of Historic Places or listed as eligible for listing on the register, unless the project complies with all conditions and restrictions of the agreement and receives clearance to complete the work from the Corps of Engineers. Failure to comply with the cultural resource agreement would constitute non-compliance with the regional permit. **You must inform the Corps of Engineers of any projects proposed in locations listed in the agreement that will have the potential to affect cultural resources.**

14. The regional permit does not authorize you to take an endangered species. In order to legally take a listed species, you must have separate authorization under the Endangered Species Act (ESA). If authorization under the ESA contains mandatory terms and conditions to implement the reasonable and prudent measures that are associated with an "incidental take", such terms and conditions become part of the regional permit. Failure to comply with the ESA terms and conditions would constitute an unauthorized take, and it would also constitute non-compliance with the regional permit. The Corps of Engineers will informally consult with the U.S. Fish and Wildlife Service to comply with the ESA and to make a determination of the affect on Federally listed species. If you have any questions concerning threatened and endangered species occurring in your project area, you should contact the U.S. Fish and Wildlife Service at the Columbia Field Office located at 608 East Cherry Street, Columbia, Missouri 65201.

15. **Discretionary Authority.**

a. The Corps of Engineers has the discretion to require an individual permit on a case-by-case basis for any proposed structure and has the discretion to revoke verifications under this regional permit for any uncompleted structures if the cumulative impacts to the watershed are shown to warrant such an action.

b. The cumulative impacts of this regional permit may be re-evaluated at the discretion of the Corps of Engineers at any time, but will be re-evaluated at least every five (5) years. To evaluate potential cumulative impacts, you must submit an annual status report to the Corps of Engineers after each construction season. The report will include the number and location of completed impoundments for that verification period with the acres of mitigation established. Also, a cumulative number of dams constructed in each watershed will be listed.

c. Individual verifications will be issued for each proposed dam and will be valid for two (2) years. Work verified by the regional permit but not completed within 2 years from the date of the verification letter require new verification for the uncompleted portions of the project. You must submit a new application for the uncompleted portions of the project to receive a new verification.

d. Project construction activities may not be initiated until the Corps of Engineers has determined that the project meets the requirements of the Regional Permit and has provided written notification that the individual project meets the conditions of the Regional Permit.

16. That the attachments to and conditions listed in the attached Section 401 water quality certification from the Missouri Department of Natural Resources dated October 17, 2002, are considered to be part of this permit.

Further information:

1. Congressional Authorities: You have been authorized to undertake the activity described above pursuant to:

- () Section 10 of the Rivers and Harbors Act of 1899 (33 U.S.C. 403).
- (X) Section 404 of the Clean Water Act (33 U.S.C. 1344).
- () Section 103 of the Marine Protection, Research and Sanctuaries Act of 1972 (33 U.S.C. 1413).

2. Limits of this authorization.

- a. This permit does not obviate the need to obtain other Federal, state, or local authorizations required by law.
- b. This permit does not grant any property rights or exclusive privileges.
- c. This permit does not authorize any injury to the property or rights of others.
- d. This permit does not authorize interference with any existing or proposed Federal project.

3. Limits of Federal Liability. In issuing this permit, the Federal Government does not assume any liability for the following:

- a. Damages to the permitted project or uses thereof as a result of other permitted or unpermitted activities or from natural causes.
- b. Damages to the permitted project or uses thereof as a result of current or future activities undertaken by or on behalf of the United States in the public interest.
- c. Damages to persons, property, or to other permitted or unpermitted activities or structures caused by the activity authorized by this permit.
- d. Design or construction deficiencies associated with the permitted work.
- e. Damage claims associated with any future modification, suspension, or revocation of this permit.

4. Reliance on Applicant's Data: The determination of this office that issuance of this permit is not contrary to the public interest was made in reliance on the information you provided.

5. Reevaluation of Permit Decision. This office may reevaluate its decision on this permit at any time the circumstances warrant. Circumstances that could require a reevaluation include, but are not limited to, the following:

- a. You fail to comply with the terms and conditions of this permit.
- b. The information provided by you in support of your permit application proves to have been false, incomplete, or inaccurate (See 4 above).

c. Significant new information surfaces which this office did not consider in reaching the original public interest decision.

Such a reevaluation may result in a determination that it is appropriate to use the suspension, modification, and revocation procedures contained in 33 CFR 325.7 or enforcement procedures such as those contained in 33 CFR 326.4 and 326.5. The referenced enforcement procedures provide for the issuance of an administrative order requiring you to comply with the terms and conditions of your permit and for the initiation of legal action where appropriate. You will be required to pay for any corrective measures ordered by this office, and if you fail to comply with such directive, this office may in certain situations (such as those specified in 33 CFR 209.170) accomplish the corrective measures by contract or otherwise and bill you for the cost.

6. Extensions. General condition 1 establishes a time limit for the completion of the activity authorized by this permit. Unless there are circumstances requiring either a prompt completion of the authorized activity or a reevaluation of the public interest decision, the Corps will normally give favorable consideration to a request for an extension of this time limit.

Your signature below, as permittee, indicates that you accept and agree to comply with the terms and conditions of this permit.

This permit becomes effective when the Federal official, designated to act for the Secretary of the Army, has signed below.

 P.E.

William J. Bayles
Colonel, U.S. Army
District Engineer, Rock Island District

27 Nov 2002
Date

When the structures or work authorized by this permit are still in existence at the time the property is transferred, the terms and conditions of this permit will continue to be binding on the new owner(s) of the property. To validate the transfer of this permit and the associated liabilities associated with compliance with its terms and conditions, have the transferee sign and date below.

Transferee

Date

STATE OF MISSOURI
DEPARTMENT OF NATURAL RESOURCES

Bob Holden, Governor • Stephen M. Mahfood, Director

www.dnr.state.mo.us

OCT 17 2002

Mr. Wayne Hannel
U.S. Army Corps of Engineers
Rock Island District
Clock Tower Building
P.O. Box 2004
Rock Island, IL 61204-2004

Dear Mr. Hannel:

Enclosed are the proposed State of Missouri 401 Water Quality Certification general conditions on the 2002 general permit for CEMVR-OD-P-416820-1 for flood detention dams. The Missouri Department of Natural Resources and the Natural Resources Conservation Service have worked together to establish certifications that are agreeable to both organizations. We hope these general conditions can be accepted by the Corps, which will eliminate the necessity of processing many individual certifications on PL-566 flood detention dams. If these are not accepted by the Corps, the applicant will still receive these same conditions through a separate 401 application to the state. We trust that you will find these acceptable for incorporation to the general permit so that the applicant can save time on the approval process.

If you have any questions, please contact Georganne Bowman by e-mail at nrbowmg@dnr.state.mo.us or Don Boos at nrboosd@dnr.state.mo.us, by phone at (573) 751-7428, or by mail at Missouri Department of Natural Resources, Water Pollution Control Program, P.O. Box 176, Jefferson City, MO 65102-0176.

Sincerely,

WATER POLLUTION CONTROL PROGRAM

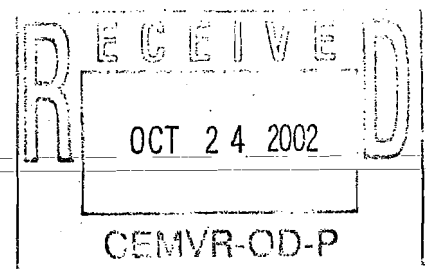

Jim Hull
Director

JH:gbp

Enclosures

- c: Roger Hansen, Natural Resource Conservation Service
Clif Baumer, Natural Resource Conservation Service
Chris Hamilton, Natural Resource Conservation Service
Jim Ptacek, Army Corps of Engineers, Kansas City District
Jason Daniels, U.S. Environmental Protection Agency, Region 7
Kelly Srigley-Werner, U.S. Fish and Wildlife Service
Gene Gardner, Missouri Department of Conservation
Mike Wells, Missouri Department of Natural Resources, GSRAD

Integrity and excellence in all we do



WATER QUALITY CERTIFICATION CONDITIONS FOR GENERAL PERMIT 32

(Flood Detention Dams)

1. Only structures designed and constructed as ponds as described in *Pond Conservation Practice Standard*, Code 378, Natural Resource Conservation Service (NRCS) Field Office Technical Guide, Section IV, are authorized by this certification.
2. Only first or second order streams shall be impounded under this general permit. (Stream order is delineated by the Strahler's Method.)
3. Care should be taken to keep machinery out of the waterway as much as possible. Fuel, oil and other petroleum products, equipment and any solid waste should not be stored below the crest of the surveyed impoundment structure at any time, or in the adjacent floodplain beyond normal working hours. All precautions should be taken to avoid the release of wastes or fuel to streams and other adjacent waterbodies as a result of this operation. Petroleum products spilled into any waterbody or on the banks where the material may enter waters of the state should be immediately cleaned up and disposed of properly. Any such spills of petroleum shall be reported as soon as possible to the Missouri Department of Natural Resources' 24-hour Environmental Emergency Response number at (573) 634-2436.
4. All jurisdictional wetland and spring impacts that cannot be avoided or minimized will be compensated by mitigation according to the enclosed "Missouri Aquatic Resources Mitigation Guidelines."
5. In order to maintain water quality from degradation by livestock, impoundments five (5) acres or less shall limit livestock access using NRCS's *Heavy Use Area Protection Standard*, Code 561, NRCS Field Office Technical Guide, Section IV, for protection of the access area. Impoundments over five (5) acres should limit livestock access with the use of best management practices or alternative watering systems.
6. Clearing of vegetation/trees should be the minimum necessary to accomplish the activity.
7. Any land disturbance activities disturbing one (1) or more acres of total area for the entire project requires a stormwater permit from the Water Pollution Control Program for land disturbance activities. Note: this is one (1) acre of area disturbed for the total project, not one (1) acre of water of the United States. In this regard, please contact the Water Pollution Control Program at (573) 751-6825.
8. Only clean, nonpolluting fill should be used for dam structures.
9. Work should be conducted during low flow whenever possible.
10. Augmented flow shall be maintained at all impoundments that have watersheds of 640 acres or more contained within the combination of their own and the adjacent controlled tributaries.
11. An electronic copy of verifications sent to the U.S. Army Corps of Engineers with baseline information on each structure site will be sent to the following Water Pollution Control Program address: nrbowmg@dnr.state.mo.us.
12. ~~This certification does not authorize any construction activities that are located in or occurs within two (2) miles upstream of a designated outstanding state or national resource water (10 CSR 20-7.031).~~

**NATURAL RESOURCES CONSERVATION SERVICE
CONSERVATION PRACTICE STANDARD**

POND

(No.)

CODE 378

Definition

A water impoundment made by constructing a dam or an embankment or by excavating a pit or dugout.

In this standard, ponds constructed by the first method are referred to as embankment ponds, and those constructed by the second method as excavated ponds. Ponds constructed by both the excavation and the embankment methods are classified as embankment ponds if the depth of water impounded against the embankment at spillway elevation is 3 feet or more.

Purpose

To provide water for livestock, fish and wildlife, recreation, fire control, irrigation, crop and orchard spraying, maintain or improve water quality, aesthetically pleasing on the landscape, and other related uses.

Scope

This standard establishes the minimum acceptable quality for the design and construction of ponds if:

1. Failure of the dam will not result in loss of life; in damage to homes, commercial or industrial buildings, main highways, railroads; or in interruption of the use of public utilities.
2. The product of the storage times the effective fill height of the dam is less than 3,000 acre-feet. Storage is the volume (acre-feet), in the reservoir below the elevation of the crest of the auxiliary spillway. The effective fill height of the dam

is the difference in elevation (feet) between the auxiliary spillway crest and the lowest point in the cross section along the centerline of the dam. For dams on existing roads or other sites without a measurable channel at centerline, the lowest elevation at the downstream toe will be used to determine effective height. If there is no auxiliary spillway, the lowest elevation along settled top of dam is the upper limit.

3. The overall height of the dam is less than 35 feet; and the dam is hazard class (a).

Overall height is the difference in elevation in feet between the lowest elevation in the top of dam (excluding the auxiliary spillway) and the lowest elevation in the natural bed of the stream or watercourse or the lowest point on the toe of the dam (whichever is lower).

Dams with an overall height of 35 feet or more shall meet the requirements of the Missouri Department of Natural Resources, Dam and Reservoir Safety Council and meet or exceed the requirements of Technical Release 60 (TR-60).

Any dam beyond the scope of this standard will be designed in accordance with Technical Release 60 (TR-60). See Section 520.22, National Engineering Manual for definition of classes of dams.

Conditions where practice applies

Site conditions. Site conditions shall be such that runoff from the design storm (see Table 3) can safely pass through (1) a natural or constructed auxiliary spillway, (2) a combination of a principal spillway and an auxiliary spillway, or (3) a principal spillway. Where more than one site exists, select as a final location the one that disturbs the least

Conservation practice standards are reviewed periodically, and updated if needed. To obtain the current version, contact the Natural Resources Conservation Service.

amount of wildlife habitat. Consider landowner's priorities and best achieves the objectives with the least negative impact on other important resources.

Drainage area. The drainage area above the pond must be protected against erosion to the extent that expected sedimentation will not shorten the planned effective life of the structure. The drainage area shall be large enough so that surface runoff and subsurface flow will maintain an adequate supply of water in the pond. The water quality shall be suitable for its intended use. Missouri supplement to the National Engineering Handbook (NEH) Part 650, Engineering Field Handbook (EFH) Chapter 11, may be used as a guide in determining minimum size of contributing drainage area.

Reservoir area. The topography and soils of the site shall permit storage of water at a depth and volume that insures a dependable supply, considering beneficial use, sedimentation, season of use, and evaporation and seepage losses. If surface runoff is the primary source of water for a pond, the soils shall be impervious enough to prevent excessive seepage losses or shall be of a type that sealing is practicable.

The minimum pond size shall be that required to meet the calculated needs. The minimum depth shall be 8 feet over 10 percent of the normal water surface area unless fish production is an important design consideration. Where underlying material prevents excavation to 8 feet, the minimum depth shall be 5 feet over 25 percent of the normal water surface. Minimum depth and surface area does not apply to ponds primarily for wildlife water.

Ponds primarily for fish production. For best management, minimum surface area should be 1.0 acre. Ponds shall be at least eight (8) feet deep over an area of approximately 1,000 square feet. Shoreline, excluding embankment and waterway outlets into the pond, shall be sloped 3 (horizontal) to 1 (vertical) or steeper from normal water surface to a depth of 3 feet. On ponds with a surface area of 6 acres or greater, this requirement may be reduced to 75 percent of the shore line. For ponds larger than 3 acres, provisions shall be

made to drain the pond in a 14-day period. An available pumping system of adequate size will meet this requirement.

Management shall be according to Missouri Standard and Specification for Fishpond Management (399).

Investigations. Sufficient investigations shall be made of the dam site and borrow areas to determine suitability of site and materials for construction, dam stability, and water holding ability. A complete analysis of foundation and earth fill materials shall be made when, in the opinion of the responsible engineer, such an analysis is necessary. National Engineering Manual - Part 531 and Missouri supplements regarding dam site investigations will be followed.

DESIGN CRITERIA FOR EMBANKMENT PONDS

Foundation cutoff. A cutoff of relatively impervious material shall be provided under the dam if necessary. The cutoff shall be located at or upstream from the centerline of the dam. It shall extend up the abutments as required and be deep enough into a relatively impervious layer or provide a stable dam when combined with seepage control. The cutoff trench shall have a bottom width adequate to accommodate the equipment used for excavation, backfill, and compaction operations. Side slopes shall be 1-1/2 (horizontal) to 1 (vertical) or flatter as needed to be stable. The cutoff shall be of sufficient size and extent to prevent excessive seepage under or around the dam.

Seepage control. Seepage control is to be included if (1) pervious layers are not intercepted by the cutoff, (2) seepage may create swamping downstream, (3) needed to insure a stable embankment, or (4) special problems require drainage for a stable dam. Seepage control may be accomplished by (1) foundation, abutment, or embankment drains, (2) reservoir blanketing, or (3) a combination of these measures.

Earth embankment. The minimum top width for a dam is shown below. If the embankment top is to be used as a public road, the minimum width shall be 16 feet for

one-way traffic and 26 feet for two-way traffic. When embankment top is to be used as a farm road, the minimum top width is 12 feet. Guardrails or other safety measures shall be used where necessary and shall meet the requirements of the responsible road authority.

Overall height of embankment ^{1/} (feet)	Top width (feet)
12 or less	6
12 - 16	8
16 - 22	10
22 - 26	12
26 - 35	14

^{1/} Determine overall embankment height to nearest foot only.

The combined upstream and downstream side slopes of the settled embankment shall not be less than 6 (horizontal) to 1 (vertical), and no slope steeper than 2-1/2 (horizontal) to 1 (vertical). All slopes must be designed to be stable, even if flatter slopes are required. Slope stability shall be evaluated based on soil mechanics analysis or past experience in the surrounding area.

Suitable vegetation shall be established on all earth dams and adjacent critical areas.

If needed to protect the face of the dam, special measures, such as berms (level or sloping), rock riprap, sand-gravel, soil cement, or special vegetation (Reference Technical Releases No.56 or No.69), shall be provided. Potential wave erosion factors such as orientation, exposure, and fetch length should be considered for all ponds to determine if protection is needed. History of other sites in surrounding area shall be considered when evaluating wave protection. In some areas wave erosion is severe even on small pool areas. Wave erosion protection shall be provided on the dam for all reservoirs exceeding 5 acre surface area unless otherwise evaluated and approved by the responsible engineer. Minimum wave protection to be used: (1) an 8 foot berm at principal spillway elevation or (2) construct upstream slope 4 (horizontal) to 1 (vertical)

or flatter. For pool sizes of 10 acres or more, compute wave height by Technical Release - 56 (TR-56) or Technical Release 69 (TR-69). Wave heights over 1 foot may require sloping berms or rock riprap.

The minimum elevation of the top of the settled embankment shall be 1 foot above the water surface in the reservoir with the auxiliary spillway flowing at design depth. The minimum difference in elevation between the crest of the auxiliary spillway and the settled top of dam shall be 2 feet for all dams having more than a 20-acre drainage area or more than 20 feet in effective height.

The design height of the dam shall be increased by the amount needed to insure that after settlement the height of the dam equals or exceeds the design height. The actual percent increase selected by designer shall be based on (1) soil mechanics test results, (2) history of dams in the surrounding area, and (3) the type of compaction designated. The following minimum shall be met:

(a) 3 to 5 percent increase where fill material is placed in 9-inch layers and compacted by heavy hauling equipment or liquid filled tamping roller. (Sheepsfoot or wedgefoot drum rollers are considered tamping rollers.)

(b) 5 to 10 percent increase where fill construction and compaction is by bulldozer or light hauling equipment, i.e., unloaded scrapers. Individual layers shall be 5 inches in thickness or less.

Principal spillway. A pipe conduit, with needed appurtenances, shall be placed under or through the dam except where rock, concrete or other types of mechanical spillways are used or where the rate and duration of flow can be safely handled by a vegetated or earth spillway.

The crest elevation shall not be less than 0.5 foot below the crest of the auxiliary spillway for dams having a drainage area of 20 acres or less and not less than 1 foot for those having a drainage area of more than 20 acres.

When design discharge of the principal spillway is considered in calculating peak outflow through the auxiliary spillway, the crest elevation of the inlet shall be such that full flow will be generated in the conduit before there is discharge through the auxiliary spillway. Sufficient stage (difference in elevation between crest of auxiliary spillway and invert of principal spillway inlet) shall be provided to insure efficient use of principal spillway. The inlet section and outlet section shall be designed to function satisfactorily for the full range of flow and hydraulic head anticipated.

The capacity of the pipe conduit shall be adequate to discharge long duration, continuous, or frequent flows without flow through the auxiliary spillway. The diameter of the pipe shall not be less than 4 inches. If the pipe conduit is 10 inches or greater, its design discharge may be considered in the hydraulic design.

Table 3 gives the minimum requirements for sizing the principal spillway and determining the temporary water storage volume needed in determining the stage required between the crest of the principal spillway and the flow line of the auxiliary spillway.

Pipe conduits under or through the dam shall meet the following requirements: (1) the pipe shall be capable of withstanding external loading without yielding, buckling, or cracking, (2) pipe strength shall not be less than that of the grades indicated in Table 1 or Table 1a for PVC plastic pipe and in Table 2 for corrugated aluminum and galvanized corrugated steel pipe, (3) the inlet and outlet sections shall be structurally sound and made of materials compatible with that of the pipe, and (4) all pipe joints shall be made watertight by the use of couplings or gaskets or by welding or caulking.

The conduit slope shall be adequate to provide positive drainage after consolidation has occurred. Slope of the outlet section for conduits 15 inches in diameter or greater shall not exceed 7 percent.

When conduit design requires an elbow, the outlet section from the elbow to outlet end shall not be less than 16 feet in length. The conduit extension beyond end support or

downstream toe of fill shall not be less than 6 feet.

Invert of the outlet pipe section shall be no higher than 2 feet above the outlet channel flowline unless otherwise approved by the responsible engineer.

Acceptable pipe materials for effective fill heights are:

(a) 35 feet or less

Cast in place reinforced concrete
Reinforced concrete pipe
Corrugated steel pipe
New or good quality used welded steel pipe

(b) 25 feet or less

Cast in place reinforced concrete
Reinforced concrete pipe
Corrugated steel pipe
New or good quality used welded steel pipe
Ductile iron pipe
Corrugated aluminum pipe
Plastic pipe

Welded steel pipe shall meet tolerance requirements of ASTM A53 or equivalent specifications. Welded steel pipe shall be new, new reject, or high quality used pipe.

Minimum effective* wall thickness for welded steel pipe shall be:

(a) $3/16$ (0.188) inches for pipe diameters 24 inches or less

(b) $1/4$ (0.25) inches for pipe diameters over 24 inches

* effective wall thickness - wall thickness minus maximum depth of rust or corrosion pits

Aluminum pipe will not be used in soils that are outside the pH range of 4 to 9.

Concrete pipe shall be laid in a concrete bedding or a concrete cradle, if required.

Plastic pipe that will be exposed to direct sunlight shall be made of ultraviolet-resistant materials and protected by coating, shielding, or provisions for replacement as necessary. Connections of plastic pipe to less flexible pipe or structures must be designed to avoid stress concentrations that could rupture the plastic pipe.

The maximum height of fill over any pipe must be evaluated by Technical Release 77 (TR-77), use Tables 1, 1a, 2, or other suitable methods. Pipe shall be watertight. The joints between sections of pipe shall be designed to remain watertight after joint elongation caused by foundation consolidation. Cantilever outlet sections, if used, shall be designed to withstand the cantilever load. Pipe supports shall be provided when needed. Outlet pipe supports will be used on conduits larger than 18 inches for corrugated metal pipe and larger than 24 inches for welded steel pipe. For all pipe sizes, PVC plastic pipe shall not protrude from the embankment more than six (6) feet unless an outlet pipe support is installed. Pipe support will be according to an approved standard design and will be installed at the intersection of downstream slope of fill and outlet channel. Other suitable devices such as a Saint Anthony Falls (SAF) outlet or impact basin may be used to provide a safe outlet.

Cathodic protection shall be provided to reduce corrosion of welded steel and corrugated steel pipe if the need and importance of the structure warrant. Cathodic protection should normally be provided for corrugated steel pipe if the saturated soil resistivity is less than 4,000 ohms-cm or the pH is lower than 5. Conservation Practice Standard Irrigation Water Conveyance, Steel Pipeline (430-FF) provides criteria for cathodic protection of welded steel pipe. A pipe layout that ensures good drainage reduces the rate of metal corrosion. In highly corrosive soils use of alternate pipe materials such as plastic pipe should be considered.

Anti-seep collars shall be installed around the pipe conduit or pond drain pipe in the normal saturation zone if any of the following conditions exist:

1. The overall height of the dam exceeds 15 feet.
2. The conduit is smooth pipe larger than 8 inches in diameter.
3. The conduit is corrugated metal pipe larger than 12 inches in diameter.

Anti-seep collars and their connections to the pipe shall be watertight. The collar material shall be compatible with pipe materials. The maximum spacing shall be approximately 14 times the minimum projection of the collar measured perpendicular to the pipe but shall not exceed 25 feet. Minimum collar projection is 1.0 foot. For design considerations, see Missouri supplement to the National Engineering Handbook (NEH) Part 650, Engineering Field Handbook.

Closed conduit spillways designed for pressure flow must have adequate antivortex devices.

If needed to prevent clogging of the conduit, an appropriate trash guard shall be installed at the inlet or riser entrance. For safety reason, all vertical drop inlets will be constructed to prevent accidental injury to livestock and humans. This may be accomplished by using a horizontal antivortex baffle, trash rack, or guard rail.

Other pipelines. A pipe with a suitable valve shall be provided to drain the pool area if needed for proper pond management or if required by state law. The principal spillway conduit may be used as a pond drain if it is located so as to accomplish this function.

Supply pipe through the dam to watering troughs and other appurtenances shall have an inside diameter of not less than 1-1/4 inches. Supply pipes shall be installed in conjunction with a suitable intake device with strainer, valve, and provisions to avoid freezing.

Dry hydrant installations may be planned with new pond construction. Dry hydrants through embankments shall be installed in accordance with principal spillway criteria.

Trickle tube capacity shall be at least equal to the maximum spring or base flow. Minimum tube size is 4 inch diameter. Crest elevation shall be at least 0.5 foot below the crest of the auxiliary spillway. Trickle tubes through the dam shall meet all requirements for a principal spillway except flood-routing is not required. Trickle tubes installed in the abutment around the end of the dam may be corrugated polyethylene or polyvinyl chloride tubing. Tubing may be installed through the dam at a point where the height of dam above natural ground is 3 feet or less and a minimum of 9 inches of sand backfill is placed all around the conduit, beneath the topwidth of the dam. Pipes or tubing with equivalent strength and durability may be used.

Auxiliary spillways. Auxiliary spillways convey large flows safely downstream from earth embankments.

An auxiliary spillway must be provided for each dam, unless the principal spillway is large enough to pass the routed design hydrograph peak discharge and the trash that comes to it without overtopping the dam. A closed conduit principal spillway having a conduit with a cross sectional area of 3 sq ft or more, an inlet that will not clog, and an elbow designed to facilitate the passage of trash is the minimum size and design that may be used without an auxiliary spillway. The minimum capacity of a natural or constructed auxiliary spillway shall be that required to pass the peak flow from a design storm of the frequency and duration shown in Table 3 less any reduction creditable to conduit discharge and detention storage.

The auxiliary spillway shall safely pass the peak flow or the storm runoff shall be routed through the reservoir. The routing shall start with the water surface at the elevation of the crest of the principal spillway or at the water surface after 10 days drawdown, whichever is higher. The 10-day drawdown shall be computed from the crest of the auxiliary spillway or from the elevation that would be attained if the entire design storm were impounded, whichever is lower. Auxiliary spillways shall provide for passage of the design flow at a safe velocity to a point downstream where the dam will not be endangered.

Constructed auxiliary spillways are open channels and usually consist of an inlet channel, a control section, and an exit channel. They shall be trapezoidal and shall be located in undisturbed or compacted earth. The side slopes shall be stable for the material in which the spillway is to be constructed. Spillway sideslopes shall be 2-1/2 (horizontal) to 1 (vertical) or flatter. Auxiliary spillway shall have a bottom width of not less than 10 feet

Upstream from the control section, the inlet channel shall be level upstream for at least 25 feet or a distance needed to protect and maintain the crest elevation of the spillway. The inlet channel may be curved to fit existing topography. The grade of the exit channel of a constructed spillway shall fall within the range established by discharge requirements and permissible velocities.

Spillway dikes or shaped exit channels shall extend to the point downstream that ensures the spillway flows do not damage the earth embankment. Sideslopes of the constructed spillway dike shall have a slope of 2-1/2 (horizontal) to 1 (vertical) or flatter, a minimum top width of 4 feet, and a minimum height of 2 feet above the spillway grade.

Structural auxiliary spillways. If chutes or drop spillways are used for principal spillways or auxiliary spillways, they shall be designed according to the principles set forth in the National Engineering Handbook (NEH) Part 650, Engineering Field Handbook for Conservation Practices; National Engineering Handbook, Section 5, Hydraulics, Section 11, Drop Spillways, and Section 14, Chute Spillways. The minimum capacity of a structural spillway shall be that required to pass the peak flow expected from a design storm of the frequency and duration shown in Table 3 less any reduction creditable to conduit discharge and detention storage.

Visual resource design. The visual design of ponds in areas of high public visibility and those associated with recreation shall be carefully considered. The underlying criterion for all visual design is appropriateness. The shape and form of ponds, excavated material, and plantings are

to relate visually to their surroundings and to their function.

The embankment may be shaped to blend with the natural topography. The edge of the pond may be shaped so that it is generally curvilinear rather than rectangular. Excavated material can be shaped so that the final form is smooth, flowing, and fitting to the adjacent landscape rather than angular geometric mounds. If feasible, islands may be added for visual interest and wildlife value.

DESIGN CRITERIA FOR EXCAVATED PONDS

Runoff. Provisions shall be made for a pipe and auxiliary spillway if necessary. Runoff flow patterns shall be considered when locating the pit and placing spoil material (see Table 3).

Side slopes. Side slopes of excavated ponds shall be stable and shall not be steeper than 2-1/2 (horizontal) to 1 (vertical). If livestock will water directly from the pond, a watering ramp of ample width shall be provided. The ramp shall extend to the anticipated low water elevation at a slope no steeper than 4 (horizontal) to 1 (vertical).

Perimeter form. If the structures are to be used for recreation or are located in high public view, the perimeter or edge must be curvilinear in form.

Inlet protection. If surface water enters the pond in a natural or excavated channel, the side slope of the pond shall be protected against erosion.

ramps are constructed in an excavated pond, the fence shall permit livestock access to the ramp area only. In other cases the fence will be located no closer than 25 feet (horizontal distance) from the normal water line. Fence materials and fence installation shall be as outlined in the standards and specifications for Conservation Practice Fence (382).

Where the pond is to be developed as wildlife land, the fence will be located no closer than 40 feet to the sides of the normal water and 70 feet from the upper end of the normal pool.

Excavated material. The material excavated from the pond shall be placed so its weight will not endanger the stability of the pond side slopes and where it will not be washed back into the pond by rainfall. It shall be disposed of in one of the following ways:

1. Uniformly spread to a height not exceeding 3 feet with the top graded to a continuous slope away from the pond.
2. Uniformly placed or shaped reasonably well with side slopes assuming a natural angle of repose for the excavated material behind a berm width equal to the depth of the pond but not less than 12 feet
3. Shaped to a designed form that blends visually with the landscape.
4. Used for low embankment and leveling.
5. Hauled away.

EMBANKMENT AND EXCAVATED PONDS

Since ponds are potentially hazardous, safety aspects must be considered in the design. If the area is used for recreation, it is recommended to erect warning signs, place lifesaving equipment nearby, and post instructions of what to do in emergencies.

Where an adjacent area is used for grazing or is open to livestock, the pool area, earthfill, and vegetative spillway shall be fenced to exclude livestock. Where watering

Fencing may be necessary to exclude traffic that may endanger the vegetative cover on the embankment and spillway areas and to prevent the use of the facilities for purposes other than intended.

The exposed surfaces of the embankment, earth spillway, borrow areas, and other areas disturbed during construction shall be seeded or sodded. The seedbed preparation and treatment and the seeding mixtures and methods shall be as outlined in the standards and specification for

Conservation Practice Critical Area Planting
(342).

PLANS AND SPECIFICATIONS

Plans and specification for installing ponds shall be in keeping with this standard and shall describe the requirements for applying the practice to achieve its intended purpose.

Drawings and construction specifications shall be provided to the landowner or his/her representative with sufficient copies for the contractor. Special construction specifications shall be prepared for the complex sites. The national guide specification and NRCS Handbooks shall be utilized in preparing these specifications. Missouri Construction Specifications 378-A and 378-B, as applicable, will be used for all other sites.

OPERATION AND MAINTENANCE

The following University of Missouri Agricultural Guide provides information on operating and maintaining structures with embankment dams:

1548 "Maintaining Small Dams"

Table 1 – Maximum allowable earthfill cover over PVC pipe for earth dams^{1,4,5}

Schedule for SDR (Standard Dimension Ratio) ²	Maximum depth of fill over pipe ^{3,5} (feet)
SDR41	8
SDR35	9
SDR32.5	10
SDR26	14
SDR21	21
SDR17	32

Table 1a– Maximum acceptable earthfill cover (feet) over various other PVC Pipe Materials^{4,5,6}

Type	Size (Inside Diameter)				
	4"	6"	8"	10"	12"
AWWA C900					
100 psi	15	15	15	15	15
150 psi	27	27	27	27	27
200 psi	35	35	35	35	35
ASTM D1785					
Schedule 40	25	17	13	11	10
Schedule 80	35	35	30	27	25
Schedule 120	35	35	35	35	35

1 Polyvinyl chloride pipe, PVC 1120 or PVC 1220, conforming to ASTM D1785 ASTM D2241 or equivalent.

2 SDR = $\frac{\text{outside diameter (Inches)}}{\text{wall thickness (Inches)}}$

3 Fill depths are based on 7 1/2% pipe deflection in accordance with Technical Release 77 - Design and Installation of Flexible Conduits - Plastic Pipe.

4 PVC pipe is not permitted in dams with effective fill height greater than 25 feet.

5 Backfill around pipe shall be carefully placed and well tamped with a density equal to or greater than 85% of Standard Proctor.

6 Polyvinyl chloride pipe, PVC 1120 or PVC 1220 conforming to ASTM D1785, AWWA C900, or equivalent.

**Table 2 -- Minimum gages or thickness for corrugated metal pipe
(2-2/3 inches x 1/2 inches corrugations)**

Fill over pipe	Steel						Aluminum ¹			
	Minimum gage Pipe diameter (inches)						Minimum thickness (inches) Pipe Diameter (inches)			
	21 and less	24	30	36	42	48	21 and less	24	30	36
1 - 15	16	16	16	14	12	10	0.06	0.06	0.075	0.075
15 - 20	16	16	16	14	12	10	0.06	0.075	0.105	0.105
20 - 25	16	16	14	12	10	10	0.06	0.105	0.135	(2)

1 Riveted or helical fabrication.

2 Not permitted.

Table 3

This table gives minimum requirements for sizing principal and auxiliary spillways and for determining temporary storage volume. The minimum design storm shall be Type II, 24 hour duration of frequency shown below. This table does not apply to pond dams having an overall height greater than 35 feet.

Drainage Area	Effective Height of dam	Storage ^{a/}	Condition of Vegetated Spillway ^{b/}	Principal Spillway Minimum Design Storm ^{c/}	Auxiliary Spillway Minimum Design Storm ^{c/}
(Acres)	(Feet)	(Acre-Ft)		(Frequency)	(Frequency)
20 or less	20 or less	Less than 50	Good Fair Poor	^{d/} ^{e/} 1	10
20 or less	Greater than 20	Less than 50	Good Fair Poor	^{e/} ^{e/} 2	25
Greater than 20	20 or less	Less than 50	Good Fair Poor	1 ^{f/} 2 ^{f/} 5	25
ALL OTHERS (WITH OVERALL HEIGHT 35 feet or less)			Good Fair Poor	2 5 10	50

^{a/} Total storage below crest of auxiliary spillway or top of dam if an auxiliary spillway is not provided.

^{b/} Description of condition from end of constructed auxiliary spillway channel to main channel or gully downstream from the dam. Good - Uniform slope with no drops to outlet channel, good sod. Fair - Uniform slope with small drops, good sod; or uniform slope with small drops, fair vegetation, and shrubby banks. Poor - Steep slopes or raw gully banks, sparse vegetation.

^{c/} For drainage areas up to 600 acres, storage may be determined using approximate reservoir routing methods in the Engineering Field Handbook Supplement to Chapter 11.

^{d/} No principal spillway is required except that where the pond is spring fed or there are other sources of steady base flow, a trickle tube shall be installed.

^{e/} A trickle tube shall be installed when a principal spillway is not designed.

^{f/} A trickle tube may be used when drainage area is 150 acres or less and the auxiliary spillway design flow is less than:

- a) 200 cfs with good vegetated spillway condition.
- b) 150 cfs with fair vegetated spillway condition.

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**NATURAL RESOURCES CONSERVATION SERVICE
MISSOURI CONSTRUCTION SPECIFICATION**

FOR

EARTH DAMS

(378-A)

General

Construction operations shall be carried out in such a manner and sequence such that erosion and air and water pollution will be minimized and held within legal limits. A land disturbance permit from the Missouri Department of Natural Resources may be needed if the disturbed area is greater than five acres in size.

The completed job shall present a workmanlike appearance and shall conform to the line, grades, and elevations shown on the drawings or as staked in the field.

All operations shall be carried out in a safe and skillful manner. Safety and health regulations shall be observed and appropriate safety measures used.

Foundation preparation

The foundation area shall be cleared of trees, logs, stumps, roots, brush, boulders, sod, and rubbish. A minimum of 3 inches of topsoil and sod shall be stripped from foundation area. The topsoil and sod are to be stockpiled.

Existing stream channels crossing the foundation area shall be sloped 2:1 or flatter and deepened and widened as necessary to remove unconsolidated sediments, stumps, roots, and other objectionable material and to accommodate compaction equipment.

After stripping, the foundation area will be prepared to assure bonding with the fill by removing loose dry material, scarifying, diskings, adjusting moisture, and compacting as necessary.

Cutoff trench

The minimum depth shown on the drawing is an estimate. Final depth of cutoff trench shall be determined by observation. Side slopes of cutoff trench shall be 1 1/2:1 or flatter, as needed to be stable. Sand, gravel, and other water conducting materials shall be removed to prevent leakage under the dam.

When rock or other hard layers are encountered, a bulldozer mounted single tooth ripper shall be used to loosen all weathered material. Stair-step rock or hard ledges will require handwork to remove all loose materials and hand backfill with clay before machine backfill is started.

In some cases, it will be necessary to thoroughly clean the bottom of rock core trenches to ensure good bond and prevent leakage.

Fill placement

The material placed in the fill shall be free of detrimental amounts of sod, roots, frozen soil, stones over 6 inches in diameter (except for rock fills), and other objectionable material. To the extent they are suitable, excavated materials are to be used as fill material. The distribution and gradation of materials shall be such that there will be no lenses, pockets, streaks, or layers of material differing substantially in texture or gradation from the surrounding material. Where it is necessary to use material of varying texture and gradation, the more plastic material shall be placed in the center and upstream portions of the fill. Foundation areas and cutoff trenches shall be kept free of standing water when fill is being placed on them.

The placing and spreading of the fill shall be started at the lowest point of the foundation and the fill shall be brought up in approximately horizontal layers not to

**NRCS MOFOTG
December 1998**

exceed 9 inches in thickness. Each layer shall be spread, processed, and shall be compacted by one of the following methods, as specified on the drawings:

Dozer - Complete coverage by tread or track of hauling or spreading equipment. Each lift shall not exceed 5 inches in thickness.

Roller - two passes of standard tamping type roller over the entire area to be compacted. Complete coverage by the treads of loaded hauling equipment is considered equivalent to two (2) passes of tamping roller. Each lift shall not exceed 9 inches in thickness.

The tamping-type roller shall have tampers or feet projecting not less than six (6) inches from the surface of the drum and shall have a minimum static load on each tamper of 250 pounds per square inch of tamping area. Tamping rollers with minimum static load on each tamper of 125 pounds per square inch of tamping area may be used if the number of passes is increased to four (4) or the thickness of lifts is reduced to four (4) inches. (Sheepsfoot or wedgefoot drum rollers are considered tamping rollers.)

An opening in the fill for drainage during construction is permitted. Care must be taken when the fill closure is made to assure proper compaction and bond of the fill material to the existing fill. The opening shall have a bottom width wide enough to allow equipment to work on a horizontal

Additional details:

plane. As the drainage opening is filled, the side slopes of the existing fill shall be excavated until solid material is uncovered and good bond can be attained.

Moisture control

The minimum moisture content of the fill material and foundation shall be such that, when kneaded in the hand, the fill material will form a ball which does not readily separate. The maximum moisture content is when conditions are too wet for efficient use of the hauling and compaction equipment.

Borrow areas

All borrow areas outside the pool area shall be graded and left so they are well drained, protected from erosion, and may be seeded. Borrow areas inside the pool area shall have side slopes of 2:1 or flatter.

Placement of topsoil

Available topsoil should be placed on the auxiliary spillway, the downstream slope, top, exposed surface of the upstream slope of the dam, and any other disturbed areas.

Vegetation

Refer to JS-AGRON-7 for seeding and mulching recommendations or equivalent.

**NATURAL RESOURCES CONSERVATION SERVICE
MISSOURI CONSTRUCTION SPECIFICATION**

FOR

PIPE SPILLWAY

(378-B)

Materials

Materials and fabrication shall be as specified on the drawings.

Corrugated metal pipe shall conform to the requirements of ASTM A760, A762, A885, B745, or B790 as appropriate. Plastic pipes through a dam shall be polyvinyl chloride pipe, PVC 1120 or 1220 conforming to ASTM D1785, ASTM D2241, or AWWA C900. The SDR 35 PVC plastic sewer pipe shall conform to ASTM D3034. Welded steel pipe shall meet tolerance requirements of ASTM A53 or equivalent specifications. Welded steel pipe shall be new, new reject, or high quality used pipe. Anti-seep collars shall be of materials compatible with the pipe.

Installation

The pipe conduit shall be placed on a firm foundation to the lines and grades shown on the drawings. Installation shall be conducted in a skillful and workmanlike manner.

Anti-seep collars are to be installed at locations shown on the drawings with watertight connections. When the bottom half is placed in a trench, special backfill and compaction will be required to prevent leakage.

Where no cradle is provided under the pipe, the foundation shall be covered with one (1) inch of loose, friable ML or CL soil material (Unified Soil Classification System) immediately prior to placing the pipe. This material should be saturated before additional backfill is placed.

Selected backfill of friable ML or CL material shall be placed around structures, pipe conduits, and anti-seep collars at approximately the same rate on all sides to prevent unequal pressures. Water packing is permitted for smooth steel conduits 36 inches or less in diameter when total fill over the conduit will be ten (10) feet or less. Rubber tire, hand, or manually directed power tamper will be used on backfill around all conduits or structures where water packing is not permitted or used. Extreme caution must be exercised in backfill and compaction around structures or conduits to prevent damage, movement or deflection. Compaction on the bottom half of conduits must be firm to fill all voids and supply lateral support but not to the point where uplift pressure is exerted. Fill adjacent to concrete shall not be placed until the concrete is strong enough to support the load. Adequate moisture must be maintained in all backfill material.

The minimum moisture content of fill material and foundation shall be such that when kneaded in the hand, the fill material will form a ball which does not readily separate. The maximum moisture content is when conditions are too wet for efficient use of the hauling and compaction equipment.

Equipment shall not be operated over any structure or conduit until there is sufficient backfill to prevent damage.

Additional details: _____

**NATURAL RESOURCES CONSERVATION SERVICE
MISSOURI CONSTRUCTION SPECIFICATION**

FOR

WATER SUPPLY SYSTEM FOR EARTH DAMS

(378-C)

Materials

Materials and fabrication shall be as specified on the drawings and as recommended by the manufacturer of the tank. The inside diameter of the pipe shall be as shown on drawings. All plumbing components shall be compatible with the tank and pipe used.

Plastic pipe 2 inches or less in diameter meeting ASTM specifications D-1785, D-2239, D-2241 or AWWA C-901 may be used. Plastic pipe over 2 inches in diameter shall be Polyvinyl Chloride (PVC) 1120 or 1220 conforming to ASTM D-1785 or D-2241. The ASTM or AWWA designation shall be stamped on the pipe. Steel pipe shall meet ASTM specification A-53 or equivalent. Other pipe meeting MO-NRCS Pipeline Standard 516 is acceptable.

Tanks shall be durable enough to withstand forces exerted by the water, soil, and livestock and shall have a minimum design life of 10 years. Crushed rock or gravel shall be composed of hard durable rock. Poured concrete for pad or tank shall conform to Construction Specification 750, Reinforced Concrete.

Pipe Installation

The pipe trench within the dam or its foundation shall be excavated with side slopes of 1.5:1 or flatter. The pipe shall be placed on a firm foundation to the lines and grades shown on the drawings. All parts of the water system shall be installed and connected according to the manufacturer's recommendations. All joints shall be watertight.

Backfill for plastic pipe shall be free of rocks and other sharp-edged materials. Backfill material shall have adequate moisture for

compaction. Compaction may be achieved by hand, rubber tire, or manually directed power tampers. Deformation or displacement of pipe must not occur during backfilling. Plastic pipe may be filled with water and capped to prevent collapsing. Equipment shall not be operated over the pipe until there is sufficient backfill to prevent damage.

The outlet pipe should be buried below frost line or otherwise protected from freezing.

Testing

Before backfilling, the pipe shall be filled with water and tested at design working head or a minimum head of 10 feet whichever is greater. All leaks shall be repaired and the test repeated before backfilling.

Pad and tank installation

The pad and the area surrounding the tank should be graded to allow surface water to drain away from the tank. Tanks shall be located away from dam or critical erosion areas whenever possible.

The foundation area for the pad and tank shall be cleared of all material not suitable for the subgrade. Poorly or somewhat poorly drained soils will have a layer of gravel at least 6 inches thick, as the subgrade, if a concrete pad is specified. The tank shall be placed on a firm foundation and shall be installed level.

The pad shall extend at least 2 feet from the sides of the tank where livestock have access. Pads using gravel or suitable on site material shall have a minimum thickness of 10 inches. Concrete pads shall have a minimum thickness of 4 inches. The top of the pad should be a minimum of 12 inches below the top of the tank.

Additional Details:

**NATURAL RESOURCES CONSERVATION SERVICE
CONSERVATION PRACTICE STANDARD AND SPECIFICATION**

HEAVY USE AREA PROTECTION

(acre)
CODE 561

DEFINITION

Protecting heavily used areas by establishing vegetative cover, by surfacing with suitable materials, or by installing needed structures.

PURPOSE

- Stabilize areas - urban, headquarters (or farmstead), recreation, or other facilities - intensively used by people, animals, or vehicles
- Provide controlled access for livestock to ponds and streams for watering
- Improve water quality
- Reduce erosion
- Improve aquatic habitat

CONDITIONS WHERE PRACTICE APPLIES

On frequently and intensively used areas that require special treatment to provide protection from erosion, livestock traffic, or other deterioration. This also includes urban and recreation areas.

DESIGN CRITERIA

General. All planned work shall comply with Federal, state, and local laws and regulations.

Drainage and erosion control. Provision shall be made for surface and subsurface drainage, as needed, and for disposal of

runoff without causing erosion or water quality impairment. All treatment areas shall be shaped to prevent ponding of water.

Design Load. The design load will be based on the type of traffic, (vehicular, animal, or human) anticipated on the heavy use area. Areas that support vehicular traffic shall be designed for a minimum wheel load of 4,000 pounds.

Surface treatment. Individual designs shall be site specific. Table 1 will be used as a general guideline. The surface treatment shall meet the following criteria:

Asphalt The thickness of the asphalt course, the kind and size of aggregate, the type of proportioning of bituminous materials, and the mixing and placing of these materials shall be in accordance with good highway construction practice for the expected loading. Asphalt material and installation conforming to Section 403 of MoDOT standard specifications for highway construction is satisfactory. All areas paved shall have a minimum of 6 inches of base course consisting of gravel, crushed stone, or other suitable material. Geotextile in conformance with Missouri Construction Specification NRCS-MO753 may be used in conjunction with base course material.

Concrete The quality and thickness of concrete and the spacing and size of reinforcing steel shall be appropriate for the expected loading and in accordance with NRCS criteria and sound engineering practice. Concrete shall comply with the guidance in the current Construction Specification NRCS-MO750. Concrete shall

Conservation practice standards are reviewed periodically, and updated if needed. To obtain the current version, contact the Natural Resources Conservation Service.

be placed on compacted or dense foundations or gravel bases.

Aggregate The total minimum thickness for a fine and/or coarse aggregate surface shall be as needed but in no case shall it be less than 6 inches.

If other surfacing materials such as cinders, tanbark, bark mulch, brick chips, and sawdust are used, the minimum thickness shall be as needed, but in no case shall it be less than 2 inches thick.

Structures. All structures shall be designed according to appropriate NRCS design criteria and standards and specifications.

Sprays and artificial mulches. Sprays of asphalt, oil, plastic, manufactured mulches, and similar materials shall be applied according to the manufacturer's recommendations.

Geotextile. Geotextile shall be considered on all sites with a soft or wet foundation. NRCS, National Engineering Handbook (NEH), Parts 642 and 643 (formerly NEH, Section 20) provide guidance for specifying quality and installation of geotextile. AASHTO M-288 (latest edition) may be used in the selection of the geotextile. Missouri Construction Specification NRCS-MO753 for geotextile may be used in lieu of or in conjunction with the previous references.

Vegetative Measures. Liming, fertilizing, soil preparation, seeding, sodding, and vegetation management shall be according to the planned use and conservation practice standard Critical Area Planting (342).

Additional Criteria Applicable to Controlled Access for Livestock

General. The treatment area shall extend an appropriate distance from facilities such as portable hay rings, water troughs, feeding troughs, mineral boxes, or other components.

Foundation preparation shall consist of removal and disposal of soil and other

material that is not adequate to support the design loads.

The top surface of the watering access in a channel shall be a minimum of 6 inches below the existing channel bottom.

The ramp for the crossing/access shall extend up to the existing top of bank elevation.

Ramp slope shall be 6 (horizontal) to 1 (vertical) or flatter. An alternative configuration is a stairstep access with a minimum tread (horizontal distance) of 6 feet and a maximum rise (vertical distance) of 9 inches.

For livestock watering, provide access locations at least one every quarter mile in accordance with conservation practice standard Prescribed Grazing (528A).

Construct a fence to exclude livestock from the remaining streambanks and surface waters. Conservation practice standard Fence (382) or Use Exclusion (472) shall be used as needed to meet the intended purpose.

Refer to NRCS, National Engineering Handbook (NEH), Part 650, Engineering Field Handbook, Chapter 16 - Streambank and Shoreline Protection for details and specifications on lakeshore watering access, streambank watering access, and floating electric fence.

Stream crossing and livestock access facilities shall have a stable surface. The surface may be coarse aggregate, concrete, or natural bedrock.

Coarse aggregate shall conform to ASTM (American Society of Testing and Materials) Specification C33 unless otherwise shown on the construction drawings or designated by the engineer. The size number shall be between 1 and 467, as defined in Table 2, ASTM C33. Fine aggregate may be size number 5 through 67. Equivalent size aggregate conforming to MoDOT Standard and Specifications for Highway Construction, Section (1005, 1006, or 1007) may be used.

For concrete surfaced ramps, use a minimum 5-inch thick concrete slab. Reinforcement is required for cast-in-place concrete slabs. The concrete surface shall be roughened to provide a non-skid surface. Concrete shall comply with the guidance in the current Construction Specification NRCS-MO750.

Precast concrete panels may be used in lieu of cast-in-place concrete slabs.

A minimum of 1/2-inch diameter steel reinforcement on 18-inch centers, in both directions, shall be used.

Concrete surfaced ramps shall be placed over firm, native mineral soil material or a minimum gravel subbase thickness of 4 inches.

Concrete surfaced ramps may not be placed on organic soils unless a suitable base is provided to support the anticipated loads.

Additional Criteria Applicable to Improved Water Quality

Heavy use areas should be located to best serve the intended purpose. Where one of the purposes is water quality or stream protection, the heavy use area should be placed as far away from the waterbody or watercourse as possible.

Safety considerations for people and domestic animals shall be included in the design of the heavy use area protection.

Additional Criteria Applicable to Recreation Areas

The treatment area shall be conducive to the overall recreation area and aesthetically blend with the general landscape and surroundings.

CONSIDERATIONS

The location of heavy use areas should consider existing traffic patterns and provide flexibility for changes.

Recommendations vary on the size of heavy use protection areas required for livestock. Treatment area for mature cattle varies from 50 square feet per animal in semi-confined to 400 square feet per animal in total confinement to 4,000 or more square feet for animal exercise areas. Heavy use area protection may also be used for directing livestock (lanes) to various facilities. The size of a heavy use protection area is dependent on the landowner's operation including type of animal, time the animals are confined, or the intended use. Heavy use protection areas should be kept as small as practicable.

When heavy use areas are vegetated for protection, consideration must be given to the type and number of animals and the amount of time they are confined. The area should be sized so that the selected vegetation can be maintained in vigorous condition during the growth period and not destroyed by animal traffic.

When surface treatments such as bark mulch, wood-fiber, or other non-durable materials are used for short-term livestock containment areas, consideration should be given to vegetating the affected area with a cover crop. Surface treatments that are harmful to livestock shall not be used. For example, mulch high in tannic acid would be harmful to hooves.

Provisions should be made to collect and treat manure accumulations and contaminated runoff in accordance with a waste management system plan for the operating unit.

Any work in and/or around streams may require a permit from the US Army Corps. of Engineers, state water quality (permitting) authority, or local authority.

Extreme caution should be taken to minimize erosion and water quality impairment when locating watering points or stream crossings.

Heavy use areas may have an affect on the water budget, especially on volumes and rates of runoff, infiltration, and transpiration due to the installation of less pervious surfaces. Changes in runoff to off-site areas should be evaluated in regard to Federal, state, and local laws and regulations.

Heavy use areas may affect the quality of the surface water from the surfacing of confined animal areas due to an increase in the movement of sediment, animal by-products, and soluble and sediment-attached substances carried by runoff.

Consider locating watering sites on ridges (higher ground) rather than in draws (lower areas), to reduce operation and maintenance difficulties. Southerly slopes receive more sunlight and dry out faster; thus minimizing erosion and water quality problems around watering access locations, tanks, and troughs.

Heavy use areas may affect surface and groundwater by the introduction of nutrients on vegetated areas, and oils and chemicals associated with vehicular traffic. Sufficient distance shall be maintained between heavy use areas and sinkholes, other karst features, or wells to minimize impact on water quality.

For areas around livestock watering facilities or on areas that are frequently scraped, consideration should be given for the use of concrete in lieu of aggregate surfaces.

For urban and recreational areas, traffic control plants, landscaping timbers, and wooden walkways should be evaluated for effectiveness and aesthetics.

PLANS AND SPECIFICATIONS

Plans and specifications for heavy use area protection shall be in keeping with this standard and shall describe the requirements for applying the practice to achieve its intended purpose. Plans and specifications shall include construction drawings, construction specifications, job sheets or other similar references. These documents shall specify the requirements for installing the practice, including the kind, amount and quality of materials to be used.

OPERATION AND MAINTENANCE

The Operation and Maintenance (O&M) plan shall specify that the treatment areas and associated practices be inspected annually and after significant storm events to identify repair and maintenance needs.

The O&M plan shall detail the level of repairs needed to maintain the effectiveness and useful life of the practice.

For livestock operations, the O&M plan for heavy use areas may be included as a part of an overall waste management system plan. Periodic removal of manure accumulations will be addressed in the O&M plan.

Table 1

Typical Surface Material Installations

Foundation Condition	Cross Section Option ⁴
Firm ¹	Raised earth
Firm	Minimum 6" (2 inches fine aggregate over 4 inches coarse aggregate) ³
Firm	Minimum 2" of other surfacing material such as cinders, tan bark, bark mulch, brick chips, or sawdust
Firm to medium	Minimum 6" (2 inches fine aggregate over 4 inches coarse aggregate) over geotextile, meeting Missouri Construction Specification NRCS-MO753 Geotextile ³
Firm to medium	Minimum 2" fine aggregate over 2" coarse aggregate over 6" base course of graded rock ^{2,3}
Firm	5" reinforced concrete with designed control joint spacing, over minimum 4" sand and gravel
Firm with permeable foundation	5" reinforced concrete with waterstop, over 6" sand and gravel
Firm	Minimum 3" asphalt over 6" sand and gravel
Medium to soft ¹	Minimum 4" (2 inches fine aggregate over 2 inches coarse aggregate) over 8" base course of graded rock ^{2,3}
Medium to soft (wet)	Minimum 4" (2 inches fine aggregate over 2 inches coarse aggregate) over 8" base course of graded rock over geotextile, meeting Missouri Construction Specification NRCS-MO753 ^{2,3,5}
Soft	Minimum 4" (2 inches fine aggregate over 2 inches coarse aggregate) over 18" base course of graded rock ^{2,3}
Soft (wet)	Minimum 4" (2 inches fine aggregate over 2 inches coarse aggregate) over 18" base course of graded rock over 6" sand and gravel ^{2,3,5}

- 1 Guidance can be found in National Engineering Handbook (NEH) Part 650, Engineering Field Handbook (EFH) Chapter 4 and Figure 4-14 for information regarding bearing capacity and foundation properties.
- 2 Graded Rock: Maximum stone size is the base course thickness dimension with a maximum of 10% passing the 3/4" sieve. All sizes between the limits are to be represented.
- 3 The 2" layer of fine aggregate over coarse aggregate is intended to protect livestock from injury. If coarse aggregate is reasonably fine, the topping of fine aggregate may be replaced by coarse aggregate material.
- 4 Special consideration shall be given when heavy use area is close to watertable or permeable bedrock is present.
- 5 Geotextile can be replaced by 6 inches of sand and gravel or 6 inches of sand and gravel may be replaced by geotextile.

STATE OF MISSOURI AQUATIC RESOURCES MITIGATION GUIDELINES

OBJECTIVE: The goal of the federal Clean Water Act is to restore and maintain the chemical, physical and biological integrity of the Nation's waters including wetlands. These guidelines will help determine the minimum acceptable levels of mitigation in regards to permits issued under Sections 404 and 401 of the federal Clean Water Act for the State of Missouri.

These guidelines were developed by the Missouri Department of Natural Resources (MDNR) with cooperation from the Missouri Department of Conservation (MDC), the U.S. Fish and Wildlife Service (USFWS), the U.S. Environmental Protection Agency (EPA), the U.S. Army Corps of Engineers (COE), the Natural Resources Conservation Service (NRCS) and the Missouri Department of Transportation (MoDOT).

AUTHORITY: These guidelines are intended to comply with the following authorities:

1. Clean Water Act (33 USC 1251 et seq.)
2. National Environmental Policy Act (42 USC 4321 et seq.)
3. Executive Order 11990
4. Missouri Clean Water Law, Chapter 644, RSMO and implementing regulations
10 CSR 20-7.031, Water Quality Standards

The guidelines are consistent with the regulations and policies, including the Water Quality Standards, of the Department of Natural Resources and the Missouri Clean Water Commission as well as other policies or rules of the Department of Natural Resources and the cooperating agencies.

- A. Mitigation is defined to include: avoiding impacts, minimizing impacts, rectifying impacts, reducing impacts over time and compensating for impacts. This definition can be simplified into three general types: avoidance, minimization and compensatory mitigation. These guidelines will address these three general types of mitigation.
1. **Avoidance:** No impacts to aquatic resources should occur if there is a practicable alternative to the proposed impacts which would have less adverse impacts to the aquatic ecosystem, so long as the alternative does not have other significant adverse environmental consequences. If the impacts to the resource are so significant, the project should not be permitted even if no alternatives are available.
 2. **Minimization:** Appropriate and practicable steps to minimize adverse impacts will be required through project modifications and permit conditions.
 3. **Compensatory Mitigation:** Appropriate and practicable compensatory mitigation will be required for unavoidable adverse impacts to aquatic resources which remain after avoidance and minimization have been done to the extent practicable. The COE, or other agency with authority to delineate wetlands using the appropriate delineation manual, will determine the jurisdictional boundaries of wetlands or other waters at the project site.
- B. Compensatory mitigation sites shall be recorded as deed restrictions in perpetuity, or some other method as approved by the COE and the MDNR, that will reserve the mitigation area in perpetuity or aquatic resource protection and wildlife purposes.

- C. Projects in aquatic areas with federal or state endangered, rare or threatened species must consult with the USFWS and/or MDC for information to avoid/minimize any adverse impacts to these species.

GENERAL CRITERIA

- A. Definitions: The following definitions describe the various terms relating to wetland mitigation to be used by MDNR for purposes of these guidelines:
1. *Aquatic Resources*: All aquatic areas which fall under the jurisdiction of Section 404 of the Clean Water Act.
 2. *Created Wetland*: The conversion of a persistent non-wetland area into a wetland. Creation techniques vary but usually entail excavation or the construction of berms, levees and water control structures which establish wetland hydrology. Once the hydrology has been introduced, wetland plants may grow naturally, or it may be necessary to transplant desired vegetation from other established wetlands. Even when wetland vegetation is established, it will take an indeterminate amount of time for hydric soils to develop. Thus, created wetlands, also called artificial wetlands, may not meet the criteria for a true wetland for years after its creation.
 3. *Degraded Wetland*: A wetland altered through impairment of some physical or chemical property which results in a reduction of habitat value or other reduction of functions.
 4. *Enhanced Wetland*: An existing wetland where some activity of people increases one or more values; often with an accompanying decline in other wetland values.
 5. *Preservation*: The protection of ecologically important wetlands or other aquatic resources in perpetuity through the implementation of appropriate legal and physical mechanisms. Preservation may include protection of upland areas adjacent to wetlands as necessary to ensure protection and/or enhancement of the aquatic ecosystem.
 6. *Restoration*: Wetland restoration is the act of returning an area that was previously a wetland, or is presently a degraded wetland, back to a condition of equal or greater acreage and/or function within the same wetland classification type. In many cases, reestablishing the hydrology is sufficient to reactivate the seedbed that lies dormant in the wetland soil. For example, restoration of a drained wetland may be as simple as removing the drainage tiles or plugging up the drainage ditch that removed the water from the area.
 7. *Shrub*: A woody plant which at maturity is usually less than six meters (20 feet) tall.
 8. *Tree*: A woody plant which at maturity is usually six meters (20 feet) or more in height.
 9. *Watershed*: Watershed or basin areas, for these guidelines, will use the cataloging unit boundaries (eight digit number) as developed by the U.S. Geological Survey (USGS) and shown on the enclosed maps.
 10. *Wetland*: Areas which are inundated or saturated by surface or ground water at a frequency and duration sufficient to support, and that under normal circumstances do support, a prevalence of vegetation typically adapted for life in saturated soil conditions. Wetlands generally include swamps, marshes, bogs and similar areas.

B. Mitigation Site

1. Compensatory mitigation shall occur on-site unless:
 - a. On-site mitigation is impractical
 - b. On-site mitigation will not adequately replace lost functions
 - c. It is determined that off-site mitigation is environmentally preferable considering the type of aquatic resource impacted and the historic loss of aquatic resource types and functions in the watershed.
2. Off-site mitigation shall be conducted: adjacent to or connected with other protected sites in the same watershed unless the applicant demonstrates the impracticality of doing so.
3. Compensatory mitigation shall be done in the same watershed where adverse impacts occurred, unless the impracticability of doing so is demonstrated.
4. Exceptions:
 - a. Mitigation for linear projects (i.e., along highway right-of-way or pipelines) with impacts in several watersheds may be done at a single mitigation site.
 - b. If mitigation in one site is not possible, mitigation for a single project may be conducted at more than one site and with more than one mitigation technique.

C. Mitigation Type:

1. Mitigation shall be in-kind unless the applicant demonstrates the impracticality of in-kind habitat mitigation or;
2. It is determined that out-of-kind habitat mitigation is environmentally preferable considering the type of aquatic resource impacted, and the historic loss of aquatic resources and the functions and values in the watershed.

D. Mitigation Method: Unavoidable losses to aquatic resources may be compensated for in several ways.

1. Restoration of historic wetlands (i.e., prior converted cropland). This is the preferred method for wetlands compensation.
2. Creation of wetlands in areas where wetlands did not historically exist.
3. Enhancement of existing wetlands. This method should not result in secondary impacts to wetlands or the aquatic system.
4. Preservation of existing wetlands. This method should only be used in unusual circumstances, determined on a case by case basis and will generally receive only partial credit. Therefore, more acreage would be required as compared to other methods of compensation.

5. Other.

- a. Mitigation for aquatic resources besides wetlands should be dealt with case by case since providing wetland acreage may not be appropriate for other aquatic resource impacts. Methods may include: restoring a degraded reach, designing a new reach as close to a natural one as possible or riparian plantings.
- b. Other methods of compensatory mitigation exist. These include banking and in lieu fee. These types of agreements shall be determined on a case by case basis. Applicants wanting to use one of these methods must still go through the avoidance and minimization process. On-site mitigation is preferred unless there is some extenuating circumstance in which off-site mitigation would better serve the resource that is damaged. Any mitigation banks that are used shall be developed by following the current federal guidance for mitigation banks. The first guidance was issued November 28, 1995. This guidance may be fine tuned at a later date to be specific to the State of Missouri.

E. Mitigation Ratios

1. Acreage ratios are useful to ensure consistency among projects and as a surrogate for more complex functional assessment methodologies when seeking to ensure the replacement of lost aquatic habitat including wetland functions. The ratios reflect the uncertainty of mitigation success, the time delay between the loss of functions and the reestablishment of those functions and the value of the aquatic resource from a water quality perspective.
2. The following ratios have been developed by the participating agencies for use in the State of Missouri for wetland creation/restoration. The ratios are intended for use by projects for which the sequencing requirements have been completed and it has been determined at that point that compensatory mitigation is appropriate. The ratios are not intended for enforcement purposes, however, the high end of the range may be an appropriate place to begin negotiations for enforcement cases.

Farmed Wetlands	1.0-1.5
Emergent	1.0-3.0
Shrub-Scrub Wetlands	1.5-3.0
Wooded Wetlands	2.0-4.0
Open Water	1.0
Streams	Case by Case (refer to General Criteria D.5.a. & b.)

These ratios may be increased when:

- a. Mitigation is not conducted before or concurrently with or prior to a development project.
 - b. Out-of-watershed mitigation is proposed.
 - c. Projects impact functioning mitigation sites.
 - d. Other relevant circumstances make increases in the ratio appropriate.
3. Rare and unique aquatic habitats may not be appropriate for any mitigation and therefore no impacts should occur in these areas. This would include fens, mature bottomland woodland or other areas as described by the current NRCS Missouri categorical exclusion and red flag areas.

F. Wetland Classification (from Cowardin, Classification of Wetlands and Deepwater Habitats of the United States, FWS/OBS-79/31, December 79)

1. "If vegetation (except pioneer species) covers 30% or more of the substrate, we distinguish classes on the basis of the life form of the plants that constitute the uppermost layer of vegetation and that possess an areal coverage 30% or greater. For example, an area with 50% areal coverage of trees over a shrub layer with a 60% areal coverage would be classified as Forested Wetland; an area with 20% areal coverage of trees over the same (60%) shrub layer would be classified as Shrub-Scrub Wetland. When trees or shrubs alone cover less than 30% of an area but in combination cover 30% or more, the wetland is assigned to the class Shrub-Scrub. When trees and shrubs cover less than 30% but the total cover of vegetation (except pioneer species) is 30% or greater, the wetland is assigned to the appropriate class for the predominant life form below the shrub layer."

G. Mitigation Plan

1. All mitigation plans must be submitted and approved before work begins on the project. The applicant must also demonstrate financial and technical capability to do the work and show that a suitable site is available.
2. When possible, mitigation should be completed before project proceeds or completed prior to or at the same time the project is completed. Failure to achieve this may result in increased mitigation ratios.
3. Mitigation plans should include the following information.
 - a. Clear statement of objectives;
 - b. Description of the wetland functions that will be lost and those that will be replaced;
 - c. Statement of the location and description of the baseline elevation and hydrology of the mitigation site;
 - d. Detailed construction plan with post-construction contour map, detailed location map and as built drawings;
 - e. Plans for establishment of vegetation including what, where and when if planting is proposed. Also, detailed drawings of planting plan and any proposed structures;
 - f. Description of a mitigation monitoring program;
 - g. Performance standards for site grading, hydrology and plant community establishment, composition and survival;
 - h. Contingency plan;
 - i. Guarantee that the work will be performed as planned; and
 - j. Provisions for long-term management and maintenance.