NATURAL RESOURCES CONSERVATION SERVICE
CONSERVATION PRACTICE STANDARD

PIPELINE

(Feet)

CODE 516

DEFINITION

Pipeline having an inside diameter of 8 inches or less.

PURPOSE

This practice may be applied as part of a resource management system to achieve one or more of the following purposes:

- Convey water from a source of supply to points of use for livestock, wildlife, or recreation.
- Reduce energy use.
- Develop renewable energy systems (i.e., In-pipe Hydropower).

CONDITIONS WHERE PRACTICE APPLIES

Where it is desirable or necessary to convey water in a closed conduit from one point to another.

CRITERIA

Federal, State and Local Laws and Permits

Design, construction, operation and maintenance activities shall comply with all federal, state, local laws, rules, and regulations governing work in or along streams, floodplains or wetlands as well as pollution abatement, health, utility or safety activities.

Permits may be required from the following agencies as well as others:

1. ***U.S. Army Corps of Engineers (USACE)***
2. ***West Virginia Department of Environmental Protection (DEP)***
3. ***West Virginia Department of Natural Resources - Public Lands Corporation (Stream Activity Application)***
4. ***US Fish and Wildlife Service***
5. ***WV Division of Forestry***
6. ***Local City and County permits***

The owner or operator is responsible for securing all permits or approvals and for performing all planned work in accordance with WV laws and regulations. NRCS employees are not responsible and shall not procure permits, rights, or approvals or enforce laws and regulations. NRCS may provide the landowner or operator with technical information, pertaining to the rights or approvals to construct, operate, and maintain the practice.

All required permits shall be acquired before construction begins.

- **Capacity.** For livestock water, the installation shall have a capacity to provide seasonal high daily water requirements for the number and species of animals to be supplied. T***he*** s***easonal maximum daily water needs must be delivered within a 12 hour period or less (6 hours is typically used for design) and at the required delivery rate (3 GPM or greater).*** Animal water requirements can be obtained from the NRCS Field Office Technical Guide, ***NRCS Conservation***

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Practice Standard 614, Watering Facilities or WV Eng WS 614-A.

For recreation areas, the water capacity shall be adequate for all planned uses. Typical examples are drinking water, fire protection, showers, flush toilets, and irrigation of landscaped areas.

Additional water capacity will be provided for wildlife when applicable.

Sanitary protection. If water from the pipeline is to be used for human consumption, applicable state and local regulations shall be met.

Pipeline Systems: ***A pipeline can deliver water by means of a pressurized or gravity system or both. Pressurized flow is flow induced under automatic pressure (pump) and flow is controlled by a pressure switch, a timer or a manual switch which turns a pump on and off. Gravity flow is where the water supply surface is higher than all points in the pipeline and pressurized flow is not required to deliver the water.***

Pipe Size: ***Once the required flow rate is determined for the pipeline, complete a hydraulic analysis and evaluate the capacity, velocity, friction losses, pressure rating, allowable working pressure, material specifications and site conditions for the specific.***

The pipeline (gravity or pressurized) design and detailed hydraulic analysis may be completed using WV Eng Pipeline Design (516) Worksheet, Design Guides, programs or handbooks.

In lieu of a detailed hydraulic analysis, a pressurized pipeline with a flow rate of

- ***3-4 GPM requires a minimum ¾" inside diameter (ID) pipeline and a maximum length of 500' and a maximum uphill elevation change of 30 feet and minimum pressure tank setting of 30 PSI.***
- ***5-8 GPM requires a minimum 1.0" inside diameter (ID) pipeline and a maximum length of 500' and a maximum uphill elevation change of 30 feet and minimum pressure tank setting of 30 PSI.***
- ***9-26 GPM requires a minimum 1.5" inside diameter (ID) pipeline and a maximum length of 500' and a maximum uphill elevation change of 30 feet and minimum pressure tank setting of 30 PSI.***

In lieu of a detailed hydraulic analysis, a gravity pipeline with a flow rate of

- ***3-4 GPM requires a minimum 1.0" ID pipeline with a minimum downhill pipe slope of 1% along any section of pipe (except the last 20' as it approaches the tank) and a minimum downhill elevation change from the source of water to the discharge point of 20 feet and a maximum of 1000' of pipeline.***
- ***5-8 GPM requires a minimum 1.25" ID pipeline with a minimum downhill pipe slope of 1% along any section of pipe (except the last 20' as it approaches the tank) and a minimum downhill elevation change from the source of water to the discharge point of 20 feet and a maximum of 1000' of pipeline.***
- ***9-22 GPM requires a minimum 2.0" ID pipeline with a minimum downhill pipe slope of 1% along any section of pipe (except the last 20' as it approaches the tank) and a minimum downhill elevation change from the source of water to the discharge point of 20 feet and a maximum of 1000' of pipeline.***

All pipe must withstand the pressure it will be subjected to, including hydraulic transients, internal pressures and external pressures. As a safety factor against surge or water hammer, the working pressure should not exceed 72% of the pressure rating of the pipe and the design flow velocity at system capacity should not exceed 5 ft/sec. If either of these limits is exceeded, special consideration must be given to flow conditions and measures must be taken to adequately protect the pipeline against surge.

Steel pipe shall meet the requirements of AWWA Specification C-200.

Plastic pipe shall conform to the requirements of the following ASTM specifications, as applicable:

D 1527 Acrylonitrile-Butadiene-Styrene (ABS) Plastic Pipe, Schedules 40 and 80

D 1785 Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120

D 2104 Polyethylene (PE) Plastic Pipe, Schedule 40

D 2239 Polyethylene (PE) Plastic Pipe (SIDR-PR) Based on Controlled Inside Diameter

D 2241 Poly(Vinyl Chloride) (PVC), Pressure-Rated Pipe (SDR)

D 2282 Acrylonitrile-Butadiene-Styrene (ABS) Plastic Pipe (SDR-PR)

D 2447 Polyethylene (PE) Plastic Pipe, Schedules 40 and 80, Based on Outside Diameter

D 2513 Thermoplastic Gas Pressure Pipe, Tubing and Fittings

D 2737 Polyethylene (PE) Plastic Tubing

D 2672 Joints for IPS PVC Using Solvent Cement

D 3035 Polyethylene (PE) Plastic Pipe (SDR-PR) Based on Controlled Outside Diameter

AWWA C900 Polyvinyl Chloride (PVC) Pressure Pipe, 4 inches through 12 inches

AWWA C901 Polyethylene (PE) Pressure Pipe and Tubing, ½ inch through 3 inches

Plastic pressure pipe fittings shall conform to the following ASTM specifications, as applicable:

D 2464 Threaded Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80

D 2466 Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40

D 2467 Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80

D 2468 Acrylonitrile-Butadiene-Styrene (ABS) Plastic Pipe Fittings, Schedule 40

D 2609 Plastic Insert Fittings for Polyethylene (PE) Plastic Pipe

D 2683 Socket-Type Polyethylene Fittings for Outside Diameter-Controlled Polyethylene Pipe and Tubing

D 3139 Joints for Plastic Pressure Pipes Using Flexible Elastomeric Seals

D 3261 Butt Heat Fusion Polyethylene (PE) Plastic Fittings for Polyethylene (PE) Plastic Pipe and Tubing

Solvents for solvent-welded plastic pipe joints shall conform to the following ASTM specifications, as applicable:

D 2235 Solvent Cement for Acrylonitrile-Butadiene-Styrene (ABS) Plastic Pipe and Fittings

D 2564 Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Pipe and Fittings

D 2855 Making Solvent-Cemented Joints with Poly(Vinyl Chloride) (PVC) Pipe and Fittings

Rubber gaskets for pipe joints shall conform to the requirements of ASTM F477, Elastomeric Seals (Gaskets) for Joining Plastic Pipe.

Of the above types of pipeline, ASTM D2239 (based on inside diameter) or D2447 (based on outside diameter) is the most frequently used for stockwater pipeline.

Drainage. Valves or unions shall be installed at low points in the pipeline so that the line can be drained as needed.

For access, valves placed below ground shall be installed in a valve box or minimum 6" diameter HDPE or PVC pipe and extend 6" above natural ground. All valve boxes shall be covered with a secure lid to prevent unauthorized access. Valves buried greater than 2' deep shall be opened/closed with an extended "tee" handle.

Check valves shall be installed as needed to protect groundwater quality or maintain a full pipeline. ***Pressure relief valves shall be installed on the discharge side of the check valve where back flow may occur and at the end of the pipeline when needed to relieve surge.***

Vents. Design shall provide for entry and removal of air along the pipeline, as needed, to prevent air locking or pipe collapse. If parts of the line are above the hydraulic gradient,

periodic use of an air pump may be required. Provisions shall be made for pressure relief, air relief and vacuum relief as needed to protect the pipeline. ***An air-vacuum release valve may be used in lieu of an open vent.***

Joints. Watertight joints that have a strength equal to that of the pipe shall be used. Couplings must be of material compatible with that of the pipe. If they are made of material susceptible to corrosion, provisions must be made to protect them.

Protection. When steel pipe is used, interior protective coatings shall be provided in accordance with NRCS Conservation Practice Standard 430FF, Steel Pipe. If a coal-tar enamel protective coating is needed for corrosion protection, the coating shall meet the requirements of AWWA Specification C-203.

Steel pipe installed above ground shall be galvanized or shall be protected with a suitable protective paint coating, including a primer coat and two or more final coats.

Plastic pipe installed above ground shall be resistant to ultraviolet light throughout the intended life of the pipe.

All pipes shall be protected from hazards presented by traffic, farm operations, freezing temperatures, fire, thermal expansion and contraction. Reasonable measures should be taken to protect the pipe from potential vandalism.

To eliminate water from freezing in the pipe, the depth of buried pipe shall be below the frost depth penetration. Frost depth varies in WV from 24 inches in the south to 40 inches in northern WV or at higher elevations. Bury waterlines below the frost depth according to your local building codes or Figure 1, whichever is greater.

Vegetation. Disturbed areas shall be established with vegetation or otherwise stabilized as soon as practical after construction. Seedbed preparation, seeding, fertilizing, and mulching shall conform to NRCS Conservation Practice Standard 342, Critical Area Planting.

Visual resources. The visual design of pipelines and appurtenances in areas of high public visibility shall be carefully considered.

Additional Criteria Applicable to Reduce Energy Use

Provide analysis to demonstrate reduction of energy use from practice implementation.

Reduction of energy use is calculated as average annual or seasonal energy reduction compared to previous operating conditions.

Additional Criteria Applicable to Develop Renewable Energy Systems

Renewable energy systems shall meet applicable design criteria in NRCS and/or industry standards, and shall be in accordance with manufacturer's recommendations. Hydropower systems shall be designed, operated, and maintained in accordance with the Microhydropower Handbook, Sections 4 and 5, as appropriate.

CONSIDERATIONS

No special considerations have been identified for this practice.

PLANS AND SPECIFICATIONS

Plans and specifications for installing pipelines shall be in keeping with this standard and shall describe the requirements for applying the practice to achieve its intended purpose. If the pipeline is a component of a system that includes additional conservation practices, the information necessary to construct these additional practices will also be conveyed on the plans.

The NRCS Engineering Field Handbook, Chapter 5, Preparation of Engineering Plans, will guide the development of drawings and specifications.

OPERATION AND MAINTENANCE

An O&M plan specific to the type of installed pipeline shall be provided to the landowner. The plan shall include, but not be limited to, the following provisions:

- Opening/closing valves to prevent excessive water hammer;
- Filling at the specified rate requirements;
- Inspecting and testing valves, pressure regulators, pumps, switches and other appurtenances;

- Maintaining erosion protection at outlets;
- Checking for debris, minerals, algae and other materials which may restrict system flow; and
- Draining and/or providing for cold weather operation of the system.

REFERENCES

McKinney, J.D., et al. Microhydropower Handbook, IDO-10107, Volumes 1 & 2. U.S. Department of Energy, Idaho Operations Office.

USDA-NRCS, National Engineering Handbook, Part 650, Engineering Field Handbook, Chapter 5, Preparation of Engineering Plans.

National Engineering Handbook, Part 631, Chapter 32-Well Design and Spring Development; Part 650, Chapter 3-Hydraulics and Chapter 12-Springs and Wells.

National Engineering Handbook (NEH), Part 650, Chapter 5-Preparation of Engineering Plans

WV5-Engineering Field Handbook, Appendix A- Quick Reference Design and Construction Support Data for Conservation Practice

NRCS National and State Utility Safety Policy (NEM Part 503-Safety, Subpart A - Engineering Activities Affecting Utilities 503.00 through 503.06)

Associated WV Conservation Practice(s) Watering Facility (614), Water Well (642), Pumping Plant for Water Control (533), etc. are located in WV e-FOTG Section IV- at http://www.nrcs.usda.gov/technical/efotg/ (click on WV from the US map)

NRCS National and State Utility Safety Policy (NEM Part 503-Safety, Subpart A - Engineering Activities Affecting Utilities 503.00 through 503.06)

Miss Utility of West Virginia (MUWV); Call Before you Dig, 1-800-245-4848 - http://www.muwv.org/

American Society of Agricultural Engineers; S376.1 Design, Installation and Performance of Underground, Thermoplastic Irrigation Pipelines.

Nebraska Stockwater Pipeline Handbook, April 2008 USDA Natural Resource Conservation Service

MU Guide Pumps and Watering System for Manage Beef Grazing

Understanding Gravity-Flow Pipelines, British Columbia Ministry of Agriculture and Lands, January 2006

Pipelines for Watering Range Livestock, Agriculture and Agri-Food, Canada

Figure 1 – Extreme Frost Depth

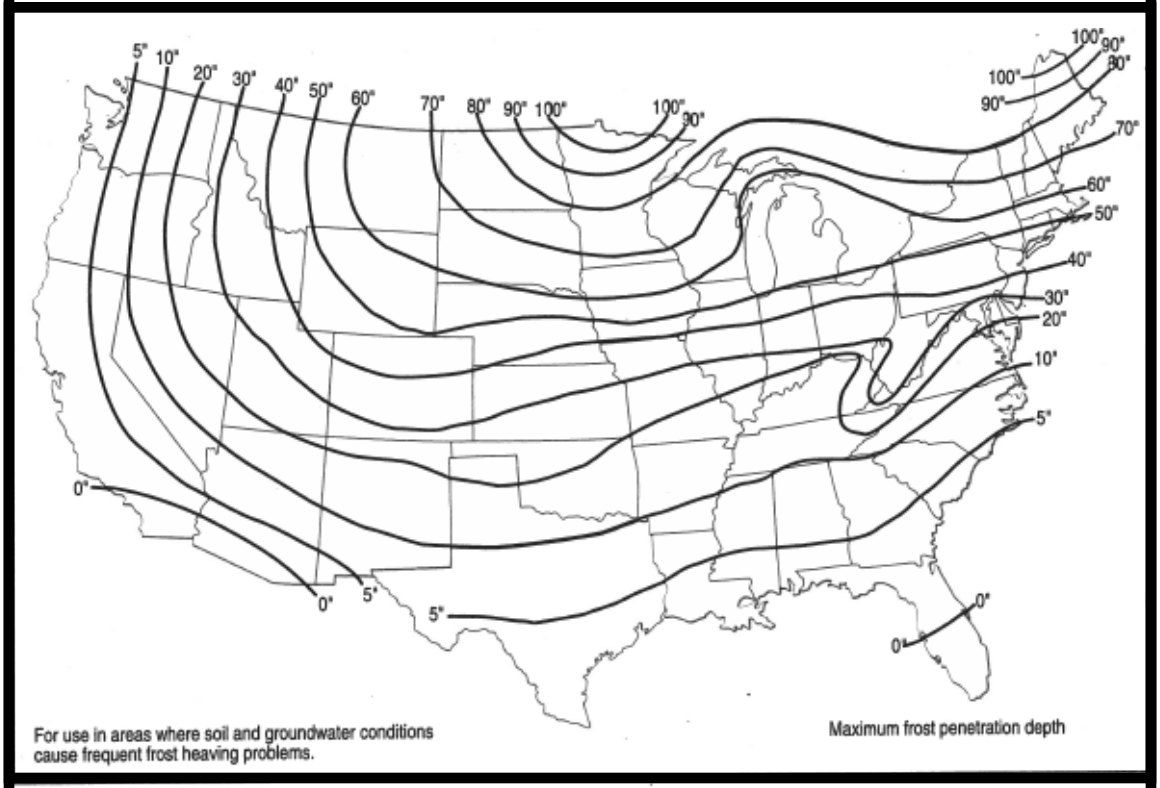

Figure 36. Extreme frost depth. (*Source: MidWest Plan Service*)

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