of all reinforcing steel shall be covered with at least 1-1/2 inches of concrete.

e. Curing

Concrete shall be prevented from drying for at least seven days after it is placed. Exposed surfaces shall be kept continuously moist during this period by covering with moistened canvas, burlap, straw, sand or other approved material unless they are sprayed with a curing compound. Wooden forms left in place during the curing period shall be kept wet.

Concrete, except at construction joints, may be coated with a curing compound in lieu of continuous application of moisture. The compound shall be sprayed on moist concrete surfaces as soon as free water has disappeared but shall not be applied to any surface until patching, repairs and finishing of that surface are completed. Concrete shall be wet cured or remain in forms until immediately before patching, repairs, or finishing is performed. Curing compound shall not be allowed on any rebars.

Curing compound shall be applied in a uniform layer over all surfaces requiring protection at a rate of not less than one gallon per 150 square feet of surface. Surfaces subjected to heavy rainfall or running water within three hours after the curing compound has been applied, or otherwise damaged, shall be resprayed.

Any construction activity which disturbs the curing material shall be avoided during the curing period. If the curing material is subsequently disturbed, it shall be reapplied immediately.

Steel tying or form construction adjacent to new concrete shall not be started until the concrete has cured at least 24 hours. Vehicles, overlying structures, or other heavy loads shall not be placed on new concrete slabs for at least three days, unless the concrete strength can be shown to be adequate to support such loads.

f. Form Removal and Concrete Repair

Forms for walls and columns shall not be removed for at least 24 hours after placing the concrete. When forms are removed in less than seven days, the exposed concrete shall be sprayed with a curing compound or be kept wet continuously for the remainder of the curing period. Forms which support beams or covers shall not be removed for at least seven days, or 14 days if they are to support forms or shoring.

Forms shall be removed in such a way as to prevent damage to the concrete. Forms shall be removed before walls are backfilled. Columns shall be at least seven days old before any structural loads are applied.

Where minor areas of the concrete surface are "honeycombed," damaged or otherwise defective, the area shall be cleaned, wetted and then filled with a dry-pack mortar. Dry-pack mortar shall consist of one part Portland cement and three parts sand with just enough water to produce a workable paste.

g. Concreting in Cold Weather

Concreting in cold weather shall be performed in accordance with ACI-306R-88. In addition, the contractor shall provide a written plan at least 24 hours in advance of placing concrete in cold weather, and shall have the necessary equipment and materials on the job site before the placement begins.

h. Concreting in Hot Weather

Concreting in hot weather shall be performed in accordance with ACI 305, of which some specific interpretations are set forth below. The supplier shall apply
effective means to maintain the temperature of concrete below 90 degrees Fahrenheit during mixing and conveying. Exposed surfaces shall be continuously moistened by means of fog spray or otherwise protected from drying during the time between placement and finishing and during curing. Concrete with a temperature above 90 degrees Fahrenheit shall not be placed.

i. Backfilling New Concrete Walls

Backfilling and compaction of fill adjacent to new concrete walls shall not begin in less than 14 days after placement of the concrete, except that walls that can be backfilled on both sides simultaneously may be done so within seven days.

Heavy equipment shall not be allowed within three feet of a new concrete wall. Provide compaction near the wall by means of hand tamping or small, manually-directed equipment.

5. WOOD STRUCTURES

All framing shall be true and exact. Timber and lumber shall be accurately cut and assembled to a close fit and shall have even bearing over the entire contact surfaces. Nails and spikes shall be driven with just sufficient force to set the heads flush with the wood surface. Deep hammer marks in the wood shall be considered evidence of poor workmanship and may be sufficient cause for rejection of the work.

Holes for lag screws shall be bored with a bit not larger than the body of the screw at the base of the thread. Holes for bolts shall be bored with a bit no more than 1/16" larger than the bolt diameter to achieve a snug fit without forcibly driving the bolt.

Washers shall be used in contact with all bolt heads and nuts that would otherwise be in contact with wood.

All joints shall be fastened with the number, type, and size of fasteners specified, at the locations or spacing specified.

If field cuts of pressure-treated wood expose untreated interior wood, the untreated surfaces shall be covered with two coats of a liquid preservative, as approved by the Engineer.

Roof trusses shall be handled, installed and braced according to the Truss Plate Institute’s HIB-91, “Handling, Installing and Bracing MPC Wood Trusses.”

Wood structures shall be backfilled within the limits shown on the drawings by placing material in uniform lifts not to exceed nine inches. Compaction within three feet of walls shall be accomplished by means of hand tamping or small manually-directed equipment.

6. GEOMEMBRANE STRUCTURES

Semi-rigid and flexible covers which utilize geomembranes shall be installed as required by the manufacturer, and as otherwise set forth in Section 8 and Construction Specification PA521A-PE/PP.

7. STRUCTURES INSTALLED ACCORDING TO STANDARD DETAIL DRAWINGS PREPARED BY OTHERS

Commercially available structures shall be installed as shown on the drawings provided to and concurred in by NRCS. All materials furnished and installed shall conform to the quality and grade noted on the drawings. A site specific set of construction drawings shall be at the site during construction.

Modification of the structure outside limits shown on the drawings shall not be made without prior review and approval by the Engineer with appropriate approval authority. The Supplier or Contractor who submitted the original standard detail drawings shall be responsible for making
any changes. Sufficient design documentation to allow an adequate review of the proposed modification shall accompany any request for a change.

Within thirty (30) days of the completion of construction of the structure, the Contractor or Supplier shall furnish written certification to the Engineer that all aspects of the installation are in conformance with the requirements of the drawings and specifications.

8. ADDITIONAL CONDITIONS WHICH APPLY TO THIS PROJECT ARE:
Supplement A – “Guidelines for Selecting Corrosion-Resistant Fasteners for Use with Preservative-Treated Wood”

Based on a review of technical information posted by the major U. S. preservative manufacturers and selected fastener and connector manufacturers, the following guidelines summarize the current state-of-practice regarding the selection of metal fasteners and connectors for use with ACQ and copper azole (CA) preservative-treated wood:

<table>
<thead>
<tr>
<th>AWPA Use Category and Description</th>
<th>Appropriate Fastener/Connector Types</th>
</tr>
</thead>
<tbody>
<tr>
<td>UC 3A or B – Exterior Construction, Above Ground</td>
<td><strong>Fasteners</strong></td>
</tr>
<tr>
<td>UC 4A – Ground Contact or Fresh Water, Non-critical components</td>
<td>Hot-Dipped (HD) Galvanized per ASTM A153 or Stainless Steel (SS), Type 304 or 316</td>
</tr>
<tr>
<td></td>
<td><strong>Connectors</strong></td>
</tr>
<tr>
<td></td>
<td>HD Galvanized per ASTM A653, Class G185 or Stainless steel, Type 304 or 316</td>
</tr>
<tr>
<td>UC 4B - Ground Contact or Fresh Water, Critical components or difficult to replace</td>
<td>Stainless steel, Type 304 or 316</td>
</tr>
</tbody>
</table>

**Other Preservatives:**

1. For CCA-treated wood, HD galvanized fasteners and connectors as specified above are recommended. CCA is less corrosive than ACQ and CA.
2. For ACZA-treated wood, SS fasteners and connectors as specified above are recommended. ACZA contains ammonia and is significantly more corrosive than ACQ and CA.
3. For other preservatives, the more stringent of the preservative manufacturer’s recommendations and the fastener/connector manufacturer’s recommendations should be followed.

**Notes regarding NRCS-type structures:**

1. Use Category UC 3A and B include railings, decking, bracing, and slats on composter bins.
2. Use Category UC 4A includes posts such as those used in composter bins.
3. Use Category UC 4B includes structural building poles and permanent wood foundations.
NATURAL RESOURCES CONSERVATION SERVICE
CONSERVATION PRACTICE STANDARD

FENCE
(Ft.)

SPECIFICATION

CODE 382

SCOPE
Fences are constructed as barriers to control the movement of animals and people, including vehicles. Fences may be designed or installed as permanent or temporary use.

Permanent fencing is intended to be in place for long periods of time with minimum maintenance requirements; therefore, it should be built with durable materials and constructed to endure a longer life span. Permanent fences are most often used for exterior grazing or property boundaries and/or where animals or humans are prohibited. This can include fencing associated with Waste Storage Facilities (WSF), Waste Transfer (WT), and Heavy Use Areas (HUA).

Temporary or moveable fences are designed to be in place for short periods of time. Temporary fences are best used as subdivision fences for frequent movement or control of animals and where the exact location of the fence may not be the same from time to time. This fencing offers maximum flexibility in rotational stocking systems for subdividing pastures to enhance grazing efficiency, livestock movement, and afford temporary stream and riparian protection.

FENCE TYPE OR STYLE (SEE Table 1)
Barbed wire fence is commonly used as multi-strand permanent fencing material for perimeter fences, land use boundaries, exclusion, livestock containment and isolation areas as well as interior cross fencing to facilitate grazing management. Barbed wire fence is generally not recommended for horses, sheep, goats and hogs.

Woven, net and mesh wire fences are used as permanent fences for both perimeter and subdivision fences. Wire spacing and height varies depending on the type of livestock or animals being controlled.

Woven wire fences consist of a series of horizontal (line) wires and vertical (stay) wires, and are offered in two main types including “hinge joint” and “continuous stay fixed knot.”

In a hinge-joint woven wire fence, the vertical stays actually wrap around the line wires. In a continuous stay fixed knot fence, the vertical stay wires are fixed with a separate wire to the line wire. Both of these main types come in various designs (line and stay spacing), tensile strength grades and metallic coating types and grades. High-tensile continuous stay fixed knot woven wire at 12.5 gauge may be used for all animals as specified by manufacturer.

High tensile smooth wire fence is commonly used as a multi-strand permanent fence for both perimeter and subdivision purposes. It can be used to control almost all animals when properly spaced. Smooth wire may be steel, aluminum or vinyl coated and electrified or non-electrified.

Electric fences may be permanent or temporary. The electrical power source can be from 110 or 220 electrical current or battery. Batteries may be re-charged by solar or electrical power. Livestock must be trained to respect electric fence.

Board fences are usually wood or some composite material used for permanent and subdivision purposes. Board fence is used primarily where aesthetics or animal safety is a concern and most often used around horses or for working facilities.

Other fence types may include chain link, pipe, vinyl, galvanized panel, guard rail, and cable fences. These are commonly used around homesteads, waste storage facilities and in corrals. They may be used to restrict access to unsafe or prohibited areas.
Heavy use area containment fencing is used to control access into and out of feed areas to minimize damage to soil and pasture around these permanent feed sites. This fencing is usually constructed of board, pipe, guard rail, cable or high tensile smooth wire built to sustain heavy use by high numbers of livestock around a confined feed area.

Non-conventional fencing includes variations of alternative fence systems that may be acceptable when installed according to manufacturer's recommendations and pre-approved by the PA NRCS State Grassland Conservationist. Alternative fence systems are often applicable for horses and other animals having special needs.

MATERIAL SPECIFICATIONS
Acceptable fencing criteria for various fencing needs may be selected from Tables 1 and 2; except when fencing requirements are shown in a set of Engineering Drawings and Specifications associated with WSF, WT, and HUA. Install as per details included; variations must be approved by the Engineer of Record.

The materials used in the construction of a chosen fence type must be new and of high quality and meet the size, strength, durability and lifespan requirements found in this specification including Tables 3 - 9.

Variations of what is presented in this document may be approved if alternatives will meet or exceed current specifications. Sufficient documentation must be presented to PA NRCS State Grassland Conservationist.

INSTALLATION
Fence-Line Clearing
Prior to construction, the fence line shall be cleared of any obstruction that would hinder fence placement and operation. Clearing along stream banks will be held to a minimum except as required for stream crossings. The soil surface along the fence line shall be relatively smooth such that placement of the bottom wire does not exceed specified maximum wire spacing from soil surface.

Setting posts
All post shall be set and maintained in a vertical position or leaning slightly (1-2° off vertical) away from direction of wire tension.

Posts in curves should be set approximately 4" off vertical. Posts set with a driver have about 9 times the holding strength of hand-set posts. If hand set, holes should be at least 6" larger than the diameter of the posts and all backfilled material shall be thoroughly tamped in layers no thicker than 4 inches. The post hole shall be filled to the ground surface. Concrete backfill is not necessary when posts are driven or hand set with proper tamping; however, if used it shall be roded into place in layers not thicker than 12 inches and shall completely fill the post hole to the ground surface. No stress shall be applied to posts set in concrete for 24 hours.

Line Posts
Specifications of line posts are found in Table 4. The maximum spacing of line posts for permanent fences is found in Table 1 and will be the same for all types of posts. Spacing will vary depending on terrain and pressure from livestock. Installation shall ensure that adequate fence height is maintained based on its purpose.

Note: Landscaping timbers should not be used for any post or brace component of a fence system.

Installing Curves
Installing curves in high tensile, woven wire, and barbed wire fences is permissible as long as the change in direction from one post to the next does not exceed 20 degrees. Posts on curves shall be 5 inch minimum top diameter for changes up to 14 degrees and 6 inch minimum top diameter for changes up to 20 degrees.

Posts on curves should be driven 48 inches deep with 4 inches of lean to the outside of the curve and spaced no closer than 4 foot apart. (In an 8-foot long section, 14 degrees is approximately 24 inches off straight line and 20 degrees is approx. 35 inches off the straight line).

Line Posts – Stream Crossing
Anchor posts are required on both sides of a stream crossing. For crossings less than 16 feet wide, standard line posts set on both sides will be adequate. For crossings wider than 16 feet, or when non-electrified heavy flood gate is used, a single H-brace assembly or other suitable brace shall be used.
- Where needed, flood gates will be attached below bottom wire and will be designed to allow water and debris to pass while still controlling livestock. Some type of hinged or breakaway floodgate works best.

Posts that are set in low areas or gullies may need to be weighted or anchored to prevent lifting out.

**Stays or battens between line posts**

Stays or wire spacers or battens may be used to maintain desired wire spacing between line posts; note that specifications for post spacing differs with and without stays (Table 1). Stays shall be secured sufficiently to remain in position along wire line.

**Offset Brackets**

Offset brackets made of galvanized high tensile spring wire with an insulator of high density polyethylene with ultraviolet stabilizer or porcelain can be attached to standard barbed wire fence or woven wire fence to provide transmission line and/or to protect a standard fence. Other corrosion resistant offset brackets with insulators that attach directly to the fence posts can also be used.

Place offset brackets up to 40 feet apart and attach to wires of standard fence next to post. If control of animals is desired, place offset brackets at 2/3 the height of the animals to be controlled. Make sure no wires of the old fence come in contact of the electric fence wire, as a short will occur. Use offset brackets that hold the electric wire at least 4 inches from the non-electrified fence material.

**Post Bracing**

Bracing of anchor (pull) posts is required at all corners, gates, fence ends and at definite slope and alignment changes in the fence line. The type of fence, number of fence wires, and length of span will determine type, size and spacing of bracing required to support a fence. See Table 8 for additional information.

Bracing shall withstand the forces of the fence load and transfer to the surrounding soil. They come in a number of configurations depending on the purpose and number of posts utilized. The length of braces should be at least 2 times the height of the fence fabric they are supporting. See Tables 5 and 6 for selection criteria and design specifications of single and double brace assemblies.

**Corner braces** are required at all points where the fence alignment has a change of 20 degrees or more from one post to the next. (In an 8-foot long section, 20 degrees is approx. 35 inches off the straight line).

**End braces** are required where fence ends and on both sides of gate openings and has pull from only one direction.

**In-line pull post assemblies** are located in straight sections of the fence line and where there are sudden changes in elevations, such as at the bottom and top of slopes. Tie off all wires at in-line pull assemblies and start new wires for the next fence section. Posts that are set in low areas or gullies may need to be weighted or anchored to prevent lifting out.

**Single post braces** may be used with 2-strand or less high tensile electrical wire (Table 7) if corner/end post are set 4' deep. If this cannot be accomplished, then a single H corner/end brace assembly should be used.

**Brace Rails**

Refer to Table 6 for Criteria and Specifications.

- Placement of the horizontal brace rail will be between the top two wires of the fence or fence fabric. This should be a minimum 3 feet above ground.
- The length of the horizontal brace shall be at least 2 times the height of the fence fabric it is supporting.
- The longer the brace rail the stronger the brace.
- The brace and anchor posts should be fastened to the compression brace using galvanized brace pins (3/8" X 9" and 3/8" X 4"), drilled through vertical post and into end of horizontal brace, 2" deep. An H-brace bracket (dacromet-coated heavy gauge steel) may be used in place of brace pins. Install with minimum 1.75" screws.
- Do not notch vertical posts (wood) for stabilizing horizontal brace support as this will increase chance of wood rot.

**Note:** Landscaping timbers should not be used for any post or brace component of a fence system.

**Adjoining Fences**

A fence adjoining an existing fence must terminate in a brace assembly as required per fence brace specifications in Table 5, 6, and 7.
Tension of Brace (Guy) Wires
For guy wires use two complete loops of 12½ gage HT wire or one loop of 9 gauge soft wire, or a single 3/16" galvanized cable with cable lock.

For horizontal braces, brace wire will be double wrapped and stapled to brace post at a height of just above the brace member and to the anchor (pull) post at a point approximately 2-3 inches above the ground level.

Brace (Guy) wire will be tightened using a wire tighter or strainer. Another suitable method is to tension the brace wire with a chain grab and splice using a double crimp or compression sleeve.

INSTALLATION OF WIRE:
Barbed and woven wire will be stretched to sufficient tension prior to being fastened to posts. Temperature variations must be considered (wire will tighten in cold weather and expand in hot weather). See wire specification requirements in Table 3.

Tensioning the Wire
Woven Wire - In warm weather, wire shall be stretched until 1/3 of the height of the "tension curve" is removed. In cold weather, remove ½ of the tension curve. Fixed-Knot High Tensile Woven Wire - The tension crimp should be ½ the size of an un-tensioned crimp.

Barbed Wire - In warm weather, a 100 ft. stretch of wire should sag no more than 4 inches in the middle (prior to attaching to posts) and no more than 2 inches in cold weather.

High Tensile Wire - Tension should be 250 lbs. for cattle, horses, goats and sheep. For electrified high tensile wire the tension should be sufficient to maintain the proper average height and spacing of the fence wires.

Tension Springs
In-line wire spring-tensioners are designed to indicate lbs. of tension on the line, assuming placement within the line is appropriate.

On most fences the use of one tensioner per pull will provide sufficient indication of the tension on adjacent wires.

Springs offer only 3-6 inches of elasticity therefore are of little benefit when something like a tree falls on the wire.

Staples and fasteners
Staples should be installed into post to allow free slippage of wire.

Staples shall be driven diagonally across the grain of the wood and at a slight downward angle (except in dips of landscape) and shall not be driven so tightly as to bind the wire against the post.

Electrically charged smooth wires must be attached to conductive posts with an appropriate ceramic, UV resistant HDPE (High Density Polyethylene) or HDPP (High Density Polypropylene) or tube type plastic reinforced insulators.

For steel line posts, the fencing shall be fastened with either 2 turns of 14 gauge galvanized steel wire or the post manufacturer's special wire clips. For all other types of posts, attach as specified by manufacturer.

Tie off of wire or insulators: High tensile wire is tied off using the "thread through method" (a half hitch and 3 wraps) or with compression sleeves. A length of high tensile wire is fastened around the groove of the insulator then looped around the post and stapled on opposite side of post. An alternative is the tubular plastic reinforced insulator to prevent cracking of the plastic and grounding of the wire. All insulators must be rated for use with high tensile fence.

Wire attachment to posts
Attaching Fence Wire to Anchor (Pull) Post:
For Barbed wire fences, wires will be attached to anchor (pull) post by one complete wrap around the post, double stapled (wood posts) or wired (steel posts) and ends tightly wrapped around stretched wire five times. Compression sleeves may be used to connect ends of brace wire.

For Woven or Mesh wire, determine amount of wire needed to fully wrap around post once, then remove enough vertical stays to provide that length. The wire ends are then attached as described in previous paragraph. All lines are stapled to the post.

For High Tensile wire, the line wires are attached to each anchor post by wrapping the post and securing with a half hitch with 3 wraps, or using appropriate double crimp sleeves.
Fixed-knot woven wire fence shall be stapled to wood post or fastened to steel post at every horizontal wire using manufacturer recommended wire clips.

High Tensile electric wire that pulls through corners or bends may be suspended from the inside of posts in corners and bends using ceramic or appropriate UV resistant HDPE or HDPP donut type plastic high strain insulators. The tubular plastic reinforced high strain insulators can wrap around the outside of bends and corner posts.

Attaching Fence Wire to Line Post:
Barbed wire shall be attached at each post with 1.5 inch staples driven to allow slippage. The top wire shall be at least 2 inches below the top of posts on wood posts and at least 1 inch below the top on steel posts. Wire shall be spaced no more than 10 inches apart and often closer depending on livestock controlled.

Woven wire and fixed-knot woven wire fencing shall be attached to posts at the top 3 and bottom 3 strands on every posts and then alternate every other line making sure you attached to the missed lines on the next alternating line post.

HT electric wire shall be attached using ceramic or appropriate UV resistant HDPE or HDPP plastic insulators. The tubular plastic reinforced high strain insulator can be used on the outside of corners, curves or bends.

Post side wire placement: the wire shall be placed on the livestock side of line posts and on the outside of curves and bends.

Wire Splicing
There are two basic ways to splice wire:
1. Hand knot
2. Crimping or compression sleeves (per manufacturer recommendation)

Barbed wire and woven wire shall be spliced by means of a western union splice or by suitable compression sleeves applied with a tool designed for the purpose.

Gates
Gates weighing less than 100 lbs may be hung from single end post properly installed. Heavy metal or wood gates more than 6 ft. wide shall best be attached to the pull post of an H-brace or diagonal floating brace.

All gates must be substantial enough to withstand expected pressures from livestock and wildlife.

A 12 ½ gauge overhead or insulated underground transmission line will be used to carry electricity across all gate openings (including electrified gates) to charge the remainder of the fence.

Gates Over Streams and Ditches
Hanging gates should terminate approximately 6 inches above average normal water level.

Non-electric flood gates should be hinged such that gate will swing with rising water during storm events.

An electrified flood gate may be used to minimize debris problems on stream crossings. The electrified flood gate is constructed by stretching an electrified wire across the drainage above high water flow level. Attach, with compression sleeves, hanging galvanized chains or wire to the electrified wire at a spacing of 6 inches for goats, hogs and sheep or 12 inches for cattle and horses. It is advisable to connect the gate to electric fence with double insulated cable through a cut-off switch and flood gate controller.

Stream Bank Protection
Permanent fencing will be placed at least 10 feet from the top of the stream bank and should allow for more area in meanders and in areas with bank erosion to minimize corner bracing. Permanent fencing setback distance from drainage ditches should be enough to allow sufficient room for vegetation management and fence maintenance.

SAFETY
- Electrical fences shall be clearly labeled or identified with the appropriate warning signs spaced every 300 feet where the public has access. Barbed wire shall not be electrified because of safety hazard.
- Fencing operations can result in painful and serious injury. Wear heavy gauntlet leather gloves to protect hands and wrists, and boots or high-top shoes to protect legs and ankles.
- Tough, close fitting clothing will reduce risks of catching on wire. Wear safety glasses to protect eyes from injury. When stretching woven, fixed-knot, or barbed wire, stand on the opposite side of the post from the wire and stretcher unit.
• It is dangerous to use a tractor to stretch wire fencing because of potential breaking of the wire resulting in serious injury from the recoil of the clamp bar, chain, or wire. Keep chains and wire stretching clamps in good condition.

• Carry staples, nails, or other fasteners in a metal container or in an apron and not in your trouser pockets. Do not hold fasteners in your mouth which is a common but extremely dangerous habit.

• If you handle preservative treated posts, do not rub your hands or gloves on your skin, nose, eyes, or mouth. Wash your hands after handling treated posts. Minimize the inhaling of sawdust. Do not burn treated posts or apply the ash to a garden. Properly dispose of treated wood in a landfill.

Additional conditions which apply to this practice:
1. A professional fencing contractor is recommended during the planning phase of any fence system.

2. Woven wire for sheep and goats should have vertical wire wide enough (9" to 12") or narrow enough (<4") to minimize potential injury. Otherwise use an electric offset wire to keep animals away from woven wire that might "entangle" them.

3. Never use household electrical wire for any part of an electrified fence. Splicing wires of different metals often results in oxidation and corrosion which causes short circuits and poor conductivity.

4. A digital voltmeter is essential to monitoring and maintaining electrical power fences.

5. Avoid placing electrical fences parallel with telephone or commercial power lines since static field can sometimes be created.

6. It is recommended that fences be located 20 feet or more from streams with a maintenance gate to allow for emergency access to water. This distance can also lessen fence maintenance by reducing flood damage. Temporary fencing may be used to protect streambanks while using forage adjacent to the stream.
Construction Specification
432. DRY HYDRANT

1. SCOPE
The work shall consist of furnishing materials and installing all components of a dry hydrant, as outlined in this specification and to the dimensions and grades shown on the drawings.

2. MATERIALS
All materials shall be new, with manufacturers' warranties, as applicable. Their estimated minimum service life shall be 10 years or more, or as otherwise specified in Section 6.

a. Pipe. The pipe material installed for the hydrant system shall conform to the following specifications:

<table>
<thead>
<tr>
<th>Material</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Iron</td>
<td>ANSI/AWWA C151/A21.51</td>
</tr>
<tr>
<td></td>
<td>ANSI/AWWA C115/A21.15</td>
</tr>
<tr>
<td>Steel</td>
<td>ASTM-A-120, AWWA-C-202</td>
</tr>
<tr>
<td></td>
<td>ASTM-A-53</td>
</tr>
<tr>
<td></td>
<td>ASTM-A-134</td>
</tr>
<tr>
<td></td>
<td>ASTM-A-135</td>
</tr>
<tr>
<td>Plastic</td>
<td>PVC ASTM D1785</td>
</tr>
<tr>
<td></td>
<td>PVC ASTM-D-2241 SDR-26+</td>
</tr>
<tr>
<td></td>
<td>ABS ASTM-D-2282 SDR-26+</td>
</tr>
</tbody>
</table>

The pipe and fittings, where applicable, shall be marked by the manufacturer as described in the applicable ASTM or ANSI/AWWA specification. Fittings shall be rated, in strength and quality, equal to the pipe being specified. Joints shall be air and water tight and shall meet the requirements of the applicable ASTM or ANSI/AWWA standards.

b. Dry Hydrant Head. The hydrant sleeve shall be made of bronze, brass, aluminum alloy or other durable, non-corrosive metal. Sleeve must be permanently affixed inside a PVC head using epoxy adhesive and stainless steel bolts.

The hydrant head shall be able to accept a 6-inch NHT (American National Fire Hose Thread) connection to provide maximum supply, and shall conform to ASTM 2466.

All hydrants shall contain a removable head strainer and stainless steel snap ring that can be removed without special tools. The strainer shall be conical in shape to maximize straining area. Unless otherwise approved prior to installation, all hydrants shall use a rubber "0" ring between the threaded sleeve and PVC head.

c. Dry Hydrant Cap. The cap shall be of snap-on/snap-off design and removable without special tools. It shall be joined with a steel cable or chain and be permanently attached to the dry hydrant head. The cap shall be hard plastic or of same metal as NHT connection for maximum corrosion resistance.

d. Strainer. Fabricate a strainer of material compatible with the pipe or use corrosion resistant manufactured well screens. Individual inlet holes shall not exceed 3/8-inch diameter. All components, including pins, shall be non-corrosive. Screens and strainers shall have a minimum surface area of 4 times the pipe cross sectional area. A strainer may be formed by drilling 1/4-inch to 3/8-inch diameter holes with a minimum of one-hole diameter between the holes in PVC pipe. Drilled holes shall be deburred and the pipe cleaned before putting the strainer into service. The screens or
strainers shall be capped with a removable end cap.

e. **End Cap.** The end cap must be easily removed without special tools. Perforations are required in the end cap to improve flow conditions into the strainer and for jetting action for silt cleanout.

Other required materials shall be as shown in the drawings, or as defined in Section 6 of this specification. However, the contractor shall verify that all equipment furnished as part of the dry hydrant system is compatible with the local fire department(s) equipment.

### 3. CERTIFICATIONS

The dry hydrant system shall be certified by the contractor responsible for the final installation to the fact that it conforms to all the applicable construction specifications and requirements of the material and/or equipment manufacturers.

### 4. STRUCTURAL INSTALLATION

All components of the system shall be installed to the lines and grades as shown on the drawings.

All equipment shall be installed to the manufacturers' recommendations.

a. **Pipe.** The pipe shall be fitted with intake screen or strainer and standard fire truck hose adapters for quick connect/release operations acceptable to the local fire department.

PVC pipe shall be protected from ultraviolet rays by painting with an exterior latex or similar paint.

The depth at which the pipe is installed shall be below the frost-free depth for the area.

All pipes shall be installed to provide water tight and airtight joints. Pipe shall be placed on undisturbed soil or non-yielding compacted material. Over excavation must be corrected as noted on the drawings or as directed by the responsible engineer or his designated representative. Backfill shall be placed so as not to damage the pipe nor disturb alignment in any way. All pipes shall be properly bedded as designated on the drawings or in Section 6.

b. **Pipe Intake.** The pipe intake shall be installed at the depth shown in the drawings. Where the intake is more than 3 feet off the bottom, a trash rack may be used in lieu of a screen.

A dry hydrant installation shall provide for a positive slope toward the water source. In pits or impoundments, the intake screen or strainer shall be supported and secured at least two feet above the pool bottom. The intake shall be at least 4 feet beyond the earth slope.

c. **Testing.** Allow pipe joint sealants to cure before testing the piping system. The contractor is responsible for performing an initial pump test at the design capacity after installation to confirm satisfactory operation. Give careful attention to silt, debris, or other interference that may limit the full operation of the hydrant.

d. **Access.** Vehicle access to and from the dry hydrant shall be provided for fire truck and pumper units. Access shall have an all-weather surface, be well drained and be at least 12 feet wide for ease of movement by personnel and equipment during an emergency.
5. VEGETATION

All exposed earth surfaces shall be protected by a vegetative cover as soon, after installation of the structure, as practical. Vegetation, if required, shall be established at the locations shown on the drawings and/or staked in the field, and as set forth herein, in Section 6, and/or as shown on the drawings.

6. ADDITIONAL CONDITIONS

WHICH APPLY TO THIS PROJECT
ARE:
CONSTRUCTION SPECIFICATION

PA 558 – ROOF RUNOFF STRUCTURE

1. SCOPE

The work shall consist of furnishing, fabricating, and installing all components of the roof runoff structure(s) as outlined in this specification and as shown on the drawings.

2. MATERIALS

GUTTERS, DOWNSPOUTS, AND SUPPORTS shall be made of aluminum, galvanized steel, wood, or plastic, and the size and type set forth in Section 4, or as shown on the drawings. Aluminum gutters and downsputs shall have a nominal thickness of at least 0.027 and 0.020 in (0.07 and 0.05 cm), respectively. Galvanized steel gutters and downsputs shall be at least 28 gauge. Wood gutters shall be redwood, cedar, cypress, or pressure-treated, and shall be clear and free of knots. Plastics shall contain ultraviolet stabilizers. Supports shall have sufficient strength to withstand anticipated water, snow, and ice loads. The type of supports for manufactured gutters and downsputs shall be determined by the manufacturer’s requirements given the type of installation and type of gutter or downspout.

DRAINFILL for subsurface drains and drip-lines shall meet the size and quality requirements of PADOT Publication 408, Section 704, Type A, Coarse Aggregate, with gradation as shown in Section 4 or in the drawings.

DRAINPIPE for subsurface drains and drip-lines shall be perforated corrugated polyethylene (PE) pipe and fittings meeting the requirements of ASTM F405 or ASTM F667.

APPURTEANCES, such as storage tanks, guard pipe, flush diverters, etc., if required, shall be of the materials set forth in Section 4 and/or the drawings.

3. INSTALLATION

Gutters and drain pipes shall be installed at the locations and grades shown on the drawings. Gutter supports shall have maximum spacing of 48 in (120 cm) for galvanized steel and 24 in (60 cm) for aluminum or plastic. Joints shall be made watertight with the use of mastics or by welding. Dissimilar metals shall not be in contact with each other. Wood gutters shall be mounted on fascia boards using furring blocks that are a maximum of 24 in (60 cm) apart.

Gutters shall be hung so that the outer edge of the gutter is below the projection of the roof line as shown on the drawings. Roof edges shall be nearly level. Replacement or repair of structure members may be necessary to provide a nearly level and uniform roof edge.

Downspouts shall be securely fastened at the top and bottom, with intermediate supports that are a maximum of 10 ft (3 m) apart.

Drainpipe shall be installed in accordance with ASTM F449.

Drainfill shall be placed in the drip drain trench in such a manner so as not to be contaminated with adjacent soil. Geotextile may be used to envelop the bottom and sides of the drainfill to accomplish this. Geotextile shall have properties equal to or exceeding the requirements of PADOT Publication 408, Section 735, Class 1 geotextile.

Outlets shall be located as shown on the drawings. Where downsputs empty directly onto the ground surface there shall be an elbow to direct the flow away from the building and splash blocks or other protection to prevent erosion. Downsputs shall not outlet into foundation drains.

4. ADDITIONAL CONDITIONS WHICH APPLY TO THIS PROJECT ARE:
CONSTRUCTION SPECIFICATION

PA 558 – ROOF RUNOFF STRUCTURE

1. SCOPE

The work shall consist of furnishing, fabricating, and installing all components of the roof runoff structure(s) as outlined in this specification and as shown on the drawings.

2. MATERIALS

GUTTERS, DOWNSPOUTS, AND SUPPORTS shall be made of aluminum, galvanized steel, wood, or plastic, and the size and type set forth in Section 4, or as shown on the drawings. Aluminum gutters and downspouts shall have a nominal thickness of at least 0.027 and 0.020 in (0.07 and 0.05 cm), respectively. Galvanized steel gutters and downspouts shall be at least 28 gauge. Wood gutters shall be redwood, cedar, cypress, or pressure-treated, and shall be clear and free of knots. Plastics shall contain ultraviolet stabilizers. Supports shall have sufficient strength to withstand anticipated water, snow, and ice loads. The type of supports for manufactured gutters and downspouts shall be determined by the manufacturer’s requirements, given the type of installation and type of gutter or downspout.

DRAINFILL for subsurface drains and drip-lines shall meet the size and quality requirements of PADOT Publication 408, Section 704, Type A, Coarse Aggregate, with gradation as shown in Section 4 or in the drawings.

DRAINPIPE for subsurface drains and drip-lines shall be perforated corrugated polyethylene (PE) pipe and fittings meeting the requirements of ASTM F405 or ASTM F667.

APPURTENANCES, such as storage tanks, guard pipe, flush diverters, etc., if required, shall be of the materials set forth in Section 4 and/or the drawings.

3. INSTALLATION

Gutters and drainpipes shall be installed at the locations and grades shown on the drawings. Gutter supports shall have maximum spacing of 48 in (120 cm) for galvanized steel and 24 in (60 cm) for aluminum or plastic. Joints shall be made watertight with the use of mastics or by welding. Dissimilar metals shall not be in contact with each other. Wood gutters shall be mounted on fascia boards using furring blocks that are a maximum of 24 in (60 cm) apart.

Gutters shall be hung so that the outer edge of the gutter is below the projection of the roof line as shown on the drawings. Roof edges shall be nearly level. Replacement or repair of structure members may be necessary to provide a nearly level and uniform roof edge.

Downspouts shall be securely fastened at the top and bottom, with intermediate supports that are a maximum of 10 ft (3 m) apart.

Drainpipe shall be installed in accordance with ASTM F449.

Drainfill shall be placed in the drip drain trench in such a manner so as not to be contaminated with adjacent soil. Geotextile may be used to envelop the bottom and sides of the drainfill to accomplish this. Geotextile shall have properties equal to or exceeding the requirements of PADOT Publication 408, Section 735, Class 1 geotextile.

Outlets shall be located as shown on the drawings. Where downspouts empty directly onto the ground surface there shall be an elbow to direct the flow away from the building and splash blocks or other protection to prevent erosion. Downspouts shall not outlet into foundation drains.

4. ADDITIONAL CONDITIONS WHICH APPLY TO THIS PROJECT ARE:

Technical Guide Section IV Pennsylvania February 2015
HEAVY USE AREA PROTECTION
CONSTRUCTION SPECIFICATION

1. SCOPE

The work shall consist of furnishing materials and installing all components of the paved surface treatment areas for heavy use area protection as outlined in this specification and the drawings.

2. MATERIALS

All materials used shall conform to the quality and grade noted on the plans, set forth in Section 6, or as otherwise listed below:

PORTLAND CEMENT shall be Type I, IA, II, or II A and conform to ASTM-C150, unless otherwise set forth in Section 6. If Type I or II is used, an air-entrainment agent shall be used.

CONCRETE AGGREGATE shall meet the requirements and gradation specified in ASTM-C33. Coarse aggregate shall meet the gradation for size numbers 57 or 67.

WATER used in mixing or curing concrete shall be clean and free from injurious amounts of oil, acid, salt, organic matter or other deleterious substances.

REINFORCEMENT BARS shall be grade 40 or higher, and shall conform to ASTM-A615, A616, or A617. Welded wire fabric reinforcement shall conform to ASTM-A185 or A497. Reinforcement shall be free from loose rust, oil, grease, curing compound, paint or other deleterious coatings.

CONCRETE ADMIXTURES shall conform to ASTM-C260 for air-entrainment, and ASTM-C494, type A, D, F or G, for water-reduction and set-retardation, and type C or E for non-corrosive accelerators.

POZZOLAN shall conform to ASTM-C618.

COAL COMBUSTION BYPRODUCTS (CCB) shall have a chemical analysis that provides adequate cementing and safety (toxicity) for the purpose intended.

CURING COMPOUND shall meet the requirements of ASTM-C309, Type 2, Class A or B, or as otherwise required in Section 6.

MASONRY COMPONENTS shall meet the requirements of ASTM-C90 & C270, and be placed in accordance with ACI-530.

PRECAST CONCRETE units shall comply with ACI-525 and 533.

PREFORMED EXPANSION JOINT FILLER shall conform to the requirements of ASTM-D1752, Type I, II, or III, unless bituminous type is specified, in which case it shall conform to ASTM-D994 or D1751.

JOINT SEALERS shall conform to the requirements for ASTM-C920, Federal Specification SS-S-210A, or Federal Specification TT-S-227, as appropriate for the specific application.

WATERSTOP. Vinyl-chloride polymer types shall be tested in accordance with Federal Test Method Standard No. 601, and shall show no sign of web failure due to brittleness at a temperature of -35 degrees Fahrenheit. Colloidal (bentonite) waterstops shall be at least 75 percent bentonite in accordance with Federal Specification SS-S-210A. Non-colloidal waterstops shall only be used if approved by the Engineer.

AGGREGATES. Aggregates shall meet the requirements of Pennsylvania Dirt and Gravel Road Program (DSA), PennDOT Pub. 408, Section 703, for the gradations specified in the drawings or Section 6, or as otherwise set forth in Section 6.
BITUMINOUS CONCRETE. Bituminous concrete shall meet the requirements of PennDOT Pub. 408, Sections 401, 420 and 421, for the course(s) specified in the drawing or Section 6, or as otherwise set forth in Section 6.

WOOD shall be graded and stamped by an agency accredited by the American Lumber Standards Committee as meeting the required species, grade, and moisture content. In the absence of such a stamp, the Contractor or material supplier shall provide written certification that the wood products meet the designated quality criteria.

PRESSURE TREATED WOOD PRODUCTS shall be Douglas Fir, Southern Yellow Pine, or as otherwise specified on the drawings or in Section 6. They shall be treated with preservatives in accordance with the American Wood Preservers Association (AWPA) Standard C16, "Wood Used on Farms, Pressure Treatment." Each piece shall bear the AWPA stamp of quality. In the absence of such a stamp, the Contractor or material supplier shall provide written certification that the pressure treated wood meets the designated quality criteria.

FASTENERS for wood structures shall be stainless steel, galvanized, or otherwise protected from corrosion due to contact with moisture, manure and associated gasses. The protective coatings shall be compatible and consistent with the preservative chemicals in the pressure treated wood. Additional guidance can be found in PA367, Roofs and Covers.

GEOTEXTILES. Geotextiles shall meet the requirements of PennDOT Pub. 408, Sections 212 and 735, for the Type and Class specified in the drawings or Section 6, or as otherwise set forth in Section 6.

ORGANIC SURFACES. Materials such as tanbark and saw dust shall be free of contaminants and rot.

3. FOUNDATION PREPARATION

Clear all trees, brush, fences, manure, and rubbish within the area to be protected, including any appurtenances, and borrow areas. All material removed by clearing and excavation operations shall be disposed of as directed by the Owner or his/her Representative. Sufficient topsoil is to be stockpiled in a convenient location for use on disturbed areas to facilitate seeding.

Set all base course material on undisturbed soil or non-yielding compacted material. Geosynthetics may be used, if approved by the Engineer, to further separate and/or stabilize the foundation. Over-excavation must be corrected as noted on the drawings or as directed by the Engineer or his/her designated Representative.

Surface and subsurface drainage systems shall be installed and operating adequately to remove water from the foundation to allow for proper placement of base and surface materials.

Drainfill upon which concrete is to be placed shall be covered with a geosynthetic that has an AOS between 20 and 100, inclusive.

4. BASE COURSE

The base course shall be placed on the area to the grades and thicknesses shown on the plans. The base material shall be as set forth in Section 6 and/or as shown on the drawings. The material shall be wetted and compacted by rollers or other construction equipment approved by the Engineer.

5. SURFACE TREATMENTS

a. Portland Cement Concrete
CONCRETE MIX

Unless otherwise specified in Section 6, concrete shall be proportioned to provide a minimum compressive strength at 28 days of 4,000 psi. The Contractor shall be responsible for the design of the mix and certification of the necessary strength, in accordance with ACI 301. Acceptance and certification of design mixes by PennDOT within the past year may be accepted in lieu of additional testing.

REINFORCING STEEL PLACEMENT

Reinforcement shall be accurately placed and secured in position in a manner that will prevent its displacement during the placement of concrete.

Steel shall be supported by precast concrete bricks (not clay bricks), metal or plastic chairs, or hard fieldstone. Except for dowel rods, placing steel reinforcement into concrete already in place shall not be permitted.

The following tolerances will be allowed in the placement of reinforcing bars shown on the drawings:

1. Maximum reduction in cover:
   - from exposed surfaces -1/4 inch
   - from earth surfaces -1/2 inch

2. Maximum variation from indicated spacing:
   - 1/12th of indicated spacing

Splices of reinforcing bars shall be made only at the locations shown on the drawings, unless otherwise approved by the Engineer. Unless otherwise required, welded wire fabric shall be spliced by overlapping sections at least one full mesh dimension plus too inches. All reinforcement splices shall be in accordance with ACI 318.

Reinforcing steel shall not be welded unless approved by the Designer.

The ends of all reinforcing steel shall be covered with at least 1-1/2 inches of concrete.

MIXING AND HANDLING CONCRETE

In general, concrete shall be transported and placed in accordance with ACI-304, of which some specific interpretations are set forth below.

For concrete mixed at the site, the mixing time after all cement, aggregates and water are in the mixer drum shall be at least 1-1/2 minutes. Concrete shall be conveyed from the mixer as rapidly as practical by methods that will prevent segregation of the aggregates or loss of mortar. Concrete shall be placed within 1-1/2 hours after the introduction of cement to the aggregate unless an approved set-retarding admixture is used in the mix. During periods of hot weather, it may be necessary to reduce this time.

For each load of concrete delivered to the site, a batch ticket shall be provided to the Owner or Technician by the Supplier. As a minimum, this ticket shall show the design strength, time out, admixtures (if any), and amount of water that may be added (if any) on site and still be within the design mix limits.

The Contractor shall test slump and air entrainment as necessary to insure that the concrete meets the requirements of this specification. The slump shall be three to six inches (without superplasticizers) and the air content shall be five to seven percent of the volume of the concrete. Admixtures such as superplasticizers, water-reducers and set-retarders may be used provided they are approved by the Engineer prior to concrete placement and are used in accordance with the manufacturer’s recommendations. Superplasticizers (ASTM C494, Type F or G) may be added to concrete that has a 2 to 4 inch slump before the addition, and that is not warmer than 95°F. The slump
shall not exceed 7½ inches with the addition of superplasticizer.

Concrete shall be uniform and thoroughly mixed when delivered to the job site. Variations in slump of more than one inch within a batch will be considered evidence of inadequate mixing and shall be corrected or rejected. No water in excess of the amount called for by the job design mix shall be added to the concrete.

Immediately after placement, concrete shall be consolidated by spading and vibrating, or spading and hand tamping. It shall be worked into corners and around all reinforcement and embedded items in a manner which prevents segregation. Excessive vibration which results in segregation of materials will not be allowed. Vibration must not be used to make concrete flow in forms, slabs, or conveying equipment. If the surface of a layer in place will develop its initial set, i.e., will not flow and merge with the succeeding layer when vibrated, a construction joint shall be made. Construction joints shall be made by cleaning the hardened concrete surface to exposed aggregate by sandblasting, air/water jetting, or hand scrubbing with wire brush, and keeping the concrete surface moist for at least one hour prior to placement of new concrete.

Concrete surfaces do not require extensive finishing work; however, the surface shall be smooth and even, with no depressions that would result in surface water ponding. Careful screeding (striking-off) and/or wood float finishing shall be required. Any additional desired finishing of the surface (such as roughening for improved traction) shall be accomplished after an initial stiffening of the concrete has taken place. These requirements will be stated in Section 6 or on the drawings. Exposed edges should be chamfered, either with form molding or molding tools.

The addition of dry cement or water to the surface of screeded concrete to expedite finishing is not allowed. If concrete placing is discontinued prior to completion of the entire structure, the unfinished end of the concrete shall be formed to create a proper construction or expansion/contraction joint.

**EXPANSION/CONTRACTION JOINTS**

When required in Section 6 or on the drawings, expansion/contraction joints shall contain a six-inch, Type B, vinyl waterstop with a minimum web thickness of 1/8-inch, or an approved joint sealer.

**FORM REMOVAL AND CONCRETE REPAIR**

Forms for walls and columns shall not be removed for at least 24 hours after placing the concrete. When forms are removed in less than seven days, the exposed concrete shall be sprayed with a curing compound or be kept wet continuously for the remainder of the curing period. Forms which support beams or covers shall not be removed for at least seven days, or 14 days if they are to support forms or shoring.

Forms shall be removed in such a way as to prevent damage to the concrete. Forms shall be removed before walls are backfilled. Columns shall be at least seven days old before any structural loads are applied.

Concrete that is damaged or otherwise defective shall be removed and replaced, or where feasible, repaired. The Engineer will determine the required extent of removal, replacement or repair. The plan for accomplishing the repair must be approved by the Engineer prior to beginning the repair work. Where minor areas of the concrete surface are "honeycombed," damaged or otherwise defective, the area may be cleaned, wetted and then filled with a dry-pack mortar. Dry-pack mortar shall consist of one part Portland cement and three parts...
sand with just enough water to produce a workable paste.

CONCRETING IN COLD WEATHER

Concreting in cold weather shall be performed in accordance with ACI-306R-88. In addition, the contractor shall provide a written plan at least 24 hours in advance of placing concrete in cold weather, and shall have the necessary equipment and materials on the job site before the placement begins.

CONCRETING IN HOT WEATHER

Concreting in hot weather shall be performed in accordance with ACI 305, of which some specific interpretations are set forth below.

The supplier shall apply effective means to maintain the temperature of concrete below 90 degrees Fahrenheit during mixing and conveying. Exposed surfaces shall be continuously moistened by means of fog spray or otherwise protected from drying during the time between placement and finishing, and during curing. Concrete with a temperature above 90 degrees Fahrenheit shall not be placed.

CURING

In general, concrete shall be cured in accordance with ACI-308. Specifically, it shall be prevented from drying for at least seven days after it is placed. Exposed surfaces shall be kept continuously moist during this period by covering with moistened canvas, burlap, straw, sand or other approved material unless they are sprayed with a curing compound.

Concrete, except at construction joints, may be coated with a curing compound in lieu of continuous application of moisture. The compound shall be sprayed on moist concrete surfaces as soon as free water has disappeared but shall not be applied to any surface until patching, repairs and finishing of that surface are completed.

Curing compound shall not be allowed on any rebars.

Curing compound shall be applied in a uniform layer over all surfaces requiring protection at a rate of not less than one gallon per 150 square feet of surface. Surfaces subjected to heavy rainfall or running water within three hours after the curing compound has been applied, or otherwise damaged, shall be resprayed. Any construction activity which disturbs the curing material shall be avoided. If the curing material is subsequently disturbed, it shall be reapplied immediately.

b. Bituminous Concrete

Bituminous concrete shall be installed in accordance with PennDOT Pub. 408, Sections 305, 320, & 400, as appropriate, and/or as otherwise set forth in Section 6.

c. Compacted Stone Aggregate

Compacted stone aggregate surfaces shall consist of the material specified in the drawing or Section 6. The material shall be moist and uniformly placed on the prepared base. The loose material shall be place to an adequate thickness so that when compacted the finished thickness is as specified. The stone aggregate shall be compacted with a vibratory smooth wheeled roller or other approved equipment to form a dense, smooth surface.

d. Other Materials and Structures

Surface treatments, such as saw dust, coal combustion byproducts, soil cement, etc., shall be placed as set forth in Section 6, and to the grades and thicknesses shown on the drawings.

6. ADDITIONAL CONDITIONS WHICH APPLY TO THIS PROJECT ARE:
CONSTRUCTION SPECIFICATION

TRAILS AND WALKWAYS

1. SCOPE

The work shall consist of furnishing materials and installing all components of the trails and walkways as outlined in this specification and the drawings.

2. MATERIALS

All materials used shall conform to the quality and grade noted on the plans, set forth in Section 8, or as otherwise listed below:

WEARING SURFACE, BINDER COURSE, and BASE COURSE aggregate shall meet the requirements and gradation specified in Section 8 or on the drawings.

GEOTEXTILE shall meet the requirements as outlined in the following table or as otherwise set forth in Section 8 or on the drawings:

<table>
<thead>
<tr>
<th>Requirements for Nonwoven Geotextiles</th>
<th>Property</th>
<th>Test Method</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Tensile Strength</td>
<td>ASTM D4832 Grab Test</td>
<td>115 lbs</td>
</tr>
<tr>
<td></td>
<td>Elongation at Failure</td>
<td>ASTM D 4632</td>
<td>&gt; 50%</td>
</tr>
<tr>
<td></td>
<td>Puncture</td>
<td>ASTM D 4833</td>
<td>40 lbs</td>
</tr>
<tr>
<td></td>
<td>Apparent opening size</td>
<td>ASTM D 4751</td>
<td>#40 max.</td>
</tr>
<tr>
<td></td>
<td>Permittivity</td>
<td>ASTM D 4491</td>
<td>0.10 secs⁻¹</td>
</tr>
<tr>
<td></td>
<td>Ultraviolet light (%)</td>
<td>ASTM D 4355 150 Hr Exposure</td>
<td>70%</td>
</tr>
</tbody>
</table>

PIECE shall meet the requirements specified in Section 8 or on the drawings.

WOOD PRODUCTS shall be Douglas Fir, Southern Yellow Pine, or as otherwise specified on the drawings or in Section 8. They shall be treated with preservatives in accordance with the American Wood Preservers Association (AWPA) Standard C16, "Wood Used on Farms, Pressure Treatment." Each piece shall bear the AWPA stamp of quality. In the absence of such a stamp, the Contractor or material supplier shall provide written certification that the pressure treated wood products meet the designated quality criteria.

FASTENERS for wood structures shall be stainless steel, galvanized, or otherwise protected from corrosion due to contact with moisture and soil.

3. FOUNDATION PREPARATION

All trees, brush, fences, manure, and rubbish shall be cleared within the trail or walkway area, including any associated drainage control features and borrow areas. All stumps and roots larger than two inch diameter shall be removed down to the subgrade elevation. All material removed by clearing operations shall be disposed of as directed by the Owner or his/her Representative.

Topsoil shall be stripped and stockpiled in a convenient location for use on disturbed areas to facilitate seeding.

Mineral soil shall be excavated and placed as fill as shown on the drawings to establish a uniform, stable subgrade. Wet soil, mud, and topsoil shall not be used as fill. The fill material shall be compacted as specified in Section 8 or on the drawings.

Borrow material shall be taken from the designated borrow area as needed after excavation of the trail or walkway is complete. The borrow area shall be final graded to drain freely and blend into the surrounding undisturbed area.

Excess excavated material shall be disposed of in the designated spoil area, which shall be graded to blend into the surrounding undisturbed area.

Geotextile or base course material shall be
set on undisturbed soil or non-yielding compacted material. Over-excavation must be corrected as noted on the drawings, or as directed by the Engineer or his/her designated Representative.

4. DRAINAGE STRUCTURES

Culverts, subsurface drains, and swales shall be installed as shown on the drawings. Surface and subsurface drainage structures shall be adequately removing water from the foundation to allow for proper placement of base and surface materials.

5. GEOTEXTILE

Where specified in Section 8 or on the drawings, geotextile shall be installed on the prepared subgrade. The geotextile shall be placed, overlapped and anchored as recommended by the manufacturer, unless otherwise specified in Section 8 or on the drawings.

Vehicles and heavy equipment shall not be operated directly on top of the geotextile. Base course or surface material shall be placed on the geotextile ahead of the construction equipment.

6. E&S CONTROL

E&S control measures shall be as set forth in the E&S Plan, and as otherwise detailed in the drawings.

Vegetation shall be established as set forth in Construction Specification PA 342, and/or as set forth in Section 8 and the drawings.

7. SURFACING

Where specified in Section 8 or on the drawings, the base and binder course shall be placed on the trail or walkway to the specified grades and thickness. The material shall be wetted and compacted by rollers or other construction equipment approved by the Engineer.

Surface material shall be placed to the grades and thicknesses set forth in Section 8 or on the drawings. The material shall be compacted by rollers or other construction equipment approved by the Engineer. The finished surface shall be smooth and free of projecting stones.

Vegetation shall be established in accordance with Construction Specification PA 342.

The surface material in or adjacent to surface water control devices and other structures shall be compacted using manually directed tamping equipment.

8. ADDITIONAL CONDITIONS WHICH APPLY TO THIS PROJECT ARE:
Construction Specification
587. STRUCTURE FOR WATER CONTROL

1. SCOPE

The work shall consist of furnishing materials and installing all components of the structure for water control, as outlined in this specification and to the dimensions and grades shown on the drawings.

2. MATERIALS

Unless otherwise set forth in Section 6, the following materials are to be used:

a. Earth fill material used around conduits and structures shall be obtained from the project area, or other approved sources and thoroughly compacted.

b. Pipe type, pipe sizes, fittings and other necessary pipe material shall be as specified on the drawings or as defined in Section 6 of this specification, when applicable.

c. ROCK shall be durable and obtained from sources listed in Penn DOT Bulletin 14 or as otherwise approved by the designer. Size and gradation, where required, shall be as specified in Section 6 or as shown on the drawings. The nominal size of a rock is that dimension (middle) which passes through a square opening with the same size dimension; i.e. it is not the greatest dimension. The rock shall be free from soil and trash. Rocks shall be angular or subangular in shape. However, the least dimension of any individual rock shall be not less than one-third the greatest dimension.

d. GEOSYNTHETICS shall meet the requirements set forth in Section 6 and/or on the drawings. In addition, geotextile shall meet the requirements of Penn DOT Specifications, Section 635, for the appropriate class defined in Section 212.

Certification from the manufacturer shall be provided by the Contractor that the geosynthetics meets these requirements.

e. AGGREGATE for bedding, drain fill, and concrete shall be durable and obtained from sources listed in Penn DOT Bulletin 14. The gradation shall be as set forth in Section 6 or on the drawings.

f. PORTLAND CEMENT shall be Type I, with air-entrainment agent, or Type IA, unless otherwise required in Section 6. All cement shall conform to ASTM-C150.

g. MASONRY shall meet the requirements of ASTM-C90 & C270.

h. PRECAST concrete units shall meet the requirements of ACI-525 & 533, unless otherwise specified in Section 6.

i. LUMBER shall be the dimensions and species specified in Section 6 or shown on the drawings. Wood shall be graded and stamped by an agency accredited by the American Lumber Standards Committee as meeting the required species, grade, and moisture content. Pressure treated wood products shall be Douglas Fir, Southern Yellow Pine, or as otherwise specified on the drawings or in Section 6. They shall be treated with preservatives in accordance with the American Wood Preservers Association (AWPA) Standard C16, "Wood Used on Farms, Pressure Treatment", except that only non-CCA preservatives, suitable for use in aquatic habitats, can be used. Each piece shall bear the AWPA stamp of quality. In the absence of grade and treatment stamps, the Contractor or material supplier shall provide written certification that the wood meets the designated quality criteria.
j. Other required materials shall be as shown in the drawings or as defined in Section 6 of this specification.

3. SITE ACCESS AND CLEARING

All trees, roots and boulders and other obstructions shall be removed, as necessary. Tree and brush removal shall be done in such a manner to prevent damage to other property, and to minimize erosion. Unless otherwise specified in Section 6, all cleared materials, including trash, shall be removed from the site or burned. Burning shall comply with all state and local applicable regulations.

Unless otherwise set forth in Section 6, sufficient topsoil shall be stockpiled and re-spread over disturbed areas to establish a vegetative cover.

4. STRUCTURAL INSTALLATION

Structures shall be installed as shown on the drawings or as set forth in Section 6. Construction operations will be carried out in such a manner as to minimize erosion and sedimentation.

Provisions must be made to prevent piping and settlement where underground conduits are used from a structure. Backfill shall be placed in successive layers of not more than six inches, and each lift compacted before the subsequent layer.

Commercially manufactured structures, including but not limited to gabions, precast units, etc., shall be installed as required by the manufacturer for flowing water applications.

5. VEGETATION

All exposed earth surfaces shall be protected by a vegetative cover as soon, after installation of the structure, as practical. Vegetation, if required, shall be established at the locations shown on the drawings and/or staked in the field, and as set forth herein, in Section 6, and/or as shown on the drawings.

6. ADDITIONAL CONDITIONS WHICH APPLY TO THIS PROJECT ARE:
CONSTRUCTION SPECIFICATION

606. SUBSURFACE DRAIN

1. SCOPE

The work shall consist of furnishing materials and installing all components of the subsurface drain as outlined in the specification and the drawings.

2. MATERIALS

a. DRAINFILL AGGREGATE shall meet the requirements of Penn DOT, Publication 408, Section 703, fine and coarse aggregate. The size and gradation shall be as specified in the additional conditions of this specification or on the drawings.

b. PIPE shall meet the requirements of Table 1, and as set forth in Section 9 and/or on the drawings. All pipes shall be clearly marked with the appropriate specification designation. If plastic pipe is stored on site for a length of time, it should be protected from sunlight. At the time of installation, it should be kept as cool as possible to minimize elongation of the pipe during installation.

c. GEOTEXTILE shall meet the requirements as outlined in PennDOT Publication 408, Section 735, Class 1, Subsurface Drainage.

Table 1 – Drain pipe requirements

<table>
<thead>
<tr>
<th>Type</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clay drain tile, solid &amp; perforated</td>
<td>ASTM-C-4</td>
</tr>
<tr>
<td>Clay pipe, perforated, standard and extra strength</td>
<td>ASTM-C-700</td>
</tr>
<tr>
<td>Clay pipe testing</td>
<td>ASTM-C-301</td>
</tr>
<tr>
<td>Concrete drain tile</td>
<td>ASTM-C-412</td>
</tr>
<tr>
<td>Concrete pipe for irrigation or drainage</td>
<td>ASTM-C-116</td>
</tr>
<tr>
<td>Concrete pipe or tile, determining physical properties of</td>
<td>ASTM-C-497</td>
</tr>
<tr>
<td>Concrete sewer, storm drain and culvert pipe</td>
<td>ASTM-C-14</td>
</tr>
<tr>
<td>Reinforced concrete culvert, storm drain and sewer pipe</td>
<td>ASTM-C-76</td>
</tr>
<tr>
<td>Perforated concrete pipe</td>
<td>ASTM-C-444</td>
</tr>
<tr>
<td>Portland cement</td>
<td>ASTM-C-150</td>
</tr>
<tr>
<td>Pipe, bituminized fiber &amp; fitting</td>
<td>Federal Specification</td>
</tr>
<tr>
<td>Styrene rubber (SR) plastic drain pipe &amp; fitting</td>
<td>ASTM-D-2852</td>
</tr>
<tr>
<td>Polyvinyl chloride (PVC) sewer pipe &amp; fitting</td>
<td>ASTM-D-2729</td>
</tr>
<tr>
<td>Polyvinyl chloride (PVC) pipe</td>
<td>ASTM-D-3034 type PSM</td>
</tr>
<tr>
<td>Corrugated polyethylene tubing &amp; fitting (3-6 inch)</td>
<td>ASTM-F-405</td>
</tr>
<tr>
<td>Corrugated polyethylene tubing &amp; fitting (8-24 inch)</td>
<td>ASTM-F-667</td>
</tr>
<tr>
<td>Pipe, corrugated (steel, polymer coated)</td>
<td>ASTM-A-762</td>
</tr>
<tr>
<td>Pipe, corrugated (steel, zinc coated)</td>
<td>ASTM-A-760</td>
</tr>
</tbody>
</table>
3. SITE PREPERATION
All trees, brush, fences and rubbish shall be cleared within the area that the subsurface drain will be installed. All material removed by the clearing and grubbing operation shall be disposed of as directed by the Owner or his/her Representative.

4. INSPECTION AND MATERIAL HANDLING
Material for subsurface drains shall be carefully inspected before the drains are installed. If applicable, clay and concrete tile shall be checked for damage from freezing and thawing before it is installed. Bituminized fiber and plastic pipe and tubing shall be protected from hazard causing deformation or warping. Plastic pipe and tubing with physical imperfections shall not be installed. Any damaged section shall be removed and replaced. All material shall be satisfactory for its intended use and shall meet applicable specifications and requirements.

5. SAFETY
All positive "design" responses from the Pennsylvania One Call System are noted on the plans. It is the Contractor's or Landowner's responsibility to notify One Call of pending construction and to contact the affected utility for marking at the time of construction.

The Contractor must comply with OSHA requirements Part 1926, subpart P, for protection of workers entering trench.

6. INSTALLATION
Flexible conduits, such as plastic pipe or tubing and bituminized fiber pipe, shall be installed, according to the requirements in ASTM-F-449, "Standard Recommended Practice for Subsurface Installation of Corrugated Thermoplastic Tubing for Agricultural Drainage or Water Table Control."

All subsurface drains shall be laid to line and grade and covered with approved blinding, envelope or filter material to a depth of not less than three inches over the top of the pipe. If an impervious sheet is used over the drain, at least three inches of blinding material must cover the sheet. No reversals in grade of the conduit shall be permitted.

If the conduit is to be laid in a rock trench or if rock is exposed at the bottom of the trench, the rock shall be removed below grade so that the trench can be backfilled, compacted and bedded. When completed, the tile conduit shall be not less than two inches from the rock.

Joints between drain tiles shall not exceed 1/8 inch except in sandy soils where the closest possible fit must be obtained and in organic soil where some of the more fibrous soil types make it desirable to slightly increase the space between tiles.

Earth backfill material shall be placed in the trench in a manner to ensure that the conduit does not become displaced and so that the filter and bedding material, after backfilling, meet the requirements of the plans and specifications.

If a filter is needed, no part of the conduit containing openings shall be left exposed. If a sand-gravel filter material is used, it shall be a gradation that is compatible with the base material in the trench. The trench shall be over excavated three inches and backfilled to grade with filter material. After the conduit is placed on the filter material, additional filter material shall be placed over the conduit to fill the trench to a depth of three inches over the conduit.

7. FITTINGS AND CONNECTIONS
All fitting and connections for pipe shall be made with manufacturer-supplied components made for the intended purpose.

8. CONDUIT PERFORATIONS
If perforations are specified, the water inlet area shall be at least 1inch/foot of the pipe length. The perforations shall be either circular or slots equally spaced around the circumference of the pipe in not less than three rows. Circular perforations shall not exceed 3/16 inch in diameter and slots shall not be more than 1/8 inch wide and 1 1/4 inch long for 3, 4 and 5 inch diameter pipe, or 1 1/2 inch for 6 and 8 inch diameter pipe, or 1 3/4 inch for 10 and 12 inch diameter pipe. All slots and circular perforations shall be cleanly cut.
Construction Specification

620. UNDERGROUND OUTLET

1. SCOPE

The specification covers the fabrication, installation, and construction of underground outlets.

2. MATERIALS

The materials required for the underground outlet shall be as shown on the drawings or as otherwise required in Section 9.

a. DRAINFILL AGGREGATE shall meet the requirements of Penn DOT, Publication 406, Section 703, fine and coarse aggregate. The size and gradation shall be as specified in the additional conditions of this specification or on the drawings.

b. PIPE shall meet the requirements of Table 1, and as set forth in Section 9 and/or on the drawings. All pipes shall be clearly marked with the appropriate specification designation. If plastic pipe is stored on site for a length of time, it should be protected from sunlight. At the time of installation, it should be kept as cool as possible to minimize elongation of the pipe during installation.

c. GEOTEXTILE shall meet the requirements as outlined in PennDOT Publication 408, Section 735, Class 1, Subsurface Drainage.

<table>
<thead>
<tr>
<th>Table 1 – Drain pipe requirements</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Type</strong></td>
</tr>
<tr>
<td>Clay drain tile, solid</td>
</tr>
<tr>
<td>Clay pipe, standard and extra strength</td>
</tr>
<tr>
<td>Clay pipe testing</td>
</tr>
<tr>
<td>Concrete drain tile</td>
</tr>
<tr>
<td>Concrete pipe for irrigation or drainage</td>
</tr>
<tr>
<td>Concrete pipe or tile, determining physical properties of</td>
</tr>
<tr>
<td>Concrete sewer, storm drain and culvert pipe</td>
</tr>
<tr>
<td>Reinforced concrete culvert, storm drain and sewer pipe</td>
</tr>
<tr>
<td>Perforated concrete pipe</td>
</tr>
<tr>
<td>Portland cement</td>
</tr>
<tr>
<td>Pipe, bituminized fiber &amp; fitting</td>
</tr>
<tr>
<td>Styrene rubber (SR) plastic drain pipe &amp; fitting</td>
</tr>
<tr>
<td>Polyvinyl chloride (PVC), Sch’d. 40, 80, 120</td>
</tr>
<tr>
<td>Polyvinyl chloride (PVC) sewer pipe &amp; fitting</td>
</tr>
<tr>
<td>Polyvinyl chloride (PVC) pipe</td>
</tr>
<tr>
<td>Corrugated polyethylene tubing &amp; fitting (3-6 inch)</td>
</tr>
<tr>
<td>Corrugated polyethylene tubing &amp; fitting (8-24 inch)</td>
</tr>
<tr>
<td>Pipe, corrugated (steel, polymer coated)</td>
</tr>
<tr>
<td>Pipe, corrugated (steel, zinc coated)</td>
</tr>
</tbody>
</table>
d. CONCRETE and related materials shall meet the requirements set forth in Construction Specification PA313S, Waste Storage Facility (Structure), and/or as set forth in Section 9.

All materials shall be carefully inspected prior to installation. Clay and concrete tile shall be checked for damage by freezing. Plastic pipe and tubing shall be protected from hazards causing deformation. Any damaged or imperfect pipe or tubing shall not be installed. Any pipe or tubing which is damaged during installation shall be removed and replaced.

3. SITE PREPERATION

All trees, brush, fences and rubbish shall be cleared within the area that the subsurface drain will be installed. All material removed by the clearing and grubbing operation shall be disposed of as directed by the Owner or his/her Representative.

4. INSPECTION AND MATERIAL HANDLING

Material for underground outlets shall be carefully inspected before the drains are installed. If applicable, clay and concrete tile shall be checked for damage from freezing and thawing before it is installed. Bituminized fiber and plastic pipe and tubing shall be protected from hazard causing deformation or warping. Plastic pipe and tubing with physical imperfections shall not be installed. Any damaged section shall be removed and replaced. All material shall be satisfactory for its intended use and shall meet applicable specifications and requirements.

5. SAFETY

All positive “design” responses from the Pennsylvania One Call System are noted on the plans. It is the Contractor’s or Landowner’s responsibility to notify One Call of pending construction and to contact the affected utility for marking at the time of construction.

The Contractor must comply with OSHA requirements Part 1926, subpart P, for protection of workers entering trench.

6. EXCAVATION

Construction operations shall be done in such a manner that soil and water pollution are a minimum and all state and local erosion regulations are followed.

Unless otherwise specified, excavation for each underground outlet shall begin at the outlet end and progress upstream. The trench shall be excavated to the grades and cross sections shown on the drawings. The trench width above the conduit may increase as necessary for safe installation or for the convenience of the Contractor. Trench shields, shoring, or bracing are required whenever workers will be in a trench deeper than four feet, or as otherwise required be OSHA Regulations.

7. INSTALLATION

BEDDING. In stable soils, the conduit shall be firmly and uniformly bedded throughout its entire length as required on the drawings or Section 9. Where the underground outlet foundation is in unstable soils, the bedding shall be as shown on the drawings or as otherwise required by the Engineer. Where the conduit is to be laid in rock, or rock is exposed at the trench bottom, the rock shall be removed at least two inches below the invert grade to allow for compacted bedding under the conduit.

PLACEMENT. Debris inside of pipes and tubing shall be removed prior to installation. The conduit ends shall be protected during placement. Similarly, all appurtenances, including trash guards and animal guards, shall be protected during installation to avoid damage. All underground outlets shall be laid to line and grade, and immediately covered.
with an approved blinding, envelope, or the required depth of filter material. No reversals in grade of the conduit are permitted, no more than five percent stretch is allowed. Special precautions must be taken in hot weather to observe this stretch limit.

Flexible conduits, such as plastic pipe or tubing and bituminized fiber pipe, shall be installed, according to the requirements in ASTM-F-449, "Standard Recommended Practice for Subsurface Installation of Corrugated Thermoplastic Tubing for Agricultural Drainage or Water Table Control."

Earth backfill material shall be placed in the trench in a manner to ensure that the conduit does not become displaced and so that the filter and bedding material, after backfilling, meet the requirements of the plans and specifications.

8. BACKFILL

Initial backfill shall be of selected material that is free of rocks or other sharp-edged material that could damage the pipe. Earth backfill shall be placed in the trench in such a manner that the conduit is not displaced, and that the filter and bedding materials are not contaminated or displaced. Unless otherwise specified, where the underground outlet is laid under roads or at other designated locations, the backfill shall be placed in successive layers of not more than six inches, and each lift compacted before the subsequent layer. Backfill shall extend above the adjacent ground to allow for settlement, and be well rounded over the trench.

Work areas shall be restored to their pre-construction condition or as otherwise required in the plans or Section 9.

9. ADDITIONAL CONDITIONS WHICH APPLY TO THIS PROJECT ARE:
CONSTRUCTION SPECIFICATION

642. WATER WELL

1. SCOPE
The work shall consist of furnishing materials and installing all components of the water well as outlined in this specification and the drawings.

2. MATERIALS
Casings: Casings shall be of steel, iron, stainless steel, copper alloys, plastic, fiberglass, or concrete of sufficient strength and durability consistent with the intended use of the water and the maximum anticipated differential head between the inside and outside of the casing. Unless otherwise set forth in Section 5 of this specification:

- Plastic casings made of acrylonitrile-butadiene-styrene (ABS), polyvinyl chloride (PVC), or styrene-rubber (SR) shall conform to material, dimensional and quality requirements specified in ASTM F 480.
- Filament-wound fiberglass casings (glass-fiber-reinforced-thermosetting-resin pipe, RTRP) may be used if material meets requirements specified in ASTM D 2996. Tests for long-term cyclic pressure strength, long-term static pressure strength, and short-term rupture strength as required in ASTM D 2996 are not needed because the pipe is to be used for well casing. Joints shall meet requirements specified in section 3.8, ASTM F 480.
- Fiberglass pressure pipe (also called reinforced polymer mortar pipe, RPMP, or fiberglass pipe with aggregate) shall meet or exceed requirements specified in ASTM D 3517.

Other casing materials shall be certified by the manufacturer or a registered Professional Engineer as being of adequate strength.

Joints: Well casing joints shall have adequate strength to carry the load due to the casing length and still be watertight, or shall be mechanically supported during installation to maintain joint integrity. Such mechanically supported casings shall terminate on firm material that can adequately support the casing weight.

Screen: Well screens shall be constructed of commercially manufactured screen sections, well points, or field-perforated sections. Perforation by any method is allowable provided the following provisions can be met:

- For uniform size aquifer material, screen openings are smaller than the average diameter of aquifer material;
- For non-uniform aquifer material, screen openings are smaller than 60 percent of the aquifer material;
- Screen openings, for filter/gravel pack must exclude at least 65 percent of the filter pack material;
- Size the length and open area of the screen to keep entrance velocity or shear stress below the threshold for erosion of filter pack particles and transport into the well;
- Casing must not be functionally weakened or deformed.

Gravel Pack: If gravel pack is used, it shall have the gradation and thickness specified in Section 5, or as shown on the drawings.

If acceptable filter materials are unavailable, use a commercially manufactured, pre-packed well screen. A pre-packed well screen consists of inner and outer screens that contain the engineered filter material. The material must meet the following quality criteria:

- Less than five percent fines (the proportion that passes the number 200 sieve);
Predominantly rounded, dense, siliceous materials;

- No angular particles, such as crushed rock, or flat particles, such as mica;
- No earthy or soft materials, such as clay, shale, silt, gypsum, or anhydrite;
- No organic matter, no other impurities or metallic substances;
- No material soluble in hydrochloric acid, such as limestone.

3. EQUIPMENT

The installer shall provide and operate all equipment necessary to install the well in a safe manner. The operator shall have a Water Well Driller’s License and a Drilling Rig Permit, issued by the PA Geological Survey, for the equipment used on the site.

4. INSTALLATION

Drilled, jetted, bored, and driven wells shall be sufficiently round, straight, and of adequate diameter to permit satisfactory installation of inlet, well casing, filter pack, and annular seal, and passage of tremie pipe (including couplings), if used. Hard rock formations or physically stable geologic materials may not require casing except for the uppermost 10 feet. However, casing shall be installed to seal out undesirable surface or shallow groundwater, and to support the side of the hole through unstable earth materials.

If drilling encounters erodible, friable, or otherwise unstable material, install watertight, grouted casing throughout, with the exception of the intake portions.

Provide a watertight seal in the annulus of all well casing. Acceptable sealants include mortar containing expansive hydraulic cement (ASTM C 845), bentonite-based grout, bentonite chips and pellets, sand-cement grout, neat cement, or concrete. The length of the grout seal shall be no less than 10 feet, and not less than the minimum specified in state or locally applicable construction codes.

If one or more zones are encountered that produce water of unacceptable quality, use grout or packers to prevent comingling of waters or cross-contamination of aquifers.

Provide a packer, or similar retaining device, or a sealant between the casing and the less pervious material overlying the aquifer of artesian wells. Provide a similar positive seal to separate water bearing zones where comingling of waters is undesirable.

For artesian conditions, seal the confining geologic units directly above and below the aquifer in such a manner as to retain its confining pressure.

Casing shall extend from above the ground surface down through unstable earth materials to an elevation of at least 2 feet into stable material or to the top of the screen.

If casing extends to the bottom of the drill hole, install a watertight end cap or grout seal to prevent entry of geologic material into the well from the bottom.

When the design requires telescoped screen assemblies, install one or more sand-tight seals between the top of the telescoped screen assembly and the casing.

Upon completion, provide a suitably threaded, flanged, or welded cap or compression seal to prevent entry of contaminants into the well.

Well Development: After completion of well construction, ensure that the well is developed. Well development is required regardless of whether the well is finished in unconsolidated materials or hard rock aquifers. Use one or more development techniques to effectively loosen and remove silt, fine sand, drill cuttings, drilling muds, or additives deposited by the drilling operation on the uncased borehole face and in adjacent portions of the aquifer. For screened zones, the development technique must collapse sand bridges and remove fines outside the screen. Following the development process, remove accumulated sediment at the bottom of the well bore by bailing or pumping.

Pump the well at approximately 120 percent of the anticipated normal production rate until suspended sediment and associated turbidity clears. Do not use the permanent pump to conduct any well development work.

Unless otherwise set forth in Section 5, wells to be completed without a filter pack in unconsolidated granular aquifers shall be developed following guidance provided in ASTM D 5521, Standard Guide for
Development of Ground-Water Monitoring Wells in Granular Aquifers.

The method shall be selected based on geologic character of the aquifer, type of drilling rig, and type of screen.

Aquifer Development: For massive, unfractured rock formations unresponsive to well development procedures, the use of aquifer stimulation techniques may be used to improve well efficiency and capacity, if permitted in Section 5 of this specification. Techniques may include dry ice, acidizing, explosives, or hydrofracturing, depending on the composition and structure of the formation, and as specified in Section 5.

Access Port: An access port with a minimum diameter of 0.5 inch shall be installed to allow for unobstructed measurement of depth of the water surface, or for a pressure gage for measuring shut-in pressure of a flowing well. Access ports and pressure gages or other openings in the cover shall be sealed or capped to prevent entrance of surface water or foreign material into the well. Removable caps are acceptable as access ports.

Wellhead Protection: Surface runoff and drainage that might reach the wellhead from areas used by livestock or other contaminant sources shall be diverted away from the well.

The ground surface around the well shall be graded away from the well for a distance of at least five feet in all directions. Low points where water can puddle on the surface shall be eliminated.

If the well water is intended for human consumption, the casing shall be surrounded at the ground surface by a 4-inch thick concrete slab extending at least 2 feet in all directions.

If the top of the well casing is subject to flooding from surface water, either of two methods shall be used to prevent floodwater from entering the well: (1) the well cap shall be water tight and equipped with a vent that extends two feet above the 100 year flood level, or (2) the well casing shall be extended to two feet above the 100 year flood level.

Disinfection: Wells shall be disinfected immediately following their construction or repair to neutralize any contamination from equipment, material, or surface drainage introduced during construction. The disinfection process shall comply with all local or state requirements.

Prior to final chemical disinfection, remove foreign substances, such as grease, soil, sediment, joint dope, and scum from the well and near the wellhead. Clean all pump parts before placing them into the well. Disinfect the well using a chlorine compound at a concentration of no less than 100 mg/L (100 ppm) available chlorine in solution to treat the entire well.

Water Quality Testing: Sampling and testing shall comply with all applicable federal, state, and local requirements. These requirements vary according to the water quality parameters associated with the intended use(s) of the water. Test well water according to the Construction Specification for Groundwater Testing (PA355).

Well Performance Testing. After completion of well construction and the water level is stable, conduct a pump test to determine specific capacity and dynamic water level. Record the length of test and pumping rate.

Documentation: The well driller shall provide to the landowner and the PA-DCNR Topographic and Geological Survey copies of the water well completion report.

5. ADDITIONAL CONDITIONS WHICH APPLY TO THIS PROJECT ARE:
ADDITIONAL CONDITIONS WHICH APPLY TO THIS PROJECT ARE:

A. The scope of this project includes the installation of a well for providing water to the heavy use area and to the hydrant. It includes all components necessary for the installation, erosion and sediment control provisions, final grading and any needed repair and clean up of the site. It does not include installation of the pump system or pipeline.

B. The contractor is responsible for the location and depth of the well, the method of installation, and any enhancements (e.g. gravel packs, well development, sealing of aquifers, etc.) based on what is encountered in installing the well.

C. The contractor shall explain in detail at the pre-construction meeting or provide a detailed plan of the proposed installation prior to start of construction.

D. The contractor shall review the enclosed plan view drawing, which shows information and limitations for the proposed wells. The casing **must be grouted** to a minimum as shown on the drawings or the entire length including 2ft into bedrock.

E. Wells constructed through unconsolidated (soil) surface material shall be set back at least the following minimum distances from potential contaminant sources:

<table>
<thead>
<tr>
<th></th>
<th>Distance</th>
</tr>
</thead>
<tbody>
<tr>
<td>Waste Storage Facility</td>
<td>100 ft.</td>
</tr>
<tr>
<td>Waste Treatment Lagoon</td>
<td>100 ft.</td>
</tr>
<tr>
<td>Septic Systems, Filter Areas</td>
<td>100 ft.</td>
</tr>
<tr>
<td>Fuel and Agrichemical Storage</td>
<td>100 ft.</td>
</tr>
<tr>
<td>Livestock and Poultry Housing</td>
<td>50 ft.</td>
</tr>
<tr>
<td>Barnyards, Feedlots, etc.</td>
<td>50 ft.</td>
</tr>
<tr>
<td>Sewers, Manure Transfer Lines</td>
<td>50 ft.</td>
</tr>
<tr>
<td>Silos</td>
<td>50 ft.</td>
</tr>
</tbody>
</table>

F. The desired flow rate is at least 5 gpm and the peak projected usage is 650 gal. per day. If the desired flow rate is not achieved, the landowner and contractor will determine to what depth and flow rate will be acceptable. Once the desired flow rate is achieved, any further advancement in depth shall be discussed with the NRCS representative before proceeding.

G. No aquifer development such as hydrofracturing will be permitted without concurrence from the NRCS representative.

H. Casing shall be steel with an outside diameter of 6.625" and have a wall thickness of 0.168" (3/16"). Other casing can be used if approved by the NRCS representative. All casing shall meet the strength requirements in the National Engineering Handbook, Part 631, Chapter 33 (NEH-631-33).

I. The contractor shall provide copies of the “water well completion report” to the landowner, the NRCS representative and the PA Geological Survey.

J. Any disturbed areas shall be seeded and mulched. This will be the responsibility of the landowner.

Krispin Farms
Luzerne County

642-SP4  Water Well
Water Well  July 2017