MARCELLUS SHALE COALITION™

RECOMMENDED PRACTICES: Pipeline Boring

MSC RP 2013-2 May 14, 2013

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Pipeline Boring

1.1 Purpose
The responsible development of natural gas from shale formations requires pipelines to transport natural gas, associated hydrocarbons and water. Permanent pipelines are most often installed by excavating a trench and burying the pipe several feet below the surface. Some situations require a trenchless installation method known as "pipeline boring." Examples include boring under highways, railways and water bodies.

The following recommended practices address relevant considerations and guidelines for pipeline boring and they support the Marcellus Shale Coalition (MSC) guiding principles.

1.2 Nomenclature
Another term used to describe pipeline boring is "horizontal directional drilling" (HDD). The equipment used for a pipeline boring project is unrelated to (and significantly smaller than) the equipment used to drill the horizontal shale wells in the Marcellus and Utica formations.

2.1 Planning
Planning is the first and most critical component of all construction projects. The planning process for a pipeline boring project may include the following:

- Evaluating the topography for feasibility of conducting a pipeline bore. The feasibility of pipeline boring includes local subsurface conditions, site topography and the presence of other surface features such as existing utilities.
- Conducting a geotechnical investigation in or adjacent to the area being traversed.
- Surveying the path of the intended bore. A survey would include defining the limits of the right-of-way including extra workspace that may be required on the entry and exit sides of the bore.
- Developing the bore profile.
- Identifying the location of buried utilities.
- Obtaining all required permits and authorizations.
- Developing a contingency plan.

2.2 Construction
Installation of a bored pipeline is generally accomplished in five stages:

1. Directionally drilling a small-diameter pilot hole along a pre-determined path.
2. Enlarging (or reaming) the pilot hole to a diameter that will accommodate the product pipeline(s). Several "reaming" passes may be necessary to enlarge the diameter of the bore hole incrementally, depending on the size of the required bore.
3. Inspection of the product pipeline prior to installation. This includes visual inspection for coating damage, radiographic inspection of welds and a preliminary hydrostatic test.
4. Pulling the product pipeline through the enlarged hole.
5. Post-installation inspection. This includes visual inspection of visible sections of the piping for coating damage and a hydrostatic pressure test.

The State Regulatory Agency (SRA) may require advance notice prior to boring under a water body.

3.1 Inadvertent Returns
The boring fluid or "mud" is a slurry of bentonite clay and fresh water. Bentonite clay is an inert and non-hazardous material. It is commonly used to seal water wells, soil borings, and earth structures such as ponds or dams. It is used as a suspending component in livestock feeds, as a clarifying agent in winemaking, and in many health and beauty products.

Boring fluids are approximately 4 percent bentonite by volume, with trace quantities of polymers added to improve the performance, allowing a reduction in the amount of boring mud needed. Therefore, about 96 percent of the boring fluid is water.

Pipeline boring involves circulating boring fluid from drilling equipment on the surface, through the drill pipe, and back to the surface, through the drilled annulus (the space between the drill pipe and the sides of the bore hole). Boring fluid will follow the path of least resistance, typically the drilled annulus. However, at some point in the progression of the drill, the path of least resistance may be an existing fracture or fissure in the subsurface. When this happens, circulation can be lost or reduced as mud enters the new path of least resistance. Boring mud losses are often reduced over time as fractures become sealed with boring mud and drill cuttings and, as the annulus increases in diameter with successive reaming passes, the drill hole effectively becomes the path of least resistance. This is a common occurrence in pipeline bores.

A potential environmental impact associated with pipeline boring centers on the inadvertent return of boring mud to the surface via naturally occurring fractures or fissures. Releases of boring mud in upland areas should be contained to prevent further movement of mud and then cleaned up as soon as practicable. A large inadvertent return into a watercourse has the potential to impact sensitive aquatic communities.

3.2 Corrective Actions
During construction of the pipeline bore, personnel should monitor both the ground surface and if applicable, the watercourse in the vicinity of the bore for inadvertent returns and monitor the mud volume and drilling pressures to assess loss of circulation.

Containment, response and clean-up equipment should be immediately available at the pipeline boring location to assure a timely response.

Equipment may include: hay bales, pails, sand bags, silt fences, push brooms, plastic sheeting, pumps, shovels, storage tanks, squeegees and a vacuum truck on call.

In the event of an inadvertent return, the return should be assessed to determine the amount of boring mud being released and the potential to reach watercourses. The first step is to stop the inadvertent return and re-establish circulation as quickly as possible. Adjustments to the mud properties can be considered to help accomplish this. After the inadvertent return is stabilized and cleaned up, it is a recommended practice to document post-cleanup conditions with photographs and prepare a report describing the time, place and actions taken to remediate the return and the measures implemented to prevent recurrence.

The following steps should be considered:

Upland Areas

- Evaluate the return to determine if containment structures can effectively contain the return.
- Suspend boring if the return cannot be controlled until appropriate containment is in place.

Wetland Areas

- Suspend boring until appropriate evaluation and containment measures are completed.
- If the amount of the surface return is not great enough to allow the practical physical collection from the affected area, it should be diluted with fresh water and/or allowed to dry and dissipate naturally.
- Excess mud can be held within the containment area and pumped out using small sumps, or other appropriate measures, at a rate sufficient to maintain secure containment.
- The mud may be stored in a temporary holding tank, or other suitable structure, out of the wetland area for reuse or eventual disposal.

In-Stream Areas

- Suspend boring until appropriate evaluation and containment measures are completed.
- Erect containment to the extent practicable and initiate removal of released mud.
- Collect samples of the drilling mud and of the surface water upstream and downstream of the return.

3.3 Notification Procedures

Release of bentonite to a watercourse may need to be reported to the SRA. In Pennsylvania, it must be reported immediately to the DEP. Additional reporting may be required by a river basin commission. Additionally, downstream landowners or potentially affected water users should be notified. Notification contact information should be included in the contingency plan.

4.1 Abandonment

If corrective actions do not adequately address inadvertent returns, consider sealing the borehole, drilling another hole along a different alignment, or suspending the project. If abandonment is warranted, the following procedures should be implemented to abandon the bore hole:

- Pump thickened drilling fluid into the hole as the drill assembly is extracted, using cement grout to make a plug.
- Install a soil cap close to the surface of the entry and exit holes (within approximately 10 feet of the surface), by filling with soil extracted during construction of the pit and berms.
- Re-grade the entry pit location to restore original grade and condition after the bore hole has been abandoned.

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