

**INDIANA DEPARTMENT OF TRANSPORTATION  
GEOTECHNICAL SERVICES DIVISION**

**AQUIFER PROTECTION GUIDELINES**

**1.0 SIGNIFICANCE AND USE**

- 1.1** The awareness for protecting groundwater quality prompted the 1987 Indiana General Assembly to pass Senate Bill No. 7, which amended Indiana Code 25-39 (IC 25-39) to require water well driller licensing, in addition to water well construction and abandonment standards, following 312 IAC 13.

IC 25-39 specifically exempts "wells drilled for the sole purpose of evaluating the foundation characteristics of earth materials to support bridges, roadways, buildings or other engineered structures." However, INDOT recognizes the importance of protecting groundwater quality and adopts the intent of IC 25-39 by requiring borehole abandonment procedures for all INDOT drilling, as specified herewith.

**2.0 GENERAL GUIDELINES**

- 2.1** Prior to the commencement of all geotechnical drilling, the project's Red Flag Investigation shall be consulted to determine if the project falls within suspected contaminated areas, referred to as Institutional Controls, or within solid waste boundaries. If the project does not cross one of the designated areas, the work shall commence in accordance with these guidelines. If the project does involve one of these areas, the Director of INDOT Geotechnical Services Division shall be consulted.
- 2.2** If solid waste is encountered during a drilling project, or evidence of surface or subsurface contaminants is noted, drilling shall be stopped and the Director of INDOT Geotechnical Services Division shall be notified immediately. Drilling shall not commence again without approval.
- 2.3** Boreholes with instrumentation may require specialized backfilling and abandonment. Piezometers installed in a borehole shall follow INDOT Standard Specification 204.04 requirements. Inclometers installed in a borehole shall follow Section 3.0.
- 2.4** If a void is encountered within the boring, a casing or plug shall be installed. Additionally, notification of the void shall be submitted the Director of INDOT Geotechnical Services Division. When no further exploration is needed, place a grouting basket or plug in the boring immediately above the top of the void then seal boring following Section 2.9 (regardless of depth).
- 2.5** Backfilling methods and plugging material shall be approved by INDOT Geotechnical Services Division for boreholes that are determined to be in an environmentally sensitive area (regardless of depth).

- 2.6** If a flowing artesian condition is encountered during the drilling process, capture the artesian head pressure immediately upon encounter and upon drilling completion by adding a sufficient number of augers or casing to confine the flowing water. Place a heavy grout using a tremie method within the auger or casing for the full depth of the boring. After initial grout placement, incrementally remove the auger or casing while maintaining a full column of grout and inspect for water flow at the ground surface.

Once backfilling has been completed, if water flow is still observed, reinstall augers or casing and replace grout with a heavier grout mix. When unable to capture the artesian head pressure with the addition of the auger or casing, the use of a disposable or grouting packer may be necessary to restrict the artesian flow to allow for grout placement.

- 2.7** The cave-in depth of the borehole shall be determined from ground surface.
- 2.8** For borehole depths between 0 and 15 feet (after cave-in), the bottom portion of the borehole should be backfilled with drill cuttings by dropping them in at ground surface. In boreholes where the soil is expected to settle the additional use of the auger to force the cuttings into the borehole may be beneficial. Bentonite chips should be used on the upper 2.0 feet to ensure that an opening at ground surface does not develop and surface water does not ingress into the borehole.
- 2.9** For borehole depths greater than 15 feet (after cave-in), the entire hole should be backfilled with a plugging material. The plugging material shall be in accordance with 2.10 and shall be backfilled according to industry standard practices and manufacturer's guidelines.
- 2.10** The plugging material must consist of one (1) or a combination of the following:
- A. Neat cement with not more than five percent (5%) by weight of bentonite additive.
  - B. Bentonite slurry, which can include polymers designed to retard swelling.
  - C. Pelletized, medium or coarse grade crushed bentonite.
  - D. Other materials approved by the commission as defined in 312 IAC 13.

### **3.0 INSTALLATION AND ABANDONMENT PROCEDURES FOR INCLINOMETER**

#### **3.1 SCOPE**

- 3.1.1 Inclinator casing shall be installed in accordance with AASHTO R 45-13 Standard Practice for Installing, Monitoring, and Processing Data of the Traveling Type Slope Inclinator, except as modified herein.

#### **3.2 APPARATUS**

- 3.2.1 Drilling rig capable of drilling a hole with a minimum diameter of 8 in. The depth of hole needed varies with the particular installation, locale, or discretion of the engineer. Hollow stem augers and roller bits are the approved boring methods.

- 3.2.2 Guide casing, only round plastic or aluminum, with four equally spaced longitudinal grooves on the inside of the casing compatible with the particular torpedo sensor used. Other types of casing may only be used with prior written approval from INDOT.
- 3.2.3 Protective device to minimize vandalism and large enough to allow the cable clamp-guide wheel assembly to be installed on top of the casing. A steel pipe with either a threaded cap or lockable hinged lid shall be used.
- 3.2.4 Couplings, may be extruded plastic with four equally spaced grooves.
- 3.2.5 Slurry mixture of neat cement grout consisting of 94 pounds of Portland cement mixed with no more than 6 gallons of water will be permitted. No more than 5% by weight, of additives to improve fluidity will be allowed.
- 3.2.6 Slope inclinometer sensor and assembly.

### **3.3 PROCEDURE**

- 3.3.1 Drill borehole to a minimum of 10 feet (or as directed by engineer) into sound rock to achieve sufficient rigidity. The inclinometer casing should be extended at least 10 feet past the farthest anticipated failure plane to insure the readings at the end of the casing do not show movement.
- 3.3.2 Clean borehole by flushing with water or blowing compressed air before attempting to install the inclinometer casing. Depending on installation, drilling mud, if used, may be left in place to control caving and allow for proper backfilling.

Note 1 – If the hole is likely to cave, hollow stem augers may be left in place and pulled after installation of the inclinometer casing.

Note 2 – If drilling mud was used and causes difficulty seating the casing completely in the borehole, this situation may be remedied by filling the casing with potable water.

- 3.3.3 Assemble and install inclinometer casing as specified by the manufacturer's instruction manual.

Note 3 – Orientation of the casing tracking grooves should be properly maintained throughout installation. The grooves should be oriented parallel and perpendicular to the anticipated direction of movement, or at the discretion of the engineer. The groove orientation of different inclinometers in the same project area shall be consistent to avoid confusion.

Note 4 – Each joint shall be coupled properly to prevent intrusion of slurry backfill.

- 3.3.4 Backfill around installed casing with slurry mixture. The slurry mixture shall be pumped into the borehole from the bottom in a continuous operation to prevent voids in the backfill.

Note 5 – Care shall be taken to maintain proper orientation of the slope inclinometer casing while backfilling.

- 3.3.5 Install protective device.

- 3.3.6 Monitor slope inclinometer guide casing with slope inclinometer sensor.

Note 6 – After casing is installed, the initial readings should be deferred at least 24 hours to allow the slurry mixture to settle and the casing to stabilize.

Note 7 – Refer to individual manufacturer's operating manual for recording data and data reduction.

- 3.3.7 The borehole shall be properly abandoned when the monitoring period has ended. The casing shall be abandoned using bentonite slurry or neat cement to within 2 feet of the ground surface. Care should be taken to ensure the lower portion of the casing is adequately grouted. The casing shall be terminated and capped with concrete.