

Wells/boreholes and Vacuum Holes Decommissioning Procedure

This document provides information on typical decommissioning methods that are suitable for use by industry during or following environmental and / or geotechnical site work.

Objectives

The main objectives for decommissioning are to prevent surface water infiltration into an aquifer via the monitoring well, to prevent the vertical movement or migration of contaminated water within a monitoring well/borehole to other aquifer zones and to remove potential physical hazards.

Definitions

Bentonite a type of processed natural clay material used to seal wells. When hydrated with water, bentonite has low permeability, is non-shrinking and is highly viscous. Bentonite is available in powder (for slurries), granular, chip and pelletized form.

Clay an extremely fine grained, cohesive soil material that meets the classification for clays as determined under the Unified Soil Classification System (ASTM D 2487-00) and has a relatively low permeability capable of meeting a laboratory tested value for hydraulic conductivity no greater than 10^{-6} cm/s.

Decommissioning the process of properly and permanently filling in and sealing an environmental monitoring well or borehole or vacuum hole to prevent surface water infiltration into an aquifer via the well, to remove it as a potential physical hazard and to prevent movement of water and contaminated water within the well.

Grout any stable and impervious bonding material that is capable of preventing the vertical movement of water within decommissioned monitoring wells and boreholes. Typical grout materials include bentonite and neat cement. In some cases, such as for salt water or contaminated well applications, grout may need to be specifically designed to be nonshrinking and non-reactive.

High Solids powdered, or granular, bentonite clays mixed in water to form a high density

Bentonite Grout slurry that contains at least 20 percent bentonite solids by weight and when set exhibits a flexible, low permeability grout seal.

Neat Cement cement slurry containing Portland cement and water. When cured, neat cement forms a hard, rock-like impermeable barrier.

Pressure Grout method grout placement that pumps liquid grout under pressure through a hollow tremie pipe, or hose, placed to the bottom of a monitoring well. The tremie pipe is typically gradually withdrawn as grouting proceeds to fill the monitoring well. Water is displaced as the grout fills the hole from the bottom up to the surface.

Methods

Borehole / well or vacuum holes decommissioning should be conducted by experienced environmental and geotechnical drilling contractors, or other knowledgeable industry consultants. The following are decommissioning methods recommended for typical (51 mm diameter, or 2 inch monitoring wells) and other monitoring wells. Decommissioning under

conditions other than the typical ones described should involve greater evaluation by City of Burnaby Environmental Services prior to approval.

Environmental Monitoring Wells

- 1) All pumping equipment including pumps, tubing and other obstructions from the well should be removed.
- 2) The total depth of the well should be measured and recorded.
- 3) The entire monitoring well casing should be removed. Where removal of casing is difficult and may result in geologic formation collapse into the borehole. If casing is not removed, it should be drilled out to a minimum depth of 3.5 metres prior to grouting.
- 4) Monitoring wells should be typically decommissioned by entirely filling the monitoring well or remaining borehole annulus with grout, after pulling the casing, by either:
 - a. **pressure grout method** - Placement of an appropriate mix of neat cement, sandcement concrete mix (no gravel), high solids (>20%) bentonite grout or other nonshrinking liquid grout from the bottom of the well to the top of casing using a tremie pipe or hose.
 - Volumes of liquid grout placed in a well should closely match the estimated amount needed to fill the well. Where possible, at least 0.3 m additional grout should be placed above the top of the casing, followed by a minimum of 0.3 m compacted natural fill to grade; or
 - b. **hand placement of dry granular bentonite chips** - For wells less than 5 m (16.5ft) deep, medium or coarse grade, dry screened bentonite pellets may be installed by hand pouring. For wells greater than 5 m (16.5 ft) deep it is recommended that only coarse grade (i.e. greater than 3/4 inch or 1.9 cm) dry screened bentonite pellets be used. Pelletized and/or coated bentonite materials that have slower hydration times should be used to reduce premature swelling, adhesion and possible bridging of material in the hole.
 - All dry granular bentonite pellets used should be adequately screened over a wire mesh screen during placement to prevent fine particles that are typically present in bags from entering the well and causing premature swelling and bridging. Bentonite pellets should be poured slowly into a well no faster than manufacturer recommended rates. Bentonite grout levels should be checked periodically using a weighted line to ensure bridging is not occurring in the well.
 - Volumes of bentonite pellets placed in a well should closely match the estimated amount needed for sealing. Grout should fill to the top of the casing. Where possible, at least 0.3 m additional grout should be placed above the top of the casing, followed by a minimum of 0.3 m compacted natural fill to grade.
- 5) The surface at the location of the former monitoring well/borehole should be completed meeting the MMCD and ensure paving or grading to eliminate surface water ponding, as well as using topsoils to promote the establishment of vegetation, if appropriate. The potential for grout settlement in the borehole over time should be considered and accounted for.
- 6) A written submission should be provided to City of Burnaby Environmental Services documenting the exact location of each decommissioned well/borehole on a site plan, as well as the details of the decommissioning to confirm that correct methods have been followed.
- 7) Other monitoring well grouting methods may be possible for deep monitoring wells (>30 m), larger diameter monitoring wells (>150 mm), multi-level installations, artesian flow conditions or other non-typical situations. However, site specific decommissioning

methods that do not follow the typical methods described here should be proposed in a written decommissioning plan to City of Burnaby Environmental Services by a professional geoscientist or engineer qualified in hydrogeology. The decommissioning plan must be acceptable to the City of Burnaby Environmental Services.