Appendix VIII

Guidelines for groundwater bores and wells

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1. Construction

Bores used for water supply are normally constructed by drilling, either by augering, the cable-tool method or by the rotary method. Wells are usually augered or dug.

1.1 Drilling fluids

Drilling fluids are used to stabilise drilling and completion operations. The following types of drilling fluids are acceptable for water bore drilling:

- free water-based drilling fluids;
- natural drilling fluids;
- air based drilling fluids.

Additives to drilling fluids that are acceptable for water bore drilling are classified as follows:

1. Dissolved additives

    (a) Mud-thinning agents, inorganic phosphates;

    (b) Surfactants, drilling detergents, and foaming agents.

2. Non-dissolved additives

    (a) Native solids (clays and sand);

    (b) Bentonite;

    (c) Density increasing materials;

    (d) Loss-circulating materials (not to be used in the production zone).

The contractor shall record drilling fluid properties (when used) on the well completion form.

1.2 Bore casings

The selection of bore casings is left to the contractor unless otherwise specified by the purchaser.

Permanent bore casings must be continuous and watertight from top to bottom. Inert casing should be used when saline groundwater and corrosive conditions are known to exist.

1.2.1 Joints

Casing joints must be appropriate to achieve a continuous watertight seal from top to bottom of the casing string. Typical joints include welded or threaded steel or PVC.

1.2.2 Casing installation

The method of casing installation shall be at the option of the drilling contractor, provided the installation meets the requirements of Policy 6.5.1. In all cases, casing must be sealed to prevent aquifer cross-contamination and aquifer contamination from the surface.

1.2.3 Seating and sealing of casing

(a) Seating in consolidated rock

In consolidated formations, if steel casing is used, the casing can be seated by driving it into the surface until a seal is obtained.

(b) Sealing in open hole

Casing in an open hole must be cemented into casing to create a seal and to maintain the structural integrity of the bore.

1.3 Completion of the headworks

At all times during the progress of the work, the contractor shall use reasonable precautions to prevent either tampering with the bore or the entrance of foreign material or water into the bore.

The completion of the bore or well headworks must be consistent with Policy 6.5.1 to prevent aquifer contamination from the surface. This may be achieved by:

- extending the height of casing above the ground at least 0.3m;
- sloping the ground away from the bore casing to prevent run-off from entering the bore;
- capping the bore, allowing only an access port for a 20mm diameter groundwater probe;
- concreting and sealing around the outer annulus of the casing at the surface.

1.4 Screens

The selection of screens is up to the contractor unless otherwise specified by the purchaser. It is recommended that all available information on the aquifer is evaluated for proper bore design. The screen required to ensure a highly efficient bore is determined by the thickness and hydrologic character of the aquifer. It is recommended that:

(a) Screen diameter – the minimum size that will maintain an entrance velocity of 0.03 – 0.45m/s or less;

(b) Screen length – the minimum length is determined by the following formula

$$L = \frac{Q}{7.48AV}$$

Where:

L = length of screen in metres
Q = quantity specified by the purchaser, in litres/second
A = effective aperture area per metre of screen, in square metres
V = design, entrance velocity, in metres/second

2. Grouting and sealing

Sealing consists of filling the annular space between the casing and the bore hole with a substance that forms a seal. In accordance with Policy 6.5.1, the bore must be sealed to prevent the entrance of water from any other source other than the aquifers selected or to prevent the passage of water outside the casing.

2.1 Surface seal

The annular space around the conductor and/or bore casing and the bore hole, from the surface to a designated depth should be grouted.

2.2 Sealing of selected zones

All aquifers, including the water table, which are not the target aquifer must be sealed off outside the casing to prevent leakage.

3. Bore development

Bore development consists of the application of appropriate techniques designed to bring the bore to its maximum production capacity so as to optimise the bore efficiency, specific capacity, stabilisation of aquifer material and control of suspended solids.

It is recommended that the test pump capacity exceeds that of the final capacity of the bore and that the test pump is set in excess of the anticipated pump level.

4. Abandonment of test holes and disused bores

Test holes, partially completed bores and disused bores need to be sealed to:

(a) eliminate physical hazards;

(b) prevent contamination of groundwater;

(c) conserve yield and hydrostatic head of aquifers;

(d) prevent aquifer cross-contamination (inter-aquifer flow).

The guiding principle to be followed by the contractor in sealing abandoned bores is the restoration, as far as feasible, of the controlling geological conditions before the bore was drilled.

Where possible, casing should be removed. Concrete cement grout or sealing clay should be used as sealing materials. No part of the bore should be left as an open hole. Fill material should consist of clean sand, coarse stone, clay or backfill. The groundwater

discharge from flowing bores must be controlled by cement grout before sealing. All bores should be sealed at the ground surface.

Records should be kept and supplied to the Taranaki Regional Council of abandonment procedures, including groundwater conditions, depths sealed and backfilled and materials used.