



water for life
Suavai mo le Ola

SAMOA WATER AUTHORITY

TECHNICAL SPECIFICATIONS WATER PRODUCTION BOREHOLES

Technical specifications for the construction and equipment of production boreholes

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1 Description on Construction & Equipping of Water Production Boreholes of Samoa Water Authority (SWA)

Information contained herewith describes the technical specifications applicable to the Construction & Equipping of SWA Water Production Boreholes.

The General Objective consists of Drilling, Construction and Testing of boreholes for groundwater recovery. The Provisional Scope of Specifications includes:

- The Drilling of Water Production Boreholes must be carried out with a Drill String of 12 inch Minimum Nominal Diameter.
- The Equipment of these Boreholes must use uPVC and/or steel casings, Johnson screens, filters and gravel pack, cemented seals, etc in accordance with specifications.
- Test Pumping, includes Step Testing and Constant Discharge - long duration (3 days) pumping
- The Supply and Installation of Submersible Pumps and works associated with electrical installation and connection to the existing distribution network
- Training of SWA Staff in Drilling Techniques, Borehole Equipment and Pump Testing.

2 Geological & Hydrogeological Context

The predominantly basaltic rocks of the Samoa have been erupted from a great number of volcanic cones distributed over the uplands. The oldest rocks occur mainly on Upolu Island and the youngest one in Savai'i. The general structure is that of a deeply eroded Pliocene or early Pleistocene volcanic terrain, flanked and largely buried by late Pleistocene and recent lavas.

The oldest rocks, the Fagaloa Volcanics occur mostly in the NE district and the central mountains of Upolu, to a lesser extent in SW Upolu, in northern Savai'i near Fagamalo. They consist of basaltic lava flows (aa –blocky lava fragments - and pahoehoe – pillow lavas) with associated dykes, tuffs and cone deposits.

Rocks of the four most widely distributed volcanic groups – Salani, Mulifanua, Lefaga and Puapua – rest unconformably on, and fill valleys eroded in, the Fagaloa rocks. They are all constituted of olivine basalts but differ in soil thickness and weathering depth. In general terms the older the formation, the greater the degree of weathering and the lower the permeability of the formation.

Sedimentary rocks are scarce and occur only at low altitude. They include some sands deposited by the sea and river mouth gravel, swamp mud, coral reefs and cemented beach sands at present sea level. Figure 1.0 below shows the Geological Sketch of Samoa and the Main Geologic Characteristics are summarised in Table 1.0.

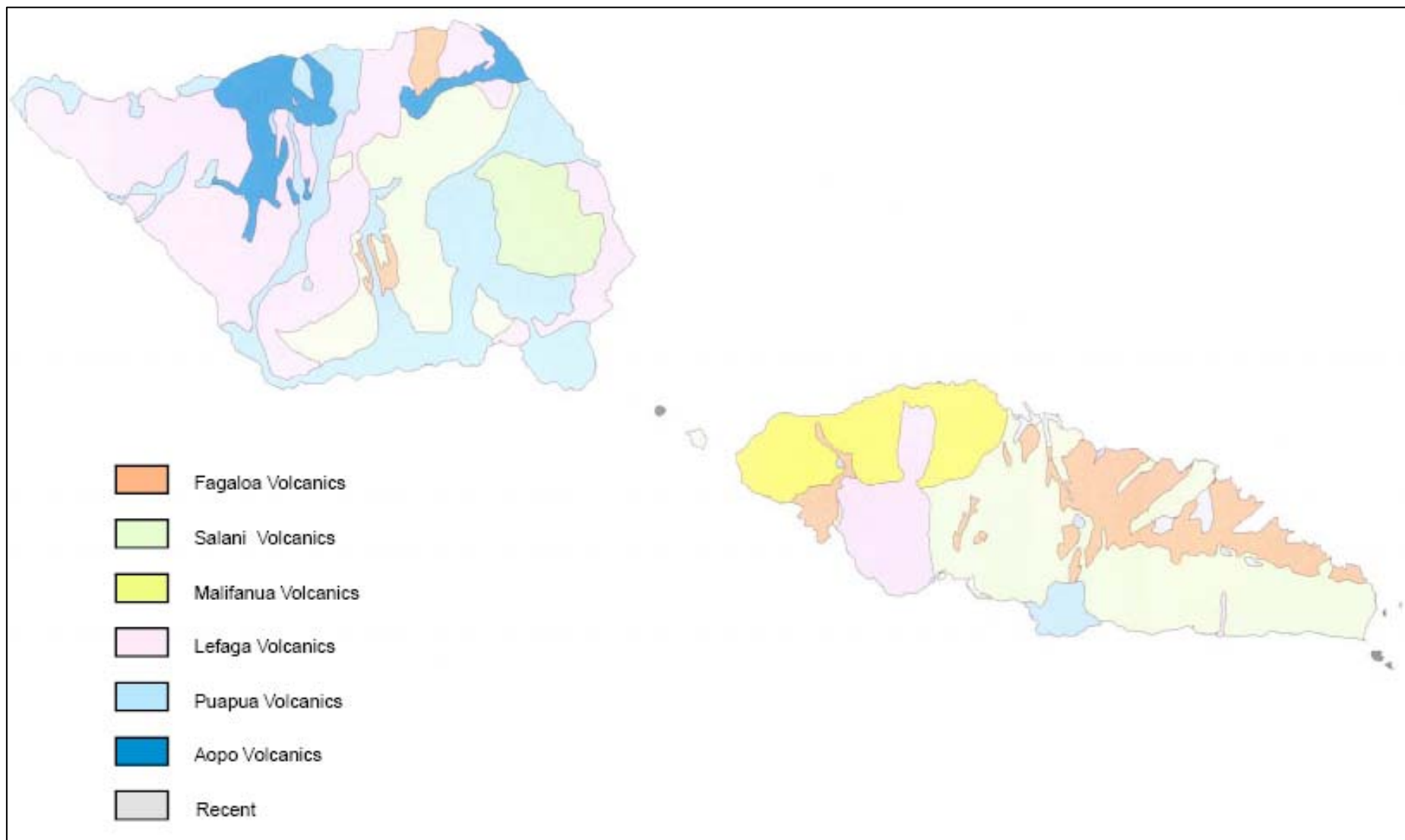


Figure 1.0 : Geological Sketch of Samoa

| FORMATION | LITHOLOGY | PETROGRAPHY | DEGREE OF WEATHERING | GROUNDWATER POTENTIAL | SURFACE WATER |
|------------------|--|--|-----------------------------|------------------------------|----------------------|
| Fagaloa | Intercalated aa and pahoehoe flows, rubbly scoria, brown ash beds, vitric tuffs and basaltic dykes | Picrite to olivine basalts, feldspathic basalt, hornblende andesite and trachyte | Important (up to 30 m) | Poor (perched) | Always |
| Salani | Fine grained porphyritic basalt at the base which grades upwards through vesicular basalt to rubbly aa | Picrite basalts and olivine dolerite, | Over 0.3 m | Locally (basal/perched) | Occasionally |
| Malifanua | Vitreous, porphyric and non-porphyric basalts, more or less vesicular and interbedded with aa | Picrite basalts and olivine dolerite, | Moderate | Good (basal) | Rare |
| Lefaga | Feldspathic porphyritic basalts with greenish and red scoria in thick irregular beds. | Picrite basalts and dolerite, | Moderate | Good (basal) | Virtually none |
| Puapua | Pahoehoe basalts, vesicular, with black and red cinder, scoria and scoriaceous basalt | Picrite and olivine basalts, vitric tuffs, | Slight | Good (basal) | Virtually none |
| Aopo | Ropy, vesicular, porphyritic basalts | | None | Good (basal) | None |

Table 1.0 : Geologic Characteristics of Samoa

The basalts in Samoa form heterogeneous highly fractured aquifers with water occurring and flowing in fractures in the rocks or in permeable porous material (tuffs, scoria, cinders). Groundwater flow is generally a combination of both. Groundwater occurs in the basal aquifer as freshwater (mainly supplied by rainwater infiltration) and saltwater (marine intrusion).

Because the freshwater lens is thin throughout most of the coastal area, the productivity of most wells is likely to be limited by saltwater intrusion. Wells located near the coast are more likely to encounter production limitations due to salinity than wells located farther inland, where the freshwater lens is thicker.

3 General Specification

The information given in this document is only provisional and given in good faith.

Unless otherwise specified in this Specification, the construction and materials of all SWA Borehole Works shall comply in all respects with the latest editions of all relevant Australia & New Zealand (AS/NZS) Engineering Standards, Specifications and Codes of Practice adopted by SWA & the Institute of Professional Engineers, Samoa (IPES), including all current amendments.

4 Construction of Boreholes

4.1 Drilling of Production Boreholes

Temporary steel casing shall be installed in every borehole where needed to protect the walls from caving, either suspended by a ground bearing bracket or correctly anchored in the underlying hard rock.

All permanent protruding steel casing shall constitute the upper and outer protection of the borehole and will be covered by a steel cap with a padlock or any closing device approved by SWA.

All water production boreholes shall be drilled (cf. Fig 3 – borehole sketches in Annex):

- at 17'1/2 (Ø 444 mm) through the overburden for a minimum of 1 m into the solid formation with a total minimum depth of 3 m.
- Run in 16" (406 mm) temporary casing.
- Run in 12" (Ø 305 mm) subsequent to the grout setting, to final depth.
- Run in 8" (200 mm) casing with the top of the continuous screen section placed 3 m below sea level.
- Insert gravel pack from bottom upwards up to 5 m above Johnson's Stainless Steel screens by means of a tremie pipe
- Insert bentonite plug and leave to swell for a minimum of 10 hours.
- Grout over whole of remaining length with clean cuttings up to 3 m below ground.
- Run in 12" (300 mm) steel protection casing protruding 0,5m above ground level prior to pulling temporary casing. Grout with cement over whole length, as temporary casing is removed and place cement plinth and steel flange and cover plate.

4.2 Sampling and Observations during Drilling

Representative samples of the strata intersected shall be collected every 1m by whatever method is standard for the drilling technique in use and approved by SWA. Precaution must be taken to guard against sample contamination due to poor circulation, hole erosion, or caving.

5 Well Design & Development

5.1 Well Design of Boreholes

Boreholes considered by SWA to be productive shall be equipped upon the completion of drilling activities. The Supervisor shall instruct on the final depth of the borehole and the location of full and slotted screens, based on the objective to obtain a constant discharge rate of at least 30 m³/h.

All production boreholes with a depth less than 100 m shall be equipped in their total depth with rigid polyvinyl-chloride-(uPVC)-casing PN10, of sizes DN200, inner diameter at least 195 mm and wall thickness at least 10 mm.

Screens will be of the Johnson type, DN200, made of stainless steel. Below the screen section a 2 m bail casing and bottom plug will be fitted. It is foreseen to install a length of 5 m screen in front of the aquiferous layers. The screen pipes shall have slot widths of 1 mm and an open area of at least 33 %. The whole column (casing and screen) will be assembled by threading. SWA checks technical specifications of the casings and screens manufacture and selects the appropriate materials supporting the pressure and tensile strengths at the scheduled installation depths.

All production boreholes with a depth less than 100 m shall be equipped in its total depth with steel plain casing sizes DN 200, inner diameter at least 195 mm. Screens will be of the Johnson type, DN200, made of stainless steel. Below the screen section a 2 m bail casing and bottom plug will be fitted. It is foreseen to install a length of 5 m screen in front of the aquiferous layers. The screen pipes shall have slot widths of 1 mm and an open area of at least 33 %. The whole column (casing and screen) will be assembled by threading or welding. SWA checks the technical specifications of the casings and screens manufacture and selects the appropriate materials supporting the pressure and tensile strengths at the scheduled installation depths. Cathodic protection must be installed between steel and stainless steel sections.

5.2 Filter Gravel

The annular space between the casing assembly and the wall of the drilled borehole shall be quartz gravel shrouded from the bottom up to 3 m above the uppermost screen section. The grain size of the filter gravel shall be uniformly graded from 2 to 4 mm unless specified otherwise by SWA. Gravel of the adapted grain size shall be made available in sufficient quantities on drill site in order to avoid any delay during borehole equipment.

Filter gravel is poured in the annular space between permanent casing and the wall of the borehole. The gravel shall be rounded and calibrated pure quartz gravel extracted from sources approved by SWA.

Directly on top of each filter gravel, an impervious clay core (bentonite) plug shall be installed in a total length of 1 m. The annular space on top of the clay plug shall be backfilled with clean cuttings up to 3 m below original ground level. The last 3 m of annular space shall be cemented after development of the borehole.

5.3 Well Development

All boreholes shall be drilled and cased straight and vertical and all casings and liners shall be set round, plumb and true to line. SWA has the right to reject any or all casings which fails to meet this specification.

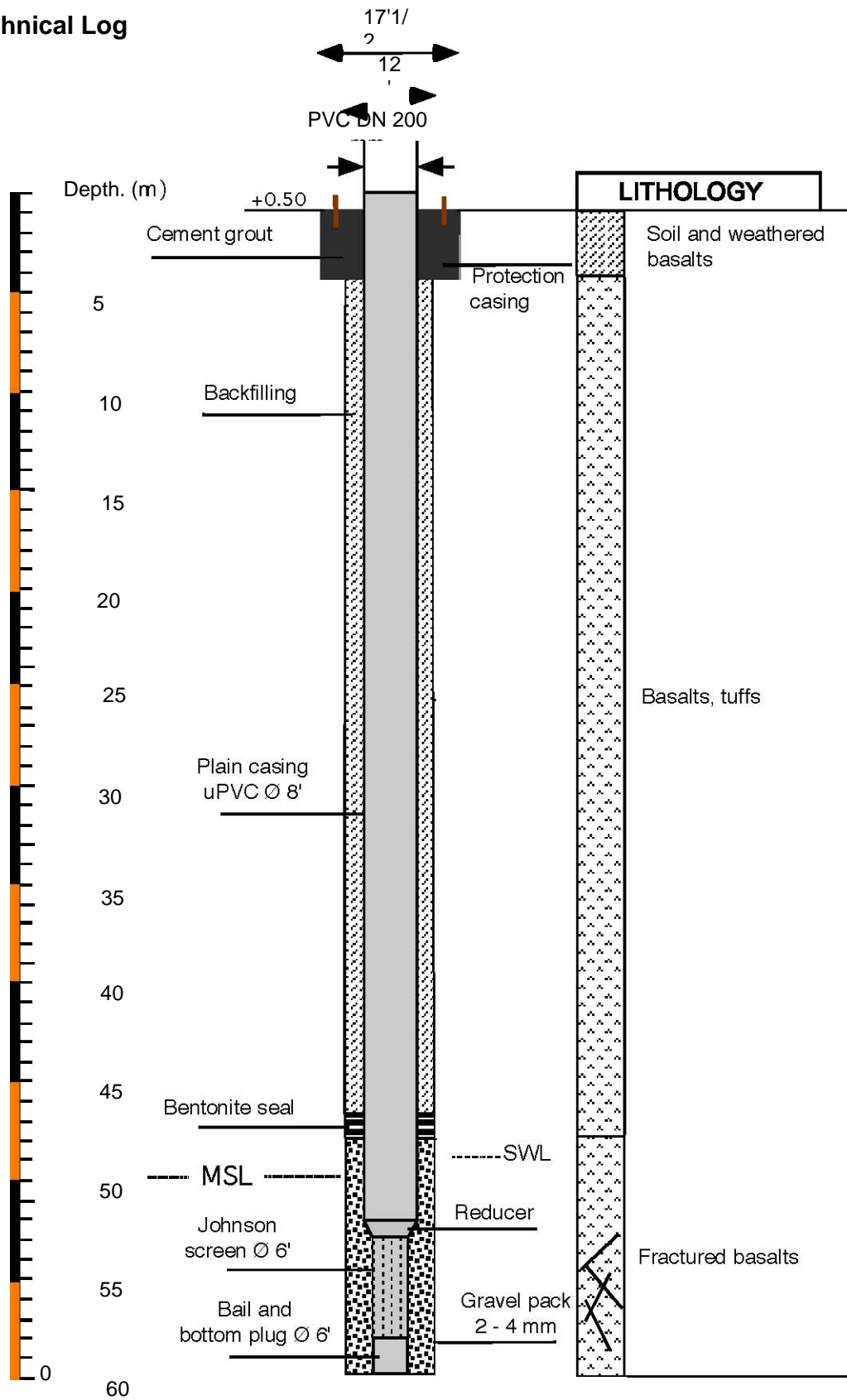
Production boreholes, on completion of construction, shall be developed to a maximum yield of water, free of suspended materials. Development will be carried out on the instructions and as directed by SWA.

The development of each borehole shall start directly after the completion of backfilling. Before development starts, the original depth of the installed permanent casing and the static water level is measured taking original ground level as reference.

Water Production Boreholes must be developed with great care to avoid any damage to the casings, the screens or the formation resulting from application of excessive pressures or inappropriate techniques during the development.

**Samoa Water Authority
Borehole Sketch**

Technical Log



WASSP DRILLING PROGRAMME SAMOA : Fig 3 -BOREHOLE SKETCH

Technical Log

