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Ashley D. Cody

IGA, NZSS, GSNZ

Geothermal and Geological Consultant
10 McDowell Street, Rotorua
E-mail: codya@wave.co.nz

Telephone 07-3470-669
Fax 07-3489-499
Mobile 025-2755-805

David Heard
D.C. Heard Ltd
28 Stanley Drive
Lynmore, Rotorua
(ph. 07-3455-558 hm; 027-4950-353)

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Geological Report: 96 Pukuatua Street

This report is provided following your verbal instructions of December 2001. On site investigations were done on Sunday 06 January 2002.

1.0 BRIEF

To inspect site at 96 Pukuatua Street and supply a geological report about ground conditions with respect to potential geothermal hazards. A separate report on engineering investigations of this area has already been provided by Tonkin and Taylor (their report No. 15549 and dated 19 September 1997).

2.0 SITE DESCRIPTION

The section is at 96 Pukuatua Street and the land parcel is known as Lot 2, DPS 82612, Town of Rotorua. Its area is 1465m² and is flat lying, on the south side of Pukuatua Street opposite the old netball courts and Kuirau Park.

Presently the site is undeveloped and is sparsely vegetated in temperate pastoral grasses. A residential dwelling had been present on this site since at least 1932 up until about 1987. Soon after that date the old house was removed and a rhyolite gravel infill brought in to compress the land and also raise its elevation.

In January 2002 the section was level with no topsoil present and the hard gravel infill partially exposed. Ground surface was about 0.3m below the level of Pukuatua Street, so that it occupies a topographic low lying area. There was no surface evidence of any warm or hot ground, nor any sulphurous deposits, to indicate any presently occurring geothermal activity.

3.0 GEOLOGICAL SETTING

The section is located on a low lying plain comprised of shallow lake silts and swampy peats. It is immediately west of higher ground under the Central Business District (CBD) of Rotorua, which is located over the broad top of a buried lava dome that outcrops as Pukeroa (or Hospital) Hill. Numerous hot spring upflows occur along the northern and western margins of this lava dome and result in the abundant geothermal activity in Kuirau Park.

Lake Rotorua water level has varied greatly but by 9,000 years ago it fell quickly to about its present day level of 280m above sealevel (m asl). About 7,000 years ago it rose again by about 13m, at which time this site at Pukuatua Street was submerged and yet again accumulated fine lake silts. By 2,000 years ago the lake had fallen to near its present day levels and this area was a swampy marsh.

This section at 96 Pukuatua Street has no evidence of surface geothermal activity nor evidence of such activity in the top 2.5m depths, which represent the past c. 2,000 years. However, deep drillhole stratigraphy and fluid data, chemistry and other information indicates that geothermal conditions are present beneath this section.

Production well RR875 is located in the northeast corner of No.96 Pukuatua Street. It is 137m deep and produces fluid of about 160°C, indicating that only a thick cover of impermeable sediments is preventing any surface geothermal activity on this property.

4.0 INVESTIGATION PROCEDURES AND RESULTS

Four ground inspection holes were augered up to 2.5 metres deep at places shown in Figure 1. These holes were sited to examine the subsurface ground conditions around the section and because of the general uniformity of subsurface materials and conditions, four holes were considered sufficient.

Stratigraphic summaries of these holes are shown in Figure 2, which also include notes about temperatures. Heatflows across the section have not been contoured because all results were at ambient, or non geothermal values.

4.1 Geothermal Wells

Any geothermal well is an additional potential threat because its steel casing is prone to corroding away and allowing superheated waters to escape to the surface, sometimes with explosive and destructive consequences.

The nearest known geothermal well is RR875 located on this section. Due north across Pukuatua Street is well RR219, which has been disused since 1987. That well is about 50m away and is under pressure. It was drilled in the 1950s and because of its age it represents a possible safety issue for surrounding property and persons. However, it is likely to be cement grouted shut very soon because of its age. There is no soakhole or flowing hot spring on this property.

4.2 Auger Hole Materials and Conditions

Locations of augered inspection holes are shown in Figure 1 and descriptions of materials found in each hole are given in Figure 2. All holes are were of broadly similar materials, with assorted infill comprising the upper 0.5-0.7 metres of ground. This was underlain by a rich loamy black soil 0.1-.2m thick, under which was a fine grained massive silt unit.

This silt was pale fawn colour in its upper horizons but graded into pale creamy grey colour within ~0.5m or so. It contained root hairs (flax and manuka?) but no evidence of any geothermal attack or weathering. No silica sinters or cemented sediments were found, confirming the absence of geothermal activity here during the last c. 7,000 years.

Water levels were at about 2m or less depth from ground level, but these water temperatures were all ambient and the waters non mineralised; ie. it *drainage?* was recent rain waters only. The silt was not penetrated to its base, but from well drilling information is expected to be in the order of 30-100m thick.

However, the silt unit is very thixotropic, or sensitive to liquefaction upon any sustained vibration. This same material occurs beneath a large area of central urban Rotorua city at very shallow depths, but in historical time spanning the past c.150 years there is no knowledge of any liquefying event having occurred anywhere in Rotorua.

4.3 Heat and Gas Flows

Auger hole profiles (Figure 2) show measured temperatures at indicated depths. All 0.2m and one metre depth temperatures measured were at ambient or non geothermal ground values of 16-18°C. at 0.2m depth and of 18-22°C at one metre depth.

(These ground temperatures represent natural conductive and non-geothermal (or ambient) heatflows of about 0.5 Watts per square metre ($W.m^2$) or less. Gas and steam upflow was not evident anywhere on the property, nor from any augered hole.

5.0 SUMMARY OF FINDINGS AND RECOMMENDATIONS

The section has been stable and without any geothermal activity or thermal problems throughout historical times spanning the past c.150 years. A house was on site during c.1932-1988 and had no history of any geothermal activity or problems. The naturally present ground materials down to at least 2.5m depth had no evidence of any geothermal alteration, attack or corrosion.

The present heatflow across the section is entirely ambient non geothermal conductive heating, of the same values as a similar site outside of the geothermal field.

5.1 Stormwater Disposal

Soakholes will not be able to infiltrate rainwaters on this property, due to the very thick and fine grained silts and clays. These fine sediments are up to about 100m thick and are unlikely to contain any coarse grained permeable beds to take water. On the contrary, any permeable unit will be under artesian pressure and will actually upflow water instead. Ideally there should be no in ground soakholes at all and rainwater should be channeled off the section if possible.

5.2 Building Footings and Ventilation

Any footings excavations should be founded upon an adequate load bearing material, which may have to be brought into the site. Although the site has a rhyolite gravel infill present, this is upon a rich organic soil layer and a peaty layer around the central to northwest of the site.

5.3 Corrosion Tolerant Materials

There is no need for any in ground pipes or cables to be constructed from materials tolerant of acid gases or high temperatures.

6.0 POTENTIAL GEOTHERMAL HAZARDS

This property is at some risk from natural and manmade geological hazards, due to its location inside the Rotorua caldera. However, it is at no greater risk from many of these potential threats than many other properties in Rotorua. The owners need to be aware of some small potential threat due to underlying geothermal conditions, as it is feasible that strong ground shaking could open fissures to allow geothermal gases or fluids to rise here. However, there is no evidence of such an event here in the past c.7,000 years.

6.1 Natural Geothermal Hazards

Any risk from natural geothermal activity to this site is most likely to be caused by strong earthquake shaking, which could be due to tectonic earthquakes or to those accompanying resumed volcanic activity near to Rotorua city. Earthquakes of sufficient strength to cause ground shaking and rupturing in Rotorua city are expected about once every 40-50 years with modified Mercalli magnitude of MM 7 or greater and about 180 years for MM 8 or greater (Hull, Downes, Van Dissen, 1994). Any resumption of nearby volcanic activity may occur at any time in the future.

6.2 Manmade Geothermal Hazards

This site could be affected by thermal activity induced by inappropriate human actions. Any geothermal well nearby would pose some risk due to its possible blowout, especially as it aged and its casing corroded away. Rotorua District Council (RDC) and Ministry of Labour both have various responsibilities to ensure reasonable safety of geothermal wells, although wells have a history of causing property damage in Rotorua city.

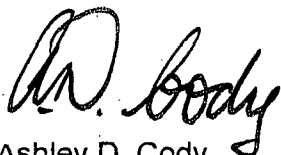
Uncontrolled increased drawoff from geothermal wells could lower the RGF pressure so that much greater zones of boiling may form, which in turn would lead to the possibility of gas or steam upflows. However, it is unlikely in the foreseeable future that geothermal energy use could become unmanaged in Rotorua.

7.0 REFERENCES

Hull, A.; Downes, G.; Van Dissen, R. 1994: "Earthquake hazards of the Bay of Plenty Region". Bay of Plenty Regional Council Resource Planning Publication 95/1, June 1995.

Please contact me if further discussion is required.

Yours sincerely



Ashley D. Cody
Geothermal Geologist

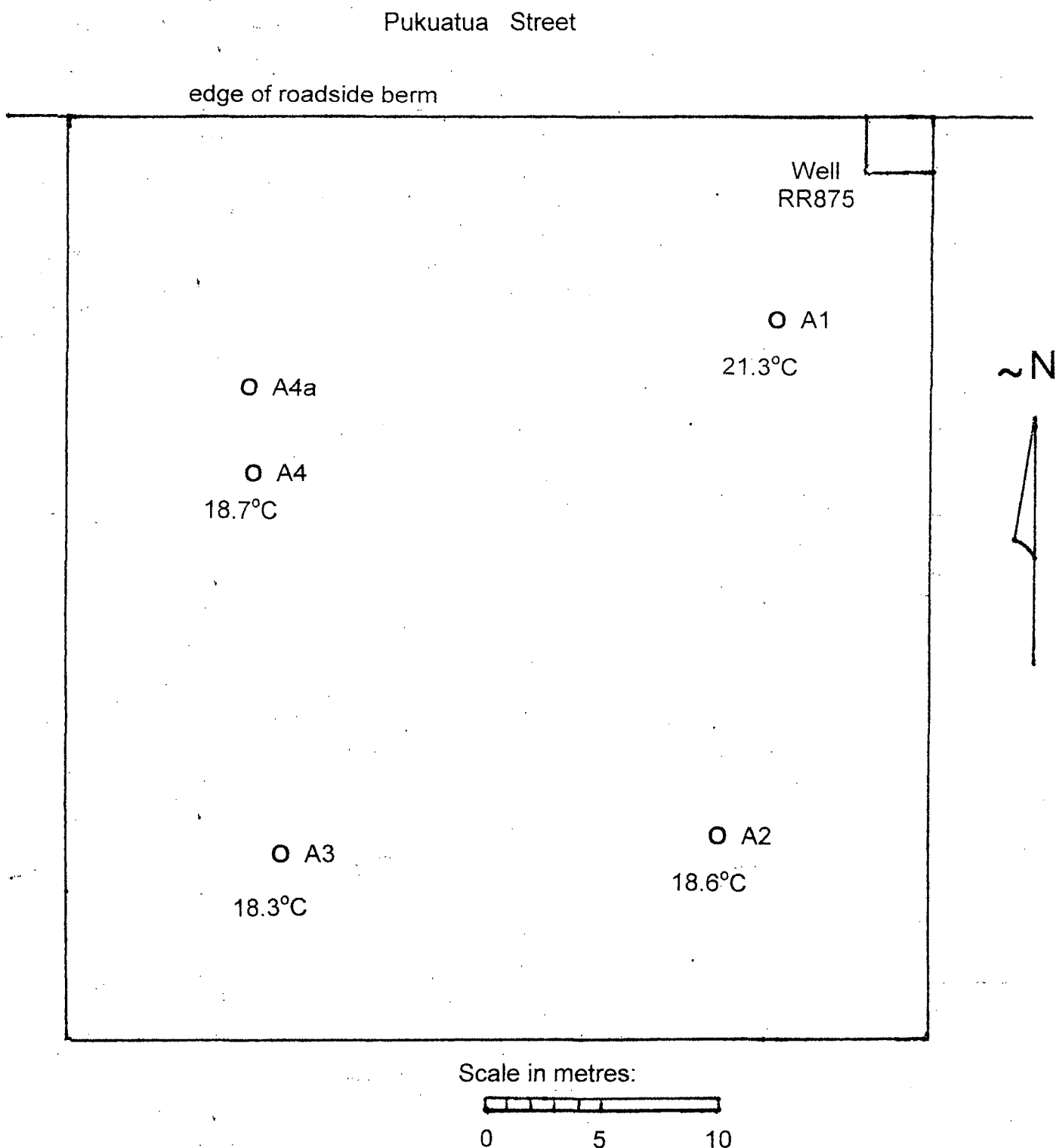


Figure 1: Location diagram of No.96 Pukuatua Street section, showing locations of augered inspection holes (A1 – A4). Scale is 4mm = one metre. Geothermal production well RR875 in cellar at northeast corner of site. Hole A4a abandoned at 0.6m depth onto horizontally lying wide concrete slab. Ground temperatures at one metre depths also shown (°C).

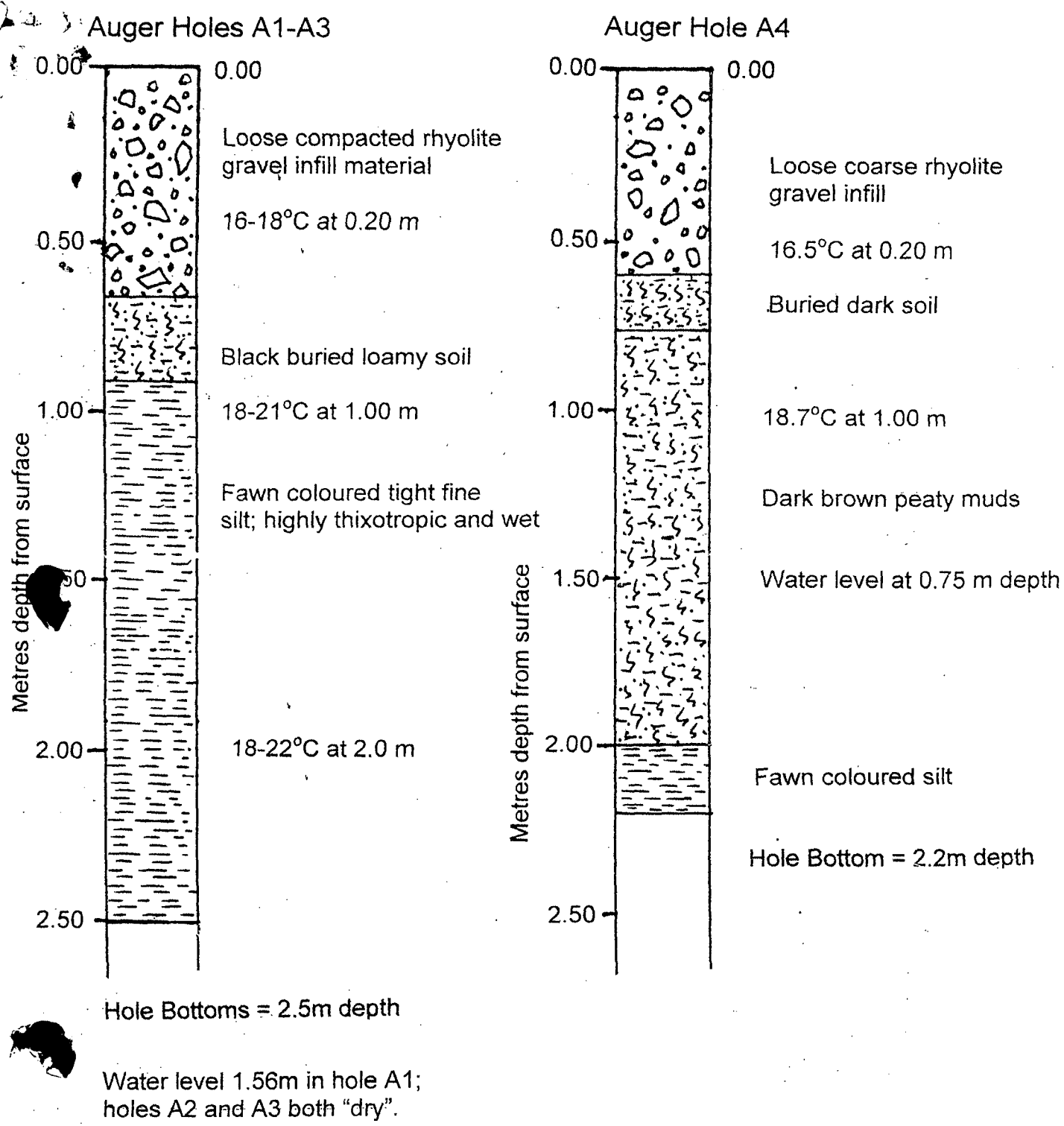


Figure 2: Ground geology in augered holes A1 – A4. Left hand profile is for all holes A1 – A3 due to close similarity of conditions and depths. Right hand profile is of hole A4, which contained a thick sequence of peat and artesian water. WL = waterlevel in metres.