A recent sinkhole collapse at Lambells Lagoon

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Cover photo: The greenhouse sinkhole
**Introduction**

At the request of the land owner, Steven Tickell and Robert Chaffer visited a property on Alphatonia Rd. at Lambells Lagoon on the 13th of February 2013 to inspect a recently formed sinkhole. The property is a plant nursery on Section 1619, Hundred of Guy. The site manager Adam accompanied us and provided background information.

**Observations**

Two sinkholes were seen, one inside a greenhouse and one in a strip of coconut palms. Their GPS coordinates are listed in Table 1 and their locations are shown in Figure 1.

The greenhouse sinkhole (Figure 2) is thought to have suddenly appeared two days earlier on the 11th of February 2013, a day on which the property received approximately 50mm of rain. The sinkhole is circular in plan, five metres in diameter and two metres deep. The walls are vertical and expose a soil profile consisting of yellow kandasol. The floor is slightly irregular and completely seals the base of the sinkhole. The hole has been partially full of water as evidenced by a film of smooth gray clay on the floor and lower walls. Numerous horizontal tree roots have been exposed. A 25mm pvc irrigation pipe that runs along the axis of the greenhouse, just below the floor level was ruptured by the collapse.

The sinkhole in the strip of coconut palms (Figure 3) formed several years ago and is now partially filled by fallen palm fronds, coconuts and trunks. It is located in a slightly low area that was very wet at the time of the visit. The sinkhole appears to have originally had similar dimensions to the greenhouse sinkhole but the walls have slumped and it is now wider and shallower. There is also no open cavity on the floor.

<table>
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<th>Sinkhole location</th>
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<th>Northing</th>
<th>Zone</th>
<th>Datum</th>
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<td>WGS84</td>
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<td>Coconut strip</td>
<td>744555</td>
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<td>52</td>
<td>WGS84</td>
</tr>
</tbody>
</table>

Table 1 GPS coordinates of the two sinkholes

![Figure 1 Location of the sinkholes, Google Earth image](image-url)
Figure 2 Greenhouse sinkhole

Figure 3 Coconut strip sinkhole
Discussion

This occurrence is of interest because there have been no prior reports of sinkholes suddenly developing over the Koolpinyah Dolostone. Only a handful of steep sided sinkholes are known from the area. These are all much larger and have eroded walls, suggesting that they are relatively old. A type of karstic collapse feature that is very abundant are broad, shallow circular depressions up to 500m in diameter, often the sites of lagoons. No active catastrophic collapses have been previously reported (Rink Vanderveld, former Water Resources extension officer...personal communication).

Cavernous dolostone has been encountered in many water bores in the district (Figure 4) indicating that there is potential for sinkhole formation.

Figure 4 Airborne magnetic survey

In the Katherine area numerous sinkholes, similar in nature to the current ones have occurred in recent times (Karp, 2002). These have been initiated mainly by alterations to the surface drainage by road works and land clearing. Collapses occur at sites where there is an existing soil filled karstic pipe. The fill becomes saturated due to the additional water, causing the plug to give way.

Sudden sinkhole collapses can be a natural phenomenon but are more commonly related to man-made changes to the hydrologic regime (Council for Geoscience 2003). These include:

- leaks from water or sewage pipes
- diversion of drainage
- rapid drawdown of the watertable

It is unlikely that the current sinkholes are natural because they are the only ones known to have formed in historic times. The presence of a network of irrigation pipes on the property suggests that
leaking pipes are a likely cause. Another contributing factor may be a deeper than normal watertable. At the time of the greenhouse sinkhole collapse the regional watertable was low for that time of year (9 metres) but was still within its seasonal range (Figure 5). A groundwater monitoring bore located 1.3km south of the property indicates that groundwater levels range between 2 and 14 metres below ground level at the peaks of the Wet and Dry seasons respectively. Pumping irrigation bores on the property could locally lower the watertable even deeper, approaching the top of the dolostone.

![Graph showing groundwater levels over time](image)

Figure 5 Groundwater levels, RN30345, the red points were measured on 20/2/2012 and 13/2/2013

Finally for a sinkhole to form there must be an existing cavity in the dolostone beneath. Geological structures can influence the location of cavities. In this case an airborne magnetic survey delineates several broad scale linear features in the bedrock of the area (Figure 4). A major one trending NNW – SSE passes directly beneath the property. It probably represents a dolerite dyke that cuts through the dolostone and is also likely to be a fault line. The adjoining dolostone will be more fractured than normal, allowing greater groundwater movement and the formation of more cavities than is usual. If the dyke is controlling the degree of cavity formation, then any future sinkhole collapses might be expected along the same trend.

A likely mechanism for the formation of the current sinkholes involves a combination of local lowering of the watertable by groundwater pumping and leakage from irrigation pipes. A low watertable allowed leaking water to saturate the soft overburden between the surface and a pre-existing cavity in the dolostone beneath (Figure 6). The roof of the cavern started to collapse progressively upwards, weakened by the weight of the overlying saturated material. The rain event on the 11th of February was the final straw that led to the collapse of the overburden into the cavity.

Sinkhole formation is impossible to predict, however a few measures can be taken to reduce the likelihood of their developing. These include avoiding water leaks and not letting water pond for long periods. Both aim to reduce localised water seepage. In the case of existing sinkholes it is
recommended that they be infilled and capped with impervious material such as clay or concrete. The aim is to avoid further seepage of water into the hole and thus continued collapse.

![Figure 6 Mechanism for sinkhole formation](image)

**References**
