



AQUIND Limited

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Environmental Statement – Volume 3 – Appendix 19.3 The Hydrogeology of Kings Pond and Denmead Meadows

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APPENDIX 19.3 THE HYDROGEOLOGY OF KINGS POND AND DENMEAD MEADOWS

1.1.1.1 This Appendix provides the supporting baseline environment data for Chapter 19 (Groundwater) of the ES Volume 1 (document reference 6.1.19).

1.1.2 BACKGROUND

1.1.2.1 Kings Pond (Plate 1) is close to the contact between the Chalk that rises gently to the north and the sands and clays of the overlying Tertiary deposits that occupy the centre of a geological syncline, (known as the Chichester Syncline), between Denmead and Havant. The Chalk is characterised by relatively thin soils and pasture whereas thicker clay rich soils hosting more abundant woodland are typical of the Tertiary deposits (also known as Palaeogene deposits).



Plate 1 - Kings Pond. Panoramic photograph taken looking south across Denmead Meadow. Surface water flows in to Kings Pond from a channel to the right-hand side (west) of the photograph and out to the south across Denmead Meadow

1.1.2.2 The Chalk is a Principal Aquifer that provides much of Portsmouth and surrounding conurbation with water. The Bedhampton and Havant Springs are important for water supply. Studies dating back to Day's work in 1964 demonstrate the link between the Chalk north of Denmead and the springs.

1.1.2.3 More recently, Mourice et al, have proved connections to the springs. Tracer tests involve tracking water as it moves through the subsurface by introducing a harmless substance into the ground and sampling the water at springs or boreholes to detect the tracer.

1.1.2.4 Relatively high groundwater levels in the Chalk north of Denmead provide the driving head for groundwater to flow through the Chalk under the Tertiary deposits in the centre of the Chichester Syncline to emerge at the springs (Plate 2).

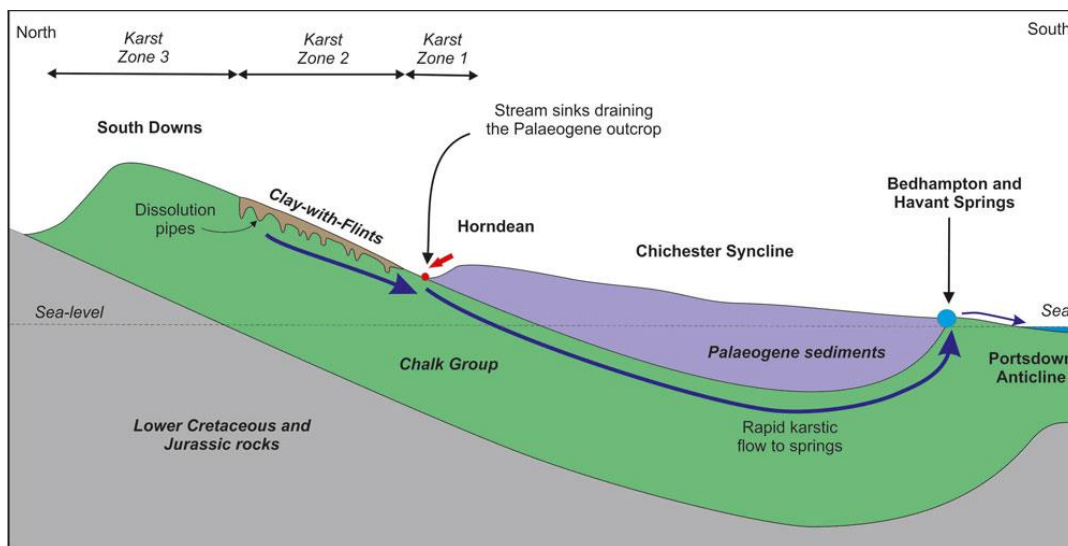


Plate 2 - British Geological Survey karst zones applied to the Chichester syncline and the Bedhampton and Havant springs

- 1.1.2.5 Despite the distance and the depth below ground in the centre of the Chichester Anticline, BGS researchers have proven a direct connection between the edge of the Palaeogene and the public water supplies of the Bedhampton and Havant springs.

1.2 KARST AND GROUNDWATER VULNERABILITY

- 1.2.1.1 Groundwater connectivity is enhanced by the development of 'karst'. Karstification of the Chalk aquifer happens naturally over time as the micro-porous limestone that makes up the Chalk aquifer is dissolved. This process leads to the enlargement of flow paths and the potential for very rapid groundwater velocities.
- 1.2.1.2 Swallow holes and springs are evidence of a karst system, they represent the start and end-points, respectively.
- 1.2.1.3 Swallow holes are hydrologically active depressions where streams or surface water has dissolved the underlying Chalk allowing surface water to sink below ground. They are typically located close to the contact between the Chalk and the Tertiary deposits. Springs are where groundwater issues at surface.
- 1.2.1.4 Tracer tests indicate travel times less than 1 day between swallow holes and springs. (Plate 3).

1.2.1.5

Research by the British Geological Survey ('BGS') has identified three 'Karst Zones' that relate to the contact between the Chalk and the overlying Tertiary sediments (Plate 2 and 3). The Tertiary sediments comprise the Bagshot Beds, the London Clay and the Lambeth Group (in order of increasing age). The most hydraulically active karst zone is Karst Zone 1, which coincides with the margin of the Tertiary /Palaeogene deposits. In the area of Denmead Meadows, Karst Zone 1 extends from the recently exposed Chalk just north of Kings Pond into the water-logged fields above the low-lying Tertiary deposits to the south. The conceptual model developed by the BGS indicates that karst is likely to be present in low-lying areas around Kings Pond.



Plate 3 - Groundwater flow to Bedhampton and Havant Springs 1 (Based on Day, 1964)

1.2.1.6 Groundwater sources (boreholes and springs) are vulnerable to contamination from surface when:

- there is no overlying geology;
- the water table is close to surface;
- the groundwater catchment is small; and
- groundwater flow paths are short.

1.2.1.7 These are characteristics of karst aquifers and it follows that the Bedhampton and Havant springs are vulnerable to contamination.

1.2.1.8 Therefore, project activities in the area of Denmead Meadows need to be carefully controlled.

1.3 THE HYDROLOGY OF KINGS POND

1.3.1.1 BGS research indicates a complex relationship between the karst network, geology and groundwater flow over short distances at the margin of the Tertiary deposits (Plate 4).

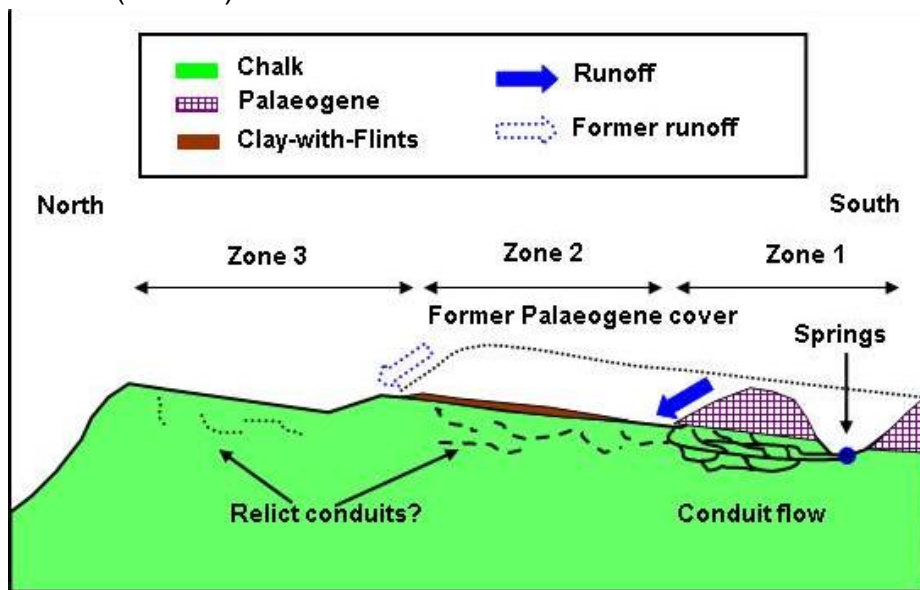


Plate 4 - The relationship between the removal of the Palaeogene sediments and the development of karst

- 1.3.1.2 Kings Pond is clearly located in Karst Zone 1 within the catchment of the Bedhampton and Havant springs. However, it is unclear whether Kings Pond is either a swallow hole and recharging the Chalk aquifer, a spring discharging from the aquifer or just a surface water pond.
- 1.3.1.3 The hydrology of the pond is controlled by two factors: 1) whether the water table rises to (or above) ground surface to create a gradient towards the pond; and 2) whether there is a hydraulic connection through the base of the pond, i.e. whether Chalk directly underlies the pond or whether the pond is within the Tertiary deposits, or has 'silted up' over time.
- 1.3.1.4 The elevation of the water table at Kings Pond will fluctuate with time, rising during winter and falling during summer. Groundwater data used by Day (1964), suggests that the water table was approximately 35 m AOD in the area of Kings Pond where the surface elevation is more like 40 m AOD. However, these data are likely to represent minimum water levels (to be confirmed). Therefore, the water table could rise towards the surface during winter and facilitate the Chalk aquifer to discharge to surface during wet periods.
- 1.3.1.5 Observations conflict slightly with the observations, despite the fact that the water table rises close to ground surface, there is uncertainty with regards to the hydrology of Kings Pond in particular the hydraulic connectivity with the Chalk aquifer. Ground investigations undertaken nearby as part of the Aquind project have proved the presence of the Tertiary deposits suggesting that there may be a clay rich barrier between the pond and the underlying Chalk. Furthermore, during the site visit in December 2018, a similar amount of water was observed flowing into Kings Pond as flows out. This observation is not consistent with the presence of a spring in the base of the Pond.

1.4 SUMMARY

- 1.4.1.1 In summary, the area around Denmead Meadow is within a karst catchment that feeds Bedhampton and Havant springs. However, despite a high-water table locally a preliminary hydrogeological study indicates that there may not be a direct hydraulic connection with the Chalk at Kings Pond. Further work would be required to demonstrate this conclusively.

REFERENCES

Maurice (2012) Karst hydrogeology of the Bedhampton and Havant springs, BGS, [Accessed 2nd September 2019], <https://www.bgs.ac.uk/research/groundwater/about/karstAquifers/bedhamptonHavantSprings.html>

