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Geotechnics • Environment • Groundwater

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27 August 2008

Catylis Pty Ltd
Level 15, 124 Walker Street
NORTH SYDNEY NSW 2060

Attention: Mr Bill Jenner

Dear Sir

GROUNDWATER CONCEPTUAL MODEL
PROPOSED RESIDENTIAL DEVELOPMENT, CATHERINE HILL BAY

1. INTRODUCTION

Further to our preliminary contamination, geotechnical and mine subsidence investigations at the above site as described in our report 39662C-01, November 2007 (Ref 1) this report provides a qualitative assessment of the likely impacts of the proposed development on identified groundwater dependant ecosystems.

We understand that Groundwater Dependant Ecosystem (GDE) communities have been identified in the vicinity of the proposed development on Areas A and B of the site as shown on the attached Harper Somers O'Sullivan drawing. The GDE communities in proximity to the site, as labelled on Drawing 104 attached, are described as follows:

GDE 1 Strip of Swamp Mahogany running in a strip along the northern side of Area B. This strip generally follows a creek line which also includes an artificial pond.

GDE 2 Freshwater wetland complex upstream of Area 1 within former mine water storage dam upslope of site and downstream strip of Swamp Mahogany along the Western side of Flowers Drive.

GDE 3 Swamp Mahogany in low lying area around creek between Areas A and B.

GDE 4 Swamp Mahogany to south of Area A in low lying areas around creek.

GDE 5 Swamp Mahogany in south east corner of Area B on well drained easterly trending slopes at elevations in the order of 5 m to 15 m AHD.

GDE 6 Swamp Mahogany to south of site in a north easterly trending gully on the opposite side of a ridge to Area B.

GDE 7 Continuation of GDE 6 above, however located down slope of the development area.

GDE 8 Riparian Melaluca Swamp Woodland on northern slopes of Area A.

GDE 9 Apple-Palm Gully Forest to the north-west of Area B.

2. BACKGROUND

The site has been subject to a desktop assessment and extensive subsurface investigation including excavation of test pits to depths of up to 3 m and drilling of bores to depths ranging up to about 30 m.

Alluvial Soils

Alluvial soils were encountered in the following location as shown on Drawing 104:

- A strip of alluvial soils which follow the creek line to the north of Area B (including GDE1 and 3) and the south of Area A (GDE4). The extent of this alluvium adjacent to the site was confirmed by subsurface investigation, with the remaining sections to the east of the site based on surface mapping;
- In-filled gully to the south of Area B which partly underlies GDE 5. This alluvium is unmapped, however it presence was confirmed by subsurface investigation. The indicated extent within the gully is approximate.

The alluvial soils comprised very soft to firm clay and loose sand to depths in the range 0.6 m to 6 m. Groundwater was encountered at depths in the range 0.9 m to greater than 3 m to the north of Area B and at about 6.5 m in the area to the south of Area B.

Residual Soils

The remainder of the site comprised residual clay soil overlying weathered rock. On the central northern parts of Area B the residual soils are overlain by filling, generally clay with layers of coal chitter, to depths in the range 0.3 m to 3.2 m. There was generally no free groundwater encountered within the depth of investigation in these areas.

Mine Workings

The southern parts of Area B, where residual soils were encountered, are underlain by bord and pillar mine workings. The level of the floor of the workings along the northern fringe is generally in the order of 0 m AHD and the workings fall to the south. The workings encountered below Area B were dry.

3. CONCEPTUAL GROUNDWATER MODEL

Based on the results of the desktop assessment, the subsurface investigation and the site topography a conceptual groundwater model has been developed for the site as follows:

- Groundwater recharge on the parts of the site proposed for development in Areas A and B is very limited due to the low permeability clay soil and weathered rock and the well drained slopes. The vast majority of rainfall is expected either run off or be lost by evapo-transpiration;

- Some recharge may occur in these areas due to infiltration through mine subsidence induced cracks in the rock. This would be expected to infiltrate near vertically to the mine workings;
- The mine workings fall to the south and any infiltration to the mine workings would be expected to drain to the workings to the south of the site;
- The alluvial soils are expected to comprise unconfined aquifers perched above the less permeable underling residual soils and rock;
- The alluvial areas are in low lying areas such as creeks and gullies and recharge to the aquifers occurs within these low lying areas. The source of the recharge water is from surface runoff from surrounding areas as well as direct rainfall within the areas. Groundwater recharge from the adjacent areas of residual soils will be very minor;
- Groundwater will flow within the alluvial areas, generally following the fall of the creek/gully as well as interact with the surface water flows in the creek. In times high rainfall and high creek levels the aquifer will be recharged and in times of low rainfall and low creek levels the groundwater may provide base-flow back to the creek and help maintain the water levels in the pond.

4. EFFECT OF DEVELOPMENT ON GROUNDWATER LEVELS

The footprint of the development is generally on residual soils or filling over residual soils with some very minor encroachments onto alluvial soils as shown on Drawing 104. Only the alluvial soils are considered to represent groundwater aquifers, these being perched aquifers within the alluvium and essentially hydraulically isolated from the residual soils and rock.

Groundwater recharge to the aquifers is considered to be due to direct rainfall in the alluvial areas as well as runoff from the surrounding residual soil areas, however not due to groundwater recharge from the residual soil areas.

Potential interactions between the proposed development and the GDEs identified in Section 1 and shown on Drawing 104 are expected to be as follows:

GDEs 1, 3 and 4 - These areas are generally within the creek and alluvial aquifer fringing the north of Area B and the south of Area A. The groundwater will generally be controlled by recharge from the upslope areas, which will include the developed areas. Groundwater levels could also be affected by changes in the creek bed levels or other controls such as weirs or culverts which may affect surface water flows and levels.

GDE 2 – This area is upslope of the proposed areas of development and therefore will not be affected by the proposed development.

GDE 5 - This is within the proposed development however is on a well drained and elevated part of the site, well above any measured or expected groundwater and therefore it is considered that this area is not associated with groundwater.

GDE 6 - This area is within an alluvial in-filled gully with a water table at depth. The area is however on the opposite side of a ridge line to the proposed development and hydraulically isolated from the proposed development for both surface water flows and groundwater flows. Therefore the proposed development will not affect the groundwater in this area.

GDE 7 – This is an area of possible alluvial infill. Recharge to this area will be primarily from the surface runoff catchment which is almost entirely shared with GDE6, with a very small proportion of the development area directly upslope. Therefore any effect the development would have on groundwater levels would be insignificant.

GDEs 8 and 9 – These are within shallow gullies over residual soils and the presence of GDEs is likely to be associated with shallow periodic saturation of the surface soils due to surface runoff rather than a water table aquifer.

In summary it is considered that the only GDEs which could be affected by the proposed development are GDEs 1, 3, 4 along the creek line. GDEs 5 and 8 are within the development boundary however it is considered that these are not associated with groundwater. Provided that the existing surface water flow rates / levels and fluctuations thereof within the creek are maintained there will be minimal impact on the groundwater levels and therefore GDEs. This can be achieved by appropriate water sensitive urban design, which would include the provision of surface water storage devices such as ponds or swales to limit peak flows.

The use of buffer zones is often an appropriate method to limit the impact of development on the groundwater regimes as the buffers reduce the impact of edge effects such as changes in groundwater recharge due to the development. In this case however such buffers would be ineffective and unnecessary. This is because the extent of the aquifer along the creek is very limited and any buffer zones would be located on residual soils which are hydrogeologically isolated from the aquifer.

Yours faithfully
DOUGLAS PARTNERS PTY LTD

Reviewed by:

Will Wright
Principal

Stephen Jones
Principal

ATTACHMENTS

Drawing 104, Groundwater Dependent Ecosystems, Surface Alluvium and Test Locations

REFERENCES

1. Douglas Partners, “Preliminary Contamination and Geotechnical Assessment, Proposed Residential Subdivision, Catherine Hill Bay”, 39662C-01, November 2007.

Test Pit

Surface Sample

Bore

Boundary of development (lots and roads)

Mapped Alluvium associated withcreek

Approximate extent of unmapped alluvium associated with creek

Groundwater Dependent Ecosystems (Related to Site)

Groundwater Dependent Ecosystems (Unrelated to Site)

GDE1 GDE2 GDE3 GDE4 GDE5 GDE6 GDE7 GDE8 GDE9

A B

Pit 1 Pit 2 Pit 3 Pit 4 Pit 5 Pit 6 Pit 8 Pit 9 Pit 10 Pit 11 Pit 13A Pit 14 Pit 15 Pit 16 Pit 18 Pit 19 Pit 20 Pit 22 Pit 29 Pit 31 Pit 32 Pit 33 Pit 34 Pit 37 Pit 38 Pit 39 Pit 40 Pit 42 Pit 43 Pit 44 Pit 45 Pit 46 Pit 47 Pit 49 Pit 50 Pit 51 Pit 52 Pit 53 Pit 56 Pit 61 Pit 63

Bore 103 Bore 104 Bore 105 Bore 106

S111 S112

C201 C206 C210 C213 C214 C218 C219 C220 C221 C222

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TITLE:
Groundwater Dependent Ecosystems
Surface Alluvium and Test Locations
Proposed Residential Subdivision
Catherine Hill Bay

CLIENT: Coal & Allied

DRAWN BY: PWW	SCALE: 1:10,000 @ A3	PROJECT No: 39662C	OFFICE: Newcastle
APPROVED BY:		DATE:	DRAWING No: 104