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15 February 2016

The Wilderness Society Newcastle
21 Gordon Avenue
HAMILTON NSW 2303

Attention: Prue Bodsworth

Dear Ms Bodsworth

PROPOSED SAND QUARRY, CABBAGE TREE ROAD, WILLIAMTOWN – REVIEW OF EIS GROUNDWATER STUDIES

Following your email of the 9th December 2015, we provide the following advice based on review of the following EIS documents for the Proposed Sand Quarry at Cabbage Tree Road, Williamtown:

1. EIS Main Text, Parts 1 and 2
2. EIS Appendix 6 – Geotechnical Groundwater Investigation
3. EIS Appendix 7 – Groundwater Impact Assessment

We have also reviewed possible interactions of the proposed sand mine previous sand mining in the region and contamination issue at the nearby RAAF site in Williamtown.

<u>Project overview</u>

An Environmental Impact Statement (the EIS) prepared for Willamtown Sand Syndicate (November 2015) sets out a proposal to quarry sand from a collection of lots located adjacent to Cabbage Tree Road, Williamtown. The location of the proposed mine is shown in Figure 1. The combined lots leased for this mine have a total area of about 176 ha.

Statutory “Groundwater management units” mapped in Figure 2 show that the mine is located on the Tomago Sandbeds.

The proposed mine is located 1 to 2 km South-East of the remediation site of previous sand mining (see Figure 3). The Williamtown RAAF based is also in close proximity, which is of significance due to the current investigations and remediation of groundwater contamination at that location. The proposed mine is located within the currently defined investigation area for the RAAF contamination (Figure 4).

The proposed extent of quarrying (excavation) is highlighted in Figure 3. It can be seen from overlay on local detailed geological maps (Figure 5) that the proposed quarry layout corresponds with the extents of the target sand formation within the lease area.

It is understood, from the EIS, that the depth of quarrying is limited by groundwater levels. Specifically, the depth of excavation is to be 1m above maximum predicted groundwater levels, or 2m above average groundwater levels:

> The Aquifer Interference Policy (AIP) provides details of the role and requirements of the Minister administering the *Water Management Act 2000* in the water licensing and assessment processes for aquifer interference activities under *the Water Management Act 2000* and other relevant legislative frameworks.
>
> The AIP applies to all activities that either penetrate, interfere, obstruct, take or dispose with/of water in an aquifer. The proposed development is designed to be at least 1 m above maximum predicted groundwater level and at least 2 m above average groundwater and therefore does not penetrate or interfere with the aquifer. Further detail on aquifer impacts is provided in Section 5.3.

(from EIS Appendix 7)

The proposed final landform, which is assessed in the EIS to meet these criteria, is shown in Figure 6.

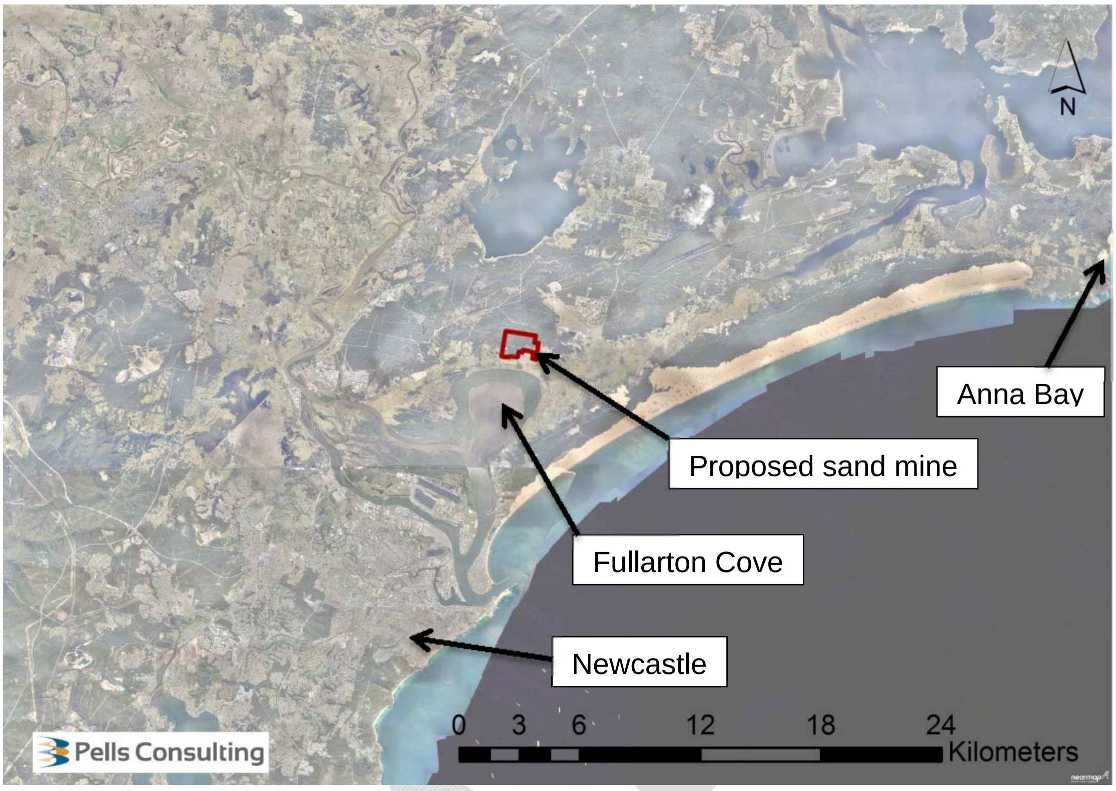

Figure 1 - Site Location

Figure 2 - Groundwater management unit - Tomago Sandbeds

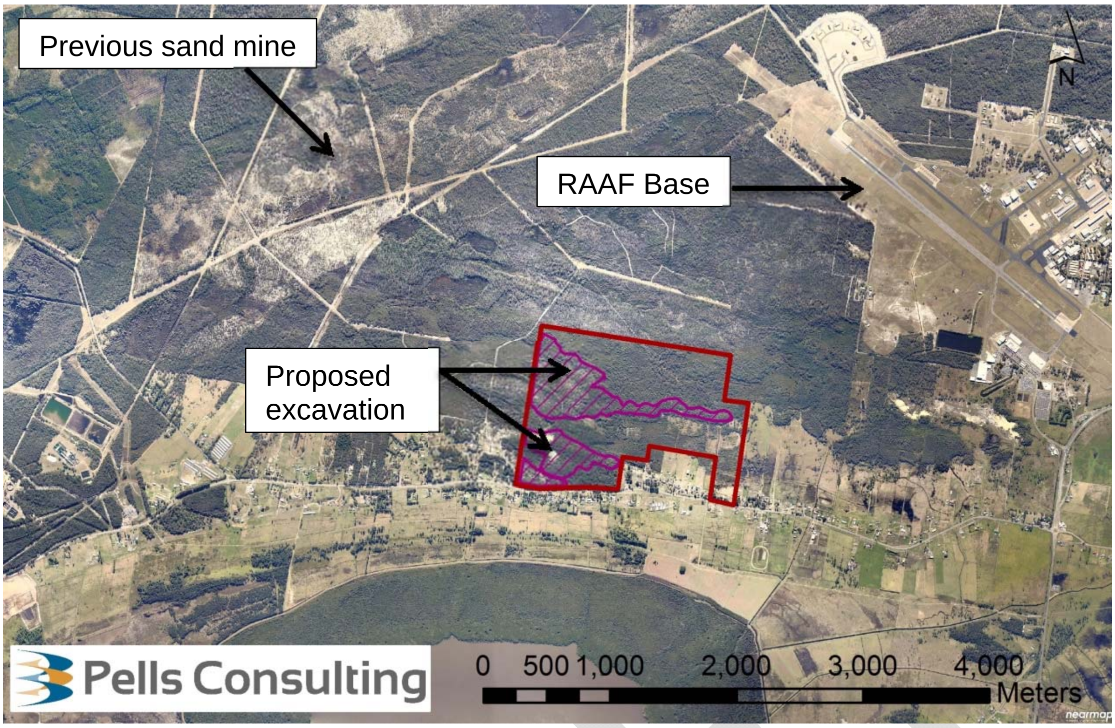

Figure 3 - Site features

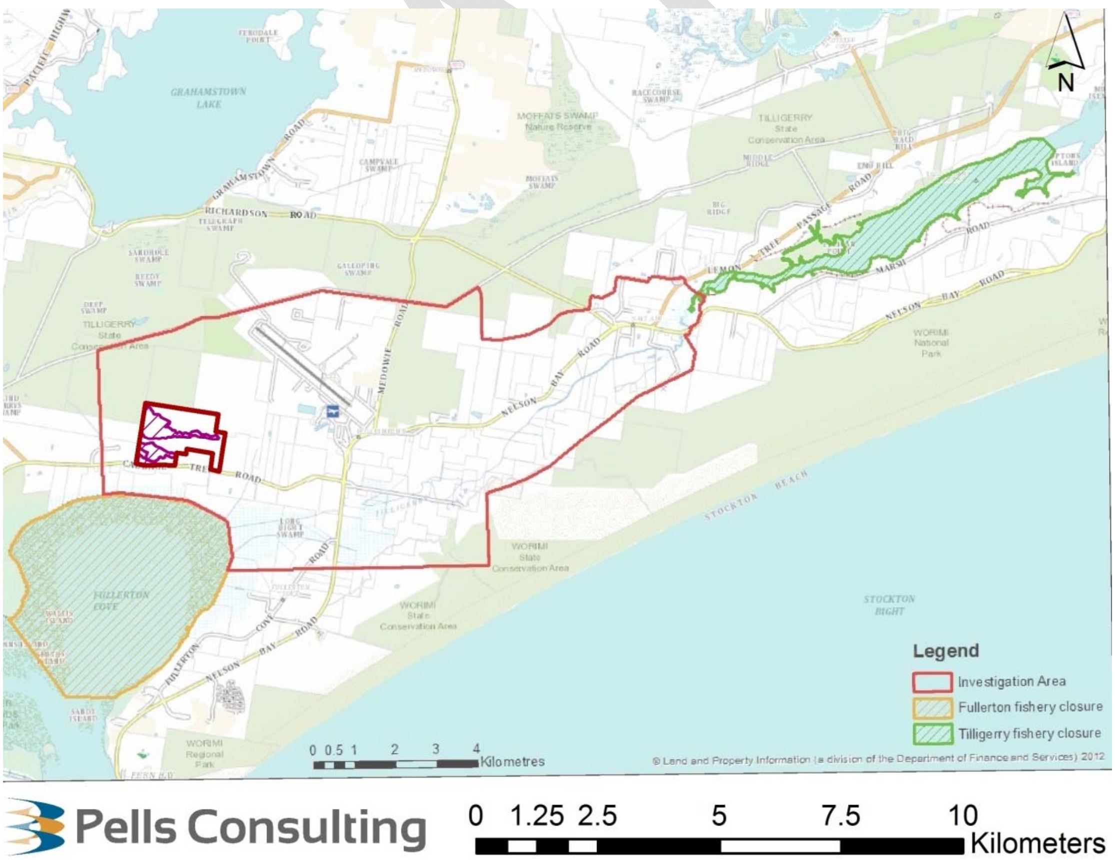

Figure 4 - Williamtown RAAF Contamination Investigation Area

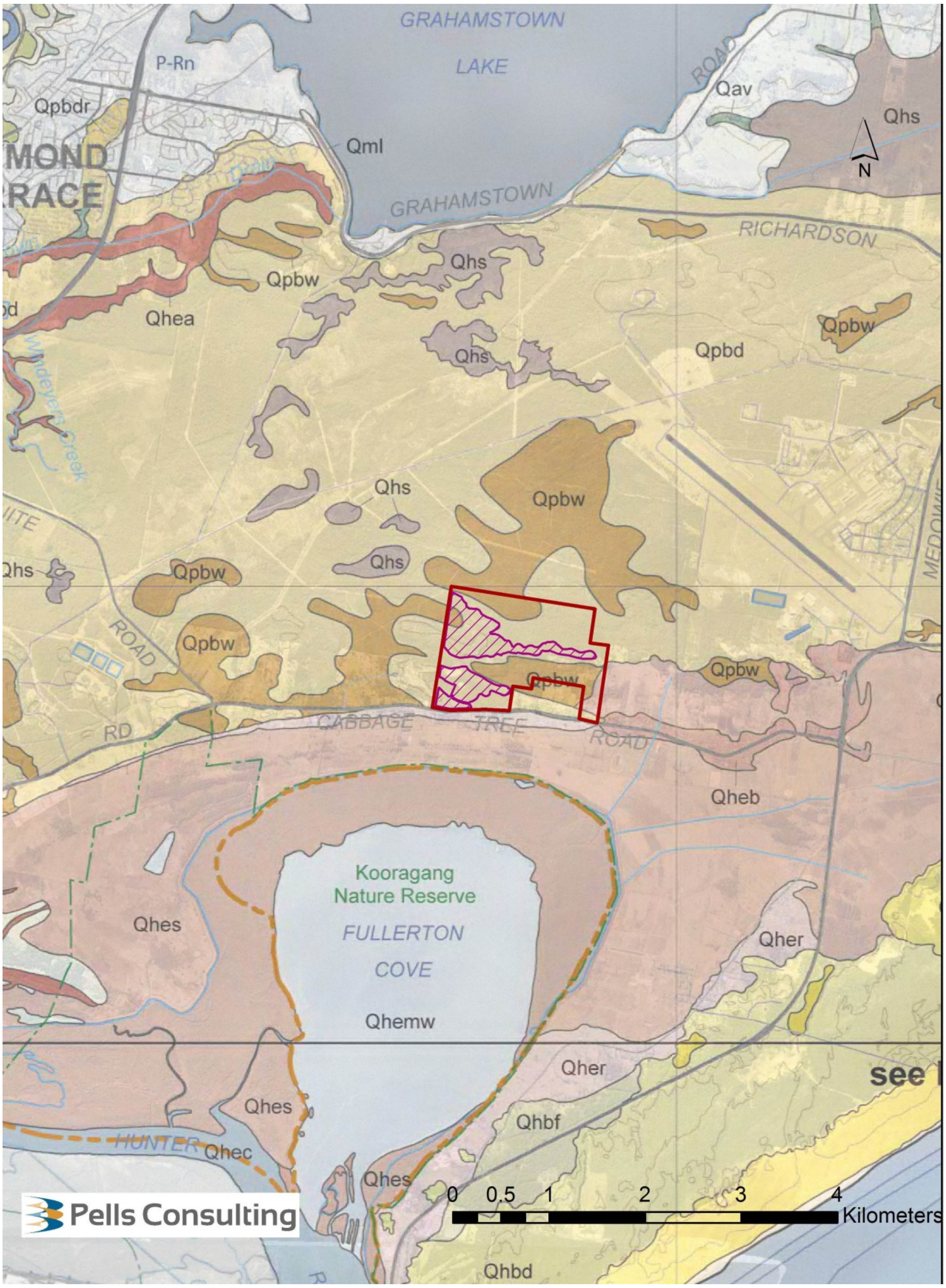

Figure 5 - Local geology

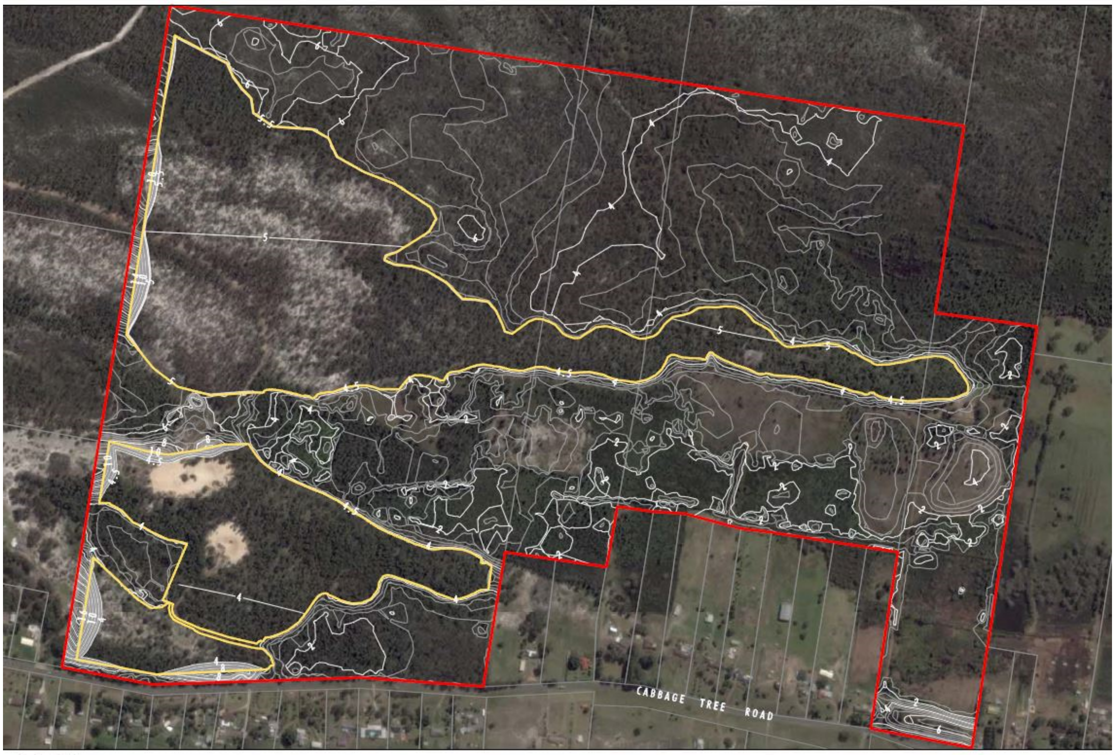

Figure 6 - Proposed final mining landform

Existing Groundwater Conditions

The Tomago Sandbeds are a large coastal groundwater resource. The significance of this resource is summarised in the following excerpt (from Hunter Water website):

> The Tomago Sandbeds is an underground water source that provides about 20 per cent of the lower Hunter's drinking water. The sandbeds are parallel to the coast between Newcastle and Port Stephens, starting at Tomago and extending north-east for 25 kilometres to Lemon Tree Passage.
>
> An extensive system of underground bores and vacuum stations draws raw water from the sandbeds and pumps it to Grahamstown Water Treatment Plant. The maximum storage is about 100,000 megalitres of water above sea level, of which Hunter Water can access about 60,000 megalitres with existing infrastructure from a portion of Tomago Sandbeds covering about 100 square kilometres.
>
> The sandbeds are a natural geological feature, consisting of a layer of highly permeable fine grained sands underlain by impervious clay and rock. The thickness of the sand layer reaches a maximum of 50 metres, but on average is 20 metres deep. The source of the water is the rainfall that lands directly on the sand surface. While a proportion of the rainfall is lost to plants and evaporation, sufficient water is stored in the sand to provide a viable and significant source of water for ongoing extraction.
>
> The sandbeds are strategically important for both ongoing and backup water supply. Ongoing supply from the sandbeds reduces the load on surface water sources (Chichester Dam and Grahamstown Dam) and thereby allows greater overall yield from the total water supply system. This large storage volume can also be used as a reserve supply during drought, and is available as a backup supply in the event of water quality issues in the surface storages.

Groundwater levels mapped during investigations of the Williamtown RAAF contamination are reproduced in Figure 7. Measured groundwater levels reported in the EIS are shown in Figure 8 (“highest groundwater levels”, from EIS Appendix 7) and Figure 9 (Groundwater levels, 17 Jan 2015, from EIS Appendix 6).

These observations show groundwater flowing generally in south or south-easterly direction. This is expected, and reflects typically coastal groundwater movement from inland recharge, which flows back towards the ocean or estuaries (ie Fullarton Cove).

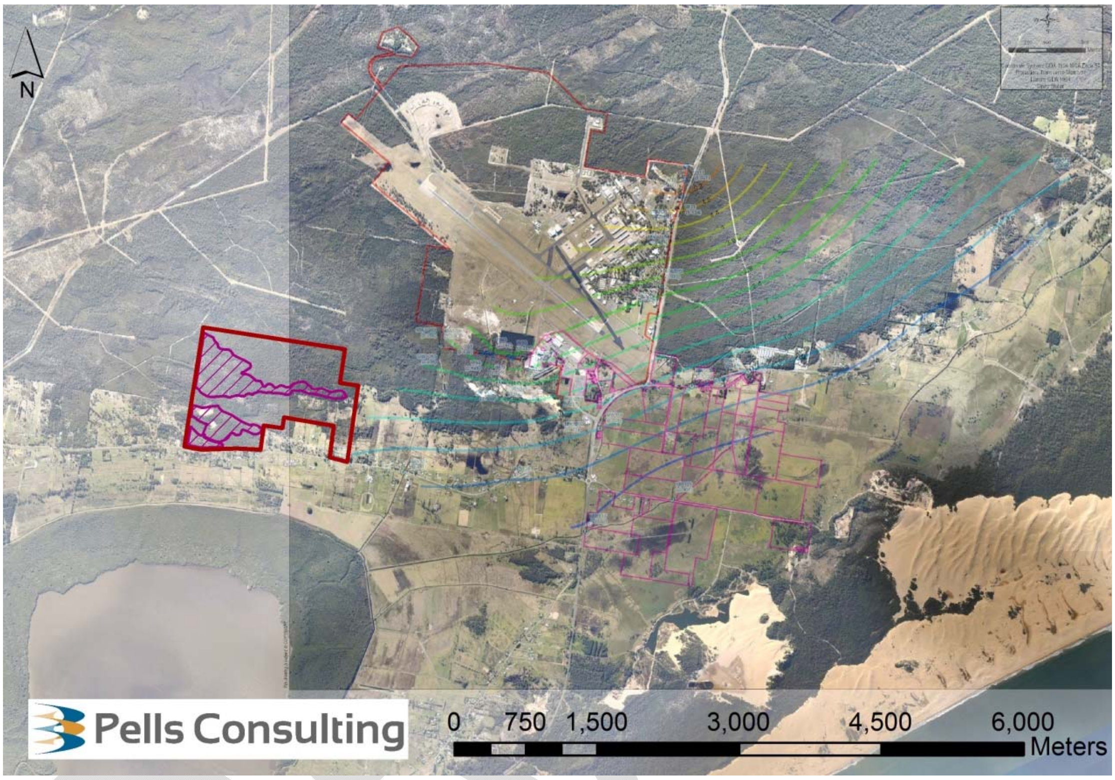

Figure 7 - Groundwater contours mapped by Contamination Investigations

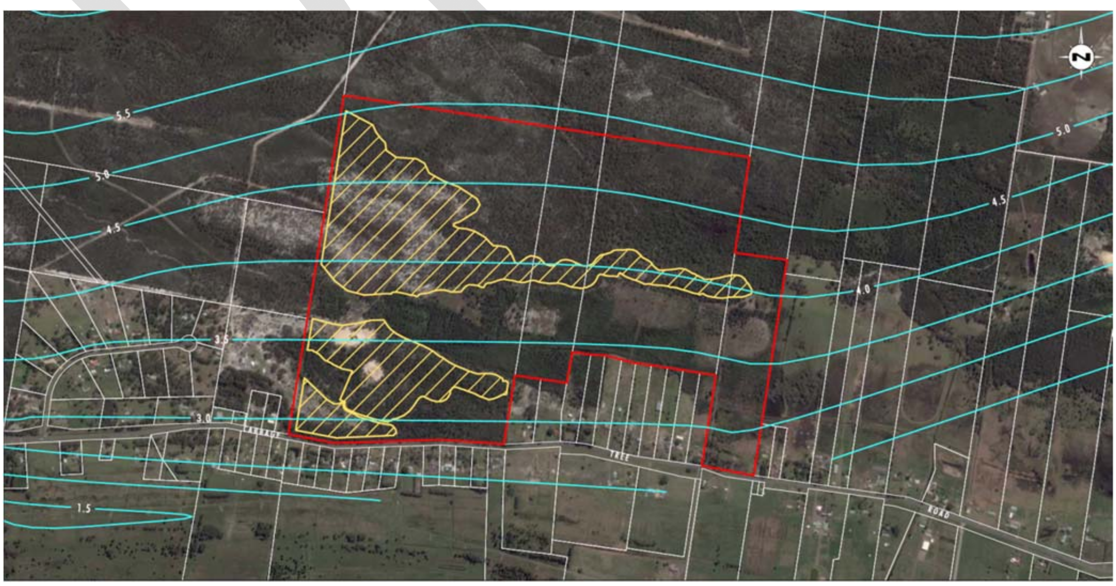

Figure 8 - Highest recorded groundwater levels (Umwelt, 2015)

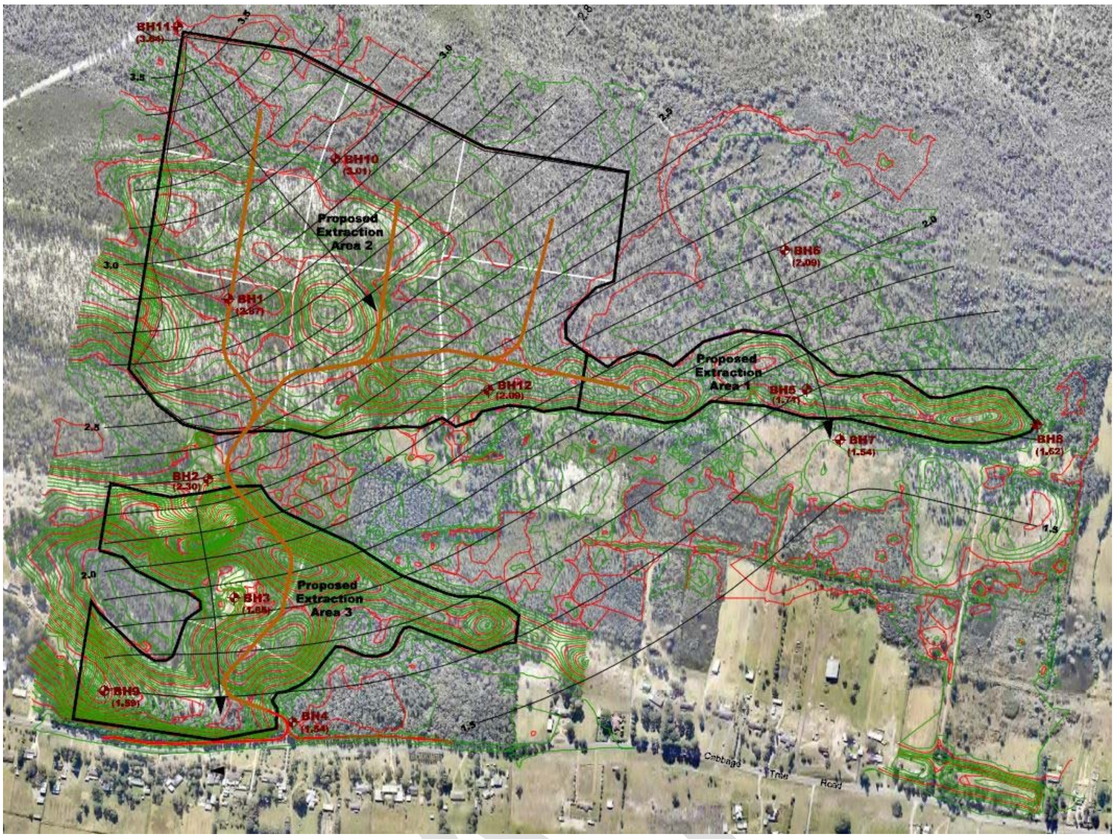

Figure 9 - Groundwater levels 17 Jan 2015

A cross-section was drawn along the profile shown in Figure 10, extending from Grahamstown Reservoir in the north, through the proposed mining site, and to Fullarton Cove. The cross-section is shown in Figure 11. Various scale exaggerations are shown.

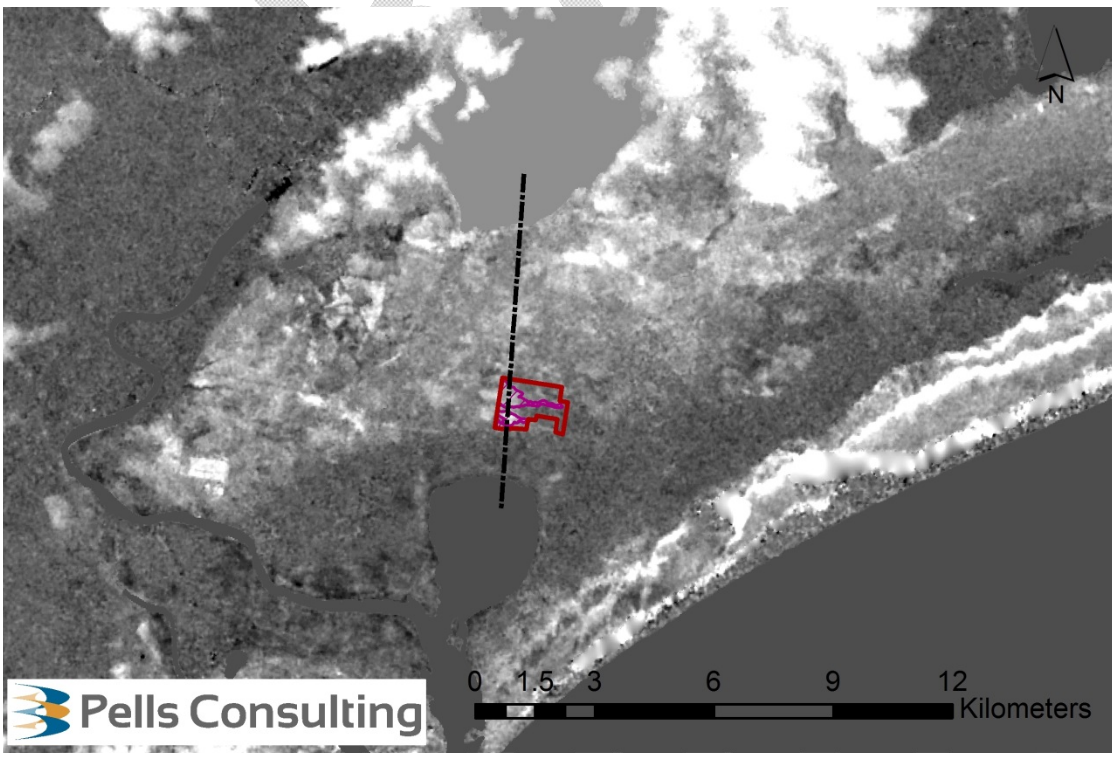

Figure 10 - Regional Topography (1 second DEM)

Water levels at Grahamstown Reservoir range from approximately 8 to 12 m AHD. At the ocean boundary, tidal range is typically from ~-0.64 (MLWS) to + 0.64 m AHD (MHWS), with mean water level at approximately 0 m AHD. These levels are shown on the cross section in Figure 11.

Also shown in Figure 11 are the proposed mining extents, and measured (Figures Figure 7 toFigure 9) and modelled (discussed below) groundwater levels.

It can be seen from the cross-sections that the topography is very flat. While the difference in water levels between inland (particularly the Grahamstown reservoir level) and the coast would generally drive a groundwater flow in the directions measured, the gradient is very low (approximately 1V:700H). Even with high permeability sand formations with a hydraulic conductivity of between 20 to 70 m/day, the gradient between the reservoir and the ocean would support groundwater flow velocity of approximately 3 to 10 cm per day.

With respect to this topography, this is considered to be a primarily "vertically forced" groundwater system. That is, the major fluxes (flow directions) would be seasonal, reflecting vertical (downward) recharge from rainfall, and vertical (upward) evapotranspiration from vegetation. It is expected that these processes would dominate flow quantities in the groundwater system, rather than the low gradient horizontal flow toward the coast.

<u>Groundwater level characterisation in the EIS</u>

Groundwater levels limit the depth of mining, and are thus are a fundamental consideration to the mining economics – the lower that groundwater levels are deemed to be, the deeper mining extraction can be made.

The formal groundwater levels adopted in the EIS are understood to be based on modelling undertaken by Umwelt (2015), as presented in Appendix 7 of the EIS. The predicted maximum level used for planning is reproduced in Figure 12. No prediction of average groundwater levels is shown.

The model was also used to predict maximum groundwater levels once mining was undertaken. From the EIS (Appendix 7), the modelling methodology was as follows:

> The maximum extraction scenario involved a change to the landform in the model. No modifications were made to the recharge and evapotranspiration characteristics of the site. As pumping is not proposed as a part of the Project and no significant changes to hardstand areas are anticipated, no other alterations to the characteristics of the groundwater model were required.

Based on this, it was concluded that the mining would have negligible impact on groundwater:

> As shown in **Figure 5.4**, there is negligible change to modelled groundwater head equipotentials as a result of sand extraction activities. Consequently, the proposal is predicted to have negligible impact on groundwater availability to groundwater dependent ecosystems in the area.

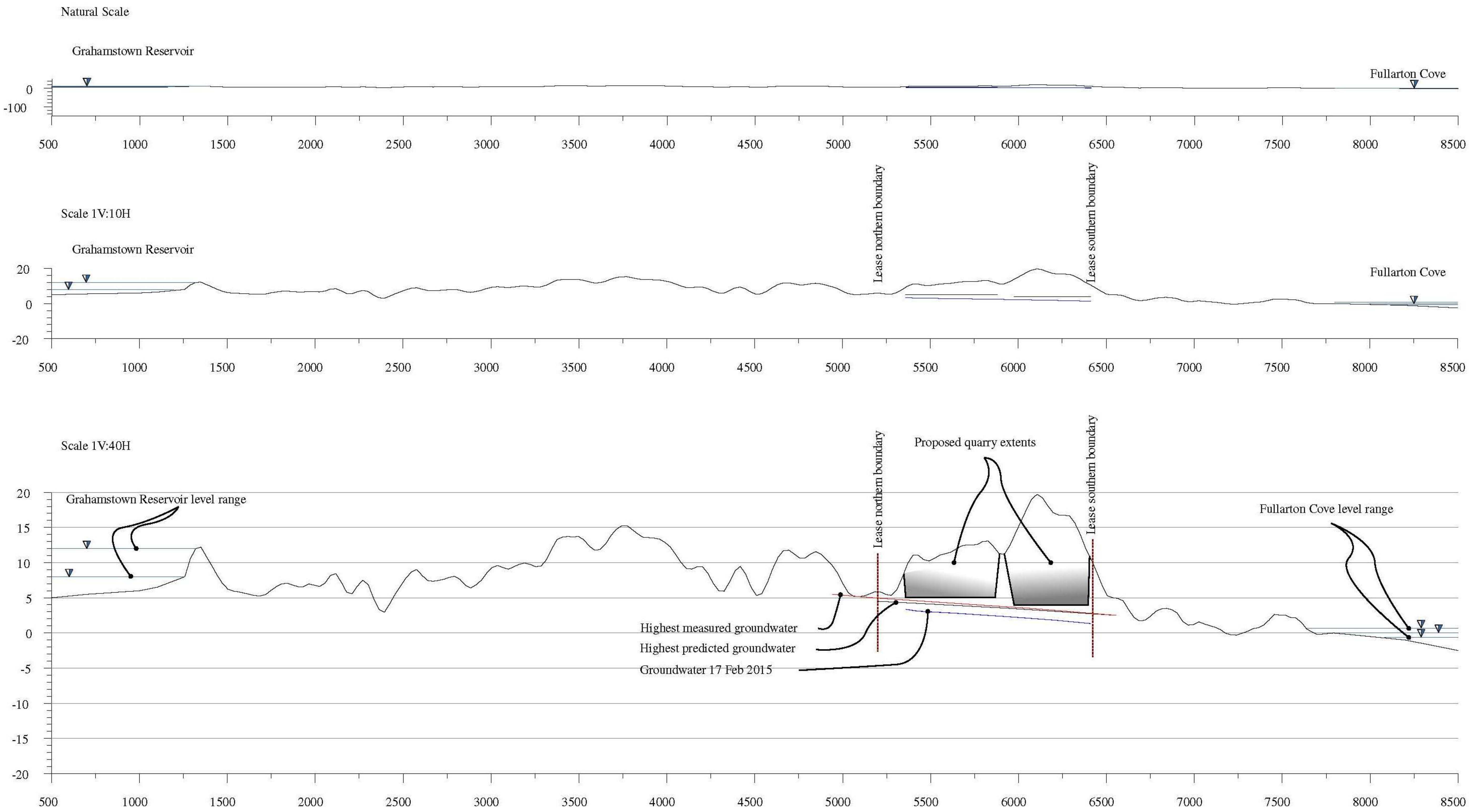

Figure 11 - Cross Section

Figure 12 - Maximum predicted recorded groundwater levels (Umwelt, 2015)

<u>Review of groundwater level characterisation and groundwater impacts in the EIS</u>

It is considered that the basis for groundwater level selection in the EIS is inappropriate because it ignores changes to recharge and evapotranspiration that will be incurred by mining. The prediction of impacts is also inappropriate, for the same reason. There is also inadequate consideration given to the issue of adjacent contamination from nearby previous mining and the Williamtown RAAF Base.

As stated above, the main fluxes in this groundwater system are considered to be vertical, ie from recharge and evapotranspiration. Horizontal flows are very mild.

Vegetation typically is responsible for consuming the vast majority of available rainfall. In most of Australia, evapotranspiration accounts for over 90% of rainfall. In this location, due to high soil permeability, recharge may be higher, which potentially reduces the losses to evapotranspiration, but evapotranspiration is nonetheless anticipated to be the primary consumer of rainfall.

When mining removes vegetation, evapotranspiration will be reduced significantly, resulting in increased recharge. In addition, the creation of a "bowl" due to excavation, will create a ponding feature, also significantly increasing recharge. These are the key groundwater processes at the site, and are not represented at all in the analysis used in the EIS to select design groundwater levels and to determine groundwater impacts.

These changes to recharge may result in local increases to groundwater levels at the mine site. Such raises in groundwater levels could potentially in inundation of the currently proposed mining plan, and groundwater levels would thus need to be drawn down, by pumping, to allow the current mining plan to be undertaken. The impacts of such pumping, and planned disposal of groundwater, is not addressed in the EIS.

The groundwater studies should be revised to consider changes to recharge and evapotranspiration in assessing design groundwater levels. The mining layout should therefore be revised accordingly.

If the mining plan is not revised, the EIS must incorporate an environmentally-appropriate plan of action for dealing with elevated groundwater levels.

As the groundwater flow is toward the ocean, it is perceived that there is potentially limited affect from the Williamtown RAAF contamination. Nonetheless, the proposed mine is within the formal examination area, and the potential interactions with this contamination source and current contamination studies should be considered.

It is also unclear why the maximum predicted groundwater levels adopted in the EIS (Figure 12) are lower than highest recorded groundwater levels (Figure 8).

It is understood that previous mining adjacent to the proposed mining was also associated with some contamination. This site is "upstream" of the proposed site. The potential for mobilisation of these contaminants should be considered in the EIS.

Yours faithfully

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