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26 June 2009

Crown Project Services Pty Ltd
Level 15, 3 Spring Street
SYDNEY NSW 2000

Attention: Mr Brodie McHutchison - Senior Project Manager

RCA AUSTRALIA
GEOTECHNICAL • ENVIRONMENTAL

Geotechnical Engineering
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Environmental Engineering
Hydrogeology
Construction Materials Testing

# ENVIRONMENTAL LETTER REPORT
# KNAUF INSULATION DEVELOPMENT, STEEL RIVER

## 1 INTRODUCTION

This letter follows your inquiry of 22 June inviting us to submit a proposal for a short report relating to the Knauf Insulation (KI) development at Steel River. RCA Australia (RCA) is pleased to have been engaged by Crown Project Services Pty Ltd (CPS).

RCA understands that this letter will be utilised by CPS in its Environmental Assessment clarifying the foundation works for the KI development. RCA has used principal engineer level staff for the preparation of this letter, consistent with previous similar engagements for Steel River. All of these RCA staff have a long association with the Steel River site and work under our third party certified quality assurance system complying with AS/NZS ISO 9001:2000.

## 2 SCOPE OF WORKS

Based on the project details provided in your email brief of 22 June the following scope of work has been undertaken.

## 2.1 BROAD CONSIDERATION OF DESIGN ISSUES - RELOCATION OF PROPOSED TERTIARY CONTAINMENT CELL (TCC)

In 2008 the *Operational and Long-term Environmental Management Plan, Proposed Tertiary Containment Cell (TCC) Steel River Site* was provided to Domaine Steel River. This document was specific to the Stages 9 and 10 development plan. As the KI site covers all of Stages 9 and 10 and some of Stage 8 the proposed location of the TCC is not suitable. CPS has proposed a location more suitable for the KI development. This location is indicated on an architectural plan attached to the email brief on 22 June (CPS reference MBA-5-A-H59-148[F].pdf).

The proposed new TCC location can be defined as being centred approximately 220m south east of the 2008 approved location of the TCC. The cell is to be located close to the residual rock embankment adjoining the southern embankment of the Steel River Stage 9 and 10 site.

Under the present engagement, RCA has reviewed this location in regard to:

- whether the approved TCC design is appropriate given the proposed location; and
- whether the proposed location will introduce any additional issues relating to groundwater and preferential flows, or other important environmental considerations.

Due to the interrelated nature of the questions, both questions have been considered in parallel in Section 2.1.1.

### *2.1.1 RCA OPINION ON PROPOSED NEW TCC LOCATION*

Having considered the present proposal RCA consider that the design is generally suitable at the proposed location, but the following amendments to the design will be required to suit the specific site constraints.

**Residual clay and fill contact plane**

The proposed TCC location is within close proximity to the residual clay (and underlying weather bedrock) profile which grades steeply away to the north along the length of the southern KI site boundary. The depth and extent of the residual clay profile beneath the site fill is not accurately mapped. Surface infiltration to the subsurface soil/fill profile is likely to preferentially flow along the surface of the residual clay due to their low permeability. The permeability differential between the site fill and the residual clay would likely cause the contact plane between fill and residual clay to become a groundwater flowpath for any surface water infiltration. The implications of this geological feature on the proposed TCC location are presented in the following.

*Surface water*

Surface water across the residual clay surface may cause localised flooding across the surface of the proposed TCC location. A diversion drain should be constructed around the foot of the residual clay embankment to divert surface water around, and away from the TCC location. Surface water diversion could be alternatively achieved by placement of a diversion drain across the top of the southern site embankment.

*Groundwater*

The contact plane between the site soil/fill and underlying residual clay is likely to form a preferential groundwater flow path. Placement of the TCC in close proximity to this contact plane may increase groundwater flow beneath the TCC and raise groundwater levels, forcing groundwater into the lower TCC layers. An additional layer of coarse drainage gravel of minimum 0.2m thickness across the base of the TCC, overlain by bidim[1], prior to placement of compacted clay, would allow dissipation and lateral groundwater discharge to the surrounding strata.

The fill and residual clay contact plane should be situated beneath the proposed TCC base. Existence of this contact plane partway down the wall of the TCC, or floor, may cause localised groundwater flow resulting in both construction difficulties and longer term groundwater management requirements. Thus the TCC is to be situated north of, and above the contact plane. Site investigation would be required prior to construction to accurately map the profile of features at the site. The distance between the contact plane and the TCC construction can be determined following mapping and would be based on the steepness of the contact plane, soil moisture and strata type in the vicinity of the contact plane.

## Material Type

The material to be excavated to create the TCC void is of unknown quality. Investigation undertaken for other projects in this area has indicated that iron and steel making slags may be present and that some cementation of these materials has occurred. Excavation of this area may be difficult and may require heavy duty excavation equipment and rock breaking techniques. Ground truthing could be undertaken to assess excavatability.

Contaminant concentrations within the area of the proposed TCC are not known. The uncertainty of site contamination in this area is like that for the original TCC location.

## Groundwater

The depth to true groundwater in the area of the proposed TCC is not known. Generally groundwater is found at depths around 6m. Due to the close proximity of a recharge point (being the fill and residual clay contact plane) groundwater may be shallower and possibly in the order of 4 to 5m from the surface. Due to the close proximity of a recharge point, groundwater levels may also vary significantly in response to rainfall. Groundwater bore installation would be required to assess groundwater depths and the level of groundwater fluctuation.

To remain consistent with the existing TCC design, the TCC base should remain above the highest predicted groundwater level. This may limit the maximum depth of the TCC to 4m from the surface but could be confirmed following groundwater monitoring.

Where additional space is required, preliminary site review indicates that the south west corner of Steel River may provide a suitable alternate TCC location. Specific cell design would be required.

[1] A specific geotextile.

**Auditor Review**

RCA recommends that 'in-principle auditor approval' be sought for the proposed TCC location based on the RCA advice contained in this letter.

## 2.2 REVIEW OF THE RCA LETTER DATED 10 JUNE 2009 (RCA REF 6586F-103/0) REGARDING PENETRATION OF THE PRIMARY CONTAINMENT AREA WITH STEEL 'UC' PILES

The existing letter outlines the general acceptability of using driven piles in the area known as the Primary Containment Cell (PCC). CPS has advised RCA that the number of piles is likely to be in excess of 400, with some directly through the primary containment cell.

RCA understands that the proposed piling on the KI project is steel UC driven piles. Consequently RCA has reviewed specific issues in regard to the site geological conditions.

### *2.2.1 SITE GEOLOGICAL CONDITIONS*

Subsurface foundation conditions comprise filling over alluvium over weathered rock. The proposed development in part overlies the PCC.

General ground conditions are indicated on the following section which is based on old BHP bores and recent drilling by Douglas Partners. This drawing is also included as an attachment to this letter.

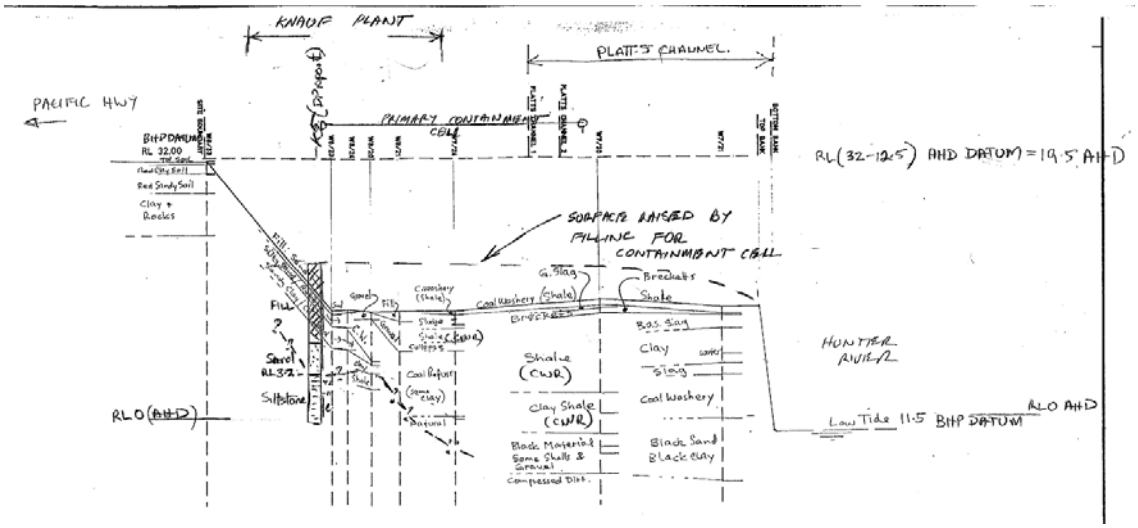



**Figure 1** *Generalised Section across the Site Based on Available Data*

It may be seen from the above that the depth of filling and alluvium over bedrock generally increase from the south of the site to the Hunter River at the north of the site.

Available data indicates shallow bedrock (less than 10m) on the southern side of the proposed plant, increasing to an unknown depth on the river side.

The general filling is uncontrolled filling which has not been placed to any engineering standard.

The alluvium underlying the filling is variable and at some locations comprising loose sands and at others mixtures of sands and variable strength clay.

The filling and alluvium is unsuitable for the support of significant loadings due to settlement and bearing limitations.

### *2.2.2 PILING CONSIDERATIONS*

Piling of significant loads is required. Owing to the shallow depth to rock the piles will be end bearing piles in the bedrock.

Driven piles are considered suitable for the site and it is understood that steel UC sections are proposed for piles. This pile type has a high expectation of penetrating obstructions in the filling. While the proposed pile type is considered suitable the following comments are made:

- The depth to rock is variable across building footprint generally increasing in depth towards the river.

- Heavy steel sections driven with sufficient energy to penetrate obstructions and achieve the full structural pile capacity would be expected to penetrate many meters into the low strength rock profile before reaching practical refusal. The depth of penetration will be variable. Pile contract documentation will need to be arranged to manage the above variability as it will be largely unpredictable with any accuracy.

- There is no data available on ground aggressivity to buried concrete/steel. It is likely that the ground will be chemically aggressive to buried structures. Accordingly, allowance for pile protection or allowance for corrosion loss will need to be made on pile design.

Groundwater levels are expected to vary up to about RL6 or 7 (AHD) based on available monitoring records. This level is at or below the 1990's BHP ground surface prior to filling placed for the PCC and remediation re-contouring.

The part of the proposed development overlying the PCC will also require piling. As such, the piles will pass through the containment cell.

The containment cell overlies filling and alluvium. The alluvium is variable comprising sands and clay. There is no engineered or natural continuous leaching barrier at the base of the PCC. The containment relies on the site being capped to prevent surface water ingress into the containment area thus preventing vertical/lateral leachate migration. As is discussed in later sections of this letter, the cap over the PCC also minimises soil hydrocarbon vapour emissions and prevents physical contact with hydrocarbon (tar) contaminated fill materials.

In terms of volatile hydrocarbon vapour migration potential, the selection of UC piles does not afford the same degree of security as other forms of driven pile, such as timber or concrete piles. The consequences of this (ie, potential management measures) are described in **Table 1**. Otherwise the penetration of the containment cell by the piles is not expected to impact on the containment cell philosophy.

It is considered that the permeability of the contact interface between the pile and the ground (alluvium and filling) would be similar to that of the existing site material to be found at depth and hence would not produce a preferential path for any leachate migration.

The permeability of the bedrock is expected to be at least one order of magnitude less than the filling and alluvium. Accordingly, movement of water (and contaminants) into the bedrock is expected to be minimal.

#### *2.2.3 RELIANCE ON 10 JUNE 2009 RCA GENERAL PILING ADVICE LETTER*

As a result of the present engagement to CPS on behalf of KI, KI are granted permission to rely on the **10 June 2009 RCA letter,** previously provided to Domaine Steel River Pty Ltd (DSR)[2].

### 2.3 ENVIRONMENTAL MANAGEMENT PLAN STAGE 9 AND 10, STEEL RIVER SITE, RCA 2008 (S910EMP)

That document was produced by RCA specifically for Stages 9 and 10 of the Steel River development in 2008. It was prepared on the basis that development of Stages 9 and 10 would essentially follow the pattern established in Steel River Stages 1 to 8 developments.

Section 6.1 of the S910EMP contains development principles for Lots containing containment cells. At the time of the S910EMP preparation, it was considered that lightly loaded structures would probably be erected over the primary and tertiary containment cells (PCC and TCC). **Table 1** presents extracts from Section 6.1 of the S910EMP that could be interpreted to inhibit certain elements of the KI project. **Table 1** also provides RCA comment on the purpose of those clauses and alternative control measures that acknowledge the nature of the proposed KI development:

[2] RCA has consent from DSR.

**Table 1** *Extracts from S910EMP Section 6.1 with Comments*

| Extract | Key issues | Comment |
|---|---|---|
| Reduction in cap thickness is not permitted for basements, since cap thickness attenuates volatile soil vapour concentrations. Sumps, pits and services can be constructed below the July 2008 surface level to a maximum depth of 1m. Specific consideration of preferred pathways for volatile flow into buildings is required under the Steel River certification scheme. | Attenuation of volatile soil vapour concentrations before they can contaminate indoor air quality.<br>Minimising the risk of human contact with hydrocarbon contaminated soils. | Specific consideration of preferred pathways for volatile flow into buildings is required.<br>There are several ways that volatile soil vapour emissions can be attenuated or managed. This needs to be considered during the detailed design phase of the project.<br>Attenuation measures include: maintenance of 1m of low permeability CWR[3] around subsurface structures; placement of geosynthetic clay liners (GCL) around subsurface structures; placement of welded HDPE (plastic) liners[4] around subsurface structures; and may include constructing subsurface structures to 'heavy duty' structural standards where the risk of cracking during service is effectively zero.<br>Management measures for volatile soil vapour emissions potentially include: inclusion of impermeable grouted seals around the top 1m of driven piles; site specific soil vapour investigations with predictive indoor air quality modelling; suspending slab floors above the filled surface of the site, (at least in the sensitive[5] parts of the development) to provide a ventilated airspace that would allow vapours to safely dissipate; and vapour barrier controls that both prevent vapour migration through floors, and collect and vent vapours safely to atmosphere.<br>All such designs and management assessments will be subject to contaminated site auditor signoff at Steel River. |
| If there is a development imperative to install facilities at a more significant depth than 1m from the current surface level, elevation of the building level of the Lot will be required. | As above | This extract did not imagine the type of development now proposed by KI.<br>Elevation of the building level of the KI development is not required. Other controls can be implemented to |

[3] Minimum of 1m thickness. Permeability should be consistent with existing site material (approximately $k=10^{-9}$ m/s).

[4] Compatibility with site contaminants would need to be confirmed.

[5] Sensitive parts of the development are considered to be those with both a relatively high human occupancy rate and enclosed air spaces, eg offices, workshops.

| Extract | Key issues | Comment |
|---|---|---|
| | | achieve the objectives of the site capping (see comments above). |
| To prevent the entry of hydrocarbon vapours into site developments, no excavations or other penetrations deeper than 1m are to occur over the primary and proposed tertiary containment cell area. For example any necessary services (such as stormwater and sewage) must be installed at maximum depths less than or equal to a maximum of 1m from the present July 2008 surface level. Hence no sumps, pits or the like with an invert deeper than 1m from the July 2008 surface are to be constructed over containment cell areas. | Minimising the risk of human exposure to hydrocarbon vapours. | This principle still holds for the proposed tertiary containment cell. Given the context of KI's intent to relocate the TCC, 'July 2008 surface level' should be taken to mean 'finished TCC surface level'.<br>The comments above and other parts of the present letter deal with the application of this extract to the PCC. |
| "Under no circumstances are underlying contained arisings to be disturbed. However, if development activity accidentally breaches tar contaminated material or vapours/odours, a site specific assessment should be made by an appropriately qualified environmental professional of whether VOC could directly enter nearby buildings." | Minimising the risk of human contact with hydrocarbon contaminated soils, vapours, and groundwater, in both the short and long terms. | It is appreciated that underlying contained arisings will be disturbed during construction of the KI development, at a minimum through having piles driven through them.<br>As below, during piling, this can be managed by appropriate safe work methodologies. Part of that methodology would be that if tar contaminated material or vapours/odours, are exposed a site specific assessment should be made by an appropriately qualified environmental professional of the implications to construction works and future site infrastructure, eg could VOC directly enter nearby buildings. |
| "Typical construction over the containment cells should include high level footings suitable for lightly loaded and settlement tolerant structures. Lightly loaded structures would include those requiring an allowable bearing pressure up to 100kPa on pad and strip footings and 5kPa over slabs on ground. Settlements can be expected to be limited to the order of 5-15mm. Heavier loads are not suitable for the containment cell affected areas." | Attenuation of volatile soil vapour concentrations.<br>Minimising the risk of human contact with hydrocarbon contaminated soils.<br>Minimising interference with the site groundwater regime, which features contamination. | As above<br>During piling, this can be managed by appropriate safe work methodologies.<br>Section 2.2 of this letter deals with this issue. |

RCA recommends that the S910EMP be modified to reflect the nature of the KI development (and become the KI-EMP). That, and adherence to the Steel River Certification system (requiring completion of Certificates C and D for the KI development) will ensure that the development of the KI plant does not contravene the Steel River site development protocols.

Thank you again for this opportunity to work with Crown Project Services Pty Ltd.

## 3 LIMITATIONS

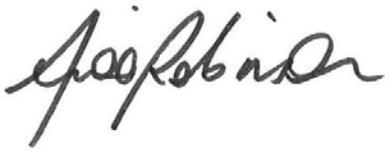
This letter considers certain technical (geotechnical and environmental) issues related to the nominated aspects of the proposed KI development at Steel River, and does not constitute legal or planning advice.

The letter has been prepared for the sole use of Crown Project Services Pty Ltd (CPS) in support of the KI Steel River proposal, and in accordance with our agreement dated 24 June 2009. The services performed by RCA have been conducted in a manner consistent with that generally exercised by members of its profession and consulting practice.

The letter may not contain sufficient information for purposes of other uses or for parties other than CPS in support of the subject KI proposal. This letter shall only be presented in full and may not be used to support objectives other than those stated in the letter without written permission from RCA.

The contained information is considered accurate at the date of issue with regard to the current conditions of the site. Conditions can vary across any site that cannot be explicitly defined by investigation.

Yours faithfully
**RCA AUSTRALIA**



Fiona Robinson
Principal Environmental Engineer

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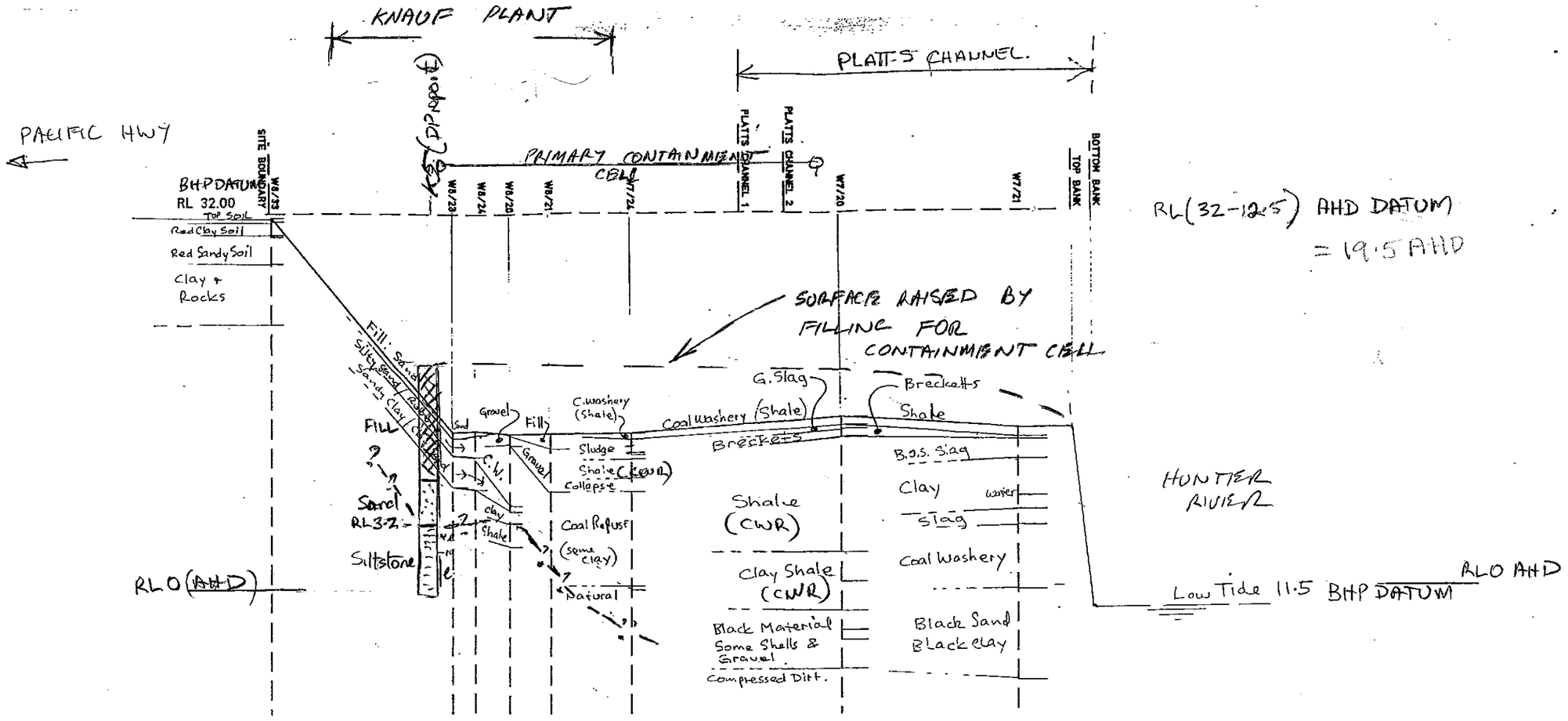
Principal Environmental Engineer

Bob Carr
Principal Geotechnical Engineer

Geoff Mason
Environment Manager

## ATTACHMENTS

Cross Section Sketch of KI Steel River site.




C' - C'

Scale 1:2500 HORIZ.
1:250 VERT.

W.O.T.S. CROSS SECTIONS. (PART ND 6498.)

PRELIMINARY

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