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RCA AUSTRALIA
GEOTECHNICAL • ENVIRONMENTAL

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SSDA REPORT
GEOTECHNICAL, MINE SUBSIDENCE AND CONTAMINATION INVESTIGATION
JOHN HUNTER HEALTH AND INNOVATION PRECINCT

Table 1 *SEARS Requirements*

Requirement	Relevant report section
Statutory and Strategic Context	
State Environmental Planning Policy No 55 – Remediation of Land	**Section 2.4** & Ref [4] & Ref [5]
Draft State Environmental Planning Policy (Remediation of Land)	**Section 2.4** & Ref [4] & Ref [5]
Soil, Water and Air	
Provide an assessment of potential impacts on surface and groundwater (quality and quantity), soil, hydrology, related infrastructure, adjacent licensed water users, riparian land groundwater dependent ecosystems and watercourse(s) where relevant and the measures to reduce and mitigate these impacts	**Section 2.2** & Ref [1]
Details of surface and groundwater monitoring activities and methodologies	**Section 2.2** & Ref [1]
An assessment of salinity and acid sulphate soil impacts	**Section 2.2** & Ref [1]
A salinity management and/or Acid Sulphate Soils management strategies, where relevant.	**Section 2.2** & Ref [1]

Contamination	
Assess and quantify any soil and groundwater contamination and demonstrate that the site is suitable for the proposed use in accordance with SEPP 55. This must include the following prepared by certified consultants recognised by the NSW Environment Protection Authority: • Preliminary Site Investigation (PSI) • Detailed Site Investigation (DSI) where recommended in the PSI.	**Section 2.4** & Ref [4] & Ref [5]
Relevant Policies and Guidelines: • Managing Land Contamination: Planning Guidelines - SEPP 55 Remediation of Land (DUAP, 1998) • Sampling Design Guidelines (EPA, 1995) • Guidelines for Consultants Reporting on Contaminated Sites (OEH, 2011) • National Environment Protection (Assessment of Site Contamination) Measure (National Environment Protection Council, as amended 2013).	**Section 2.4** & Ref [4] & Ref [5]
Mine Subsidence	
Provide details of how mine subsidence has been considered	**Section 2.3** & Ref [2] & Ref [3]
Modelling which considers the impact that grouting will have on the predicted subsidence impacts to the existing hospital, noting the importance of continued serviceability and operation.	**Section 2.3** & Ref [2] & Ref [3]

1 BACKGROUND

1.1 OVERVIEW

In June 2019, the NSW Government announced a significant expansion of the John Hunter and John Hunter Children's Hospitals with the $780 million John Hunter Health and Innovation Precinct (JHHIP) project.

The JHHIP will transform healthcare services for Newcastle, the greater Hunter region and northern NSW communities. The infrastructure will provide additional inpatient capacity to the John Hunter and John Hunter Children's Hospitals and create further opportunities for partnerships with industry and higher education providers.

The JHHIP will deliver an innovative and integrated precinct with industry-leading facilities working in collaboration with health, education and research partners to meet the current and future needs of the Greater Newcastle, Hunter New England and Northern NSW regions.

The John Hunter Health and Innovation Precinct Project is being planned and designed with ongoing communication and engagement with clinical staff, operational staff, the community and other key stakeholders with a strong focus on the following:

- Patient-centred care
- Contemporary models of care

- Future economic, health and innovation development opportunities
- Environmental sustainability

This SSDA report has been provided to detail how the Secretary's Environmental Assessment Requirements (SEARS) for the project have been addressed as detailed in **Table 1**.

1.2 SUBJECT SITE

The John Hunter Health Campus (JHHC) is located on Lookout Road, Lambton Heights, within the City of Newcastle Local Government Area (LGA), approximately 8km west of the Newcastle CBD. The hospital campus is located approximately 3.5km north of Kotara railway station.

The JHHC comprises the John Hunter Hospital (JHH), John Hunter Children's Hospital (JHCH), Royal Newcastle Centre (RNC), the Rankin Park Rehabilitation Unit and the Nexus Unit (Children & Adolescent Mental Health). JHHC is a Level 6 Principal Referral and tertiary Hospital, providing the clinical hub for medical, surgical, child and maternity services within the Hunter New England Local Health District (HNELHD) and across northern NSW through established referral networks. Other services at the campus include the Hunter Medical Research Institute (HMRI), Newcastle Private Hospital and the HNELHD Headquarters.

1.3 SSDA PROPOSAL

Approval is being sought for a new Acute Services Building and refurbishment of existing hospital facilities at John Hunter Hospital comprising:

- Construction and operation of a new seven-storey Acute Services Building (plus 4 semi-basement levels) to provide:
    - an expanded and enhanced Emergency Department;
    - expanded and enhanced medical imaging services;
    - expanded and enhanced intensive care services - Adult, Paediatric and Neonatal;
    - expanded and enhanced Operating Theatres including Interventional Suites;
    - an expanded Clinical Sterilising Department;
    - Women's Services including Birthing Unit, Day Assessment Unit and Inpatient Units;
    - integrated flexible education and teaching spaces;
    - expanded support services;
    - associated retail spaces;

  - new rooftop helipads;
  - new semi-basement car parking;
- Refurbishment of existing buildings to provide:
  - additional Inpatient Units;
  - expanded support services;
- A new Hospital entry canopy and works to the existing drop off;
- Link bridge to the Hunter Medical Research Institute (HMRI);
- Campus wayfinding and signage;
- Landscape works;
- Site preparation including bulk earthworks, tree removal, environmental clearing, cut and fill;
- Mines grouting remediation works;
- Construction of internal roads network and construction access roads and works to existing at-grade carparking;
- Connection to the future Newcastle Inner City Bypass; and
- Inground building services works and utility adjustments.

2 GEOTECHNICAL, MINE SUBSIDENCE AND CONTAMINATION ASSESSMENT

2.1 GENERAL

RCA Australia was engaged by Health Infrastructure to undertake geotechnical and contamination investigation for the proposed John Hunter Heath and Innovation Project at the John Hunter Health Campus as described in **Section 1**. This section presents an executive summary of assessments to date and has been separated into the three (3) key areas:

- Geotechnical
- Mine Subsidence
- Contamination

2.2 GEOTECHNICAL ASSESSMENT

The topography of the John Hunter Health Campus (JHHC) site is dominated by a broad east west trending ridge on which the existing hospital development is concentrated. The site of the proposed acute services building is situated on the north facing flank of the ridge with slopes of approximately 10° down to the north.

Geotechnical investigation at the site (Ref [1]) included ten boreholes to 20m depth in the area of the acute services building and a number of shallow test pits and pavement bores along the proposed alignment of internal access roads.

The subsurface strata below the site of the acute services building comprises a shallow depth of residual soil over variable strength rock comprising sandstone, pebbly sandstone and conglomerate. The Victoria Tunnel (VT) coal seam was encountered at depths of between 0m and 14m below the surface in the area of the acute services building and will lie within the proposed excavation zone for the structure. The VT seam and adjacent strata are typically highly weathered and of low strength in the vicinity of the sub crop with the ground surface. The VT seam is about 3.5m thick with some associated mudstone / siltstone bands and claystone units with a sub horizontal dip to the south west of about 1V:30H. The Shepherds Hill Formation lies beneath the VT seam and is typically between 7 and 10m thick comprising medium to high strength tuff, siltstone and sandstone and is considered to be suitable for the support of the proposed structure on concrete piers.

The acute services building requires excavations up to in the order of 8m to 10m into the slopes downhill of the existing hospital development. Excavation in medium to high strength sandstone and pebbly sandstone (present in the Kotara and Shepherds Hill Formations) may require rock cutting or heavy ripping and rock breaking pneumatic equipment for confined / detailed excavations. Deep excavations will require full height retaining structures as part of the final structure and may be used to temporarily support the excavation during the excavation and construction phase. The retaining systems will require excavation support installed progressively as they are excavated or a support system should be installed prior to excavation. This is expected to include contiguous pile walls or soldier walls through the soil and weathered rock and meshing and pattern rock bolting, meshing and dental shotcrete in the moderately weathered to fresh rock. The VT Coal Seam will require rock bolted meshing and covering by shotcrete. The excavation is at the base of the existing Kookaburra Circuit road embankment and retaining wall and special care will be required in design and construction to manage the interaction between the existing structures and the excavation.

The regional groundwater level lies at a level below RL 0m (ie at depths of over 70m below ground surface). Minor seepage from the coal seams was observed at higher levels and allowance for seepage into excavations is recommended.

Acid sulfate screening tests were undertaken on twenty soil/rock samples recovered from the boreholes. The results indicate a low potential for acid sulfate rock drainage and no requirement for an acid sulfate management plan.

For the proposed access roads, the natural subgrade conditions encountered in the test pits at the site comprised high plasticity clay, low plasticity sandy clay and rock. Rock type was variable and included sandstone, siltstone, shale and carbonaceous siltstone. Preliminary pavements designs have been provided for various subgrade conditions.

2.3 MINE SUBSIDENCE ASSESSMENT

Mine subsidence assessment has included:

- A detailed assessment of mine subsidence (Ref [2]) that involved six deep bores drilled to the base of the mine workings along with numerical modelling of potential subsidence and recommendations for management of the mine subsidence risks by mine grouting.

- A recommendation for mine grouting at the site (Ref [3]).

The JHHIP site is undermined by abandoned coal mine workings of the Lambton Colliery in the Borehole Seam. Workings were by bord and pillar method and the proposed development area of the acute services building lies entirely over first worked bord and pillar workings at a depth to seam of about 80-100m. In the Lambton Colliery, the seam thickness of the Borehole Coal Seam is shown on RT255 to be 9’ 8” (2.95m).

Pillar stability analysis of typical first worked pillars that lie under the proposed acute services building site indicate that the pillars cannot be considered to be stable in the long-term and it was concluded that the majority of first worked pillars were at least partially crushed. Previous investigations at and near the site support this conclusion.

Six deep bores to the mined seam were completed along with numerical modelling of potential subsidence. It was concluded that:

- The first worked mine conditions beneath the site are characterised by a broad panel of partially crushed pillars. It is not clear what event or mechanism would lead to further subsidence or whether this would lead to complete pillar crush and convergence. In the unlikely event of full pillar crush the maximum potential subsidence that would be caused is estimated to equal 0.48m (40% of the effective mining height of 1.83m times the extraction ratio of 65%). Potential future subsidence is estimated to range from about 0.1m to 0.45m.

- The numerical model indicates that potential or net tilt across the site due to the full crush event may range from 2 to 9 mm/m. The curvature increase is predicted to range from -0.3 km-1 to 0.3 km-1 (sag and hog). Horizontal strain is predicted to range from -3mm/m to 3mm/m (compression and tension) but could increase locally by a factor of 2 where tensile strains cause cracking and concentrate the strain.

- It is considered that a significant number of additional boreholes would be required over the site and the angle of draw to ascertain if less conservative subsidence predictions could be achieved. Alternatively, grouting of the rubble at a reasonable grid spacing of 20m would allow a “Safe, Serviceable and Repairable (SSR)” outcome. SSR refers to a structure where any damage is non-structural and the building remains:

    - Safe - no danger to users.

- Serviceable - available for its intended use.
- Repairable - damaged components economically replaceable.

It was recommended that grouting be adopted for the development. Grouting would comprise multiple bores to the mined level with backfilling of all voids and bores with cementitious grout to provide support to remnant mine pillars and limit potential settlement to an acceptable level.

Numerical modelling of the JHHIP site confirmed that SSR subsidence conditions can be achieved at the site by undertaking strategic grouting of the partially collapsed workings at the site.

The numerical modelling indicates that after the proposed strategic grouting, potential subsidence would be limited to the following parameters that may be adopted for structural design:

- Maximum subsidence (S_{max}) < 0.02m
- Tilt < 1mm/m
- Curvature < 0.05 (km^{-1})
- Horizontal Strain < 1mm/m (+/-1mm/m over 15m, +/-0.25mm/m over 60m and +/-0.1mm/m over 150m)

Modelling indicates that the existing hospital buildings to the south will experience similar magnitudes of subsidence, tilt, curvature and strain after the post grouting design subsidence event (albeit at slightly different locations). It was therefore assessed that the proposed grouting strategy will not result in more risk than would be expected to be present in the existing no grout condition.

In summary the grout plan (Ref [3]) concluded:

- Placement of grout in two out of every four bords across the building footprint and a 15m buffer (10 bords in total).
- Grout be minimum 5MPa UCS placed via 125mm to 150mm diameter boreholes drilled at a nominal spacing of 15m to 20m along the bords by tremie pipe.
- Total grout volumes required to meet design criteria may range between about 6,600m^3 and 10,000m^3.
- A preliminary grouting works specification including verification was provided. The grouting works specification will form the basis of preliminary works at the site to remediate the mine workings and prepare the site for construction.

A third-party review of the mine subsidence investigation and recommendations has been undertaken along with consultation with Subsidence Advisory NSW.

2.4 CONTAMINATION ASSESSMENT

Consistent with the framework presented by the SEPP 55 (and the draft Remediation of Land SEPP) a preliminary site (contamination) assessment (Ref [4]) was undertaken for the development which comprised review of historical photography, a search of NSW EPA records, review of previous (predominantly geotechnical) reports and a site inspection. This assessment identified that the John Hunter Health Campus site was bushland with no formal use up until the construction of the John Hunter hospital in the mid-1980s. At the time of the assessment the site of the proposed clinical services building comprised vacant bushland with access tracks. Potential contamination was identified by desktop assessment (Ref [4]) to be limited historical filling activities, inappropriate waste disposal and use of asbestos containing materials.

A further detailed site (contamination) assessment (Ref [5]) was undertaken in conjunction with geotechnical assessment (Ref [1]) and included:

- Intrusive assessment (drilling, test pitting and hand augering) across the entirety of the site to the depth of the underlying bedrock material. The contamination investigation mainly focused on the subsurface soil conditions observed within the upper 2m of the subsurface profile.

- Collection and analysis of surface and subsurface soil samples from thirty-four (34) locations within the site.

- Assessment of the suitability of material within two (2) stockpiles understood as having been sourced from a previous roadworks project (the re-surfacing of the internal road between Lookout Road and the bus turning bay) to be used within an area designated for the proposed internal road networks.

No indications of contamination or anthropogenic waste (including asbestos containing materials) were identified during the fieldworks. RCA analysed forty-eight (48) samples for hydrocarbons and metals across the site to characterise the potential for contamination.

No contamination was identified in excess of human health or ecological criteria (Ref [6]) with the exception of benzo(a)pyrene concentrations in one (1) sample in excess of the ecological investigation level for commercial land use. In the absence of sensitive ecological receptors at the site, based on the proposed development comprising building or paving, RCA considers that it is unlikely to pose a risk to the environment for the proposed site use.

RCA considers that the site is suitable for the proposed use. Soil excavated as part of the construction process, subject to the absence of anthropogenic materials (which is considered to be potentially present within the fill embankments) as well as geotechnical and aesthetic requirements, is suitable for use as fill at the site.

All samples were classified as general solid waste in accordance with the relevant guidelines for disposal at a licenced waste facility. Natural materials encountered onsite are considered to be able to be classified as VENM based on the fieldwork observations and sample results.

RCA recommends industry best practice management measures be undertaken during construction with the implementation of best practice dust, soil and water management measures and an unexpected finds protocol which allows for separation and assessment of anthropogenic waste or odorous material in the event that is identified.

The material in the stockpiles is suitable for use as select in road embankment construction. During the excavation of the material RCA would recommend the implementation of unexpected finds protocol as per industry best practice in the instance that material significantly differs from those assessed.

REFERENCES

[1] RCA Australia, *Geotechnical Investigation Report, John Hunter Health and Innovation Precinct*, RCA Ref 14399-207/1, prepared for Health Infrastructure December 2019.

[2] RCA Australia, *Mine Investigation Report, John Hunter Health and Innovation Precinct*, RCA Ref 14399-211/1, prepared for Health Infrastructure April 2020.

[3] RCA Australia, *Mine Grouting Report, John Hunter Health and Innovation Precinct*, RCA Ref 14399-215/2, prepared for Health Infrastructure April 2021.

[4] RCA Australia, *Preliminary Site (Contamination) Assessment, John Hunter Health and Innovation Precinct*, RCA Ref 14399-203/1, prepared for Health Infrastructure November 2019

[5] RCA Australia, *Contamination and Waste Classification Report, John Hunter Health and Innovation Precinct*, RCA Ref 14399-208/3, prepared for Health Infrastructure Report December 2019.

[6] NEPC, *National Environment Protection (Assessment of Site Contamination) Measure*, 1999 as amended 2013.