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Integrated Practical Solutions

Report on
Summary of Investigations

Proposed Residential Development
Off Link Road, Wallsend

Prepared for
Eden Estates (Newcastle) Pty Ltd

Project 91610.05
December 2020

Douglas Partners
Geotechnics / Environment / Groundwater

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The undersigned, on behalf of Douglas Partners Pty Ltd, confirm that this document and all attached drawings, logs and test results have been checked and reviewed for errors, omissions and inaccuracies.

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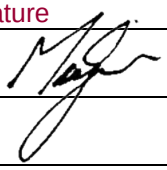
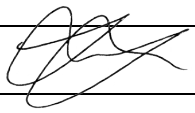
Author		7 December 2020
Reviewer		7 December 2020

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Report on Summary of Investigations
Proposed Residential Development
Off Link Road, Wallsend

1. Introduction

This report presents the results of a summary of investigations undertaken for a proposed residential development located along the Link Road, Wallsend. This summary report was commissioned by Trevor Jensen of Eden Estates (Newcastle) Pty Ltd.

It is understood that residential development is proposed for the site.

Douglas Partners Pty Ltd (DP) has undertaken a number of previous investigations within the site for the proposed residential development, as outlined below:

- Desktop Geotechnical Assessment of the site (DP, 2020a);
- Draft Desktop Mine Subsidence Investigation (DP, 2020b);
- Geotechnical Investigation of Filled Areas (DP, 2020c); and
- Assessment for Asbestos within area of site (DP, 2019).

Various drawings from these referenced reports have been reproduced (noting Drawings 4-1 and 4-2 have been amended slightly for greater clarity) within this summary report. The numbering from the drawings have been retained within this report for consistency.

To date, only limited subsurface investigation has been undertaken across the site which is included in reports DP (2019) and DP (2020c).

The purpose of this summary report is to provide an overview of the geotechnical and mining characteristics of the site, the principal identified site constraints to future residential development, and possible strategies to address these constraints to allow development.

Reference should be made to the individual investigation/assessment reports carried out by DP, as listed above and in the reference section, for further details on the investigation methodology, results, laboratory testing, analysis and outcomes.

2. Site Description

A full site description of the site is provided in the referenced reports by DP and not repeated herein. A brief description is as follows.

The site covers a large area of land extending from Elermore Vale in the south-east, Glendale in the south, Wallsend in the north, Cameron Park in the west and Edgeworth in the south-west. The Newcastle Link Road bisects the site area and runs east-west as indicated on Figure 1 below. The site is primarily covered with vegetation, although some areas of the site have been previously cleared. The cleared areas were mostly associated with pit top facilities for former coal mining collieries.

Figure 1: Site location plan with site shown in red (provided by client)

3. Geotechnical and Mining Characterisation of Site

Based on the results of the assessments undertaken to date, the site can be characterised as follows:

- The site is primarily covered with vegetation, although some areas of the site have been previously cleared;
- The cleared areas (northern and north-eastern areas) were mostly associated with pit top facilities for former coal mining collieries. Drawings 5-1 and 5-2, in Appendix B present the 1974 Orthophoto images with notes on the identified features which generally relate to the past mining activities on the site. These include:
    - Several former box cuts and a trial box cut around the pit top facilities;
    - Previous open cut pits;
    - Filled areas where coal rejects and overburden have been placed;
    - A number of dams around the pit top facilities, including Goat Hill Dam;

- The majority of the site has been undermined within the underlying Dudley / Young Wallsend Seam, Borehole Seam or both. The extent and type of workings identified during beneath the site are shown in Drawings A1 and A2 (Young Wallsend / Dudley Seam Workings) and Drawings B1 and B2 (Borehole Seam Workings). These drawings show the areas of various types and extents of mining as follows:
  - Areas of primary extraction in bord and pillar workings;
  - Areas of secondary extraction in bord and pillar workings;
  - Areas of partial extraction in bord and pillar workings;
  - Areas of mini longwall panel extraction;
  - Areas identified on record traces (RT) as goaf;
  - Areas identified as open cut workings; and
  - Areas of unknown workings described on the record traces as 'old workings in Wallsend Colliery'.

The layout of the mining and risks of mine subsidence depends on mining practice at the time of extraction and the need to protect surface development, if present.

4. Identified Geotechnical and Mine Related Hazards

4.1 General Approach of Risk Assessment

A number of geotechnical hazards in relation to preliminary assessment of relative risk levels between each hazard to future development have been identified during the desktop assessment as either:

- Low Risk — Whilst a risk of adverse effects is present, the risk could be effectively managed through good engineering practices and design to accommodation the associated risks;
- Moderate Risk — These areas have been identified to have a risk of adverse impacts on the future development and would require additional investigation to qualify the risks and allow geotechnical inputs into design to manage the risks and allow future residential development in these areas of the site; and
- High Risk — These areas have been identified that have a significant risk of adverse impacts on future development and would require extensive risk reduction measures to allow development in these areas. Detailed additional investigation would be required in these areas to further qualify the risks and inform possible risk control measures and/or suitable development types within these areas.

Drawings 8-1 and 8-2, in Appendix B, provide an indication of where the principal hazards have been identified on the site (noting reference should be made to Drawings 4-1 and 4-2 for areas of fill which appears to have been placed on the site prior to 1974), and are briefly discussed in Sections 4.2 to 4.12 below. A summary of the assessed risk level and approximate area of the site affected by the hazard is provided in the section titles.

4.2 Uncontrolled Fill (Moderate to High Risk – North-eastern and northern area of site)

Drawing 4-1 and 4-2 in Appendix B provide both an indication on the depth of fill placed across the site since 1974 (shading), the approximate area of fill which appears to have been on the site prior to 1974 (green polygons) and the depth of fill encountered in test pits and bores undertaken by DP and others at the site. The ability of the existing fill to support future development is dependent on a number of factors, primarily relating to the degree of control used during placement of the fill, particularly in relation to the compaction achieved during placement. The results of the in-situ testing undertaken during DP (2020c), primarily comprising standard penetration testing (SPT), were utilised to provide guidance on the level of compaction (and relative density) of the fill material.

The results of the assessment indicate that the majority of the fill is in a poorly compacted condition and in areas contains shallow groundwater and is not suitable in its current condition to support future structures or surface development, and site improvement measures would be required to allow development within these areas of the site.

These improvement measures would also be tailored to mitigate additional identified risks, such as potential for combustion of carbonaceous material and generation of acid, and is likely to include removal of the existing fill and recompaction after blending with non-carbonaceous material.

It may be possible to undertake a less onerous earthworks procedure, such as partial removal and re-compaction of the upper portion of the existing fill together with the provision of a suitable capping layer, followed by support of future structures via piled foundations through the existing fill profile to be founded within the underlying rock profile. This alternative site preparation option as the approach to earthworks will depend on the type and scale of development; relatively rigid multi-storey buildings, for example, would probably require piles but flexible warehouse-type buildings may be suitable to be supported on re-compacted fill with some structural allowances to accommodate settlement.

4.3 Potentially Unstable Ground (Low to High Risk - North-eastern and Northern areas)

Reference to the Lake Macquarie City Council Geotechnical Engineering Policy Part 1 indicates that the risk associated with steep slopes is dependant primarily on the presence of coal or tuff and the topography. A similar approach is likely to be taken by Newcastle City Council. In general, areas of steeper ground (greater than 15°) which correlate with coal outcrops or the presence of tuff are considered to be at higher risk of instability and hence greater engineering assessment and control is required for development.

Drawing 8-1 to 8-2 in Appendix B shows the areas of the site with slopes of greater than 15°.

The trial box cut experienced a high wall failure and exposed an ancient landslide of up to 12 m in height overlying the Nobby's Tuff. Some tension cracking was observed in the steep ground upslope of the former trial box cut during the 2020 inspection by DP.

Apart from this area of the site (steep ground associated with the ridge north-west of the former trial box cut), no signs of gross deep seated slope instability were observed elsewhere on the site.

Deep seated instability can often occur near the outcrop of coal seams. Accurate delineation of the outcrop will be important in this regard and will require subsurface investigation.

4.4 Mine Openings (High Risk – Mainly Northern Area)

A review of the record traces and Umwelt (2006) was undertaken to establish the presence and location of existing mine openings, such as tunnels and shafts. Some of the RTs provide coordinates for the mine openings whereas others do not. Umwelt (2006) indicates some entrances were backfilled as part of the Phase 1 remediation. Shafts were generally capped with an engineer designed concrete slab. In general, the mine entrances sealed during closure of the mine appear to have been completed satisfactorily. The Umwelt (2006) report also notes that that some entrances, such as No 4 Tunnel Entries and the Wallsend Bore Entry, could not be located and hence there is a possible hazard if these missing entries were not properly sealed.

The approximate location of these shaft and mine openings are shown on Drawing 8-1 and 8-2 of (DP, 2020a). Further investigation will be required, including subsurface investigation to locate key shafts within these record traces to allow more accurate georeferencing and positioning of mine openings.

Confirmation of the sealing of these mine openings would be required together with their exact location where not known.

It is unlikely that SA NSW would allow construction of development or structures over these mine openings. Generally the mine openings are either shafts, which may range in diameter from less than 1 m to up to approximately 3 m, or adits, which are likely to be in the order of 4 m to 6 m in width and of variable length as it increases in depth to the working seam.

4.5 Carbonaceous Content and Combustibility (Moderate Risk - Emplacement Areas)

Based on the results of DP (2020c), coal rejects and coal fines have been placed within the site, to depths ranging from about 1 m to 28 m (refer Drawings 4-1 and 4-2 in Appendix B). The rejects area has a low risk of spontaneous combustion. There is, however, a potential for combustion from external sources (such as bushfires). The risk profile for combustion is dependent on the possible external ignition source and mechanisms. It is considered that the risk of combustion could be managed by a combination of blending the existing fill with non-carbonaceous material, recompaction of the existing fill and/or blended material, and / or provision of a suitable cap of non-combustible material over filled areas.

The appropriate thickness of the capping will be dependent on the development proposed for the fill areas. Further assessment of the appropriate thickness of capping should be undertaken as the development design of the site progresses.

Groundwater within the existing fill was also encountered at a number of locations across the site, which will necessitate the need for dewatering, depending on the development and ground improvement option chosen.

4.6 Acid Drainage (Low to Moderate Risk – Emplacement Areas)

In relation to the potential for the coal rejects to create acid, the results of testing and assessment undertaken in DP (2020c) indicated the following:

- The majority of the sediments tested have a low potential to generate acid upon oxidation, however if oxidised, significant quantities of acid may be produced as evidenced by the elevated net acid generation values;
- It seems that there is little evidence that oxidisation of the coal rejects has resulted in significant lowering of the groundwater pH levels on the site;
- Disturbance of the fill material could lead to oxidation which would require measures to guard against acid generation which could affect the surrounding environment and future structures.

The potential for the material to generate acid could be appropriately managed through the following measures:

- Minimise surface water entering the carbonaceous fill areas;
- Provision of a capping layer consisting of relatively low permeability material;
- Blending existing fill with non-carbonaceous material;
- Placement of limestone gravel races or holding and treatment ponds within the downstream watercourses, particularly during earthworks which would increase the likelihood of oxidation of the existing carbonaceous fill material;
- Alternatively, lime could be incorporated into the fill during placement to neutralise any potential acid generation;
- Construction of footing or concrete elements which are taken through the existing fill material which contains carbonaceous material using sulphur resistant concrete.

4.7 Anticipated Foundation Conditions (Low Risk – whole of site excepted filled areas)

Founding conditions at the site can be divided into three areas as follows:

- Area 1 Uncontrolled fill;
- Area 2 Bushland areas which are typically relatively undisturbed;
- Area 3 Steep Ground, which is typically in the northern area of the site;

Area 1 has been assessed in DP (2020c) as having poor foundation conditions (refer Section 4.2) but could be remediated by earthworks with due consideration of the constraints provided above.

Area 2 in general is expected to provide good founding conditions, probably allowing conventional shallow footings as per (AS2870, 2011) once mine subsidence constraints are addressed.

Area 3 would require specific slope stability assessment for future development in these areas.

4.8 Acid Sulfate Soils (Low Risk – Small Area in North-eastern Corner)

Acid sulfate soils are not considered present on the site, although a small area of the site in the north-east corner of about 2,000 m^2 is mapped as have a low risk but with no known occurrence of acid sulfate soils.

4.9 Erosion (Low Risk – Whole of Site)

While widespread erosion was noted, it was generally minor and appeared to be more significant within the soils of the Killingworth erosional group. Where present the erosion was generally minor and could be managed through appropriate site management.

4.10 Excavatability (Low to Moderate – Whole of Site)

Shallow rock is expected over the majority of the undeveloped areas of the site. The characteristics of the rock is anticipated to vary significantly throughout the site, however, based on site observations, the following general trends may be applicable:

- Sandstone of low to very high strength with joint spacing of greater than 1 m in the northern area of the site, particularly in the Kahibah and Kotara Formations;
- Very low to medium strength sandstone and siltstone within the south-eastern area of the site, particularly in the Tickhole Formation.

This constraint can be managed through appropriate selection of earthmoving equipment and earthworks management measures.

4.11 Aggressive Soils (Low Risk – Whole of Site)

The soil landscape mapping suggests the possible presence of naturally acidic or saline soils, particularly within the Killingworth Soil Landscape Group and the Cedar Hill Group, which cover the majority of the site. These soils may be aggressive to buried structures or services. The presence of such soils should be subject to further investigation, however, can generally be managed by appropriate design of buried structures and services.

4.12 Mine Subsidence Constraints (High Risk – Whole of Site)

4.12.1 Trough Subsidence Constraints

DP (2020b) included review of readily available historical data about mining at the site, digitisation of selected pillars and panels beneath the site based on review of the appropriate record traces together with assessment of the location of drifts, shafts and mine entries.

Analytical and Numerical Modelling was undertaken with reference to SANSW current policy on subdivisions and the minimum requirement for geotechnical reports.

The majority of the site has been undermined by several colleries over a period of 80 to 90 years, within two separate coal seams (Dudley/Young Wallsend Seam and the deeper Borehole Seam).

Mine record traces obtained from Department of Regional NSW, Mining, Exploration and Geoscience (DoR) were geo-referenced relative to a cadastral plan. Discussion on the identified collieries which have mined beneath the site is provided in the following sections. The drawings listed below and included in Appendix B show the outline of the workings identified beneath the site and other information, as follows:

- Drawings A1 and A2 – Identified areas of mining of the Young Wallsend/Dudley Seam and the mining methods used in specific areas of the site;
- Drawings B1 and B2 – Identified areas of mining of the Borehole Seam, the mining methods used in specific areas of the site; and
- Drawing G1 and G2 – Identified areas of mining of the Young Wallsend/Dudley Seam, as show in Drawings A1 and A2, with the addition of approximate depth to the seam based on the seam floor contours shown on the record traces and 1 m digital elevation model.

The cover to the Young Wallsend seam was calculated from a digital 1 m elevation model retrieved from the NSW Government website and seam elevation contours shown on the record traces. It is noted that some interpolation has been undertaken between areas of mining and seam contours shown on the record traces. Therefore, the depth of cover should be considered approximately only and would require subsurface investigation to confirm. Less certainty is available for the lower Borehole Seam, however based on available information a separation of 20 m has been used between the Young Wallsend Seam and Borehole Seam. This is consistent with the separation between the Young Wallsend and Borehole Seam as encountered in the Empire Shaft.

Assessment of the pillar stability was undertaken based on selected panels of similar workings within both seams. The pillar stability analysis suggests the following:

- Acceptable panel factors of safety for primary workings within both seams; and
- Areas of unacceptable pillar width:height ratios for primary (first workings) in both seams.

Numerical analysis suggests that should collapse of the standing pillars occur, areas above the Dudley/Young Wallsend and Borehole Seam workings where the depth of cover ranges between 25 m and 65 m are considered unlikely to develop tilts of more than 7 mm/m, curvatures > 0.2 km-1 or strains > 3 mm/m because the pillars are likely to remain stable in the long-term. There are, however, several potential high subsidence impact hazard zones for the site where tilts of greater than 7 mm/m could development above the old first workings pillars and partial pillar extraction workings panels in the Dudley / Young Wallsend or Borehole Seams. It is considered likely that all the proposed buildings in the study area are likely to require articulation and subsidence impact amelioration details to be included in the design of the superstructure of the proposed buildings. Some of the high subsidence impact areas of the site may experience subsidence parameters, should failure occur which may not be readily catered for in the design of residential structures without remedial grouting. Further discussions with the SA NSW regarding appropriate building design constraints are recommended.

This analysis would be confirmed and refined following additional investigation and assessment. It is expected, though, that following subsurface investigation and more detailed analysis (ie full digitization of the workings) the subsidence parameters will lessen in severity and areas of the site may be shown to have acceptable factors of safety against mine subsidence, and therefore residential structure would either need to be design for less severe subsidence parameters and alternate remedial works, such as selective grouting of the workings, may not be required in such areas.

4.12.2 Pothole Subsidence Risk

Areas of the site have been identified to have workings with a depth of cover of less than 10 times the seam thickness. To assist with the assessment of pothole risk, Drawings H1 and H2, in Appendix B, show the areas of the site where 30 m or less of cover is present to the Young Wallsend Seam and Borehole Seam. Based on the review of the RTs these areas are underlain by primary workings and hence the risk of pothole subsidence in these areas would be high.

Based on SA NSW general requirements development of these areas would require remediation by means of grouting. A grout remediation plan must be developed for this area for acceptance by SA NSW. Following grouting a verification report must be submitted to SA NSW to confirm that any future surface improvements will remain 'safe and serviceable'.

5. References

AS2870. (2011). *Australian Standard AS2870-2011 "Residential Slabs and Footings".* Standards Australia.

DP. (2006a). *Report on Geotechnical Investigation, Proposed Land Re-Development, Bulkara Street, Wallsend (Former New Wallsend No. 2 Colliery), Project 39491.* Douglas Partners Pty Ltd.

DP. (2019). *Additional Assessment for Asbestos, Former New Wallsend No 2 Colliery Pit Top Facility, off Bulkara Street, Wallsend.* Douglas Partners Pty Ltd.

DP. (2020). *Report on Desktop Geotechnical Assessment, Proposed Residential Development, New Wallsend, off Bulkara Street, Wallsend.* Douglas Partners Pty Ltd.

DP. (2020a). *Report on Desktop Geotechnical Assessment, Proposed Residential Development, New Wallsend, off Bulkara Street, Wallsend, Project 91610.03.* Douglas Partners Pty Ltd.

DP. (2020b). *Draft Desktop Mine Subsidence Assessment, Proposed Residential Development, New Wallsend, off Bulkara Street, Wallsend, Project 91610.04.* Douglas Partners Pty Ltd.

DP. (2020c). *Report on Geotechnical Investigation of Filled Areas, Proposed Residential Development, off Bulara Street, Wallsend, Project 91610.05.* Douglas Partners Pty Ltd.

SA NSW. (2018). *Procedure used by SA NSW Risk Engineers to assess surface development on merit.* Subsidence Advisory NSW.

Umwelt. (2006). *Final Report, Phase 2 Decomissioning and Rehabilitation of New Wallsend No. 2 Colliery.* Umwelt (Australia) Pty Ltd.

6. Limitations

Douglas Partners (DP) has prepared this report for this project at the New Wallsend development area, located off Bulkara Road, Wallsend in accordance with DP's proposal NCL120130 dated 22 June 2020 and acceptance received from Eden Estates (Newcastle) Pty Ltd in a purchase order LR0023. The work was carried out under a consultancy services contract. This report is provided for the exclusive use of Eden Estates (Newcastle) Pty Ltd for this project only and for the purposes as described in the report.

It should not be used by or relied upon for other projects or purposes on the same or other site or by a third party. Any party so relying upon this report beyond its exclusive use and purpose as stated above, and without the express written consent of DP, does so entirely at its own risk and without recourse to DP for any loss or damage. In preparing this report DP has necessarily relied upon information provided by the client and/or their agents.

The results provided in the report are indicative of the sub-surface conditions on the site only at the specific sampling and/or testing locations, and then only to the depths investigated and at the time the work was carried out. Sub-surface conditions can change abruptly due to variable geological processes and also as a result of human influences. Such changes may occur after DP's field testing has been completed.

DP's advice is based upon the conditions encountered during previous investigations. The accuracy of the advice provided by DP in this report may be affected by undetected variations in ground conditions across the site between and beyond the sampling and/or testing locations. The advice may also be limited by budget constraints imposed by others or by site accessibility.

This report must be read in conjunction with all of the attached and should be kept in its entirety without separation of individual pages or sections. DP cannot be held responsible for interpretations or conclusions made by others unless they are supported by an expressed statement, interpretation, outcome or conclusion stated in this report.

This report, or sections from this report, should not be used as part of a specification for a project, without review and agreement by DP. This is because this report has been written as advice and opinion rather than instructions for construction.

The scope for work for this investigation/report did not include the assessment of surface or sub-surface materials or groundwater for contaminants, within or adjacent to the site. Should evidence of filling of unknown origin be noted in the report, and in particular the presence of building demolition materials, it should be recognised that there may be some risk that such filling may contain contaminants and hazardous building materials.

Asbestos has not been detected by observation, either on the surface of the site, or in filling materials at the test locations sampled and analysed. Building demolition materials, such as concrete were however located in previous below-ground filling and these are considered as indicative of the possible presence of hazardous building materials (HBM), including asbestos.

Although the sampling plan adopted for this investigation is considered appropriate to achieve the stated project objectives, there are necessarily parts of the site that have not been sampled and analysed. This is either due to undetected variations in ground conditions or to budget constraints, or to parts of the site being inaccessible and not available for inspection/sampling. It is therefore considered possible that HBM, including asbestos, may be present in unobserved or untested parts of the site, between and beyond sampling locations, and hence no warranty can be given that asbestos is not present.

The contents of this report do not constitute formal design components such as are required, by the Health and Safety Legislation and Regulations, to be included in a Safety Report specifying the hazards likely to be encountered during construction and the controls required to mitigate risk. This design process requires risk assessment to be undertaken, with such assessment being dependent upon factors relating to likelihood of occurrence and consequences of damage to property and to life.

This, in turn, requires project data and analysis presently beyond the knowledge and project role respectively of DP. DP may be able, however, to assist the client in carrying out a risk assessment of potential hazards contained in the Comments section of this report, as an extension to the current scope of works, if so requested, and provided that suitable additional information is made available to DP. Any such risk assessment would, however, be necessarily restricted to the geotechnical components set out in this report and to their application by the project designers to project design, construction, maintenance and demolition.

Douglas Partners Pty Ltd

Appendix A

About This Report

About this Report

Douglas Partners

Introduction

These notes have been provided to amplify DP's report in regard to classification methods, field procedures and the comments section. Not all are necessarily relevant to all reports.

DP's reports are based on information gained from limited subsurface excavations and sampling, supplemented by knowledge of local geology and experience. For this reason, they must be regarded as interpretive rather than factual documents, limited to some extent by the scope of information on which they rely.

Copyright

Borehole and Test Pit Logs

The borehole and test pit logs presented in this report are an engineering and/or geological interpretation of the subsurface conditions, and their reliability will depend to some extent on frequency of sampling and the method of drilling or excavation. Ideally, continuous undisturbed sampling or core drilling will provide the most reliable assessment, but this is not always practicable or possible to justify on economic grounds. In any case the boreholes and test pits represent only a very small sample of the total subsurface profile.

Interpretation of the information and its application to design and construction should therefore take into account the spacing of boreholes or pits, the frequency of sampling, and the possibility of other than 'straight line' variations between the test locations.

Groundwater

Where groundwater levels are measured in boreholes there are several potential problems, namely:

- In low permeability soils groundwater may enter the hole very slowly or perhaps not at all during the time the hole is left open;
- A localised, perched water table may lead to an erroneous indication of the true water table;
- Water table levels will vary from time to time with seasons or recent weather changes. They may not be the same at the time of construction as are indicated in the report; and
- The use of water or mud as a drilling fluid will mask any groundwater inflow. Water has to be blown out of the hole and drilling mud must first be washed out of the hole if water measurements are to be made.

More reliable measurements can be made by installing standpipes which are read at intervals over several days, or perhaps weeks for low permeability soils. Piezometers, sealed in a particular stratum, may be advisable in low permeability soils or where there may be interference from a perched water table.

Reports

The report has been prepared by qualified personnel, is based on the information obtained from field and laboratory testing, and has been undertaken to current engineering standards of interpretation and analysis. Where the report has been prepared for a specific design proposal, the information and interpretation may not be relevant if the design proposal is changed. If this happens, DP will be pleased to review the report and the sufficiency of the investigation work.

Every care is taken with the report as it relates to interpretation of subsurface conditions, discussion of geotechnical and environmental aspects, and recommendations or suggestions for design and construction. However, DP cannot always anticipate or assume responsibility for:

- Unexpected variations in ground conditions. The potential for this will depend partly on borehole or pit spacing and sampling frequency;
- Changes in policy or interpretations of policy by statutory authorities; or
- The actions of contractors responding to commercial pressures.

If these occur, DP will be pleased to assist with investigations or advice to resolve the matter.

About this Report

Site Anomalies

In the event that conditions encountered on site during construction appear to vary from those which were expected from the information contained in the report, DP requests that it be immediately notified. Most problems are much more readily resolved when conditions are exposed rather than at some later stage, well after the event.

Information for Contractual Purposes

Where information obtained from this report is provided for tendering purposes, it is recommended that all information, including the written report and discussion, be made available. In circumstances where the discussion or comments section is not relevant to the contractual situation, it may be appropriate to prepare a specially edited document. DP would be pleased to assist in this regard and/or to make additional report copies available for contract purposes at a nominal charge.

Site Inspection

The company will always be pleased to provide engineering inspection services for geotechnical and environmental aspects of work to which this report is related. This could range from a site visit to confirm that conditions exposed are as expected, to full time engineering presence on site.

Appendix B

Drawings A1 and A2 (DP, 2020b) – Young Wallsend / Dudley Seam Workings

Drawings B1 and B2 (DP, 2020b) – Borehole Seam Workings

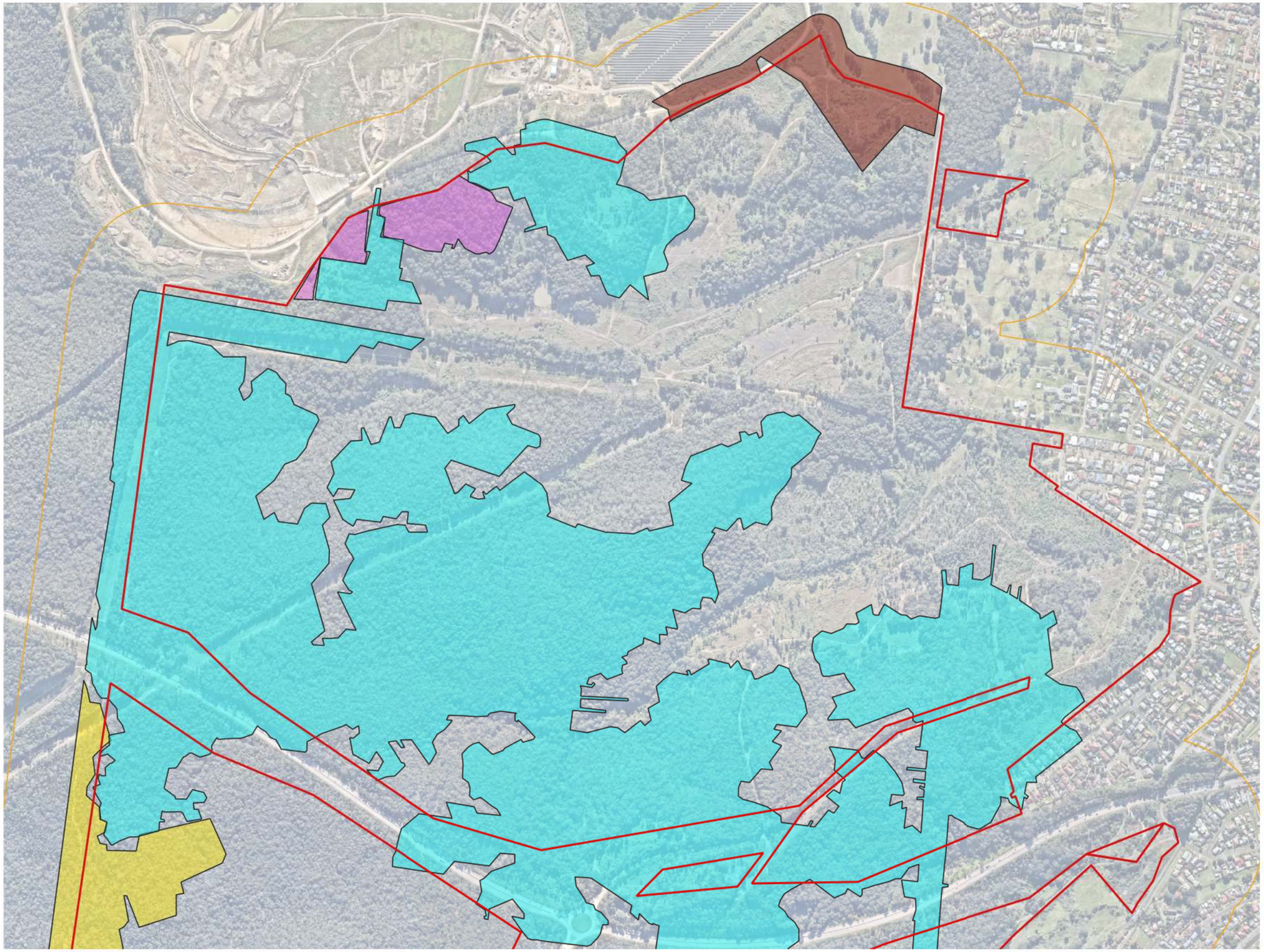
Drawings G1 and G2 (DP, 2020b) – Depth of Cover to Young Wallsend / Dudley Seam Workings

Drawings H1 and H2 (DP, 2020b) – Areas Identified with less than 30 m cover to Workings

Drawings 4-1 and 4-2 (DP, 2020c) – Fill Depth – Northern Part of Site

Drawings 5-1 and 5-2 (DP, 2020a) – 1974 Orthophoto

Drawings 8-1 and 8-2 (DP, 2020b) – Identified Areas of Geotechnical Constraints



Legend

Site Boundary

Primary Extraction Young Wallsend

Secondary Workings Young Wallsend

Partial Extraction Young Wallsend

Open Cut Areas

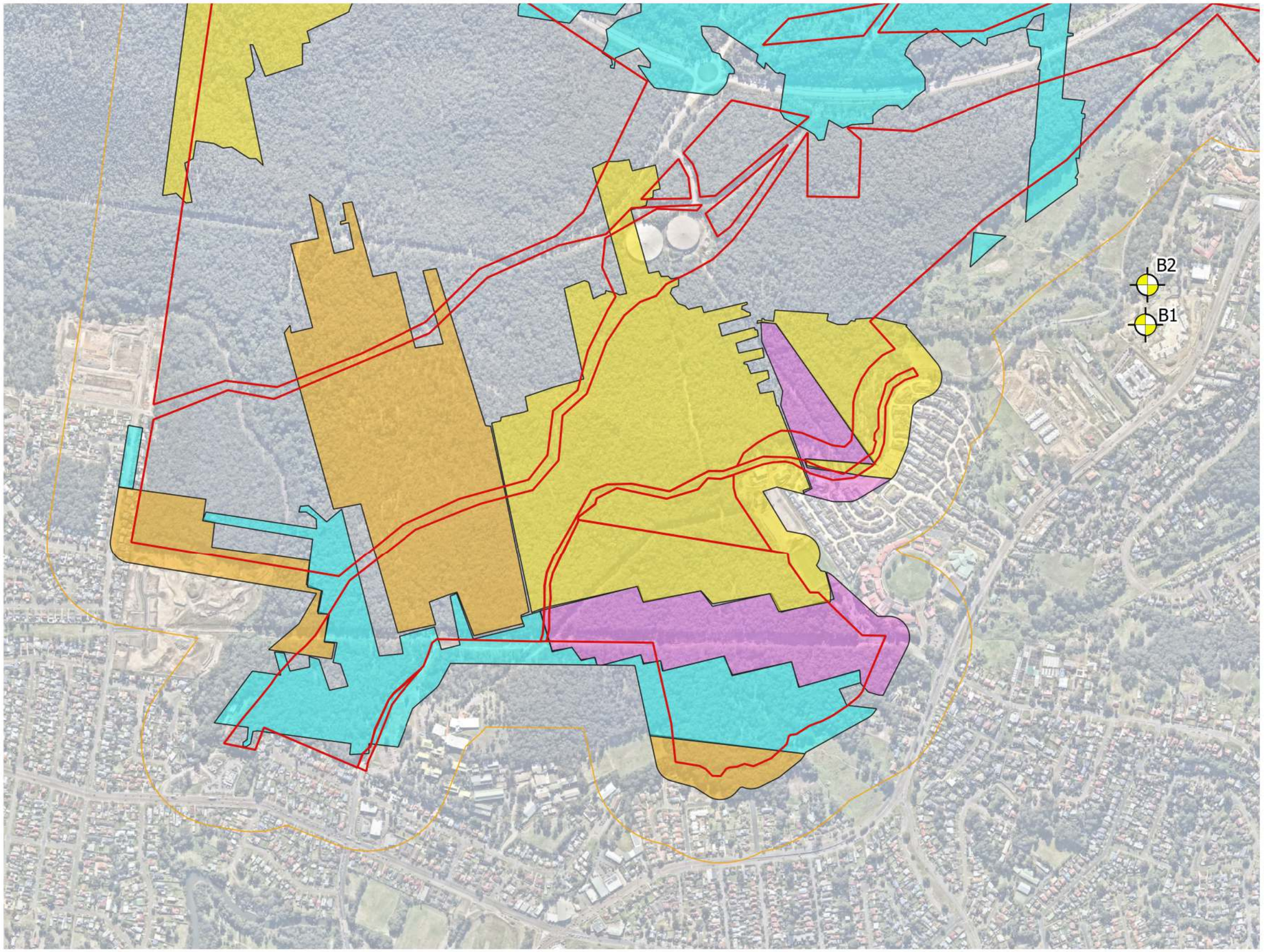
Drawing adapted from plan supplied by client, relevant record traces and Nearmap image

Douglas Partners
Geotechnics / Environment / Groundwater

CLIENT:	Eden Estates (Newcastle) Pty Ltd	TITLE:	**Young Wallsend/Dudley Seam Workings**
OFFICE:	Newcastle	DRAWN BY:	MPG		**Preliminary Desktop Mine Workings Assessment**
SCALE:	1:10000 @A3	DATE:	12.07.2019		**New Wallsend Land Parcel**

N

PROJECT No:	91610.04
DRAWING No:	A-1
REVISION:	0



Legend

- Site Boundary
- Primary Extraction Young Wallsend
- Secondary Workings Young Wallsend
- Partial Extraction Young Wallsend
- Mini-Longwall Extraction Young Wallsend
- DP Bores Project 31898D

Drawing adapted from plan supplied by client, relevant record traces and Nearmap image

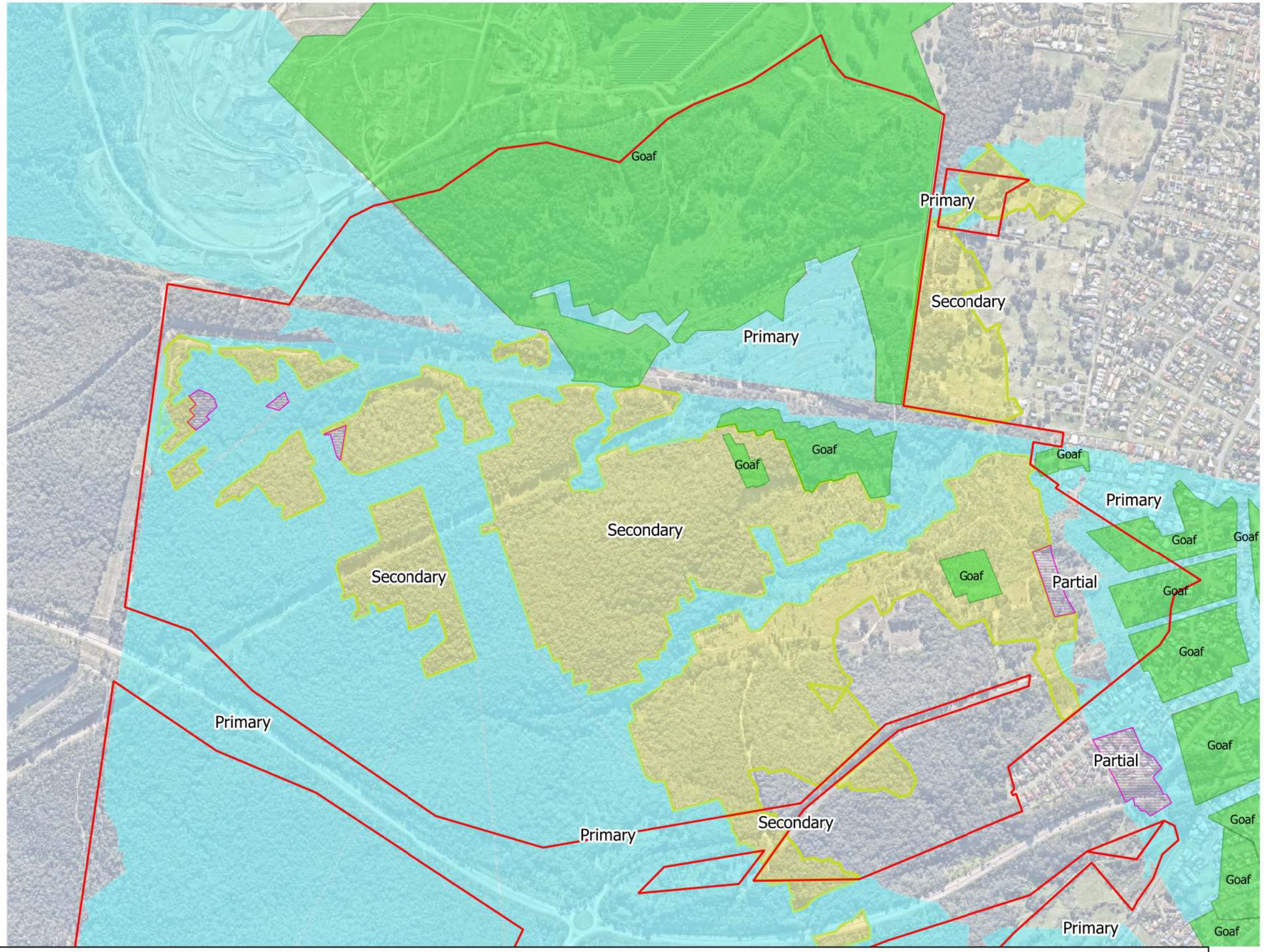
Douglas Partners
Geotechnics / Environment / Groundwater

CLIENT: Eden Estates (Newcastle) Pty Ltd		
OFFICE: Newcastle	DRAWN BY: MPG	
SCALE: 1:10000 @A3	DATE: 12.07.2019	

TITLE: **Young Wallsend/Dudley Seam Workings**
Preliminary Desktop Mine Workings Assessment
New Wallsend Land Parcel

N

PROJECT No:	91610.04
DRAWING No:	A-2
REVISION:	0



Legend

Site Boundary | Partial Extraction Jesmond | GOAF layer | Borehole Seam Primary Extraction | Borehole Seam Secondary Extraction

Drawing adapted from plan supplied by client, relevant record traces and Nearmap image

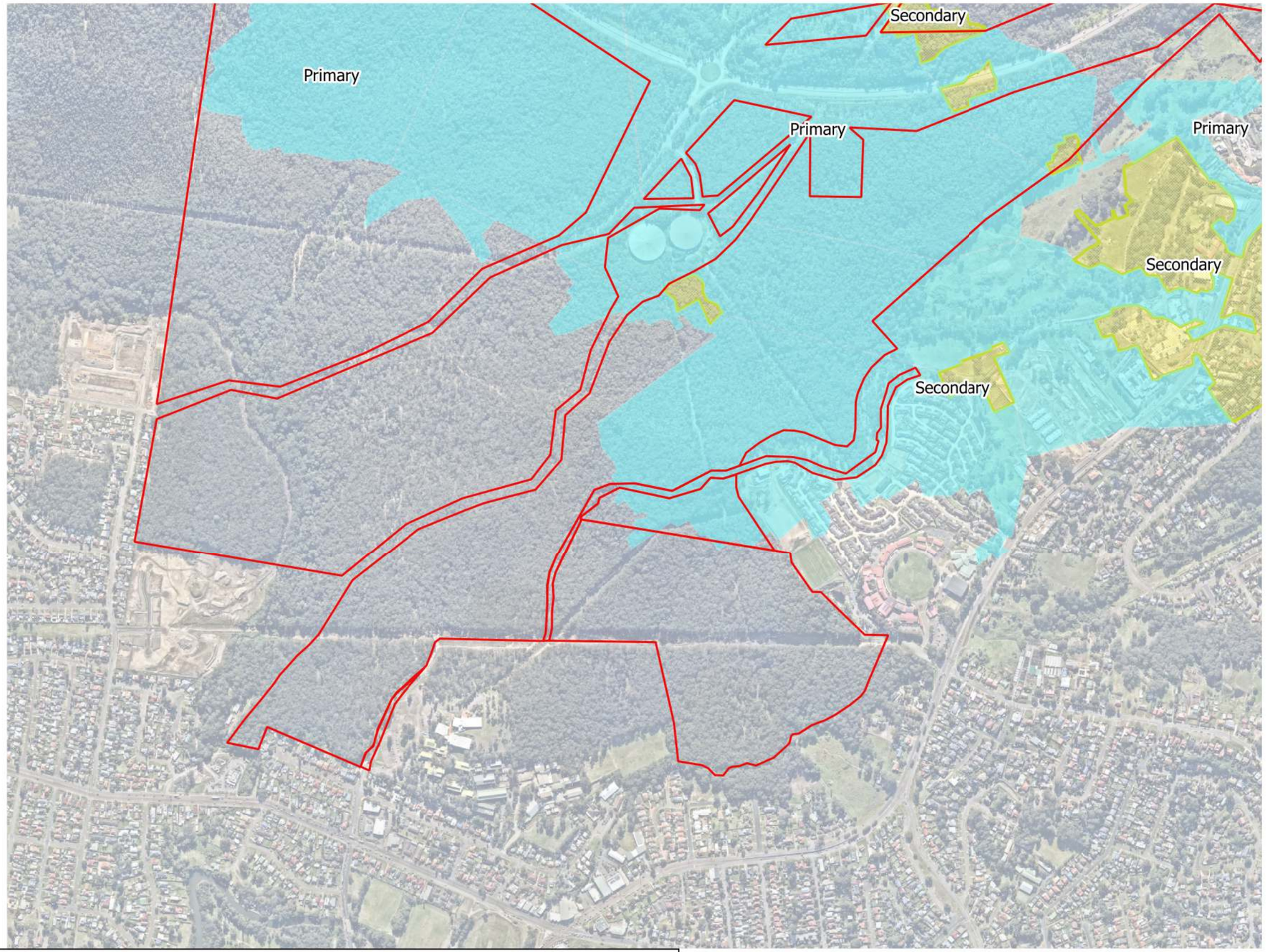
Douglas Partners
Geotechnics / Environment / Groundwater

CLIENT:	Eden Estates (Newcastle) Pty Ltd		
OFFICE:	Newcastle	DRAWN BY:	MPG
SCALE:	1:10000 @A3	DATE:	12.07.2019

TITLE: **Borehole Seam Workings**
Preliminary Desktop Mine Workings Assessment
New Wallsend Land Parcel

N

PROJECT No:	91610
DRAWING No:	B-1
REVISION:	0



Legend

Site Boundary

Borehole Seam Primary Extraction

Borehole Seam Secondary Extraction

Drawing adapted from plan supplied by client, relevant record traces and Nearmap image

Douglas Partners
Geotechnics / Environment / Groundwater

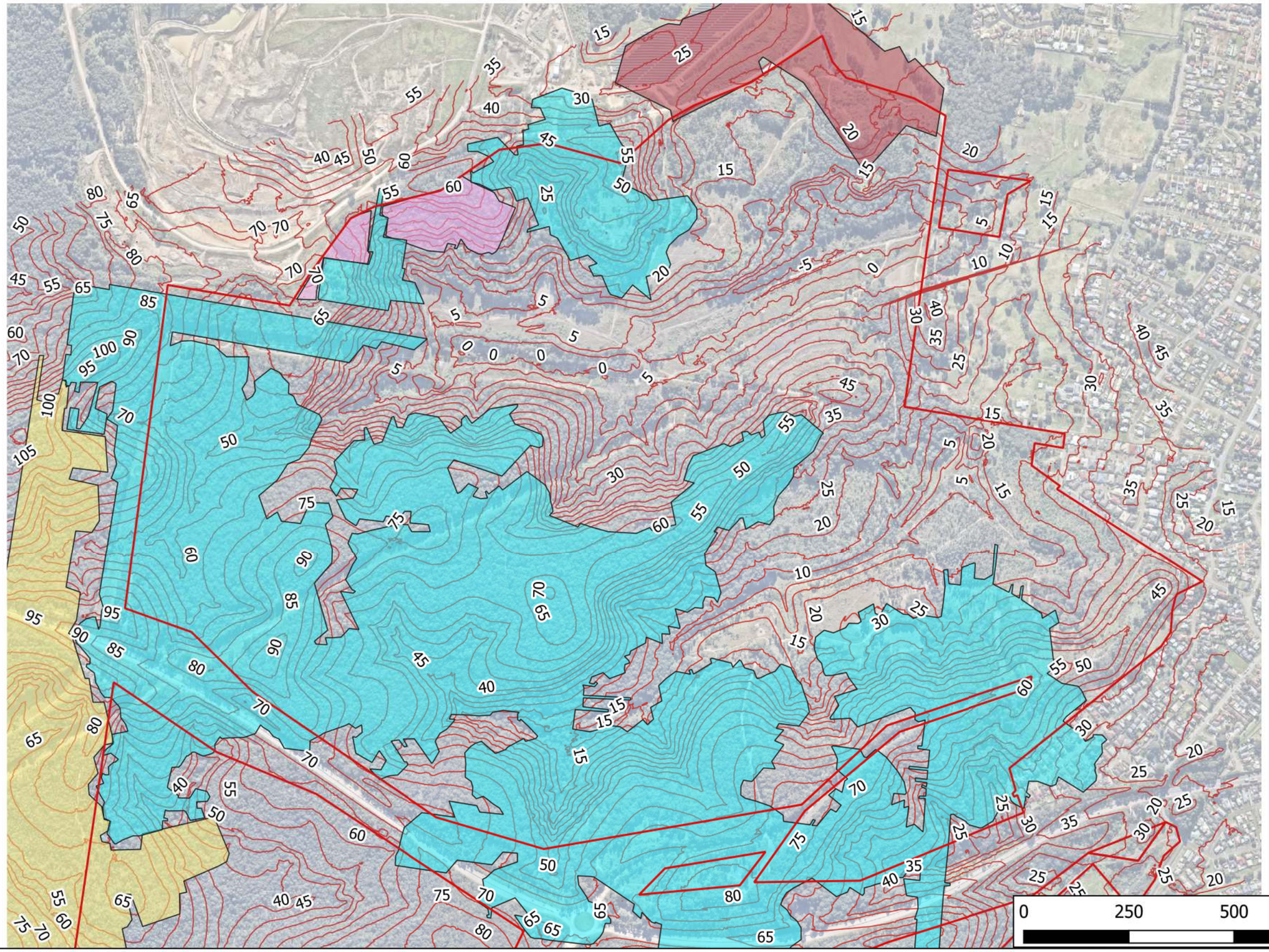
CLIENT:	Eden Estates (Newcastle) Pty Ltd		
OFFICE:	Newcastle	DRAWN BY:	MPG
SCALE:	1:10000 @A3	DATE:	12.07.2019

TITLE: **Borehole Seam Workings**
Preliminary Desktop Mine Workings Assessment
New Wallsend Land Parcel

N

PROJECT No:	91610
DRAWING No:	B-2
REVISION:	0

Drawing adapted from plan supplied client, relevant record traces and Nearmap image



Legend

- Site Boundary
- Primary Extraction Young Wallsend
- Partial Extraction Young Wallsend
- Open Cut Areas
- Depth of Cover to YW Seam Contours
- Secondary Extraction Young Wallsend

Douglas Partners
Geotechnics / Environment / Groundwater

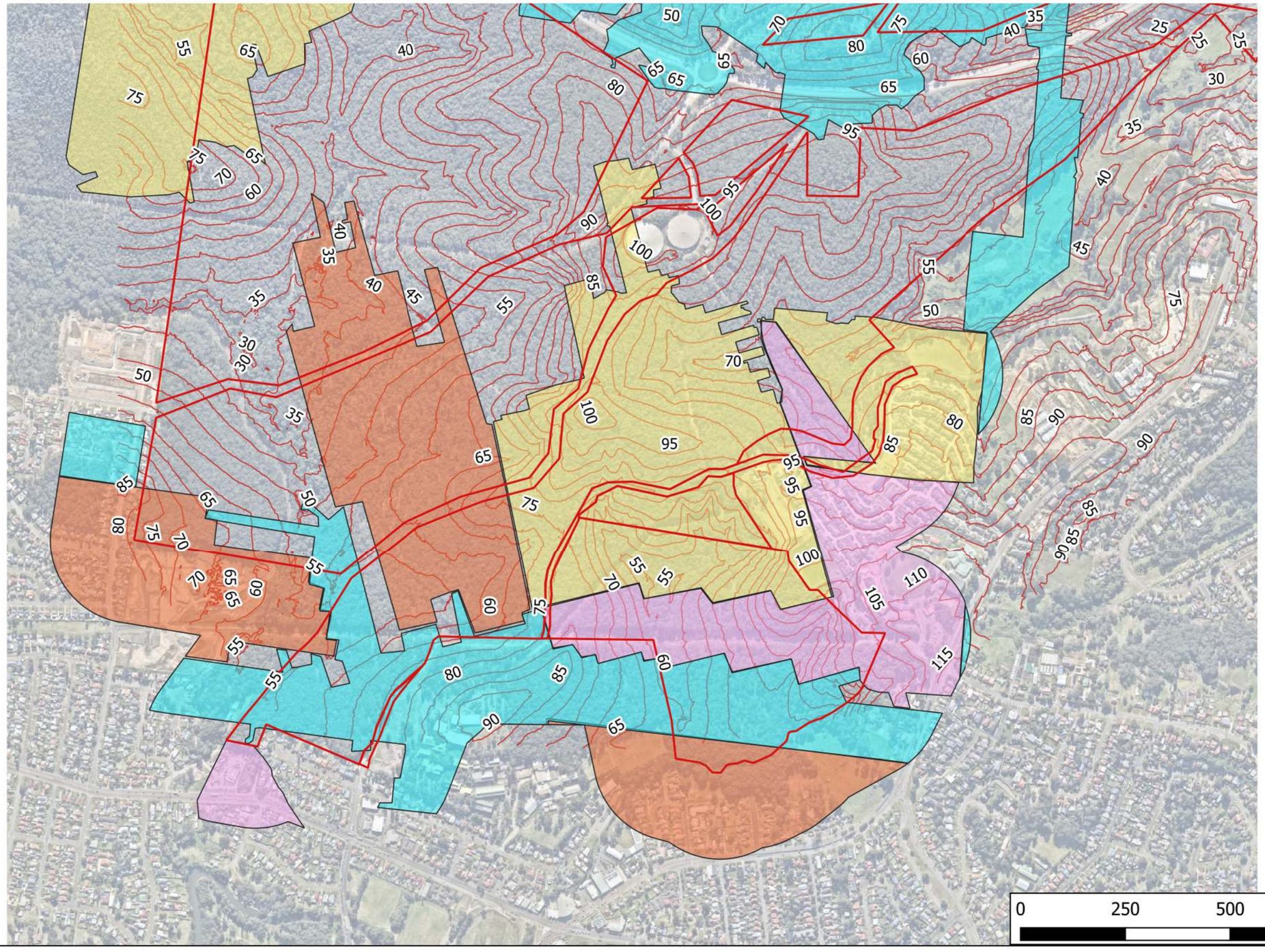
CLIENT: Eden Estates (Newcastle) Pty Ltd		
OFFICE: Newcastle	DRAWN BY: MPG	
SCALE: 1:10000 @A3	DATE: 12.07.2019	

TITLE: **Depth of Cover to Young Wallsend/Dudley Seam Workings**
Preliminary Desktop Mine Workings Assessment
New Wallsend Land Parcel

N

PROJECT No:	91610.04
DRAWING No:	G-1
REVISION:	0

Drawing adapted from plan supplied client, relevant record traces and Nearmap image



Legend

- Site Boundary
- Primary Extraction Young Wallsend
- Partial Extraction Young Wallsend
- Mini-Longwall Extraction Young Wallsend
- Depth of Cover to YW Seam Contours
- Secondary Extraction Young Wallsend

Douglas Partners
Geotechnics / Environment / Groundwater

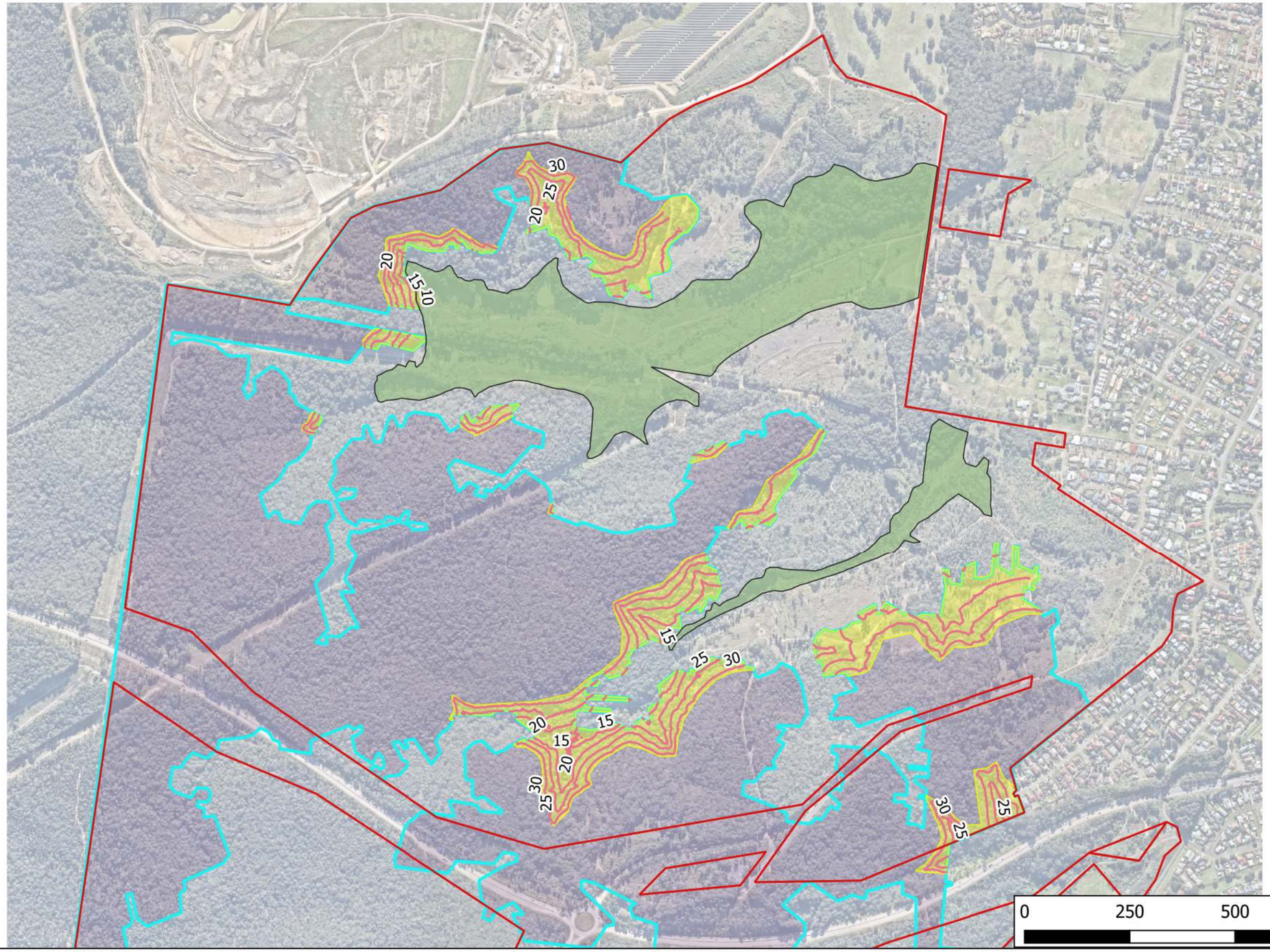
CLIENT:	Eden Estates (Newcastle) Pty Ltd		
OFFICE:	Newcastle	DRAWN BY:	MPG
SCALE:	1:10000 @A3	DATE:	12.07.2019

TITLE: **Depth of Cover to Young Wallsend/Dudley Seam Workings**
Preliminary Desktop Mine Workings Assessment
New Wallsend Land Parcel

N

PROJECT No:	91610.04
DRAWING No:	G-2
REVISION:	0

Drawing adapted from plan supplied by client, relevant record traces and Nearmap image



Legend

Site Boundary | Extent of Workings in Young Wallsend Seam | Areas of Less than 30 m cover to Young Wallsend Seam | Approximate depth of cover to Young Wallsend Seam | Areas of Less than 30 m cover to BH Seam

Douglas Partners
Geotechnics / Environment / Groundwater

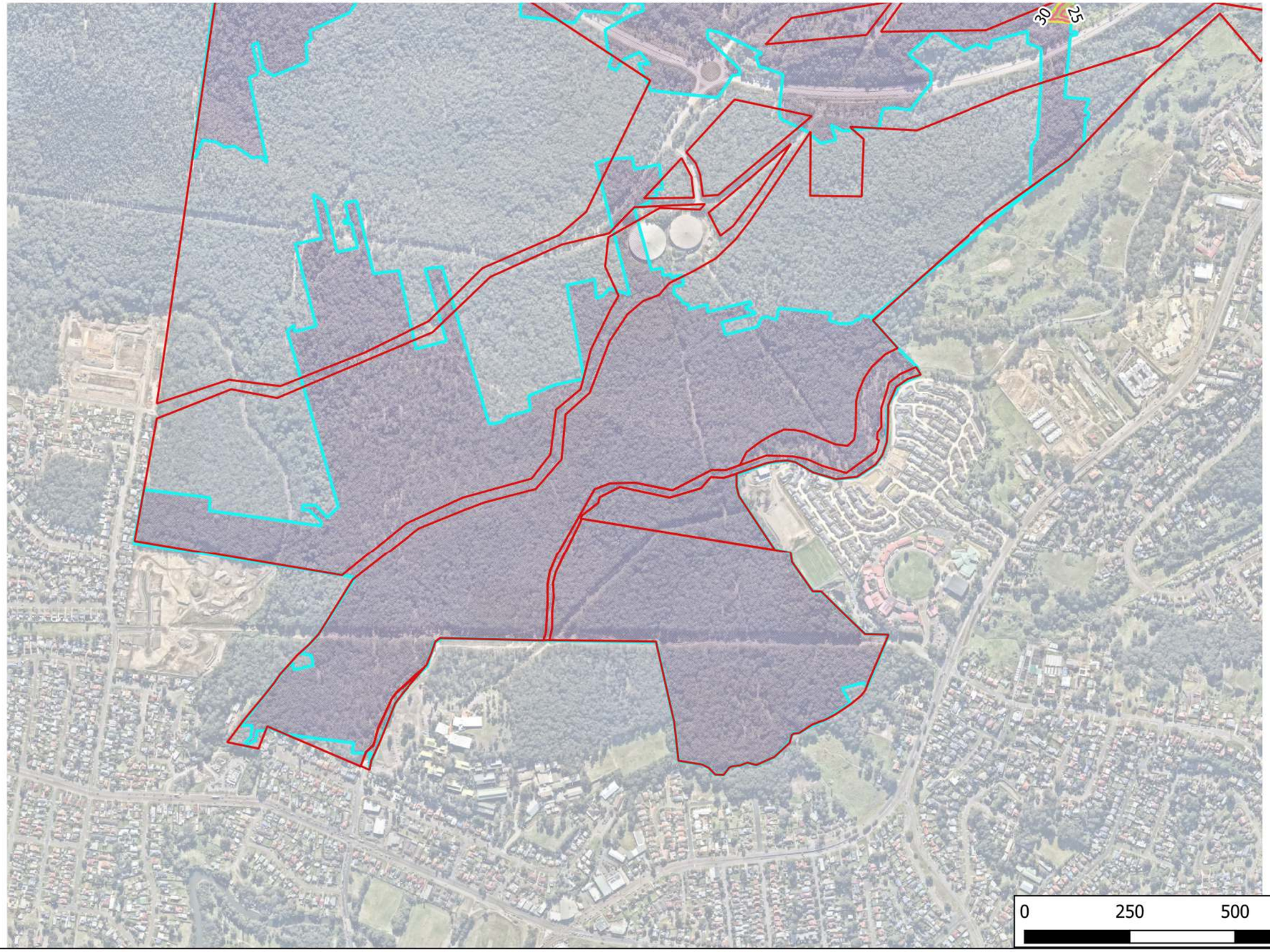
CLIENT: Eden Estates (Newcastle) Pty Ltd		
OFFICE: Newcastle	DRAWN BY: MPG	
SCALE: 1:10000 @A3	DATE: 12.07.2019	

TITLE: **Areas identified with less than 30 m of cover to Young Wallsend Seam Workings**
Preliminary Desktop Mine Workings Assessment
New Wallsend Land Parcel

N

PROJECT No:	91610.04
DRAWING No:	H-1
REVISION:	0

Drawing adapted from plan supplied by client, relevant record traces and Nearmap image



Legend

Site Boundary | Extent of Workings in Young Wallsend Seam | Areas of Less than 30 m cover to Young Wallsend Seam | Approximate depth of cover to Young Wallsend Seam

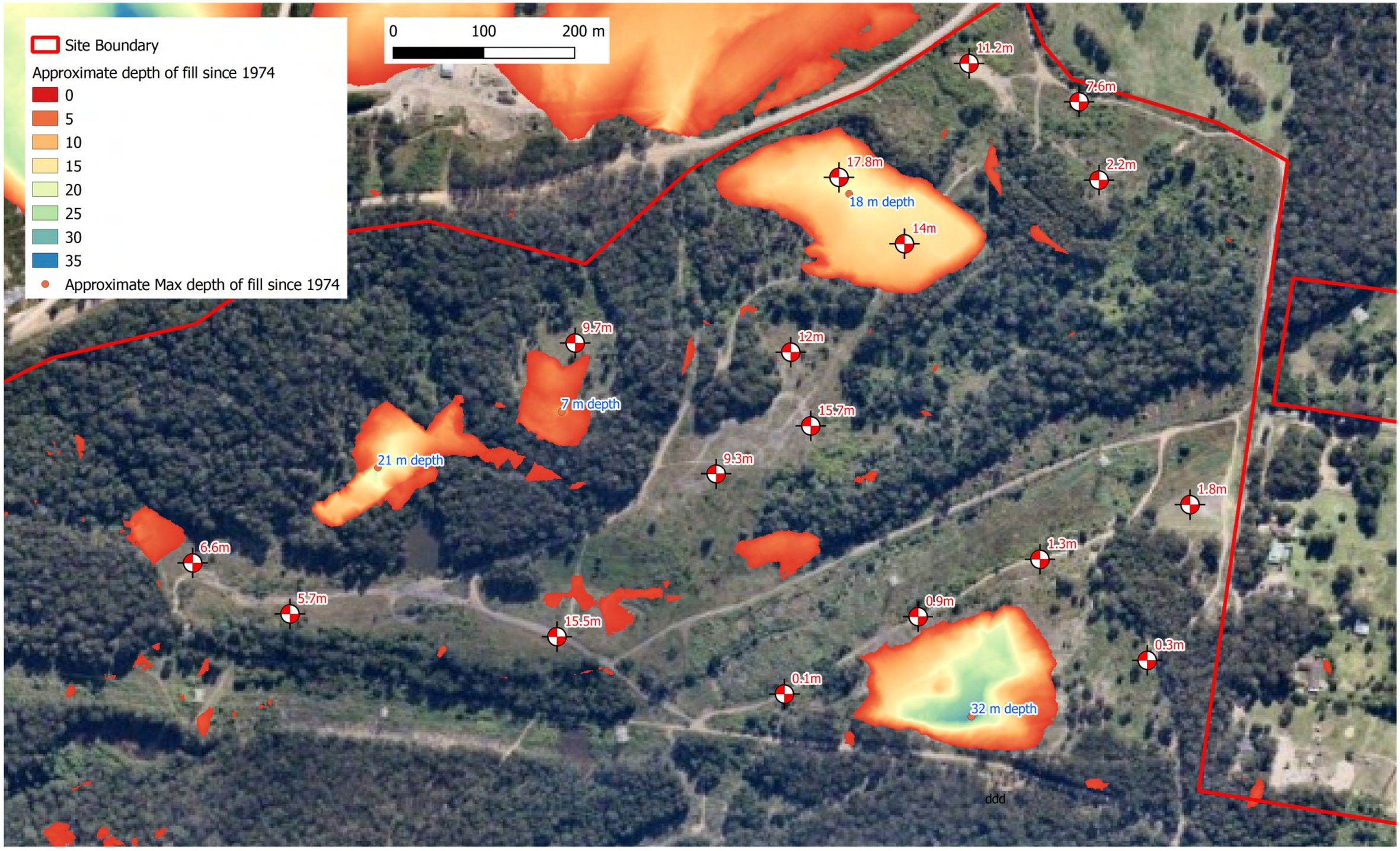
Douglas Partners
Geotechnics / Environment / Groundwater

CLIENT: Eden Estates (Newcastle) Pty Ltd		
OFFICE: Newcastle	DRAWN BY: MPG	
SCALE: 1:10000 @A3	DATE: 12.07.2019	

TITLE: **Areas identified with less than 30 m of cover to Young Wallsend Seam Workings**
Preliminary Desktop Mine Workings Assessment
New Wallsend Land Parcel

N

PROJECT No:	91610.04
DRAWING No:	H-2
REVISION:	0



Bore Locations (present) and Fill Depth

Notes: The depth of fill for the bore / pit locations are based on the subsurface conditions encountered in the bores. The approximate depth of fill shown in the heat maps is based on the existing surface levels based on lidar information minus the surface levels shown in the 1974 orthophoto.

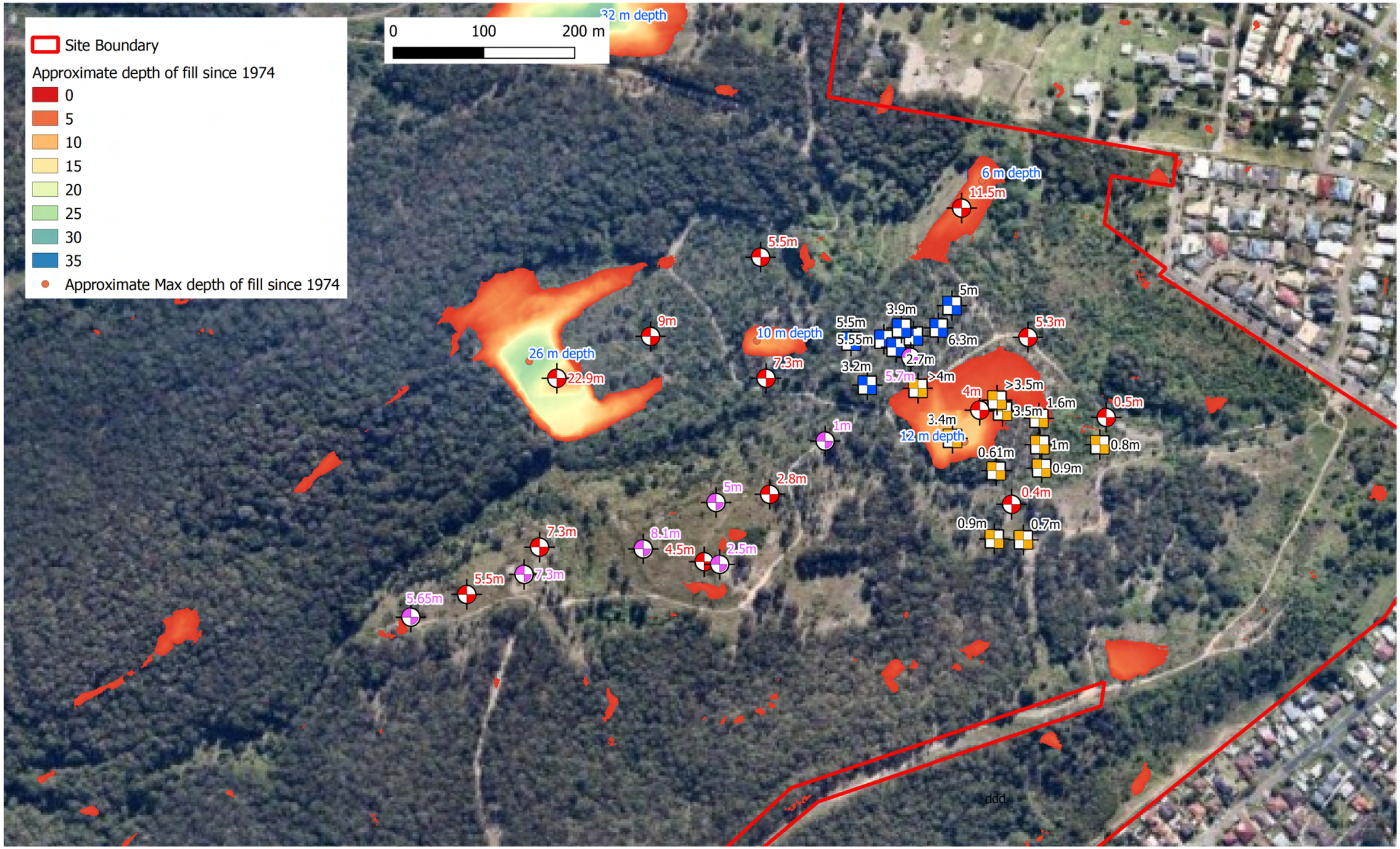
Douglas Partners
Geotechnics / Environment / Groundwater

CLIENT: Eden Estates (Newcastle) Pty Ltd		
OFFICE: Newcastle	DRAWN BY: MPG	
SCALE: 1:4000 @A3	DATE: 31.August.2020	

TITLE: **Fill Depth - Northern Part of Site**
Proposed Residential Development
New Wallsend

N

PROJECT:	91610.05
DRAWING No:	4-1
REVISION:	2



Approx Bore Locations and Fill Depth (Project 39491) | Approximate Pit Location and Fill Depth (Project 91610.02) | Approximate RGS Pit Locations and Fill Depth | Bore Locations (present) and Fill Depth

Notes: The depth of fill for the bore / pit locations are based on the subsurface conditions encountered in the bores. The approximate depth of fill shown in the heat maps is based on the existing surface levels based on lidar information minus the surface levels shown in the 1974 orthophoto.

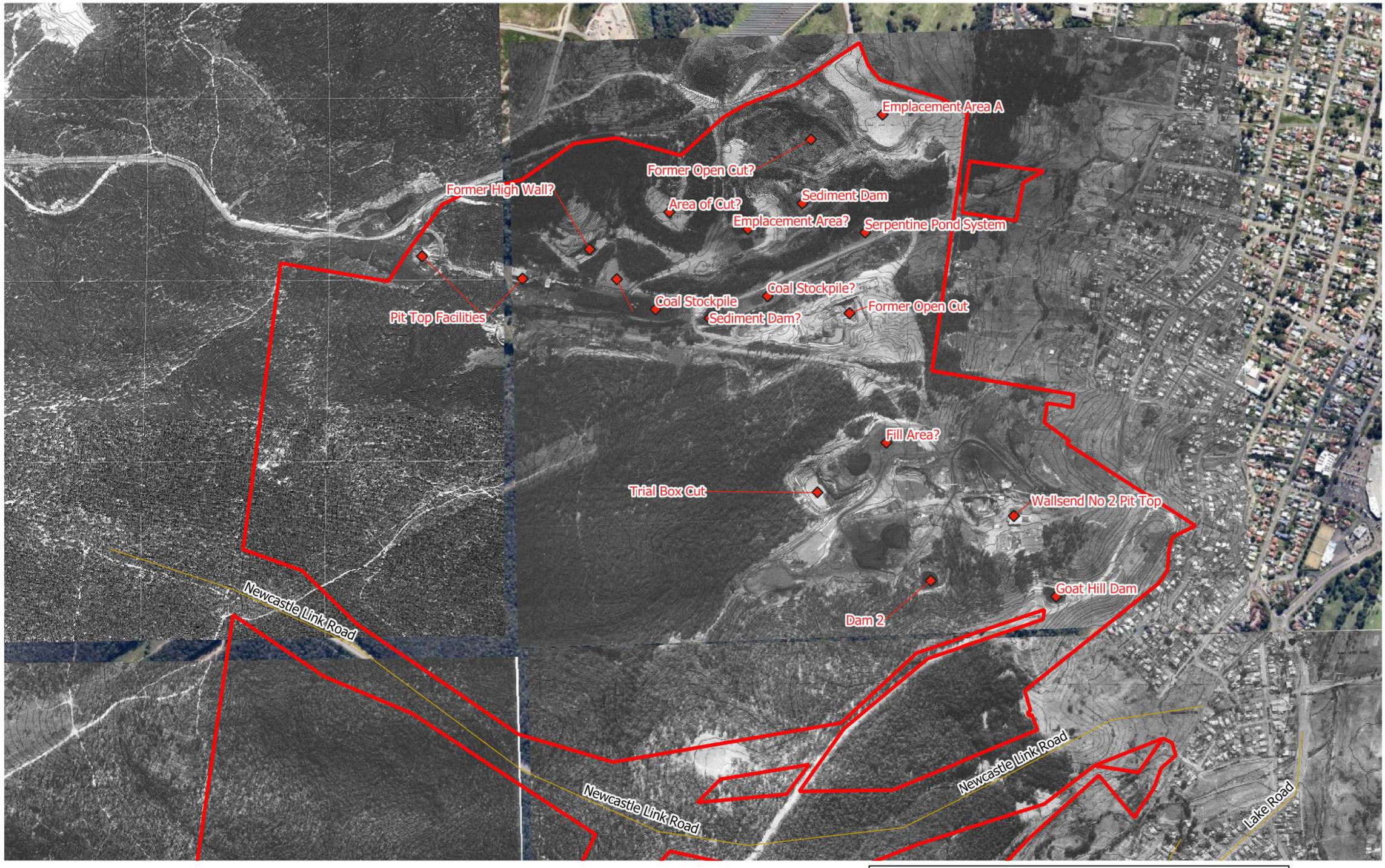
Douglas Partners
Geotechnics / Environment / Groundwater

CLIENT: Eden Estates (Newcastle) Pty Ltd		
OFFICE: Newcastle	DRAWN BY: MPG	
SCALE: 1:4000 @A3	DATE: 31.August.2020	

TITLE: **Fill Depth - Northern Part of Site**
Proposed Residential Development
New Wallsend

N

PROJECT:	91610.05
DRAWING No:	4-2
REVISION:	2



Site Boundary ◆ Identified Features in the 1974 Orthophoto

0 250 500 750 1000 m

Douglas Partners
Geotechnics / Environment / Groundwater

CLIENT:	Eden Estates (Newcastle) Pty Ltd	
OFFICE:	Newcastle	DRAWN BY: MPG
SCALE:	1:10000 @ A3	DATE: 25.May.2020

TITLE: **1974 Orthophoto**
Proposed Residential Development
New Wallsend

N

PROPOSAL:	91610.03
DRAWING No:	5-1
REVISION:	0

Site Boundary

0 250 500 750 1000 m

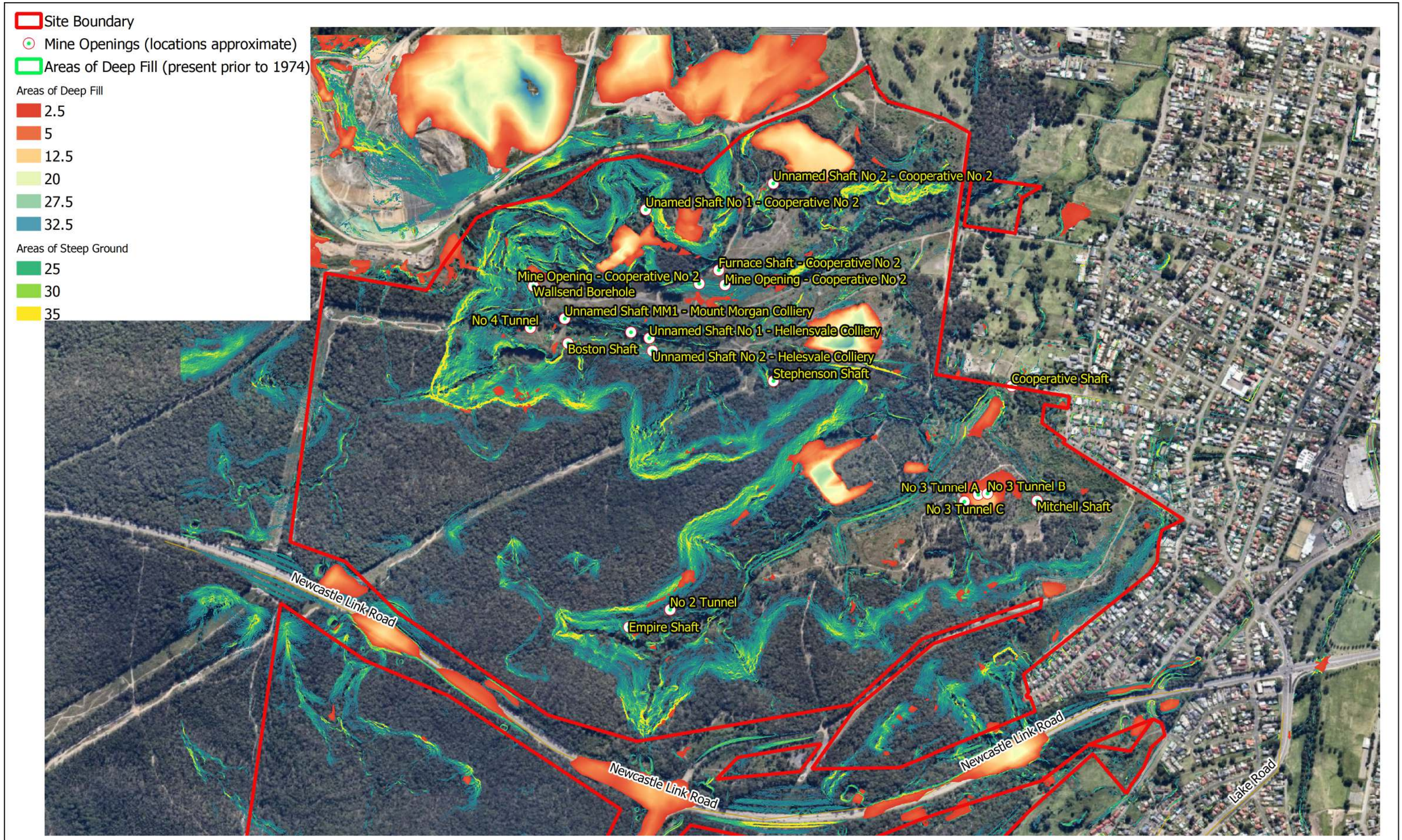
Douglas Partners
Geotechnics / Environment / Groundwater

CLIENT: Eden Estates (Newcastle) Pty Ltd		
OFFICE: Newcastle	DRAWN BY: MPG	
SCALE: 1:10000 @ A3	DATE: 25.May.2020	

TITLE: **1974 Orthophoto**
Proposed Residential Development
New Wallsend

N

PROPOSAL:	91610.03
DRAWING No:	5-2
REVISION:	0



Note that additional mine openings and shafts may be present on the site - additional work may be required to identify location and condition of openings

0 250 500 m

Douglas Partners
Geotechnics / Environment / Groundwater

CLIENT:	Eden Estates (Newcastle) Pty Ltd		
OFFICE:	Newcastle	DRAWN BY:	MPG
SCALE:	1:10000 @ A3	DATE:	10.August.2020

TITLE: **Identified Areas of Geotechnical Constraints**
Proposed Residential Development
New Wallsend

N

PROPOSAL:	91610.03
DRAWING No:	8-1
REVISION:	0

Site Boundary

Mine Openings (locations approximate)

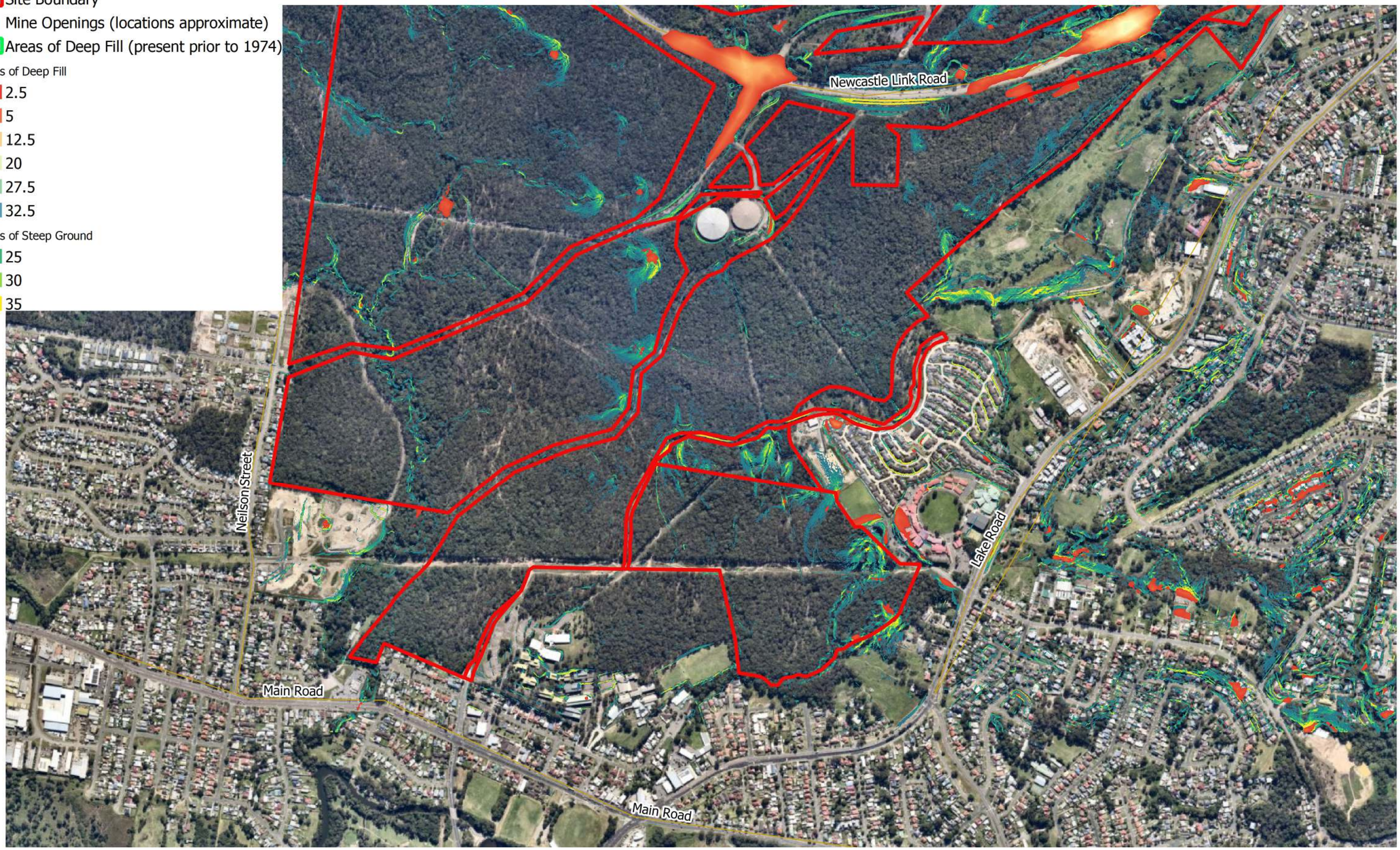
Areas of Deep Fill (present prior to 1974)

Areas of Deep Fill

- 2.5
- 5
- 12.5
- 20
- 27.5
- 32.5

Areas of Steep Ground

- 25
- 30
- 35



Note that additional mine openings and shafts may be present on the site - additional work may be required to identify location and condition of openings

0 250 500 m

Douglas Partners
Geotechnics / Environment / Groundwater

CLIENT:	Eden Estates (Newcastle) Pty Ltd		
OFFICE:	Newcastle	DRAWN BY:	MPG
SCALE:	1:10000 @ A3	DATE:	10.August.2020

TITLE: **Identified Areas of Geotechnical Constraints**
Proposed Residential Development
New Wallsend

N

PROPOSAL:	91610.03
DRAWING No:	8-2
REVISION:	0