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Resources, Environment, Land Use Planning

Tuckombil and Stokers Quarry Evaluation and Strategic Options Report

Prepared for:

ballina shire council

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Plate 1 Drilling during the Tuckombil Quarry Resource Investigation

Note: a full risk assessment was completed for drilling each hole and in this instance the high wall was assessed for stability, loose rocks and the potential for slope failure.

Executive Summary

Drilling and resultant pit design work has delineated further significant resources of basalt at the Tuckombil Quarry of approximately 7.16 million tonnes of slightly weathered to unweathered basalt, refer FIGURE 1 – STAGE 3 TUCKOMBIL QUARRY DESIGN. The total resource available is at the inferred level of confidence pursuant to the *Joint Ore Reserves Committee (JORC 2004)* guidelines for reporting on geological resources and reserves.

Table 1 Quarry Resources Tuckombil Quarry

Quarry Stage	Metres^3 (*in situ*)	Bulk Density* (*measured*)	Distinctly Weathered Basalt Volume m^3	Distinctly Weathered Basalt Tonnes t/m^3	Slightly Weathered and Unweathered Basalt Volume m^3	Slightly Weathered and Unweathered Basalt Tonnes t/m^3
Stage 1	966,600	2.2/2.7	501,100	1,102,420	465,500	1,256,850
Stage 2	1,632,400	2.2/2.7	549,700	1,209,340	1,082,700	2,923,290
Stage 3	1,264,750	2.2/2.7	159,500	350,900	1,105,250	2,984,175
Total	3,863,750	N/A	1,210,300	2,662,660	2,653,450	7,164,315

*Bulk Density measured at 2.7 t/m^3 for slightly weathered to fresh material and 2.2 t/m^3 for distinctly weathered material. Volumes are based off the conceptual pit design illustrated in FIGURE 1 and topography supplied by NSW Department of Lands and Property Information 1:25,000.
Note: additional resources exist below the proposed pit design and elsewhere which are not currently included in this total. Gaining approval on these tonnes for extraction is required. Key points to note are that the depth of overburden is low around the water tower and additionally that the majority of quarry impacts can be channelled back into the void and the workings will remain unseen from most aspects. Regardless it is recommended that if the expansion is considered by Council an amenity bund is constructed and vegetated around the perimeter of the quarry to further reduce any potential impacts.

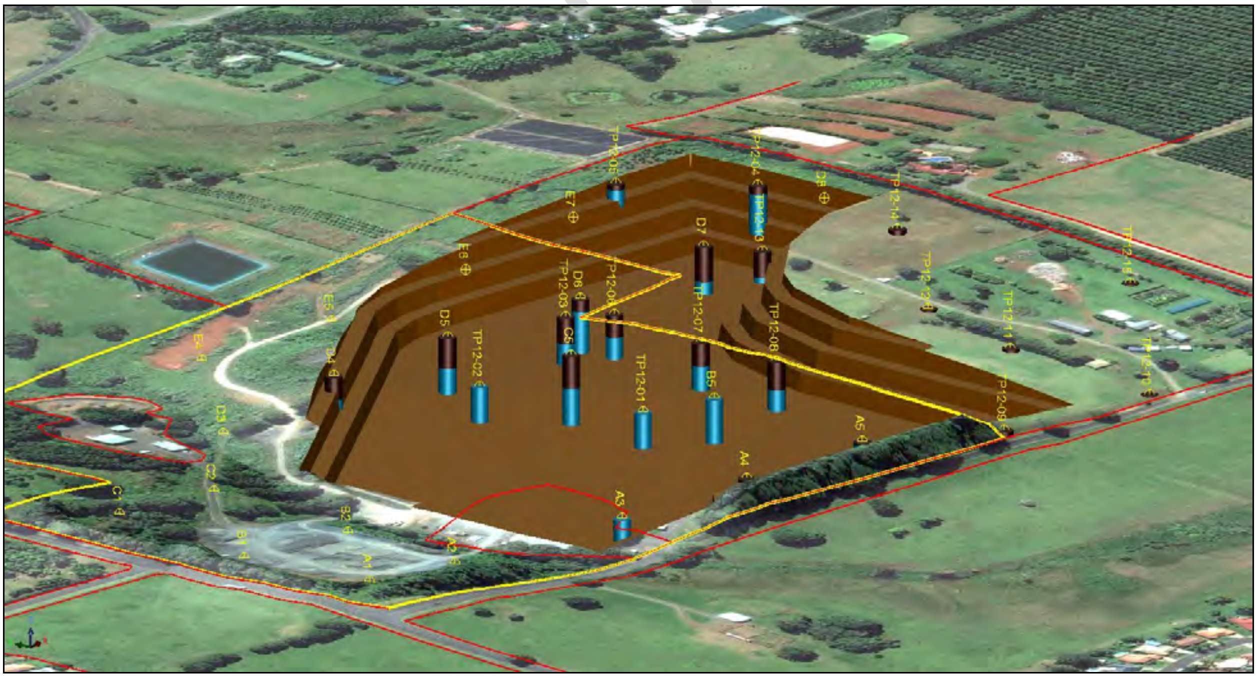


Plate 2 Stage 3 Proposed Pit Design and Expansion Tuckombil Quarry

Northeast is toward the top of page. The drill holes are colour coded for degree of weathering within the basalt and indicate a very quick transition zone from low strength distinctly weathered basalt denoted as brown within the drill hole cylinder to high strength unweathered basalt in light blue.

Plate 3 Typical Drillhole Intersection from Tuckombil Quarry

Four metres of overburden over lying 21 metres of high quality slightly weathered to unweathered basalt.
Note: this hole terminated in high quality basalt and at this point, it is unknown what the thickness of the basalt profile is.

Table 2 Quarry Resources Stokers Quarry

Quarry Stage	Metres³ (*in situ*)	Bulk Density* (*measured*)	Distinctly Weathered Argillite Volume m³	Distinctly Weathered Argillite Tonnes t/m³	Slightly Weathered and Unweathered Argillite Volume m³	Slightly Weathered and Unweathered Argillite Tonnes t/m³
Total	633,300**	2.2/2.6	538,305	1,076,610	94,995	246,987

*Bulk Density measured at 2.6 t/m³ for slightly weathered to fresh material and 2.0 t/m³ for extremely to distinctly weathered material.
**Volumes are based off the conceptual pit design illustrated in FIGURE 11 and topography supplied by NSW Department of Lands and Property Information 1:25,000. The survey data used for this pit is old, circa 2000, however the full volume at the date of survey was 733,000 m³. A depletion allowance of approximately 100,000 m³ has been subtracted from this total to allow for extraction of materials in the interim time period, i.e. 2000-2013.

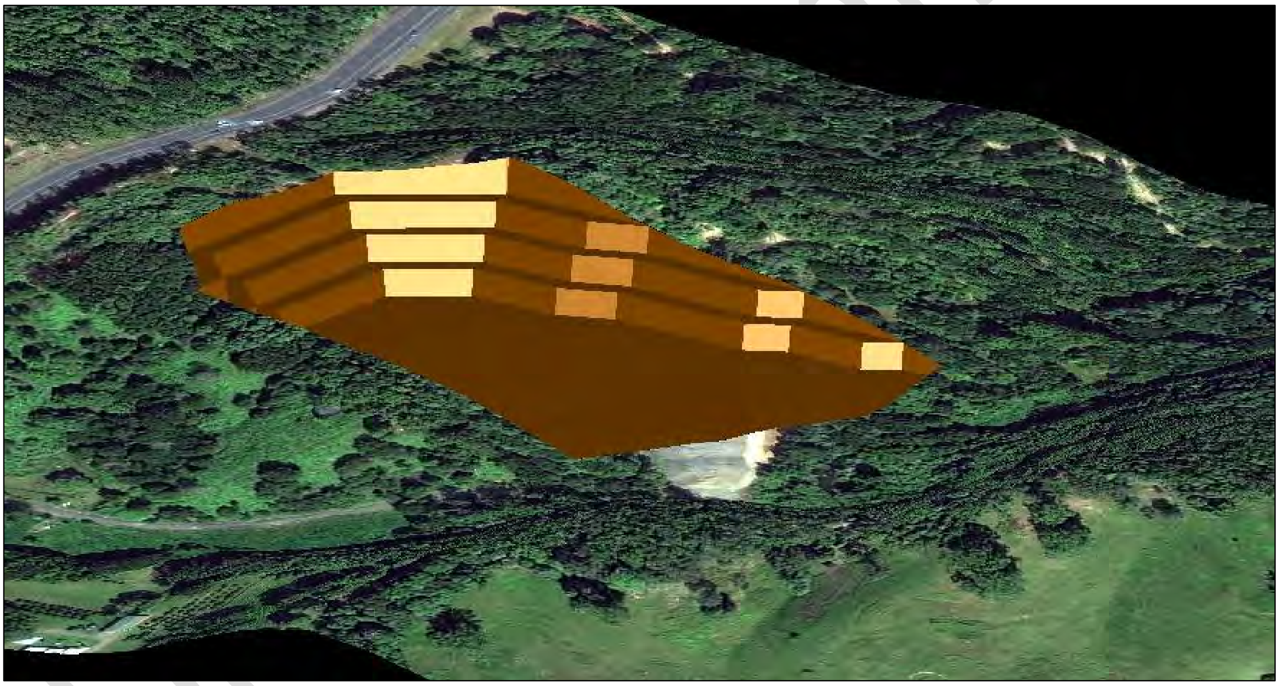


Plate 4 Aerial View of the Proposed Design Developed for Stokers Pit

The Bruxner highway is in the background to provide spatial reference for the proposed quarry design.

Key Findings

- Drilling has confirmed that high quality basalt resources exist at depth and below the thick overburden profile to the east and north east, (around the water tower), of the Tuckombil quarry. The most prospective sections of this resource, (with the least overburden), have been integrated into a staged development proposed for the quarry. Development of the resources in the proposed pit area will only be viable if the development plan, which involves staged extraction and removal of the overburden, combined with sequential removal of the high quality basalt, is generally adhered to as significant volumes of overburden are required to be removed to expose the unweathered basalt at depth. General volumetric ratios of higher quality basalt to lower quality basalt proposed to be removed within the development plan are approximately 2.2:1 high quality basalt to lower quality basalt. Accordingly the plan, requires development rigour, (i.e. the schedule and stage plan must be followed), to ensure feasibility. When the plan is benchmarked against other operational quarries in the area for overburden ratios the proposed plan is also considered realistic, economically viable and within industry standards, when the total ratio of good quality basalt to lower quality material is considered. To improve the project viability, establishing the full depth extent of the basalt will be the key project driver, as the more good quality basalt that can be defined at depth, will commensurately decrease the total ratio of overburden to be removed, which significantly helps the overall project economics. Additionally it gives any potential investor or operator certainty in that for each bcm of overburden they remove at least 2.2 bcm of unweathered high quality basalt is exposed, refer FIGURE 2 – DRILLHOLE LOCATION PLAN, OVERBURDEN THICKNESS AND INTERPRETED SITE GEOLOGY.

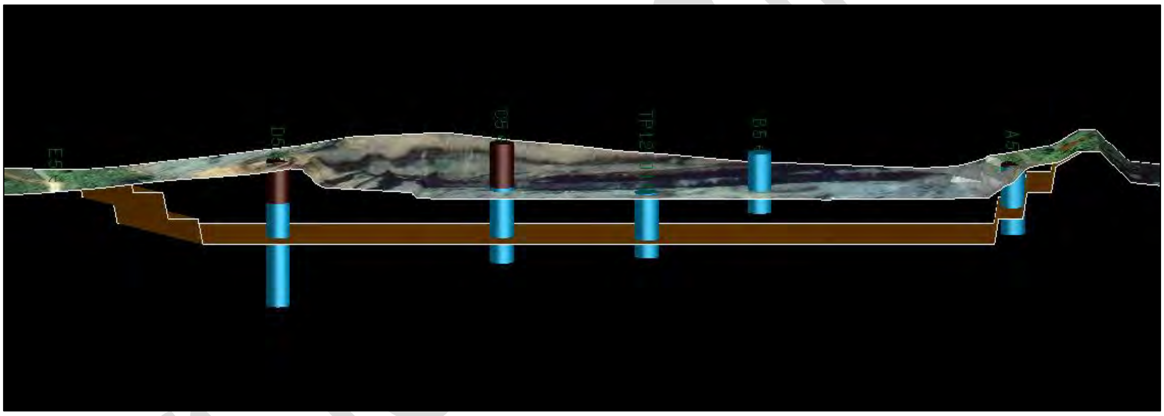


Plate 5 Cross Section Cut through the Pit in a North South Orientation

This Cross Section is cut through the pit in a north south orientation from drill hole D5 to the mid left of page to drill hole A5 to the right of page. The drill holes are colour coded for degree of weathering within the basalt and indicate a very quick transition zone from low strength distinctly weathered basalt denoted (brown within the drill hole cylinder) to high strength unweathered basalt in light blue. The critical point to note is that the resource is currently open at depth and defining additional materials in these lower bench areas will help reducing the overburden strip ratio and greatly improve the project economics and viability. Defining the resources in these areas is considered critical for project viability as the volume of overburden that is required to be removed in the next few years is large and the project will move from marginal to strongly viable if an additional two benches of basalt material can be included in the pit resources below the current pit. Drill hole D5 (drilled by Council) is the deepest hole drilled to date. The proposed pit design is the brown surface (currently 20 metres below the pit floor) and the eastern high wall is visible as the bench areas in the screenshot. Also note that basalt resources can be highly variable as experienced in many of the basalt quarries in the region and confirmation should be completed on rock quality before any decision is made to develop the quarry as proposed. While several of the old drill holes, (D5 and B5), suggest significant basalt resource exist at depth this work should be confirmed and rigorously documented as developing a quarry based on two old drill holes does contain a degree of risk.

- It is strongly recommended that several deeper core holes, (three to four), be drilled to determine the full extent of the basalt, below the current pit floor, as this work should further upgrade and optimise development proposed for the site, provided the basalt is significantly thicker than currently estimated. This work is also deemed reasonably critical as large volumes of groundwater were intersected in the quarry floor during drilling, the impact of which severely inhibited sample recovery. While the small samples that could be collected, appeared representative of higher quality unweathered basalt, (as did the recorded penetration rate which suggested competent material), only limited samples could be collected to confirm the nature and extent of the basalt below the quarry floor. Ultimately if an additional few benches of material can be found below the quarry floor, then the entire future and economics of the project becomes more favourable as the ratio of high quality stone to lower quality material improves significantly, and accordingly would make this project a major quarry resource in the area. The first bench of additional material below the proposed design would add 2.9 million tonnes, and the bench below this an additional 2.5 million tonnes provided the basalt resource is present. These volumes would greatly improve the project viability and improve the stripping ratio to approximately 1:5.

- For the immediate development if staged and sequential extraction of the overburden is not completed synchronous with removal of the good quality basalt, then the future of Tuckombil Quarry is somewhat more limited as a viable extractive industry. This is because the only remaining material exists in the north wall, under the asphalt plant, (56,500 m^3), and below the quarry floor. Extraction from the quarry floor also changes the future land use and ability of the site to freely drain if extraction develops past beyond 122 m AHD, and this scenario would require additional earthworks to aid drainage as the lowest point on site is approximately 122 m AHD.
- Placement of the overburden, and overburden management are the biggest issues facing the project viability in the short term, if a sales market cannot be found for this material. The preferred option is that the material is sold by the operator or used by Council in its public work programs. Some of the material could be blended in with the higher quality material as the high quality basalt is several times over specification, however even blending will absorb only a small volume of the material required to be removed. This is why definition of additional benches of high quality basalt is critical to the viability of the project, as it provides the operator certainty on which to invest. Even if the weathered material was provided free of charge to a large contractor i.e. for use in any future highway upgrades, this would be highly a beneficial outcome for the project.
- To allow the quarry to expand the two hockey fields would need to be relocated. Utilising the proposed development plan, Lot 7 DP622903, immediately to the east of the water tower, would also need to be purchased as buffer land. The nursery would not be required to be removed although the water tower would also require removal however an amended design could be completed which would allow the water tower to remain in place. If and when a decision is made to remove the water tower, a cost benefit analysis on removal of the water tower should be completed on *insitu* tonnes versus removal costs, to determine what the best outcome for the project is, as it may be more cost effective to leave the water tower in place.
- An alternative to these scenarios is simply that the quarry is developed to the current extraction limit and then via a staged process, after removal of the asphalt plant and other infrastructure, the rock below the asphalt plant is removed with the quarry then being rehabilitated. This option would however bring forward the rehabilitation costs, which will be significant. The longer these costs can be deferred and also integrated into the proposed

development plan, the lower these rehabilitation costs become, when considered against total revenue produced by the quarry.

- Strategic review of Stokers Quarry demonstrates that this project initially appears to be of lower strategic importance, however when integrated into the total extractive milieu, it is quite clearly a vital asset, as it allows for the production of a range of lower specification materials which have different characteristics in contrast to the basalt resource. Additionally using the high quality material at Tuckombil Quarry for the production of lower specification materials does not make practical sense and this is the real value of Stokers Quarry in that it will help to preserve the longevity of the high quality resource at Tuckombil Quarry. To close Stokers Quarry would limit the profitability, utility and commercial viability of the Tuckombil Quarry.
- Additionally, site inspection of the Stokers Quarry has revealed that if the quarry was closed "as is" significant rehabilitation costs would be incurred, as the slopes and site require significant remedial work. Accordingly it is proposed that the best outcome for the project is to decrease the buffer to the west and north to 20 metres, (which would require planning approval), and then that the proposed pit designs are invoked. The proposed design if utilised provides for a development plan which will re-sculpture the pit to a safe and stable profile. This design scenario also maximises extraction of the resource and allows the rehabilitation i.e. batter re profiling costs to be absorbed into the costs of production, which significantly reduces the cost of rehabilitation for this project. Importantly this scenario provides a usable area and asset for activities post extraction.

Other Findings

- The basalt rock when unweathered is of a generally good, quality. The homogeneity and consistency of the rock at depth, appears good although this should be confirmed by additional core drilling, as the presence of vesicular and tuffaceous basalt, (lower quality basalt), within the columnar basalt utilising percussion drilling is almost impossible to determine.
- The extremely to distinctly weathered basalt, (considered as overburden in this report), will be suitable only for the production of low specification materials.
- The previous old drilling work completed by Council in 1999-2000 should be partially recompleted as many of the drill holes do not have results reported on. If this work is completed then it should be combined with additional drill holes to more clearly define the eastern boundary of economic development i.e. in the centre of the Hockey fields. This work could be completed in one day and costs incurred for hire of both a geologist and drill rig would be no more than $5000.00 ex GST. A proposed drill hole plan is provided in FIGURE 10.
- All holes drilled on site, apart from the far eastern holes i.e. south and east of the hockey field, terminated in high strength, hard, durable and slightly weathered to unweathered basalt. The base of the deposit is unknown however several of the original holes drilled in 1999-2000 suggest that it is at least another 20 metres below the

proposed pit design floor. Incorporating this material into any pit design is the biggest value add that can be achieved for this project.

- A tuffaceous basalt i.e. low quality basalt is thought to exist below the current pit floor. The presence of this material is noted in one drill hole (D5) drilled by Council in 1999, however it has not been intersected in any other holes. That said the recent drilling, (January 2013), sampling was seriously impacted by groundwater flow which may have hidden recovery of thus unit, as it may have washed out in the fines and due to the huge volumes of water present. The presence or otherwise of this unit should be determined as it will be a key driver in understanding the future project viability. It will also allow for suitable development plans to be completed which incorporate this unit into any proposed design.
- The rock contains little free silica, (circa 1%), and when unweathered is expected to contain little secondary mineral content in the main areas of the basalt flow.
- As with most quarries the majority of development and overburden removal will be required to occur in the immediate development phase which will have significant cash flow and operational implications. To minimise these costs, and ensure project viability, it is critical that the development plans proposed are followed as the proposed plans provide for a continued supply of high quality aggregates while the overburden is removed from the eastern high-wall and north-eastern area. If these plans are not followed then in general terms the only viable material that remains to be extracted is within the quarry floor and under the asphalt plant.

Key Recommendations

- It is strongly recommended that four 40 to 50 metre deep core holes are completed to fully define the thickness of the basalt below the current pit floor and easterly expansion areas. Each hole should be drilled through the entire basalt profile to fully ascertain the thickness of basalt in the general area.
- That an additional days percussion drilling is completed to further refine the margins of the resource and to redrill some of the old historical drill areas to confirm the thickness of the basalt in these areas.
- That the buffer zones of the Stokers Pit to the west and north of the current resource area is refined to allow for an optimised pit expansion in the area. Refining these boundaries significantly improves the stability of the site while it also allows for a more useable void space post extraction.
- A more comprehensive analysis of planning and environmental constraints is presented in Section 6 of this report.

Summary

Tuckombil Quarry

This project is of high commercial value as it occurs in an area of increasing resource paucity with sustained demand. While the deposit is modest in size, the rock quality of the basalt, when unweathered is excellent and it provides a high quality material which is used for the production of sealing aggregates. Its proximity to relatively good access, combined with proportionally good buffer distances and manageable constraints make it an attractive location to operate a quarry. Extractive materials are bulky and are used in modest to large quantities in the region. Unlike mining for precious metals, iron ore or coal, extractive materials have a relatively low value and a high cost of transportation, relative to their total delivered value. Transport costs can range from 0% to 150% of the total direct cost to the consumer of quarry products. Accordingly to ensure that costs for construction materials remains balanced and affordable the proposed expansion should be seriously considered as the two other major producers will fully capitalise on the closure of the quarries by increasing prices.

Stokers Quarry

Stokers Quarry is considered to be of less commercial and strategic importance to the Shire and is also reasonably limited in the quality of materials that it can produce. That said, this project is considered viable as a stand alone operation as it provides a variable, but useable source, of low to mid range specification materials which is well located and has good access to the highway. More importantly this project preserves and complements the high quality resource at Tuckombil by providing an affordable source of lower specification construction materials to the region. This project should be extracted to completion pursuant to the proposed design as the post extraction land form design provides for a useable void after quarrying has been finalised. It will also significantly reduce the rehabilitation liability by incorporating the bulk of these rehabilitation costs into operational costs.

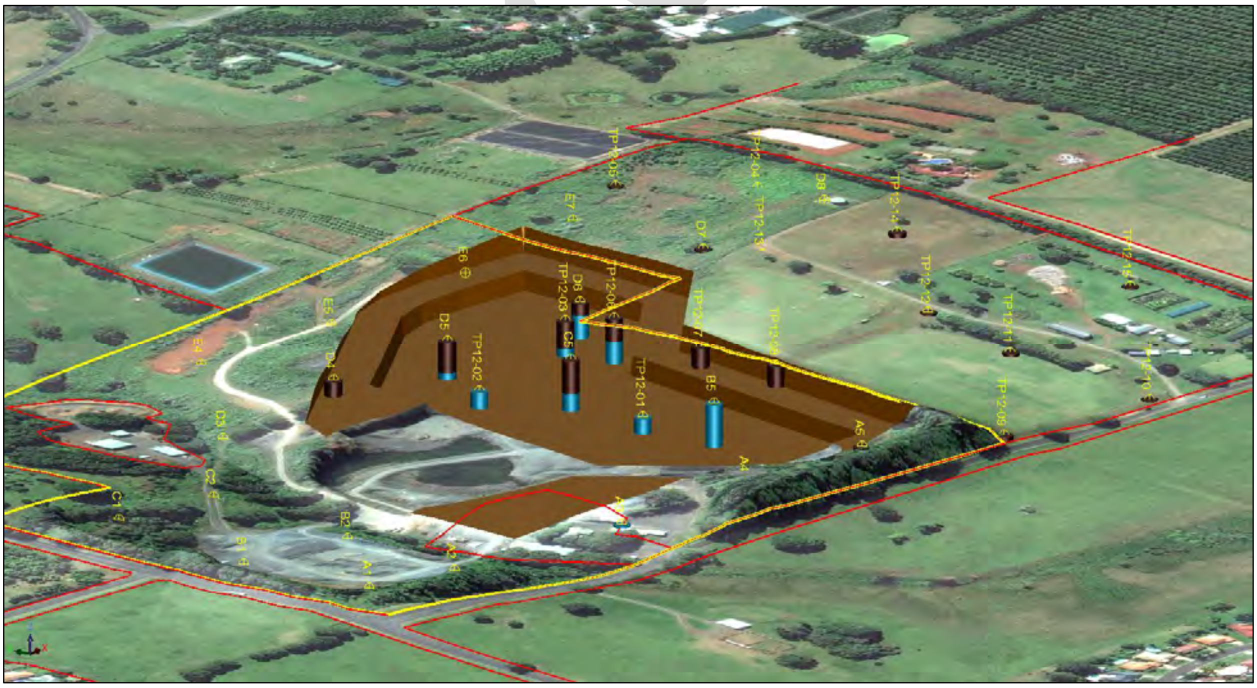


Plate 6 Stage 1 of Proposed Development Tuckombil Quarry

Strategic Options

In regard to a summary of strategic options prepared for the Council, it is proposed that the highest and best land use for the sites is to continue as quarry operations. Both quarries are viable as either stand alone operations, however more importantly they have increased utility when considered together as they both provide alternative, yet valuable sources of construction materials, which are suitable for the production of different products, but which have different uses in the area. Additionally the use of material from the Stokers Quarry preserves the higher quality resource at Tuckombil and accordingly the blend of material provided by each of the resource areas complements the production of resource material from the other. Supporting the highest and best use land use argument is that in regard to the value of the material remaining in the pit, based on the on the current royalty rate of $5.00 tonne an *insitu* value in excess of eight million dollars is derived. If an additional two benches of material can be defined below the Stage 3 pit floor, and the approval for extraction over the Hockey fields can be secured, then the value increases significantly to around 60 million dollars over the life of the project based on the royalty return. If this development proposal is accepted then the quarry could continue for another 70 years based on the current extraction rates which would outlive several future generations of planning schemes. Accordingly it is difficult to predict over such a long time frame what the most suitable option in seventy years may be for post extraction land use, however what is certain is that the best post extraction land form in 2013 will probably not be the same as in 2083.

For a true valuation on this *insitu* value of the resource a Discounted Cashflow Valuation could be completed however using this valuation methodology is more suitable for large scale mining projects, not low volume, very long life projects such as Tuckombil Quarry, as projects like this one are unfairly treated by the 20 year discount methodology. Secondly the discount factor applied to valuing the site is usually inaccurate because they are considered low volume projects, in urban areas and accordingly they become proportionally of higher risk.

In regard to Stokers Quarry this resource will likely be depleted within 20 to 30 years if fully developed however if and when quarrying activities stop then an option for post extractive land uses for this site could include a series of sports fields as indicated on FIGURE 11A – STOKERS CONCEPTUAL REHABILITATION PLAN.

In regards to the proposed expansion of the quarry, and to assuage Councils concern on the impact of the expansion, one example of many is included to demonstrate to Council, that the majority of large suburban quarries in Brisbane operate with significantly large numbers of residents in closer proximity to their operations without the majority of residents even knowing, refer FIGURE 11B – FERNY GROVE QUARRY PROXIMITY TO RESIDENTIAL DEVELOPMENT. West Burleigh Quarry is also a further good example of large operational quarry which routinely blasts within 60 meters of the busy Pacific Motorway and also within 150 metres of a large industrial estate. The days of quarry non compliance are generally long gone and while each operation may have rare and isolated non compliances in general terms most modern operations operate well within their approval conditions for managing environmental impacts. Indeed most people appreciate, albeit indirectly and rarely openly, the quarry as commonly they contain large areas of green space as buffer, which the community is free to use and which will not be developed.

In general terms few people like quarries, and generally there are also no votes in quarries, however they provide the fundamental construction materials which allow society to develop. The first suburb in Australia "The Rocks" was named after a quarry, while the iconic Kangaroo Point Cliffs in Brisbane was also once a large quarry. Without small quarries like this one, Council will be required to import materials from further afield, at significantly greater cost. This scenario is not ideal, as it leads to more trucks on the road for greater distances, which damages the roads and most people dislike trucks on roads even more than they dislike quarries. It is also clearly against the philosophy of sustainability as importation of rock, over large distances is unsustainable, when local and viable sources of construction materials can be used at lower cost.

1. Introduction

Groundwork Plus was commissioned by the Ballina Shire Council to conduct an assessment of the remaining resources at both the Tuckombil and Stokers quarry sites, refer FIGURE 3 – SITE LOCATION PLAN, FIGURE 4 – AERIAL PHOTOGRAPHY, CADASTRE AND TOPOGRAPHY PLAN – TUCKOMBIL and FIGURE 5 – AERIAL PHOTOGRAPHY, CADASTRE AND TOPOGRAPHY PLAN – STOKERS QUARRY. Drilling at the site was completed in January 2013. A total of fifteen, (15), percussion drill holes were completed by an air track top hammer rig. Very brief reconnaissance style geological mapping of the site was also completed, with mapping confirming the broad nature and distribution of the basaltic rocks on site.

1.1 Scope of work

The scope of work Groundwork was commissioned on is detailed below.

The deliverables of the Strategic Options Report, as identified by Council are:

- detail the remaining resource on site, and adjoining Council land;
- identify constraints to obtaining this resource;
- discuss development consent requirements for extraction in excess of existing limits;
- provide analysis of constraints, costs and resources leading to a feasible future quarrying (or exit) strategy;
- provide budget estimates for environmental assessment, development consent, site development and extraction costs;
- identify post closure land uses for the sites for the communities' benefit;
- review approved rehabilitation requirements, and comments on contemporary alternate options;
- provide budget estimates for approved rehabilitation measures and any recommended alternatives; and
- recommend a future site strategy for Councils consideration based on the options proposed.

Additionally, the following stages will be undertaken to complete the project:

- Stage 1. Preliminary Assessment and Research
  - Client liaison.
  - Project inception meeting.
  - Site research – operations, market demand, competition and alternatives.
  - Data collection and review including results of previous drilling programs and assessments.
  - Constraints assessment including environmental and planning constraints.
  - Site visit.

- Stage 2. Exploratory Drilling Program (if required)
  - Resource investigation – drilling of 15 to 20 x 25.1 m deep percussion holes.
  - Drill rig hire.
  - Geological supervision.
  - Analysis of drill filings.

- Stage 3. Reporting
  - Ongoing client liaison.
  - Resource estimations.
  - Quarry End Use and Rehabilitation strategy.
  - Costing estimates for extraction, end use and rehabilitation.
  - CAD drawings and drafting.
  - Completion of Strategic Options Report and submission to Client.
  - Administration.

1.2 Methodology

It is proposed to undertake this strategic options review in a staged manner. Initially a preliminary assessment will be conducted of the operations, historical resource information, planning and environmental constraints and rehabilitation obligations. A site visit will be undertaken to confirm aspects of this preliminary assessment and a provisional estimate has also been included in the event exploratory drilling (percussion) is required to identify depth of overburden and depth and quality of rock.

From the preliminary assessment the Strategic Options Report and strategy will be developed and presented to Council. The report will include:

- an estimate of the quantity, quality and location of resource;
- estimated cost of extraction and value of the remaining resource (including under existing leased areas and adjoining council owned property, including sports fields);
- a feasibility analysis to determine which areas of resource would be economically viable for future extraction including an estimate on the cost of extraction;
- identification of constraints to extracting the identified resource;
- a review of planning legislation and advice as to possibility of gaining development consent to undertake future extraction and identify constraints to development, including buffer zones; and
- a Quarry End Use and Rehabilitation strategy identifying:
  - auitable post closure community land uses, having regard to site size, attributes and location;

- a review of existing rehabilitation requirements and contemporary alternative options associated with the proposed end use;
- expected site rehabilitation and preparation costs; and
- identification of benefits to the Council and community.

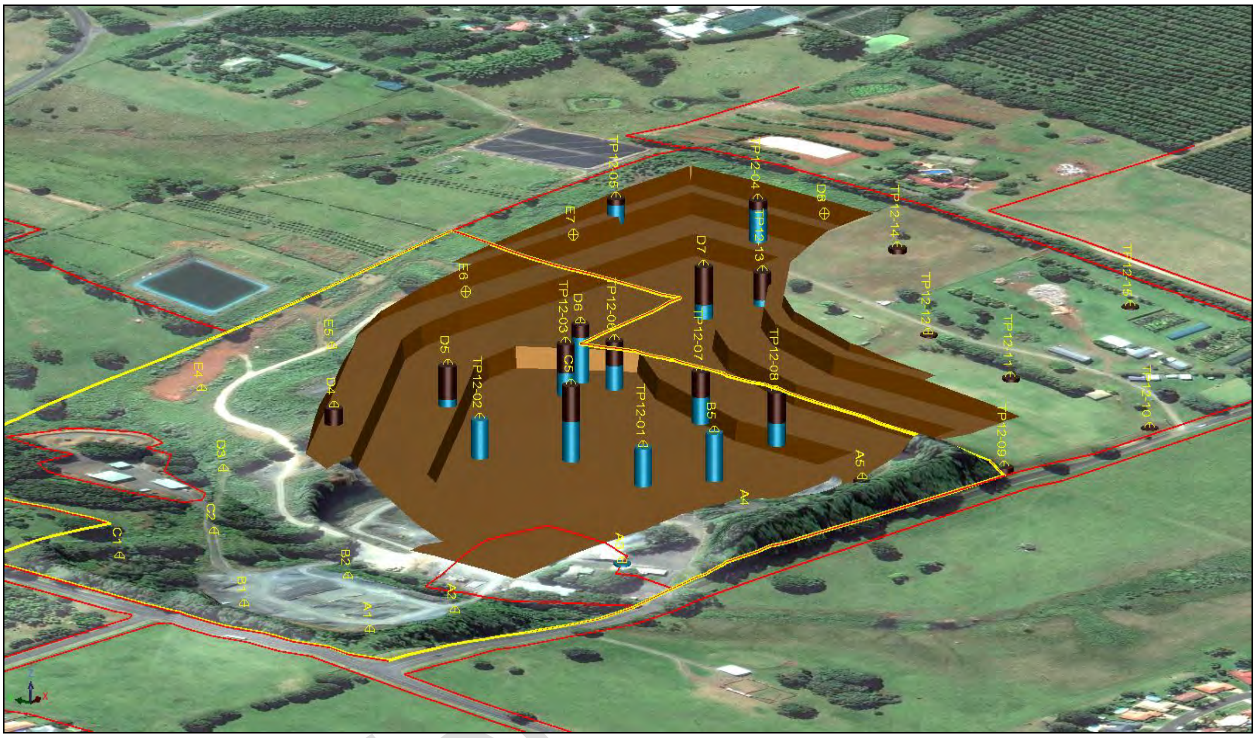


Plate 7 Stage 2 of Proposed Development Tuckombil Quarry

2. Site Details

Location: The Tuckombil Quarry is located at the intersection of Teven and Gap Road Tuckombil with access to the quarry gained via Gap Road. Stokers Quarry is located adjacent to the Bruxner Highway with access to the site also gained off Gap Road, refer FIGURE 3 – SITE LOCATION PLAN.

Area: The site comprises an area gazetted for quarrying of approximately 38.39 Hectares at Tuckombil and 8.09 Hectares at Stokers Quarry.

Real Property Description: The Tuckombil site comprises Lot 2 DP1130300 refer FIGURE 4 – AERIAL PHOTOGRAPHY, CADASTRE AND TOPOGRAPHY PLAN – TUKOMBIL. The Stokers Site consists of Lot 2 712025, refer FIGURE 5 – AERIAL PHOTOGRAPHY, CADASTRE AND TOPOGRAPHY PLAN – STOKERS QUARRY.

Site Geology: The underlying geology of the Tuckombil Quarry site is comprised of basaltic lavas and equivalent volcaniclastic rocks with sections of hematite, sericite and chlorite alteration. The Stokers Quarry site is made up of a mixed sedimentary package of rocks which is made of mainly metamorphosed colloquially described argillite's which include greywacke siltstone, mudstone and sandstone refer FIGURE 6 – REGIONAL GEOLOGY.

Plate 8 North Wall Weathering Profile at Tuckombil Quarry
Red line denoting the transition from distinctly weathered material to unweathered basalt. This photograph also shows the rapidly thickening overburden sequence which develops to the north of site.

3. Investigations

The Tuckombil site is a well developed quarry site which has good exposures of massive to columnar basalt in the current faces and floor area. While the drilling was being completed limited reconnaissance style geological mapping of the site was completed. Observations from this mapping confirmed that in general terms the basalt when unweathered is massive to columnar in form, hard, strong and durable when unweathered and has a sharp transition zone from distinctly weathered to unweathered.

The results of the investigation are discussed in Section 4 and the percussion drillhole logs are attached in APPENDIX 1 – PERCUSSION DRILLHOLE LOGS.

Plate 9 East Wall Weathering Profile at Tuckombil Quarry
The thickness of overburden being the chief issue for further development in this orientation.

Plate 10 South Wall Resources at Tuckombil Quarry
Note: high quality columnar basalt resources remain to be extracted under the asphalt plant. A total of 56,500m³ of material could be extracted from under the asphalt plant once it is removed.

The resource estimate completed for Tuckombil Quarry is based on the results returned from 15 percussion drillholes completed by Orana Drilling and combining this information with the historical drill data provided by Council. While the drill data provided to Groundwork is considered rudimentary it is taken as being accurate as it is in general accord with the findings of Groundwork. For the 2013 drilling campaign the material encountered was geologically logged pursuant to Australian Standard AS1726-1993: Geotechnical Site Investigations. Estimated material strength, drill penetration rate, degree of weathering, degree of alteration, rock structure, foliation intensity, and general rock type were recorded. The drill-hole locations are shown in FIGURE 2 – DRILLHOLE LOCATION PLAN. The percussion drillhole logs are attached in APPENDIX 2 – PERCUSSION DRILLHOLE LOGS.

The details of the drilling are listed below:

- Contractor: Orana Drilling.
- Holes Drilled: 15 Percussion Holes.
- Total Meters Drilled: 306.4 m.
- Drill Hole Inclination: Holes drilled at -90º.
- Drilling Date: April 2013.
- Hole Size: 89 mm.
- Drilling Style: Top hole hammer.

In general, the drilling conditions encountered were good apart from the two holes completed in the floor which encountered significant volumes of groundwater, which limited the efficacy of this style of drilling in this area. Drill penetration rates were recorded and varied across the site, however averaged 1.3 m/sec in the unweathered basalt. This is a similar penetration rate to the regional basalt quarries, suggesting that the rock below the pit floor and in the northeast expansion area, does have suitable characteristics for use as high quality quarried products. The low abrasion rate of the rock upon drill-bits was noted specifically by the drilling contractor by reviewing the lack of wear that occurred on the tungsten carbide drill buttons. This will reduce crushing costs for the project by reducing manganese wear. The information gained from the drilling was then used to design three stages of conceptual quarry pit designs, refer FIGURE 1 – STAGE 3 TUCKOMBIL QUARRY DESIGN, and FIGURE 7 – STAGE 1 TUCKOMBIL PROPOSED QUARRY DESIGN and FIGURE 8 – STAGE 2 TUCKOMBIL PROPOSED QUARRY DESIGN. For the Stokers site a drill program was not warranted as access was limited and additionally the site exposures clearly indicate the type and volume of material that is available. Accordingly a volumetric pit was used as the basis for the resource for this quarry.

3.1 Results

The underlying geology of the site is comprised of basaltic lava and equivalent volcaniclastic rocks with sections of hematite, epidote, sericite and chlorite alteration, refer FIGURE 2 – DRILLHOLE LOCATION PLAN.

Overburden

The residual soil and overburden was variable across the site with a range of thickness between 2 metres and 25.0 metres with the overburden thickness generally increasing towards the far east of the deposit. Drill results and field observations suggest that the overburden will be thinner on the main elevated areas i.e. around the water tower and will increase away from this area. Additionally it was noted that the thickness of the overburden was highly variable and several of the holes drilled especially around the nursery did not intersect good quality unweathered basalt. The thickness of the overburden intersected in each drill hole is indicated on FIGURE 2 – DRILL HOLE LOCATION PLAN.

In practical terms, it is likely that the overburden material in most areas will only be suitable for the production of lower specification road bases and fill.

Percussion drilling has supported the hypothesis that the material is most likely of a sub volcanic genesis as all holes intersected generally grey, massive, homogenous to flow banded, sparsely porphyritic basalt with a glassy matrix. This geological relationship for the site is presented in FIGURE 9 – CROSS SECTIONS A-A’ to C-C’, while a further recommended percussion drill hole plan is provided in FIGURE 10 – PROPOSED DRILLHOLE LOCATION PLAN.

Basalt Resource

The basalt is grey black in colour, when unaffected by weathering, a red colour when altered by hematite and a green colour when altered by chlorite, illustrated in PLATE 11 – ALTERATION OF BASALT AT TUCKOMBIL QUARRY. Textures recognised were generally consistent with the basalts of the area, being flow banded in part but with generally a massive homogenous to columnar appearance. Dominant minerals in the basalt are olivine, sanidine feldspar and pyroxene, whilst secondary minerals include calcite, ilmenite, chlorite, goethite and sphene. Smectite and goethite are also likely to be present in the more weathered material recognised on site.

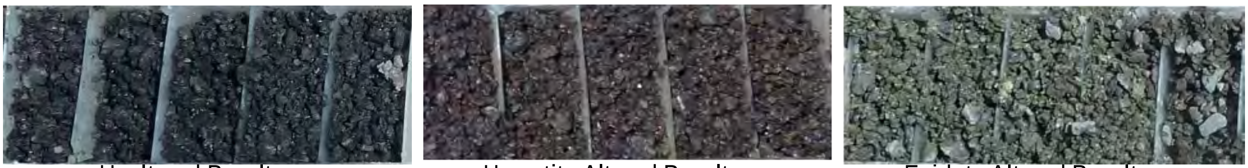


Plate 11 Alteration of Basalt at Tuckombil Quarry

The distinctly weathered basalt material generally appears of low to medium strength, and should provide source material for production of low range specification products. The slightly weathered to unweathered material appears hard, strong and durable and will continue to provide an excellent source of quarry material. The rock has limited free silica content and is predicted to be relatively innocuous in terms of alkali silica reactivity.

3.2 Field Testing

The results of the field testing on the basalt indicate that for engineering purposes, the supplied material may be summarised as:

- hard;
- strong;
- durable;
- finely crystalline and partly glassy;
- non-porous;
- essentially unweathered;
- lightly altered;
- low free silica content circa 1%; and
- suitable for use as most high quality quarried products including asphalt and concrete aggregates, ballast and road bases.

4. Resource Estimate

A resource estimation has been completed and the resources could be considered to be classified as Inferred Resources as listed in TABLE 3 and TABLE 4.

Table 3 Quarry Resources Tuckombil Quarry

Quarry Stage	Metres^3 (*in situ*)	Bulk Density* (*measured*)	Distinctly Weathered Basalt Volume m^3	Distinctly Weathered Basalt Tonnes t/m^3	Slightly Weathered and Unweathered Basalt Volume m^3	Slightly Weathered and Unweathered Basalt Tonnes t/m^3
Stage 1	966,600	2.2/2.7	501,100	1,102,420	465,500	1,256,850
Stage 2	1,632,400	2.2/2.7	549,700	1,209,340	1,082,700	2,923,290
Stage 3	1,264,750	2.2/2.7	159,500	350,900	1,105,250	2,984,175
Total	3,863,750	N/A	1,210,300	2,662,660	2,653,450	7,164,315

*Bulk Density measured at 2.7 t/m^3 for slightly weathered to fresh material and 2.2 t/m^3 for distinctly weathered material. Volumes are based off the conceptual pit design illustrated in FIGURE 1 and topography supplied by NSW Department of Lands and Property Information 1:25,000.
Note: additional resources exist below the proposed pit design and elsewhere which are not currently included in this total. Gaining approval on these tonnes for extraction is required. Key points to note are that the depth of overburden is low around the water tower and additionally that the majority of quarry impacts can be channelled back into the void and the workings will remain unseen from most aspects. Regardless it is recommended that if the expansion is considered by Council an amenity bund is constructed and vegetated around the perimeter of the quarry to further reduce any potential impacts.

Table 4 Quarry Resources Stokers Quarry

Quarry Stage	Metres^3 (*in situ*)	Bulk Density* (*measured*)	Distinctly Weathered Argillite Volume m^3	Distinctly Weathered Argillite Tonnes t/m^3	Slightly Weathered and Unweathered Argillite Volume m^3	Slightly Weathered and Unweathered Argillite Tonnes t/m^3
Total	633,300**	2.2/2.6	538,305	1,076,610	94,995	246,987

*Bulk Density measured at 2.6 t/m^3 for slightly weathered to fresh material and 2.0 t/m^3 for extremely to distinctly weathered material.
**Volumes are based off the conceptual pit design illustrated in FIGURE 11 and topography supplied by NSW Department of Lands and Property Information 1:25,000. The survey data used for this pit is old, circa 2000, however the full volume at the date of survey was 733,000 m^3. A depletion allowance of approximately 100,000 m^3 has been subtracted from this total to allow for extraction of materials in the interim time period, i.e. 2000-2013.

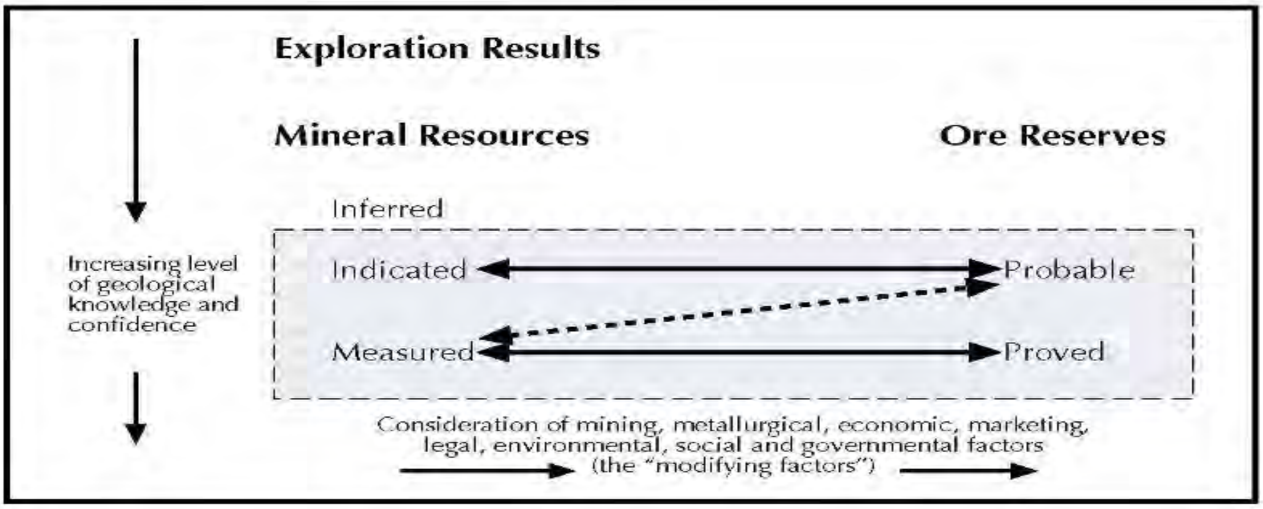
4.1 Criteria Used in Resource Estimation

- Measured Bulk Density (Apparent Particle Density of Basalt) in situ 2.7 t/m^3.
- Measured Bulk Density (Apparent Particle Density of Argillite) in situ 2.6 t/m^3.
- Estimated Bulk Density of Weathered Basalt in situ 2.2 t/m^3.
- Estimated Bulk Density of Weathered Basalt in situ 2.0 t/m^3.
- Terminal Batter Angles Unweathered Basalt/Argillite 80 º.
- Terminal Batter Angles Weathered Basalt/Argillite 41º.
- Terminal Batter in Topsoil and Clays 27º.
- Terminal Bench Width 10 m.
- Bench Height 10 m.
- Main Haul Road Width 12 m and Intra-Haul Road Width 8 m.
- Topography NSW Department of Lands and Property Information 1:25,000.

Resultant of the completed drilling and mapping work is that the resource can be categorised under *JORC 2004*. Following is the classification system as set out in the *JORC 2004* which is the Australasian Code for Reporting of Exploration Results, Mineral Resources and Ore Reserves.

An 'Inferred Mineral Resource' is that part of a Mineral Resource for which tonnage, densities, shape, physical characteristics, grade and mineral content can be estimated with a low to reasonable level of confidence. It is based on exploration, sampling and testing information gathered through appropriate techniques from locations such as outcrops, trenches, pits, workings and drill-holes. TABLE 5 below shows the relationship of the various categories of resource and reserve pursuant to JORC 2004.

Table 5 JORC 2004 Resource Diagram



The inferred resource estimate is based on in-situ volumes. The actual product yield will depend on a number of factors including, (but not limited to), final pit design, geotechnical conditions, unsaleable product and losses due to mining, sales mix, plant configuration, haul road location degree off deleterious alteration and other diluting factors.

5. Planning and Environment Assessment

5.1 Tuckombil Quarry Planning Risk Assessment

The land associated with Tuckombil Quarry was previously located within the Rural – Extractive & Mineral Resources zone of the Ballina Local Environmental Plan 1987 and Extractive Industry was a Permitted Use (with consent) in that zone. It is understood that Ballina Shire Council owns the land, and currently utilises the land immediately to the east of the existing quarry for sports and recreation purposes. In August 2012, Newton Denny Chapelle submitted an application to Ballina Shire Council seeking to amend the existing conditions of approval to introduce modern best practice blast management techniques at the quarry. A search of Council's PD online system indicates that the application is still being assessed and has been the subject of a number of submissions from local residents. It is noted that there are a high number of residential dwellings within 500 m of the quarry operations (refer FIGURE 12 – NEARBY SENSITIVE RECIEVERS).

The Ballina Shire Council has recently adopted a new Local Environmental Plan (LEP) which commenced operation in January 2013. The draft version of that LEP sought to include the quarry and surrounding land in the E3 – Environmental Management Zone (refer FIGURE 13 – DRAFT LEP ZONE). Extractive industry is a Prohibited Use in this zone. However, the adopted version of the LEP identifies the land as 'Deferred Matter' and does not assign a zoning (refer FIGURE 14 – ADOPTED LEP ZONE). It is understood that this is because the land can not be rezoned without consultation with the NSW Government as the NSW Department of Industry and Investment has included the land as an 'Identified Resource Area' as shown in the Ballina Shire Growth Management Strategy (refer FIGURE 15 – IDENTIFIED RESOURCE AREAS) and as such the land is affected by Ministerial Direction No 1.3 which seeks to:

> *'ensure that the future extraction of State or regionally significant reserves of coal, other minerals, petroleum and extractive materials are not compromised by an inappropriate development.'*

The Ballina Shire Council has also recently adopted a new Development Control Plan (DCP) which commenced operation in February 2013. The DCP identifies the land as comprising 'Natural Areas & Habitat' (refer FIGURE 16 – NATURAL AREAS AND HABITAT MAP). Section 3.3 Natural Areas and Habitat of the SCP identifies the planning objectives and development controls for land shown on the Natural Areas and Habitat Map which includes but is not limited to the following:

Planning Objectives

a. *Protect and enhance ecologically significant areas;*

b. *Provide for development that is compatible with ecological values and that minimises risk to ecologically sensitive environments; and* *c.* *Encourage development that contributes to the maintenance, enhancement or rehabilitation of environmental values and ecologically sensitive areas.*

Development Controls

i. *Development is to be sited, designed and managed to avoid or mitigate potential adverse impacts on natural areas and habitat;*

ii. *All development (except dwellings, basic agricultural buildings and routine agricultural management activities) must demonstrate a net environmental benefit;*

iii. *A development application for land containing a wildlife corridor (as identified on the Wildlife Corridors Map), must demonstrate a long term net benefit to the operation and retention of the wildlife corridor. Compliance with this provision may also meet the requirements of (ii);*

iv. *Where development is unable to be sited, designed and managed to avoid potential adverse impacts on natural areas (as identified on the Natural Areas and Habitat Map), a proposal to remove habitat may be considered. If habitat is proposed to be removed or impacts as part of a development, an offset for the loss of biodiversity may be considered by Council provided it can be demonstrated that the proposed offset will maintain or improve biodiversity outcomes and values.*

v. *Development applications in relation to land to which this section applies are to be accompanied by an ecological assessment report prepared by an appropriately qualified and experienced professional.*

The Ballina Shire Council also adopted a Local Growth Management Strategy (LGMS) on the 26 July 2012. The purpose of the LGMS is to, '*provide the framework for managing population and employment growth in Ballina Shire'*. Section 6 of the LGMS outlines the Council's vision and strategic actions for Alstonville, including the Tuckombil Quarry (referred to as 'the Gap Road Quarry') and identifies the quarry as 'Recreation – parks & reserve' (refer FIGURE 17 – ALSTONVILLE LOCAL GROWTH MANAGEMENT STRATEGY).

Environmental Risk Assessment

The identification of activities and their potential environmental impacts is fundamental to designing and implementing procedures and measures for extractive industry operations. The risk assessment adopted is a qualitative risk-based approach designed to assess risk based on:

- the likelihood of an environmental impact or event occurring; and
- the consequences of the occurrence on the surrounding environment.

The likelihood and consequences are scored between 1 and 5 for each potential impact or event TABLE 6 – DEFINITIONS OF LIKELIHOOD and TABLE 7 – DEFINITIONS OF CONSEQUENCE outline the identifiers and scores used in the risk assessment.

Table 6 Definitions of Likelihood

Rating	Descriptor	Score
Rare	May occur only in exceptional circumstances	1
Unlikely	Could occur but doubtful	2
Possible	Might occur at some time in the future	3
Likely	Will probably occur	4
Almost Certain	Is expected to occur in most circumstances	5

Table 7 Definitions of Consequence

Rating	Descriptor	Score
Negligible	Impacts not requiring any treatment or management action	1
Minor	Nuisance or insignificant environmental harm requiring minor management action	2
Moderate	Serious environmental impacts, readily manageable at low cost	3
Major	Substantial environmental impacts, manageable but at considerable cost and some disruption	4
Catastrophic	Severe environmental impacts with major consequent disruption and heavy cost	5

The consequence and likelihood scores are then plotted on the Risk Assessment Matrix, see TABLE 8 – RISK ASSESSMENT MATRIX. The final risk level assigned is a product of the likelihood and consequence scores. The higher the risk score, the higher the priority is for management.

Table 8 Risk Assessment Matrix

Likelihood		Consequence				
		Negligible	Minor	Moderate	Major	Catastrophic
		1	2	3	4	5
Almost Certain	5	5 Medium	10 High	15 High	20 Extreme	25 Extreme
Likely	4	4 Low	8 Medium	12 High	16 High	20 Extreme
Possible	3	3 Low	6 Medium	9 Medium	12 High	15 High
Unlikely	2	2 Low	4 Low	6 Medium	8 Medium	10 High
Rare	1	1 Low	2 Low	3 Low	4 Low	5 Medium

TABLE 9 – INDICATIVE MANAGEMENT OPTION FOR EACH RISK ASSESSMENT RATING describes the possible actions required for each risk assessment rating.

Table 9 Indicative Management Option for Each Risk Assessment Rating

Risk Rating	Risk Rating Scores	Indicative Management Option
Extreme	16 – 25	Manage by implementing Site management and emergency procedures, plant design controls and regular monitoring
High	10 – 15	Manage by implementing Site management and emergency procedures, specific monitoring and may require some operation/plant design controls
Medium	5 – 9	Manage by implementing specific monitoring or response procedures
Low	1 – 4	Manage by routine procedures, unlikely to need specific application of resources

Site activities have been tabulated against the potential for those activities to cause environmental harm, see TABLE 10 – IDENTIFICATION OF ENVIRONMENTAL IMPACTS AND RISKS – TUCKOMBIL QUARRY.

Table 10 Identification of Environmental Impacts and Risks – Tuckombil Quarry

Activity	Impacts									
	Stormwater & Soil Erosion	Groundwater	Land Contamination	Air Quality (Dust)	Noise & Vibration	Waste	Fauna & Flora	Visual Amenity	Spread of Declared Plants	Cultural and Heritage
Vegetation Clearing	Medium 3x2=6	Low 2x1=2	Low 2x1=2	Low 3x1=3	Low 3x1=3	Low 3x1=3	Low 3x1=3	Medium 3x2=6	Low 2x2=4	Low 2x2=4
Topsoil Stripping and Stockpiling	Medium 3x2=6	Low 2x1=2	Low 2x1=2	Low 3x1=3	Medium 3x2=6	Low 2x1=2	Low 2x1=2	Medium 3x2=6	Low 3x1=3	Low 2x2=4
Raw Material Extraction	Medium 3x2=6	Medium 2x3=6	Low 2x1=2	Low 3x1=3	High 4x3=12	Low 2x1=2	Low 2x1=2	Medium 3x2=6	Low 1x2=2	Low 1x1=1
Raw Material Stockpiling	Medium 3x2=6	Low 1x1=1	Low 2x1=2	Low 3x1=3	Low 2x1=2	Low 2x1=2	Low 2x1=2	Low 1x1=1	Low 2x2=4	Low 1x1=1
Crushing & Screening	Low 3x1=3	Low 1x1=1	Low 3x1=3	Medium 3x2=6	Medium 3x3=9	Low 2x1=2	Low 2x1=2	Low 1x1=1	Low 2x2=4	Low 1x1=1
Product Stockpiling	Medium 3x2=6	Low 1x1=1	Low 2x1=2	Low 3x1=3	Low 2x1=2	Low 2x1=2	Low 1x1=1	Low 1x1=1	Low 2x2=4	Low 1x1=1
Product Hauling	Low 2x2=4	Low 1x1=1	Low 2x1=2	Low 3x1=3	Low 2x1=2	Low 2x1=2	Low 3x1=3	Low 1x1=1	Low 2x2=4	Low 1x1=1
Maintenance Activities	Medium 3x2=6	Low 1x1=1	Medium 3x2=6	Low 1x1=1	Low 2x1=2	Medium 3x3=9	Low 2x1=2	Low 1x1=1	Low 2x2=4	Low 1x1=1
Handling of Oils, Greases, Fuels & Chemicals	High 3x4=12	Low 2x2=4	Medium 3x3=9	Low 1x1=1	Low 1x1=1	Low 3x1=3	Low 2x1=2	Low 1x1=1	Low 1x2=2	Low 1x1=1
Rehabilitation Activities	High 3x4=12	Low 1x1=1	Low 2x1=2	Low 3x1=3	Low 3x1=3	Low 2x1=2	Low 2x1=2	Low 1x1=1	Low 2x2=4	Low 1x1=1
Stormwater Management	Medium 3x3=9	Low 1x1=1	Low 1x1=1	Low 2x1=2	Low 2x1=2	Low 2x1=2	Low 2x1=2	Low 1x1=1	Low 2x2=4	Low 1x1=1
Waste Management	Medium 3x3=9	Low 1x3=3	Medium 2x3=6	Low 2x1=2	Low 2x1=2	Medium 3x3=9	Low 2x1=2	Low 3x1=3	Low 2x2=4	Low 1x1=1

Planning and Environment Risk Analysis

It is apparent that the planning framework surrounding the land is changing and that the change may not weigh in favour of the continued operations of the quarry. The high level strategic planning and environmental documents of the Council communicate a desire for operations at the quarry to cease and for the land to form part of the inter-urban break around Alstonville.

On a 'first principles' review the site is well positioned to continue and expand operations based on the following grounds:

- the site is not mapped as comprising any significant environmental values (e.g. protected vegetation);
- the proposed quarry development plan would progress the quarry benches to the east and north east increasing the distance from the majority of the nearby residential properties which are located to the south and west of the site;
- the existing and proposed quarry operations are visually screened from view by existing vegetation and natural topography; and
- the vehicular access to the site is of a sufficient standard and well maintained.

Having considered the proposed quarry development plan the environmental risk assessment conducted indicates that the activities with the greatest potential risk (e.g. raw material extraction by blasting) of causing environmental impact can be appropriately managed and adequately mitigated by employing best practice operational methods such as:

- design and implementation of blast management practices including, bore tracking, face profiling, shot design, use of electronic detonators, and engagement of suitably qualified shot firers;
- implementation of a noise management plan;
- utilisation of dust suppression on site; and
- design and implementation of a stormwater management plan on site.

Given the proximity of the site to nearby sensitive receivers and the current planning framework, if a development application was progressed for the Tuckombil quarry it is likely that detailed and comprehensive supporting assessments for noise, vibration, dust, stormwater, environmental and amenity impacts would be required. However as the potential environmental impacts can be adequately and appropriately managed by the implementation of best practice operational methods, it is anticipated that the Council's long term vision and strategy for the land is likely to have the greatest impact on the outcome of any development application.

5.2 Stokers Quarry Planning Risk Assessment

Planning Risk Assessment

The site is located in a rural area with few nearby sensitive receivers (refer FIGURE 18 – STOKERS NEARBY SENSITIVE RECEIVERS). The Ballina Shire Council has adopted a new Local Environmental Plan which commenced operation in January 2013. That LEP includes the quarry and surrounding land in the RU1 – Primary Production Zone (refer FIGURE 19 – STOKERS ADOPTED LEP ZONE PLAN). Extractive Industry is a permitted use (with consent).

It is understood that this is consistent with the previous Rural zoning of the land and aligns with the decision of the NSW Department of Industry and Investment to identify the land as an 'Identified Resource Area' as shown in the Ballina Shire Growth Management Strategy (refer FIGURE 15 – IDENTIFIED RESOURCE AREAS) and as such the land is affected by Ministerial Direction No 1.3 which seeks to:

> *'ensure that the future extraction of State or regionally significant reserves of coal, other minerals, petroleum and extractive materials are not compromised by an inappropriate development.'*

The Ballina Shire Council has also recently adopted a new Development Control Plan (DCP) which commenced operation in February 2013. The DCP identifies the land as comprising a '50m Buffer – Natural Areas & Habitat' (refer FIGURE 16 – NATURAL AREAS AND HABITAT MAP) along the Western and Northern boundary of the land and also forming part of the regions 'Wildlife Corridors'. Section 3.3 Natural Areas and Habitat of the SCP identifies the planning objectives and development controls for land shown on the Natural Areas and Habitat Map and the Wildlife Corridors Map which includes but is not limited to the following:

Planning Objectives

a. *Protect and enhance ecologically significant areas;*

b. *Provide for development that is compatible with ecological values and that minimises risk to ecologically sensitive environments; and*

c. *Encourage development that contributes to the maintenance, enhancement or rehabilitation of environmental values and ecologically sensitive areas.*

Development Controls

i. *Development is to be sited, designed and managed to avoid or mitigate potential adverse impacts on natural areas and habitat;*

ii. *All development (except dwellings, basic agricultural buildings and routine agricultural management activities) must demonstrate a net environmental benefit;*

iii. *A development application for land containing a wildlife corridor (as identified on the Wildlife Corridors Map), must demonstrate a long term net benefit to the operation and retention of the wildlife corridor. Compliance with this provision may also meet the requirements of (ii);*

iv. *Where development is unable to be sited, designed and managed to avoid potential adverse impacts on natural areas (as identified on the Natural Areas and Habitat Map), a proposal to remove habitat may be considered. If habitat is proposed to be removed or impacts as part of a development, an offset for the loss of biodiversity may be considered by Council provided it can be demonstrated that the proposed offset will maintain or improve biodiversity outcomes and values.*

v. *Development applications in relation to land to which this section applies are to be accompanied by an ecological assessment report prepared by an appropriately qualified and experienced professional.*

Environmental Risk Assessment

The identification of activities and their potential environmental impacts is fundamental to designing and implementing extractive industry operations. The risk assessment adopted is a qualitative risk-based approach designed to assess risk based on:

- the likelihood of an environmental impact or event occurring; and
- the consequences of the occurrence on the surrounding environment.

The likelihood and consequences are scored between 1 and 5 for each potential impact or event TABLE 6 and TABLE 7 outline the identifiers and scores used in the risk assessment (refer TABLE 6 and TABLE 7 above).

The consequence and likelihood scores are then plotted on the Risk Assessment Matrix (see TABLE 8 above). The final risk level assigned is a product of the likelihood and consequence scores. The higher the risk score, the higher the priority is for management. TABLE 9 (above) describes the possible actions required for each risk assessment rating.

Site activities have been tabulated against the potential for those activities to cause environmental harm, see TABLE 11 – IDENTIFICATION OF ENVIRONMENTAL IMPACTS AND RISKS – STOKERS QUARRY.

Table 11 Identification of Environmental Impacts and Risks – Stokers Quarry

Activity	Impacts									
	Stormwater & Soil Erosion	Groundwater	Land Contamination	Air Quality (Dust)	Noise & Vibration	Waste	Fauna & Flora	Visual Amenity	Spread of Declared Plants	Cultural and Heritage
Vegetation Clearing	Medium 4x2=8	Low 2x1=2	Low 2x1=2	Low 3x1=3	Low 3x1=3	Low 3x1=3	High 4x3=12	Medium 2x3=6	Low 2x2=4	Low 2x2=4
Topsoil Stripping and Stockpiling	Medium 3x2=6	Low 2x1=2	Low 2x1=2	Low 3x1=3	Medium 3x2=6	Low 2x1=2	High 4x3=12	Medium 2x3=6	Low 3x1=3	Low 2x2=4
Raw Material Extraction	Medium 3x2=6	Medium 2x3=6	Low 2x1=2	Low 3x1=3	High 4x3=12	Low 2x1=2	Low 2x1=2	Medium 2x3=6	Low 1x2=2	Low 1x1=1
Raw Material Stockpiling	Medium 3x2=6	Low 1x1=1	Low 2x1=2	Low 3x1=3	Low 2x1=2	Low 2x1=2	Low 2x1=2	Low 1x1=1	Low 2x2=4	Low 1x1=1
Crushing & Screening	Low 3x1=3	Low 1x1=1	Low 3x1=3	Medium 3x2=6	Medium 3x3=9	Low 2x1=2	Low 2x1=2	Low 1x1=1	Low 2x2=4	Low 1x1=1
Product Stockpiling	Medium 3x2=6	Low 1x1=1	Low 2x1=2	Low 3x1=3	Low 2x1=2	Low 2x1=2	Low 1x1=1	Low 1x1=1	Low 2x2=4	Low 1x1=1
Product Hauling	Low 2x2=4	Low 1x1=1	Low 2x1=2	Low 3x1=3	Low 2x1=2	Low 2x1=2	Low 3x1=3	Low 1x1=1	Low 2x2=4	Low 1x1=1
Maintenance Activities	Medium 3x2=6	Low 1x1=1	Medium 3x2=6	Low 1x1=1	Low 2x1=2	Medium 3x3=9	Low 2x1=2	Low 1x1=1	Low 2x2=4	Low 1x1=1
Handling of Oils, Greases, Fuels & Chemicals	High 3x4=12	Low 2x2=4	Medium 3x3=9	Low 1x1=1	Low 1x1=1	Low 3x1=3	Low 2x1=2	Low 1x1=1	Low 1x2=2	Low 1x1=1
Rehabilitation Activities	High 3x4=12	Low 1x1=1	Low 2x1=2	Low 3x1=3	Low 3x1=3	Low 2x1=2	Medium 3x2=6	Low 1x1=1	Low 2x2=4	Low 1x1=1
Stormwater Management	Medium 3x3=9	Low 1x1=1	Low 1x1=1	Low 2x1=2	Low 2x1=2	Low 2x1=2	Low 2x1=2	Low 1x1=1	Low 2x2=4	Low 1x1=1
Waste Management	Medium 3x3=9	Low 1x3=3	Medium 2x3=6	Low 2x1=2	Low 2x1=2	Medium 3x3=9	Low 2x1=2	Low 3x1=3	Low 2x2=4	Low 1x1=1

Planning and Environment Risk Analysis

It is apparent that the planning framework surrounding the land is changing however the change weighs in favour of the continued operations of the quarry. The high level strategic planning and environmental documents of the Council communicate a desire for operations at the quarry to continue where the environmental values of the adjoining land can be protected and enhanced. The Council's DCP prescribes a buffer of 50 m to the western and northern site boundaries to protect the environmental values of the adjoining land. Existing vegetation can be retained within the site along those boundaries and it is likely that the buffer width could be reduced to 20 m and still provide appropriate protection to the environmental values of the adjoining land subject to discussion with Council.

The environmental risk assessment conducted indicates that the activities with the greatest potential risk of environmental impacts can be appropriately managed and adequately mitigated by employing best practice operational methods.

Given the relative lack of nearby sensitive receivers and the current planning framework, if a development application was progressed for the Stokers quarry it is likely that detailed and comprehensive supporting assessments for stormwater, flora, fauna and other environmental impacts would be required. However it is apparent that the continued operation of the quarry is supported with extractive industry being deemed to be a Permitted Use (with consent).

6. Important Information

Your attention is drawn to the document – 'Important Information about your Report'. The statements presented in this document are intended to advise you of what your realistic expectations of this report should be and to present you with recommendations on how to minimise the risks associated with the geotechnical criteria for this project. The document is not intended to reduce the level of responsibility accepted by Groundwork Plus, but rather to ensure that all parties who may rely on this report are aware of the responsibilities each assumes in so doing. We would be pleased to answer any questions about this important information from the reader of this report. Further information on UNDERSTANDING YOUR REPORT is presented in APPENDIX 3.

References

Australian Geomechanics Society. *Modified Landslide Risk Management Concepts and Guidelines*

Hoek, E and Bray J. W. *Rock Slope Engineering Revised Third Edition*

Hudson, J. and Harrison J. *Engineering Rock Mechanics*

Read, J. and Stacey. *Guidelines for Open Pit Slope Design CSIRO Publishing 2009*

Glossary of Terms

Airblast Overpressure	A shock wave form, resulting from the activity of man or from natural processes, causing adverse effects to man and the environment.
Air Pollutant	A substance in ambient atmosphere, resulting from the activity of man or from natural processes, causing adverse effects to man and the environment (also called "air contaminant").
Ambient Air Quality	The quality of the ambient air near ground level, expressed as concentrations or deposition rates of air pollutants - also expressed as existing air quality.
Annual Exceedance Probability	Means the likelihood of occurrence of a flood of a given size or larger in any one year, usually expressed as a percentage. For example, if a peak flood discharge of 500 cubic metres per second has an AEP of 5 percent, it means that there is a 5 percent risk, that is the probability of 0.05 or a likelihood of 1 in 20, of a peak flood discharge of 500 cubic metres /second or larger occurring in any one year. The AEP of a flood event gives no indication of when a flood of that size will occur next.
A-scale	A sound level measurement scale. It discriminates against low frequencies approximates the human ear.
Average Recurrence Interval	Means the average period between the recurrence of a storm event of a given rainfall intensity. The ARI represents a statistical probability. For example, a 100 year ARI indicates an average of 100 years between exceedance of a given storm magnitude
Background Noise Levels	The level of the ambient sound indicated on a sound level meter in the absence of the sound under investigation (e.g. sound from a particular noise source; or sound generated for test purposes).
Blasting	The operation of breaking rock by means of explosives.
Bund Wall	A man-made earth mound.
Catchment Area	The area determined by topographic features within which rainfall will contribute to runoff at a particular point.
Concrete Products	Products manufactured primarily from Portland Cement concrete these include bricks, blocks, pavers, pipes and box culverts and other precast concrete sections.
Conveyor	A device fitted with an endless rubber belt used for moving crushed rock within the processing plant.
Crushing	The mechanical process of reducing rock size usually by pressure or impact.
Dust	Particles of mostly mineral origin generated by erosion of surfaces and the mining and handling of materials.
Ecosystem	The totality of biological processes and interactions within a specified physical environment.
Environmental Constraints	Limitations on a project by components of the environment.
Excavator	Item of earth moving equipment either tracked or wheeled fitted with a bucket on an articulated boom and used for digging material from a face in front of, or below the machine.
Fallout	The sedimentation of dust or fine particles in the atmosphere.
Fill	Material imported and emplaced to raise the general surface level of a site.

Flyrock	Rock that is propelled into the air by the force of the explosion. Usually comes from pre-broken material on the surface or upper open face.
Fresh Rock	Rock unaffected by weathering processes.
Grader	An item of earthmoving equipment, rubber tyred and fitted with a centrally mounted blade and rippers used to shape and trim the ground surface.
Ground Vibration	Oscillatory motion of the ground caused by the passage of seismic waves originating from a blast.
Groundwater	Water contained in voids such as fractures and cavities in rocks and inter-particle spaces in sediments.
Haul Road	Road used in quarry for haulage of rock from the face to the crusher and for general site access.
Lithosol	One of a group of azonal soils having no clearly expressed soil morphology and consisting of a freshly and imperfectly weathered mass of rock fragments; largely confined to steep hillsides.
Meta-greywacke	Indurated sedimentary rock consisting of unsorted detritus of the grain size of sandstone but containing fragments of feldspars and ferromagnesium minerals.
Metamorphic Rock	Any rock which has been altered by heat or pressure.
Mobile Equipment	Wheeled or tracked self propelled equipment such as trucks and front end loaders.
Monitoring	The regular measurement of characteristics of the environment.
Operational Constraints	Limitations upon a project by equipment or machinery.
Particulate Matter	Small solid or liquid particles suspended in or falling through the atmosphere.
Peak Particle Velocity	A measure of ground vibration reported in millimetres per second (mm/sec) (ppv).
Percussion Drillhole	Drillhole made by equipment using the repetitive impact of a tungsten tipped bit onto rock; rock cuttings are usually returned uphole by flushing with compressed air.
Petrological	Relating to the study of rock mineral composition at hand specimen or microscopic scale.
Podzol	A zonal soil having a very thin organic mineral layer above a leached layer which rests upon an illuvial dark brown layer.
Podzolic	A duplex soil having a light textured organically stained topsoil, underlain by a pale ‘bleached’ light textured soil layer and clay subsoil.
Primary Crusher	The first crusher through which the rock passes in the processing plant.
Processing pPlant	A combination of crushers, screens, conveyors and chutes.
Rehabilitation	The preparation of a final landform after quarrying and its stabilisation with grasses, trees and shrubs.
Revegetation	Replacement of vegetation on areas disturbed by quarrying activities.
Rip Rap	Armour rock protection for water retention structures.
Roadbase	Road pavement usually made up of densely graded crushed rock in varying sizes.
Road Grades	The longitudinal slope of a road surface usually defined by a vertical rise or fall over a horizontal distance. Gradient, grade, slope and inclination are synonymous. Thus a fall of 1 unit vertically in 12 units horizontal distance may be stated as a negative gradient (grade, slope and inclination) of 1 in 12 (or 1:12). This slope may also be expressed as a grade of -8.33º, a fall of 83.3 metres per kilometre or slope angle of 4º46'.

Sealing Aggregate	Crushed rock usually of uniform size bonded by bitumen on the surface of the road to form a wear surface.
Scalping	The removal by screening of fine material from the raw feed prior to presenting it to the crushers. This material is a combination of fine material from the blast and decomposed material.
Screening	A process which separates crushed rock into various sizes - this usually involves a mechanical vibration of the rock over a series of decks fitted with steel mesh, steel plate or polyurethane or rubber mats with fixed sized apertures.
Siltstone	A rock type intermediate in character between shale and sandstone.
Suspended Solids	Analytical term applicable to water samples referring to material recoverable from the sample by filtration.
Temperature Inversion	An increase in air temperature with height in contrast with the usual decrease of temperature with inversion height.
Topsoil	The surface layer of a poorly-developed or well-developed soil profile containing a relatively high percentage of organic material.
Weathered Rock	Rock affected to any degree by the process of chemical or physical decomposition.

Abbreviations

ABN	Australian Business Number
ABS	Australian Bureau of Statistics
ACN	Australian Company Number
AEP	Annual Exceedance Probability
AHD	Australian Height Datum
ARI	Average Recurrence Interval
BAMM	Biodiversity Assessment and Mapping Methodology
BCM	Bank Cubic Metre
DERM	Department of Environment and Resource Management (now EHP)
DPR	Development Proposal Report
EHP	Department of Environment and Heritage Protection (formerly DERM)
EMP	Environmental Management Plan
EPBC	*Environmental Biodiversity and Conservation Act*
EPP	Environmental Protection Policy
EVs	Environmental Values
FSL	Full Supply Level
KRA	Key Resource Area
LGA	Local Government Area
MCU	Material Change of Use
NCA	*Nature Conservation Act 1992*

Abbreviations continued...

NTU	Nelphametric Turbidity Units
PPV	Peak Particle Velocity
QWQG	Queensland Water Quality Guidelines
REDD	Regional Ecosystem Description Database
RP	Registered Plan
SEQ	South East Queensland
SWL	Standing Water Level
TDS	Total Dissolved Solids
VMA	*Vegetation Management Act*
WQO	Water Quality Objectives

Symbols/Measurements

°C	Degree Centigrade
dB(A)	A weighted sound pressure unit – the unit of measurement of sound pressure level heard by the human ear
dB(Linear)	The measurement of sound pressure level in which the amplitudes of the sound signal, through all frequencies of the signal, are treated equally, i.e. not weighted
g/m^2/month	Grams per square metre per month - unit for deposited dust
ha	Hectare (100 m x 100 m)
kg/m^3	Kilograms per cubic metre
km	Kilometre (= 1 000 metres)
km^2	Square kilometres
km/hr	Kilometres per hour
kV	Kilovolt
kVA	Kilovolt amps
l	Litre
l/s	Litres per second
$L_{Amax\ adj,T}$	Obtained by using fast response time weighting and arithmetically averaging the maximum levels of the offending noise during the time interval considered
$L_{Abg,T}$	The A-weighted average minimum sound pressure level measured from a graphical trace
$L_{Amax\ adj,T}$	Obtained by making adjustments for tonality and impulsiveness to $L_{Amax,T}$
$L_{Abg,T}$	Obtained by using fast response time weighting and arithmetically averaging the background noise levels (no levels from offending source) during the time interval considered

Symbols/Measurements continued…

$L_{Aeq,T}$	The "equal energy" average noise levels, and is used in some instances for the assessment of traffic noise effects or the risk of hearing impairment due to noise exposures
$L_{A10,T}$	A-weighted sound pressure level exceeded 10 per cent of the sampling time (T)
$L_{A90,T}$	A-weighted sound pressured level exceeded 90 per cent of the sampling time (T)
m	Metre
m^2	Square metre
mg	Milligram
mg/l	Milligrams per litre (parts per million)
ml	Millilitres
Ml	Megalitre
mm	Millimetre (= 0.001 metres)
mm/day	Millimetres per day
mm/s	Millimetres per second
m/s	Metres per second
Mtpa	Million tonnes per annum
pH	Measurement indicating whether water or soil is acid or alkaline
tpa	Tonnes per annum
tph	Tonnes per hour
mg/m^3	Micrograms per cubic metre
ms/cm	Micro siemens per centimetre also equals dS/m
'000t	multiples of one thousand tonnes

figures

REV	DESCRIPTION	DATE	BY

Data Sources:
Photography: Google Maps. Image date: 2010-04-11
Topography: NSW Dept Lands and Property Information, SIX Viewer. Date accessed: 2012-11-15
Cadastre: NSW Dept Lands and Property Information, SIX Viewer. Date accessed: 2012-09-19
Ecosystem:
Other:

Note:
All power and other services locations are approximate only.

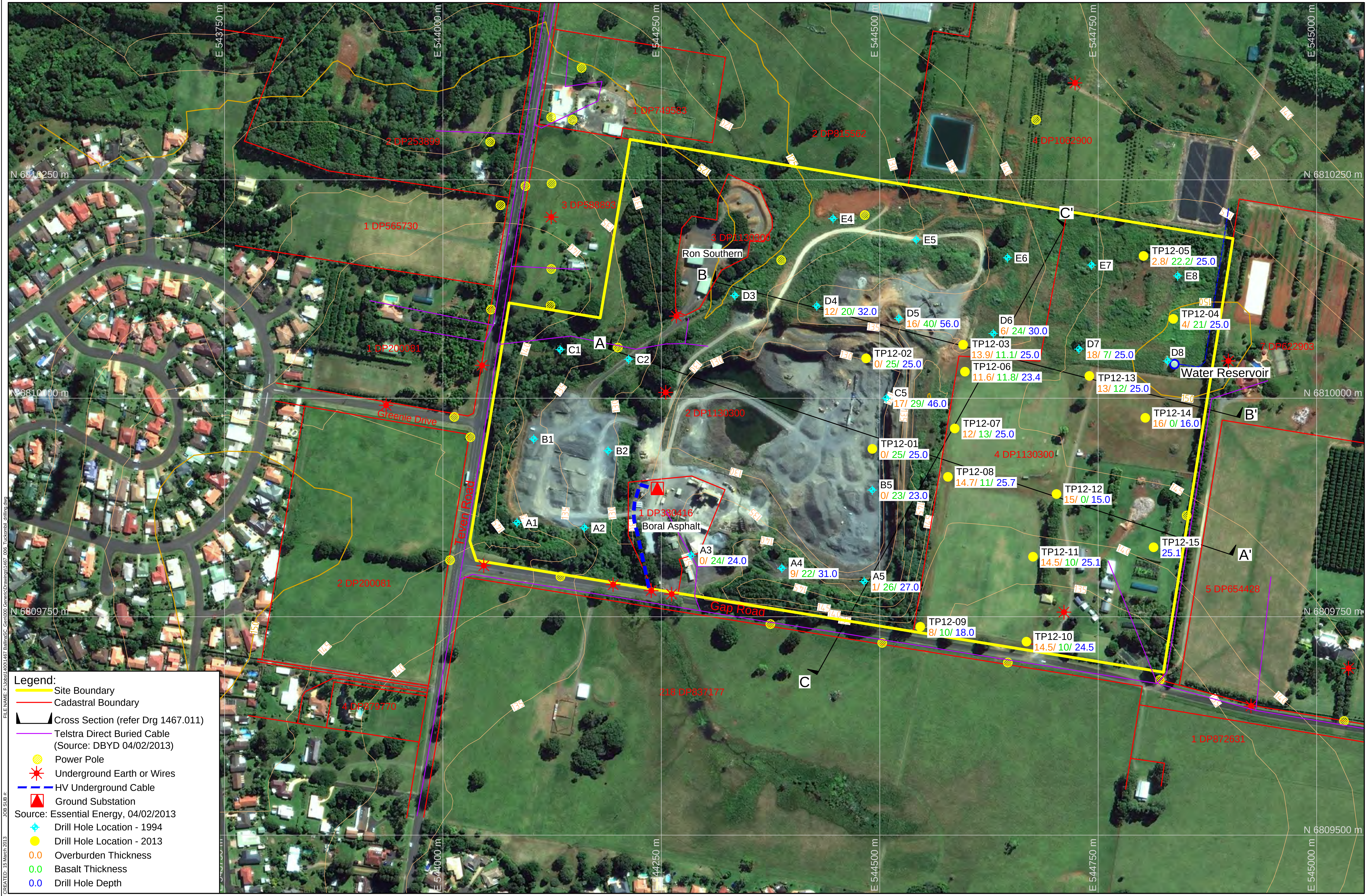
PROJECT: Tuckombil

TITLE: Figure 1 - Stage 3 Tuckombil Quarry Design

CLIENT: Ballina Shire Council

GROUNDWORK plus
PH: +61 7 3871 0411
WWW.GROUNDWORK.COM.AU

SCALE: 1:2,500 When Printed On A3 (0 – 50)
DRAWING NUMBER: 1467.009
REVISION:
DATE: 8 April 2013
DRAWN: LT
PRINTED: 8 April 2013
CHECKED:
DATUM: HORIZONTAL / VERTICAL / ZONE
MGA / AHD / 56



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Topography: NSW Dept Lands and Property Information, SIX Viewer. Date accessed: 2012-11-15
Cadastre: NSW Dept Lands and Property Information, SIX Viewer. Date accessed: 2012-09-19
Ecosystem:
Other:

Note:
All power and other services locations are approximate only.

N

PROJECT: Tuckombil

CLIENT: Ballina Shire Council

TITLE: Figure 2 - Drillhole Location Plan, Overburden Thickness and Interpreted Site Geology

GROUNDWORK plus
PH: +61 7 3871 0411
WWW.GROUNDWORK.COM.AU

SCALE: 1:4,000 When Printed On A3 (0 – 80)		DRAWING NUMBER: 1467.006	REVISION:
DATE: 8 April 2013	DRAWN: LT	DATUM: HORIZONTAL / VERTICAL / ZONE	
PRINTED: 8 April 2013	CHECKED:	MGA / / 56	

CREATED: 19 September 2012 JOB SUB #: FILE NAME: F:\Jobs\1400\1467 BallinaSC_Gen\000 Generic\Drawing\s01467_003 Site Location.dwg

REV	DESCRIPTION	DATE	BY

Data Sources:
Photography: Google Maps. Image date: 2011-09-17
Topography:
Cadastre:
Ecosystem:
Other:

Legend:
Site Boundary

N

PROJECT: Tuckombil Quarry and Stokers Quarry

CLIENT: Ballina Shire Council

TITLE: Figure 3 - Site Location Plan

GROUNDWORK plus
PH: +61 7 3871 0411
WWW.GROUNDWORK.COM.AU

SCALE: 1:50,000 When Printed On A3 — 0 1km
DRAWING NUMBER: 1467.003
REVISION:
DATE: 8 April 2013 DRAWN: LT
PRINTED: 8 April 2013 CHECKED:
DATUM: HORIZONTAL / VERTICAL / ZONE
MGA / / 56

REV	DESCRIPTION	DATE	BY

Data Sources:
Photography: Google Maps. Image date: 2010-04-11
Topography: NSW Dept Lands and Property Information, SIX Viewer. Date accessed: 2012-11-15
Cadastre: NSW Dept Lands and Property Information, SIX Viewer. Date accessed: 2012-09-19
Ecosystem:
Other:

Legend:
Site Boundary
Cadastral Boundary

Note:
Topography is approximate only and based on historical data.

N

PROJECT: Tuckombil

CLIENT: Ballina Shire Council

TITLE: Figure 4 - Aerial Photography, Cadastre and Topography Plan - Tuckombil

GROUNDWORK plus
PH: +61 7 3871 0411
WWW.GROUNDWORK.COM.AU

SCALE: 1:4,000 When Printed On A3 0 80

DRAWING NUMBER: 1467.001

REVISION:

DATE: 8 April 2013 | DRAWN: LT
PRINTED: 8 April 2013 | CHECKED:

DATUM: HORIZONTAL / VERTICAL / ZONE
MGA / AHD / 56

CREATED: 19 September 2012 JOB SUB #:
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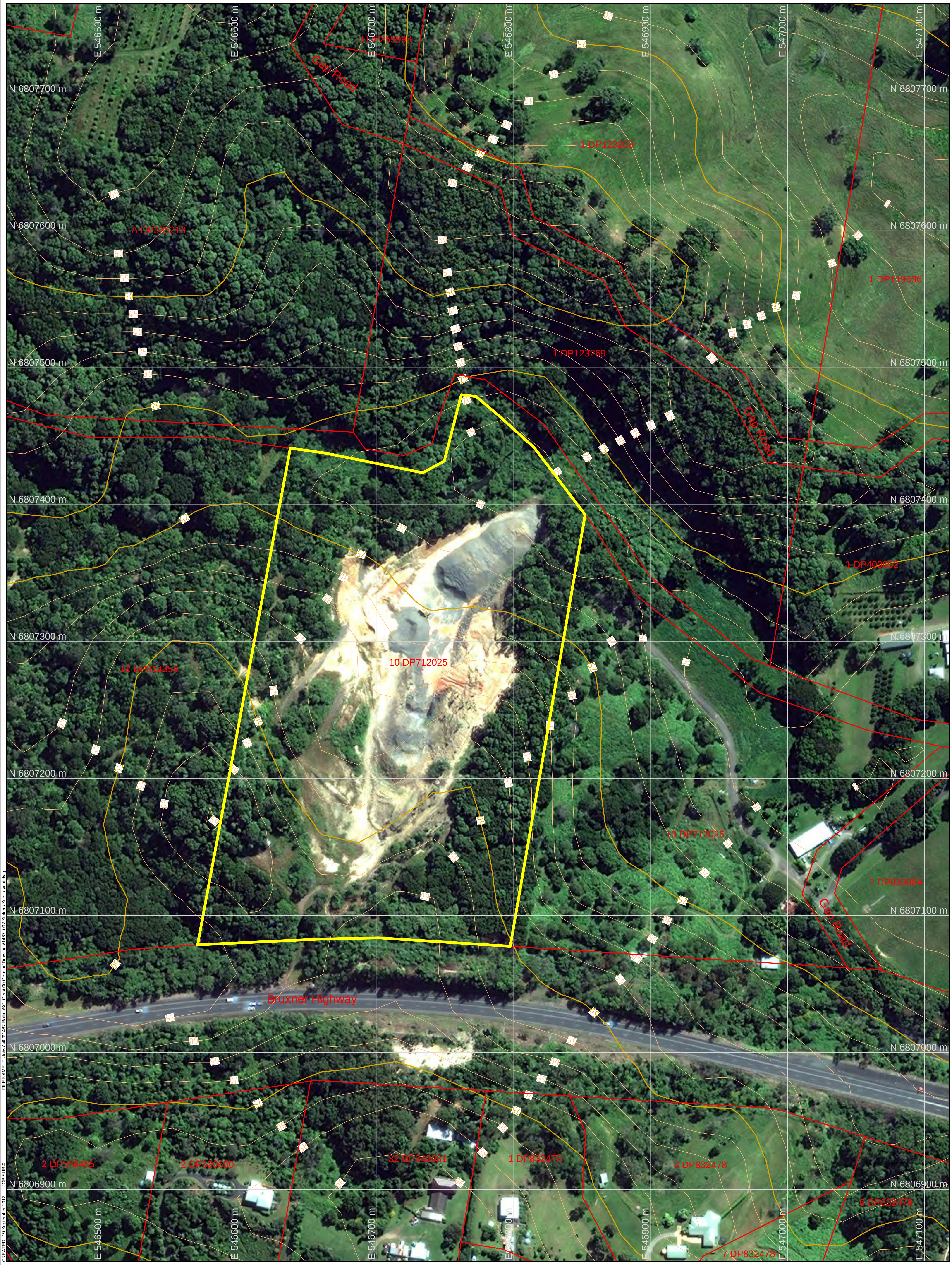


REV	DESCRIPTION	DATE	BY

Data Sources:
Photography: Google Maps. Image date: 2010-04-11
Topography:
Cadastre: NSW Dept Lands and Property Information, SIX Viewer. Date accessed: 2012-09-19
Ecosystem:
Other:

Legend:
Site Boundary
Cadastral Boundary

PROJECT: Stokers Quarry

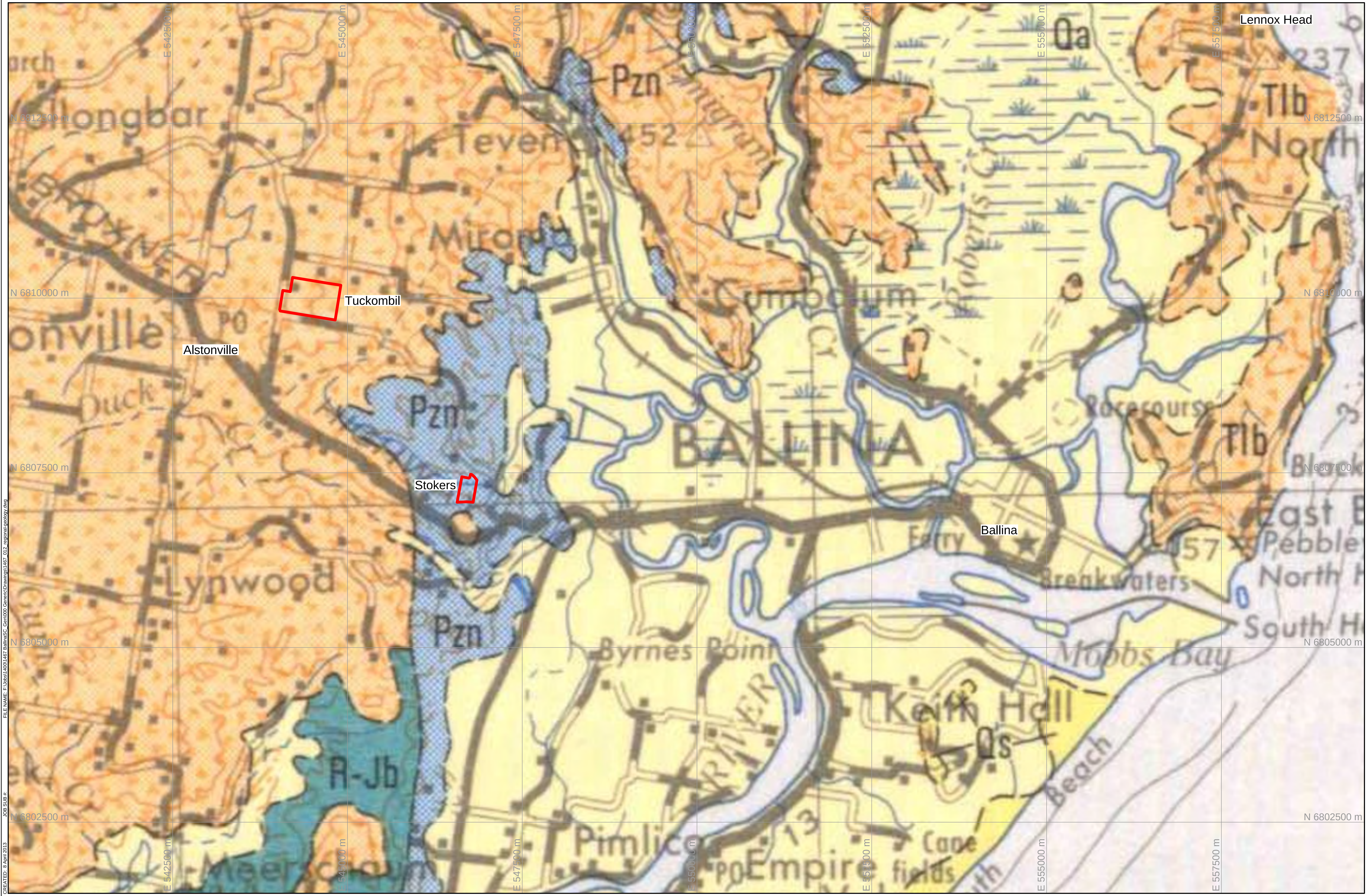
CLIENT: Ballina Shire Council

TITLE: Figure 5 - Aerial Photography, Cadastre and Topography Plan - Stokers Quarry

GROUNDWORK plus
PH: +61 7 3871 0411
WWW.GROUNDWORK.COM.AU

SCALE: 1:2,500 When Printed On A3 | 0 50
DRAWING NUMBER: 1467.002 | REVISION:
DATE: 8 April 2013 | DRAWN: LT
PRINTED: 8 April 2013 | CHECKED:
DATUM: HORIZONTAL / VERTICAL / ZONE MGA / AHD / 56

CREATED: 19 September 2012



Legend:
Site Boundary

Qa	River gravels, alluvium, sand, clay
Qs	Beach and dune sand
Tlb	Basalt, (agglomerate, bole)
R-Jb	Sandstone, siltstone, claystone, conglomerate
Pzn	Greywacke, slate phyllite quartzite

N

REV	DESCRIPTION	DATE	BY

Data Sources:
Photography:
Topography:
Cadastre:
Ecosystem:
Other: 1:250,000 Australian Geological Series, SH56-03, Tweed Heads, 1972

PROJECT: Tuckombil Quarry and Stokers Quarry

CLIENT: Ballina Shire Council

TITLE: Figure 6 - Regional Geology

GROUNDWORK plus
PH: +61 7 3871 0411
WWW.GROUNDWORK.COM.AU

SCALE: 1:50,000 When Printed On A3 — 0 — 1km

DRAWING NUMBER: 1467.012
REVISION:
DATE: 8 April 2013
PRINTED: 8 April 2013
DRAWN: LT
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DATUM: HORIZONTAL / VERTICAL / ZONE
MGA / / 56

CREATED: 8 April 2013
JOB SUB #:
FILE NAME: F:\Jobs\1400\1467 BallinaSC_Gen\000 Generic\Drawing\1467_012_regional-geology.dwg

CREATED: 2 April 2013

REV	DESCRIPTION	DATE	BY

Data Sources:
Photography: Google Maps. Image date: 2010-04-11
Topography: NSW Dept Lands and Property Information, SIX Viewer. Date accessed: 2012-11-15
Cadastre: NSW Dept Lands and Property Information, SIX Viewer. Date accessed: 2012-09-19
Ecosystem:
Other:

Note:
All power and other services locations are approximate only.

PROJECT: Tuckombil

CLIENT: Ballina Shire Council

TITLE: Figure 7 - Stage 1 Tuckombil Proposed Quarry Design

GROUNDWORK plus
PH: +61 7 3871 0411
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SCALE: 1:2,500 When Printed On A3 (0 – 50)
DATE: 8 April 2013
PRINTED: 8 April 2013
DRAWN: LT
CHECKED:
DRAWING NUMBER: 1467.007
REVISION:
DATUM: HORIZONTAL / VERTICAL / ZONE MGA / / 56

REV	DESCRIPTION	DATE	BY

Data Sources:
Photography: Google Maps. Image date: 2010-04-11
Topography: NSW Dept Lands and Property Information, SIX Viewer. Date accessed: 2012-11-15
Cadastre: NSW Dept Lands and Property Information, SIX Viewer. Date accessed: 2012-09-19
Ecosystem:
Other:

Note:
All power and other services locations are approximate only.

PROJECT: Tuckombil

CLIENT: Ballina Shire Council

TITLE: Figure 8 - Stage 2 Tuckombil Proposed Quarry Design

GROUNDWORK plus
PH: +61 7 3871 0411
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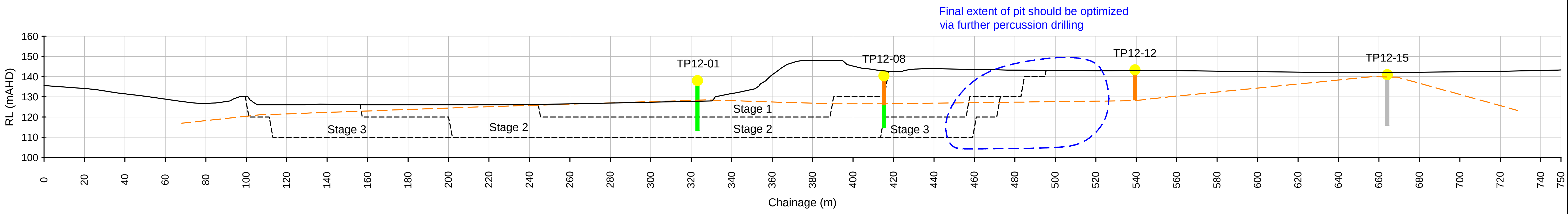
SCALE: 1:2,500 When Printed On A3 (0 – 50)

DATE: 8 April 2013 | DRAWN: LT
PRINTED: 8 April 2013 | CHECKED:

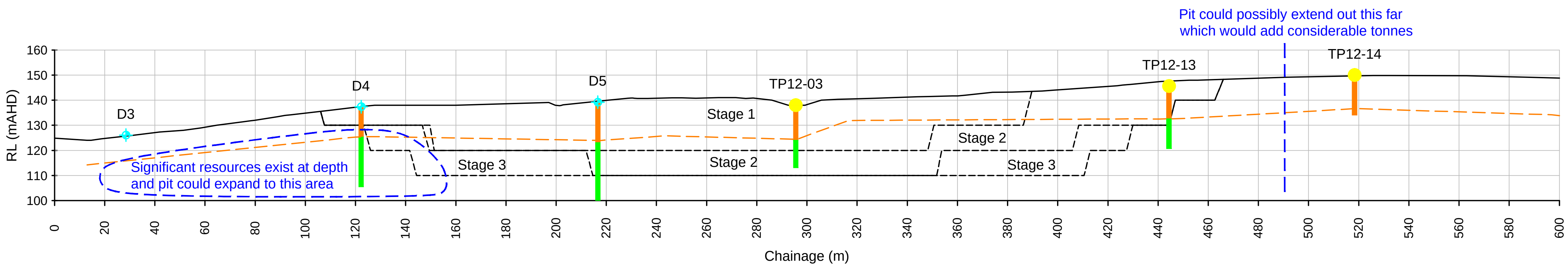
DRAWING NUMBER: 1467.008 | REVISION:

DATUM: HORIZONTAL / VERTICAL / ZONE
MGA / / 56

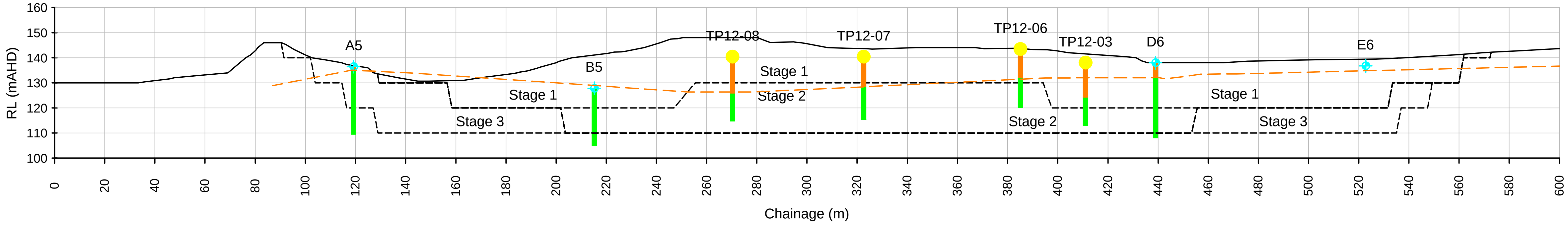
Section A-A'



Section B-B'



Section C-C'



FILE NAME: F:\Jobs\1400\1467 BallinaSC_Gen\000 Generic\Drawings\1467_011_Tuckombil_X-sect.dwg

JOB SUB #:

CREATED: 8 April 2013

REV	DESCRIPTION	DATE	BY

Data Sources:
Photography:
Topography: NSW Dept Lands and Property Information, SIX Viewer. Date accessed: 2012-11-15
Cadastre:
Ecosystem:
Other:

Legend:
- Existing Ground Surface
- Quarry Stage Extent
- Overburden Surface
- Drill Hole Location - 1994
- Drill Hole Location - 2013
- Overburden
- Basalt

PROJECT: Tuckombil

CLIENT: Ballina Shire Council

TITLE: Figure 9 - Cross Sections A-A' to C-C'

GROUNDWORK plus
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SCALE: 1:2,000 When Printed On A3 — 0 — 40

DRAWING NUMBER: 1467.011

REVISION:

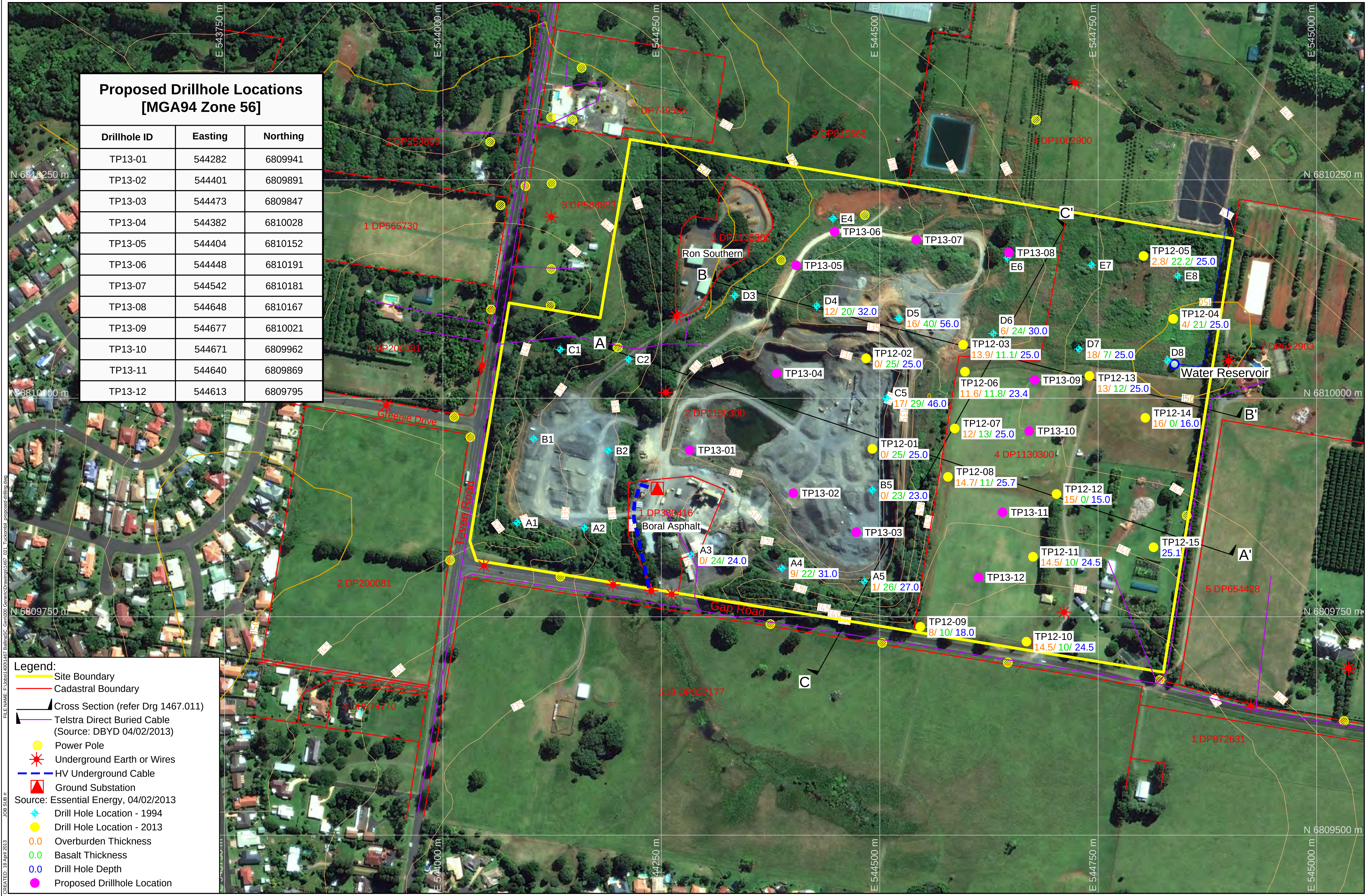
DATE: 17 April 2013 | DRAWN: LT

PRINTED: 17 April 2013 | CHECKED:

DATUM: HORIZONTAL / VERTICAL / ZONE
/ AHD /

Proposed Drillhole Locations [MGA94 Zone 56]

Drillhole ID	Easting	Northing
TP13-01	544282	6809941
TP13-02	544401	6809891
TP13-03	544473	6809847
TP13-04	544382	6810028
TP13-05	544404	6810152
TP13-06	544448	6810191
TP13-07	544542	6810181
TP13-08	544648	6810167
TP13-09	544677	6810021
TP13-10	544671	6809962
TP13-11	544640	6809869
TP13-12	544613	6809795



Legend:

- Site Boundary
- Cadastral Boundary
- Cross Section (refer Drg 1467.011)
- Telstra Direct Buried Cable (Source: DBYD 04/02/2013)
- Power Pole
- Underground Earth or Wires
- HV Underground Cable
- Ground Substation

Source: Essential Energy, 04/02/2013

- Drill Hole Location - 1994
- Drill Hole Location - 2013
- 0.0 Overburden Thickness
- 0.0 Basalt Thickness
- 0.0 Drill Hole Depth
- Proposed Drillhole Location

REV	DESCRIPTION	DATE	BY

Data Sources:
Photography: Google Maps. Image date: 2010-04-11
Topography: NSW Dept Lands and Property Information, SIX Viewer. Date accessed: 2012-11-15
Cadastre: NSW Dept Lands and Property Information, SIX Viewer. Date accessed: 2012-09-19
Ecosystem:
Other:

Note:
All power and other services locations are approximate only.

N

PROJECT: Tuckombil

CLIENT: Ballina Shire Council

TITLE: Figure 10 - Proposed Drillhole Location Plan

GROUNDWORK plus
PH: +61 7 3871 0411
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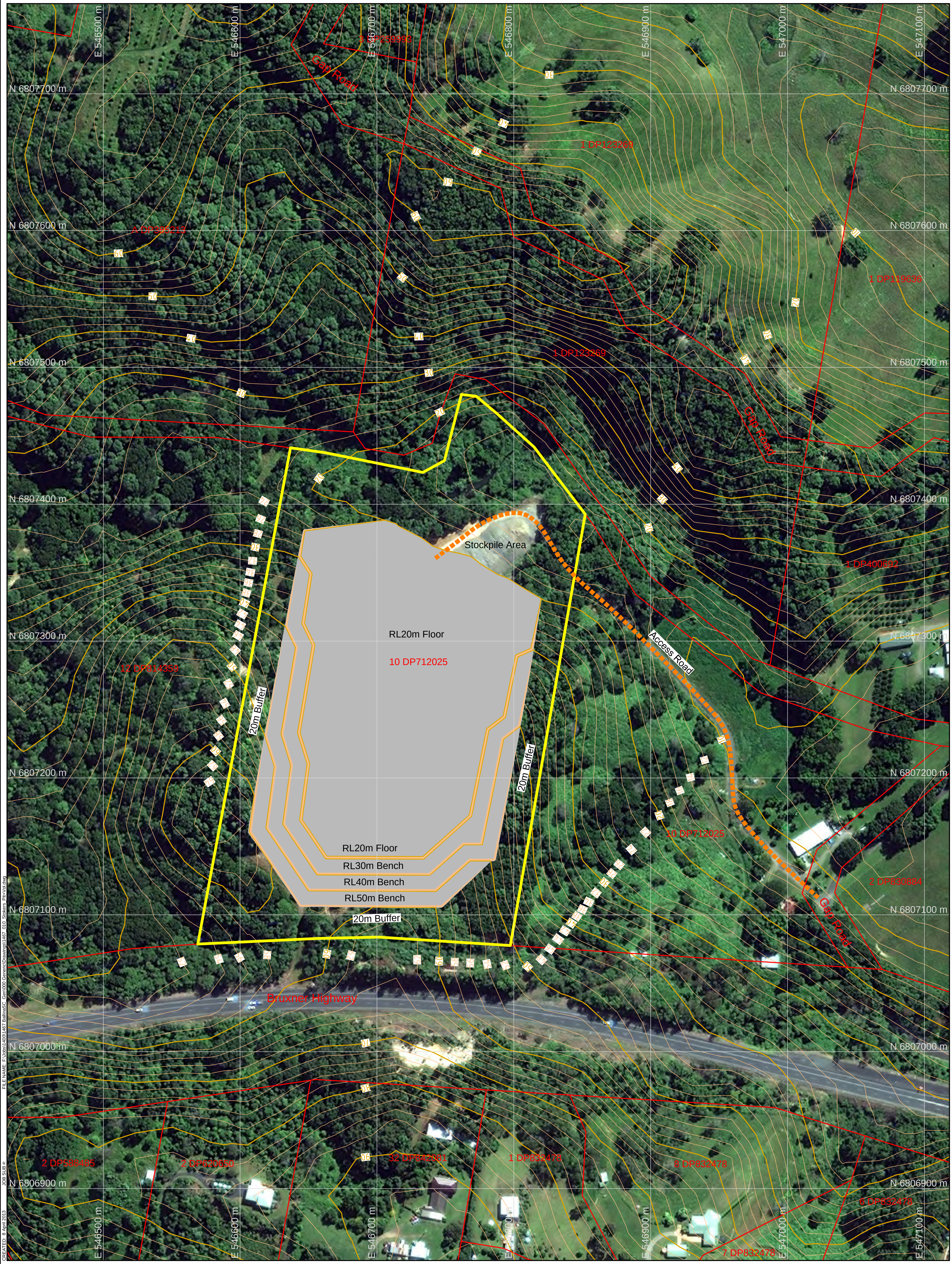
SCALE: 1:4,000 When Printed On A3 — 0 80

DRAWING NUMBER: 1467.021
REVISION:

DATE: 18 April 2013 DRAWN: LT
PRINTED: 18 April 2013 CHECKED:

DATUM: HORIZONTAL / VERTICAL / ZONE
MGA / / 56

FILE NAME: F:\Jobs\1400\1467 BallinaSC_Gen\000 General\Drawings\1467_021_Tuckombil_proposed-drilling.dwg
JOB SUB #:
CREATED: 18 April 2013



REV	DESCRIPTION	DATE	BY

Data Sources:
Photography: Google Maps. Image date: 2010-04-11
Topography:
Cadastre: NSW Dept Lands and Property Information, SIX Viewer. Date accessed: 2012-09-19
Ecosystem:
Other:

Legend:
Site Boundary
Cadastral Boundary

N

PROJECT:

CLIENT: Ballina Shire Council

TITLE:
Figure 11 - Stokers Proposed Quarry Design

GROUNDWORK plus
PH: +61 7 3871 0411
WWW.GROUNDWORK.COM.AU

SCALE: 1:2,500 When Printed On A3 | 0 50

DRAWING NUMBER: 1467.010
REVISION:

DATE: 8 April 2013 | DRAWN: LT
PRINTED: 8 April 2013 | CHECKED:

DATUM: HORIZONTAL / VERTICAL / ZONE
MGA / / 56

CREATED: 8 April 2013

REV	DESCRIPTION	DATE	BY

Data Sources:
Photography: Google Maps. Image date: 2010-04-11
Topography:
Cadastre: NSW Dept Lands and Property Information, SIX Viewer. Date accessed: 2012-09-19
Ecosystem:
Other:

Legend:
- Site Boundary
- Cadastral Boundary

N

PROJECT: Stokers Quarry

CLIENT: Ballina Shire Council

TITLE: Figure 11A - Stokers Conceptual Rehabilitation Plan

GROUNDWORK plus
PH: +61 7 3871 0411
WWW.GROUNDWORK.COM.AU

SCALE: 1:2,500 When Printed On A3 (0 – 50)		DRAWING NUMBER: 1467.022	REVISION:
DATE: 18 April 2013	DRAWN: LT	DATUM: HORIZONTAL / VERTICAL / ZONE	
PRINTED: 18 April 2013	CHECKED:	MGA / AHD / 56	

CREATED: 18 April 2013

REV	DESCRIPTION	DATE	BY

Data Sources:
Photography: Nearmap 2012. Image date: 2012-09-02
Topography:
Cadastre:
Ecosystem:
Other:

Legend:
- Site Boundary
- Cadastral Boundary
- Easement Boundary

N

PROJECT: Tuckombil Quarry and Stokers Quarry

CLIENT: Ballina Shire Council

TITLE: Figure 11B - Ferny Grove Quarry Proximity to Residential Development

GROUNDWORK plus
PH: +61 7 3871 0411
WWW.GROUNDWORK.COM.AU

SCALE: 1:7,500 When Printed On A3 — 0 — 150

DRAWING NUMBER: 1467.023

REVISION:

DATE: 18 April 2013 | DRAWN: LT

PRINTED: 18 April 2013 | CHECKED:

DATUM: HORIZONTAL / VERTICAL / ZONE MGA / / 56

REV	DESCRIPTION	DATE	BY

Data Sources:
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Topography:
Cadastre: NSW Dept Lands and Property Information, SIX Viewer. Date accessed: 2012-09-19
Ecosystem:
Other:

Legend:
Site Boundary
Cadastral Boundary
Nearby Residence
Distance from Site

PROJECT: Tuckombil

CLIENT: Ballina Shire Council

TITLE: Figure 12 - Nearby Sensitive Receivers

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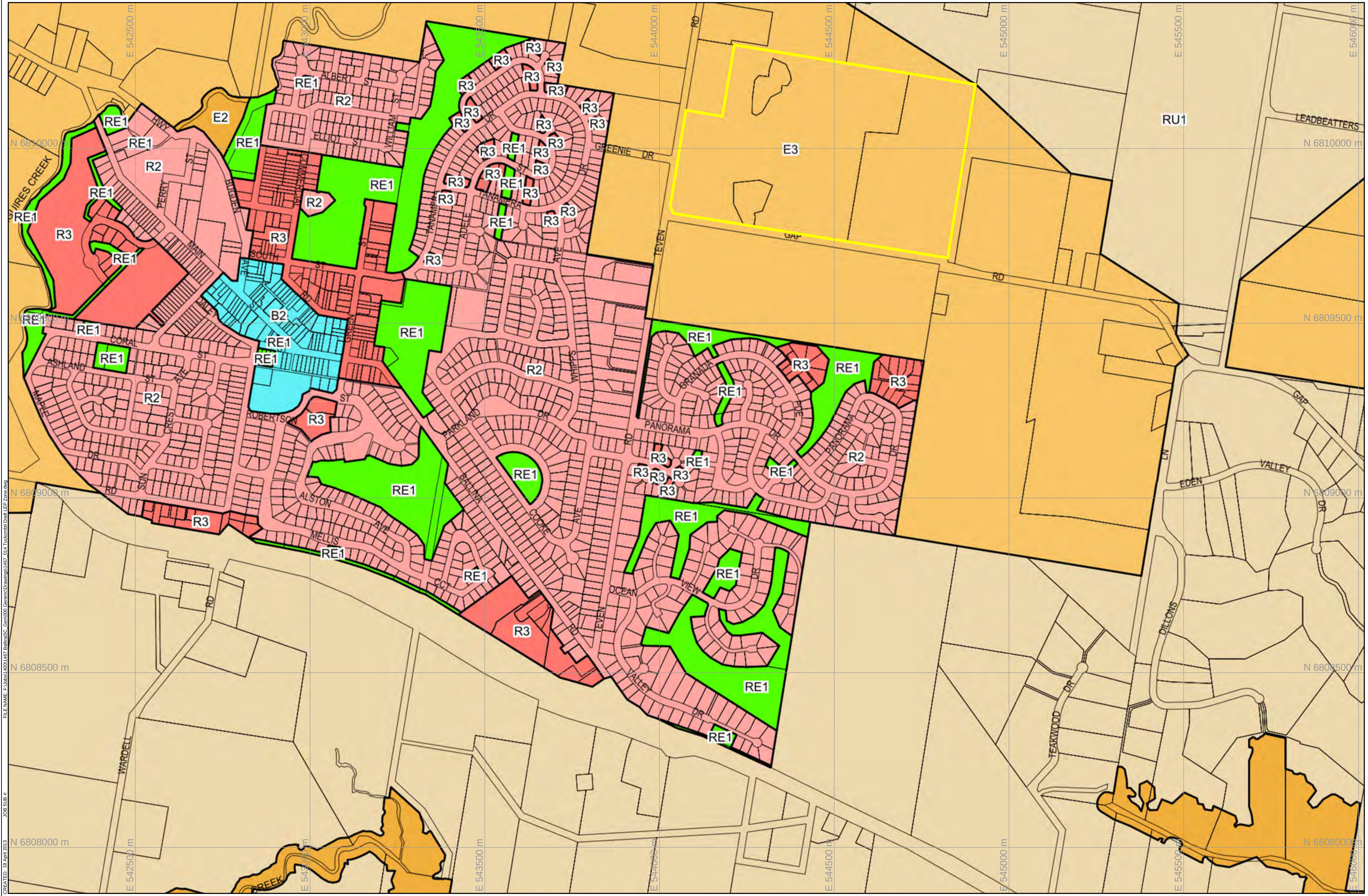
SCALE: 1:5,000 When Printed On A3 (0 – 100)

DRAWING NUMBER: 1467.013
REVISION:

DATE: 18 April 2013
DRAWN: LT
PRINTED: 18 April 2013
CHECKED:
DATUM: HORIZONTAL / VERTICAL / ZONE
MGA / / 56



CREATED: 18 April 2013

REV	DESCRIPTION	DATE	BY

Data Sources:
Photography:
Topography:
Cadastre:
Ecosystem:
Other: Ballina Local Environmental Plan 2011, Land Zoning Map - sheet LZN-005

Legend:
Site Boundary

Zones:
- R2 Low Density Residential
- R3 Medium Density Residential
- RE1 Public Recreation
- B2 Local Centre
- E2 Environmental Conservation
- E3 Environmental Management
- RU1 Primary Production

PROJECT: Tuckombil

TITLE: Figure 13 - Draft LEP Zone

CLIENT: Ballina Shire Council

GROUNDWORK plus
PH: +61 7 3871 0411
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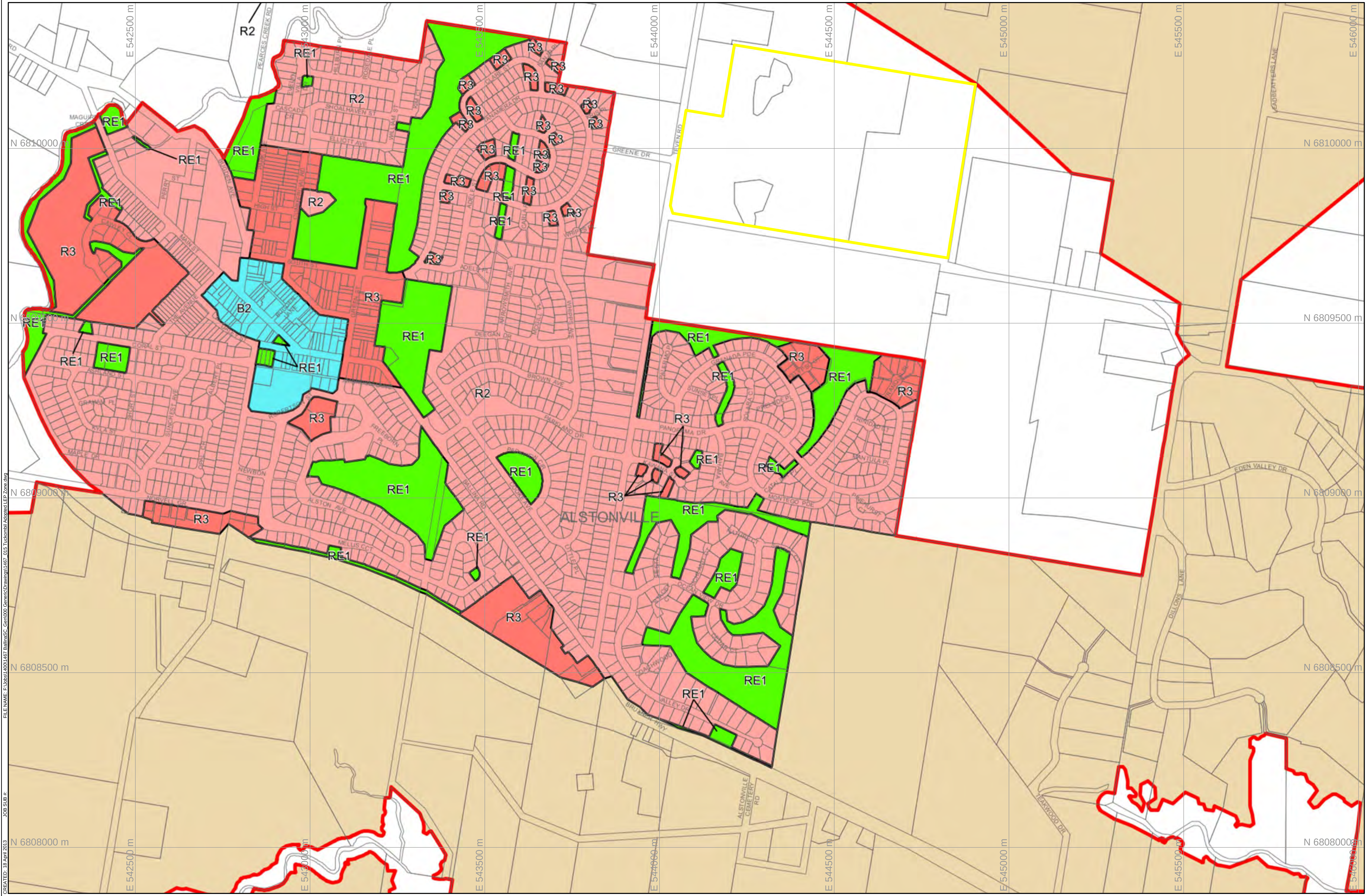
SCALE: 1:10,000 When Printed On A3 (0 – 200)

DRAWING NUMBER: 1467.014

REVISION:

DATE: 18 April 2013 | DRAWN: LT
PRINTED: 18 April 2013 | CHECKED:

DATUM: HORIZONTAL / VERTICAL / ZONE
MGA / / 56



Legend:

Site Boundary

Deferred Matter

Zones:

R2	Low Density Residential
R3	Medium Density Residential
RE1	Public Recreation
B2	Local Centre
RU1	Primary Production

CREATED: 18 April 2013

REV	DESCRIPTION	DATE	BY

Data Sources:
Photography:
Topography:
Cadastre:
Ecosystem:
Other: Ballina Local Environmental Plan 2011, Land Zoning Map - sheet LZN-002A

PROJECT: Tuckombil

CLIENT: Ballina Shire Council

TITLE: Figure 14 - Adopted LEP Zone

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PH: +61 7 3871 0411
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SCALE: 1:10,000 When Printed On A3 — 0 200

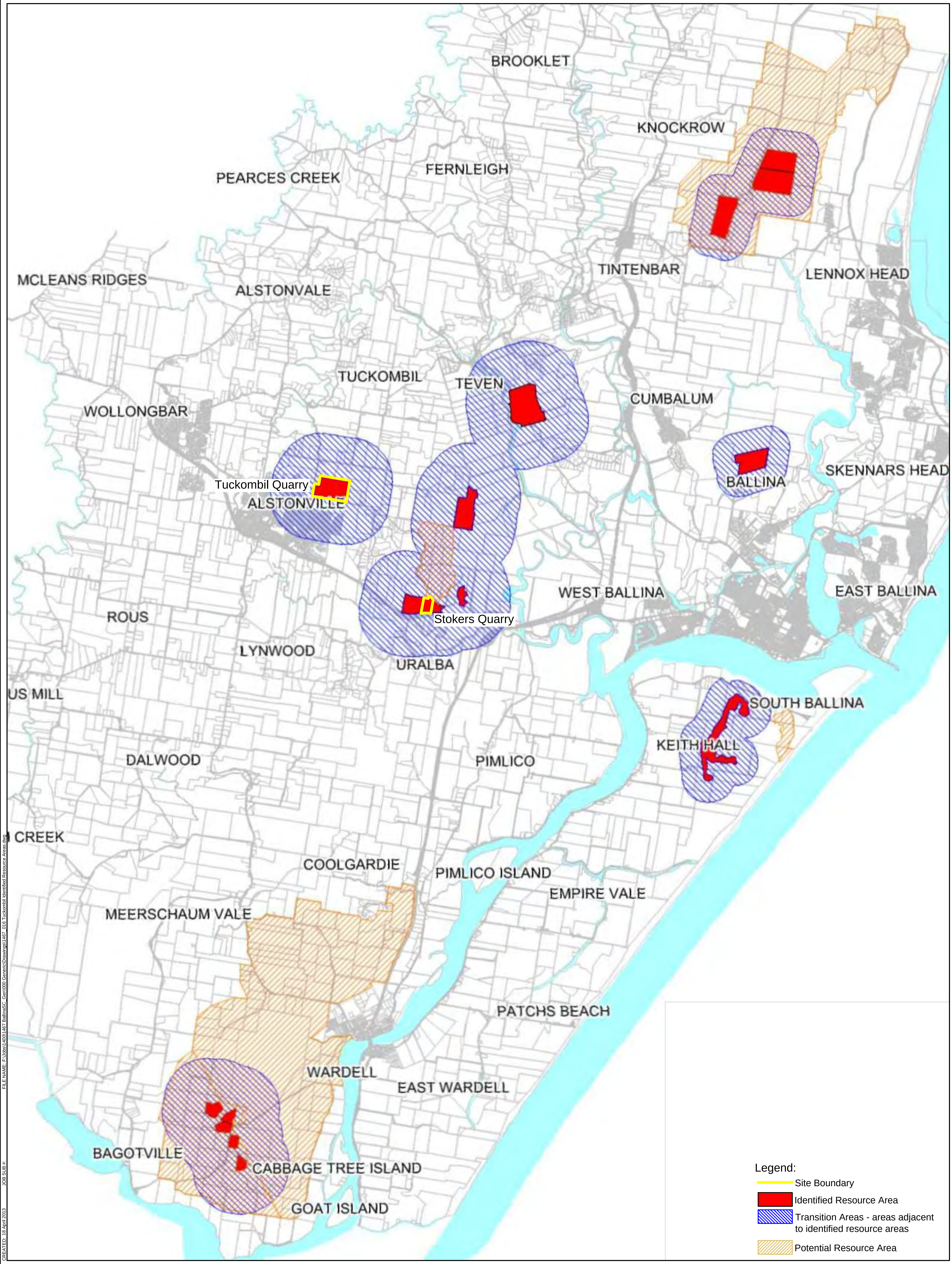
DRAWING NUMBER: 1467.015

REVISION:

DATE: 18 April 2013 | DRAWN: LT

PRINTED: 18 April 2013 | CHECKED:

DATUM: HORIZONTAL / VERTICAL / ZONE
MGA / / 56



FILE NAME: F:\Jobs\1400\1467 BallinaSC_Gen\000 Generic\Drawings\1467_016 Tuckombil Identified Resource Areas.dwg

JOB SUB #:

CREATED: 18 April 2013

REV	DESCRIPTION	DATE	BY

Data Sources:
Photography:
Topography:
Cadastre:
Ecosystem:
Other: Ballina Shire, Mineral Resources, 14/03/2012

PROJECT: Tuckombil

CLIENT: Ballina Shire Council

TITLE: Figure 15 - Identified Resource Areas

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SCALE: 1:80,000 When Printed On A3 — 0 — 1.6km

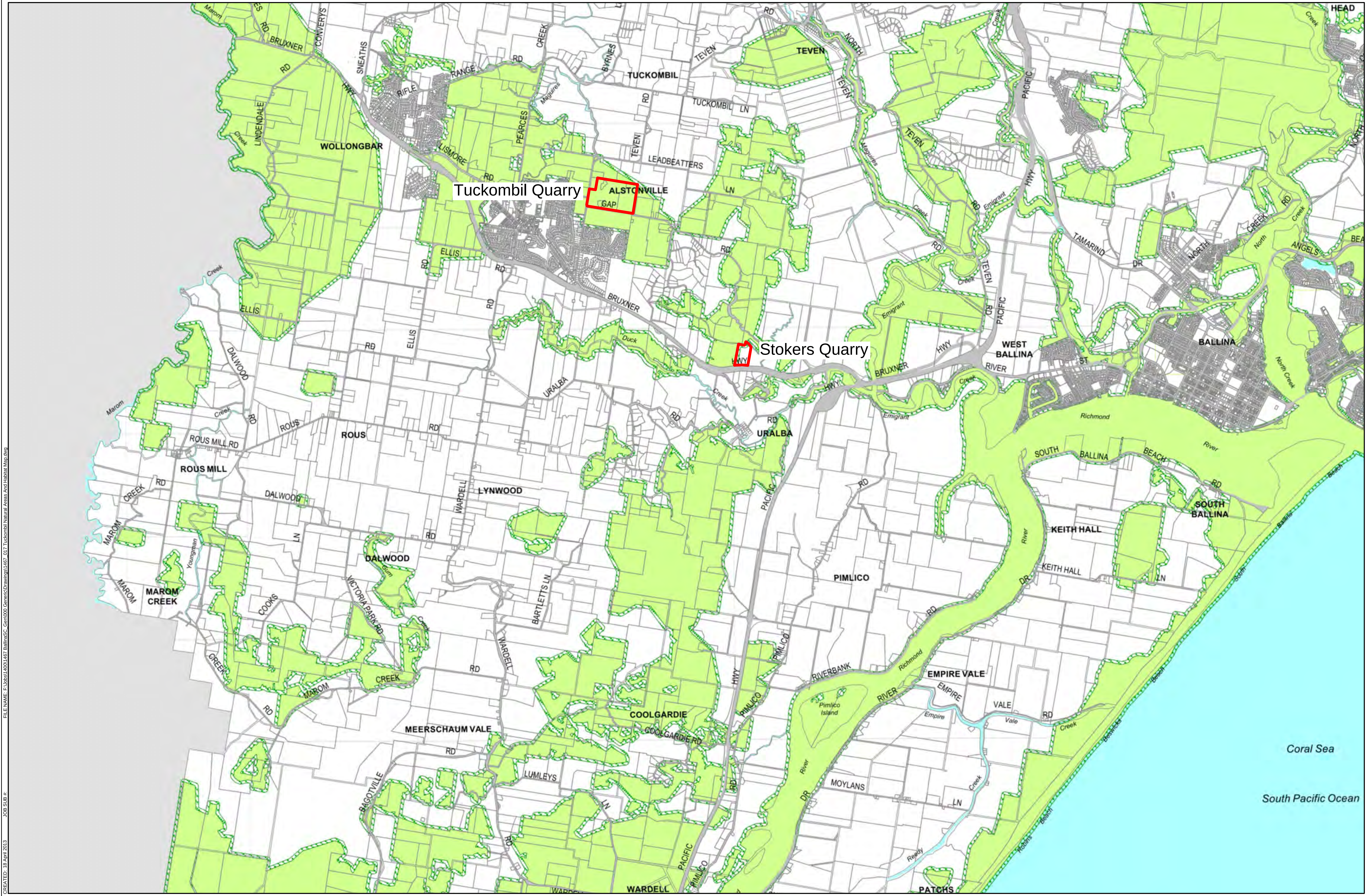
DRAWING NUMBER: 1467.016

REVISION:

DATE: 18 April 2013 | DRAWN: LT

PRINTED: 18 April 2013 | CHECKED:

DATUM: HORIZONTAL / VERTICAL / ZONE
MGA / / 56



FILE NAME: F:\Jobs\1400\1467 BallinaSC_Gen\000 Generic\Drawings\1467_017 Tuckombil Natural Areas And Habitat Map.dwg

JOB SUB #:

CREATED: 18 April 2013

REV	DESCRIPTION	DATE	BY

Data Sources:
Photography:
Topography:
Cadastre:
Ecosystem:
Other: Ballina Shire Development Control Plan 2012, Natural Areas & Habitat map, Sheet NH_002_080

Legend:
- Site Boundary
- Natural Areas & Habitat
- 50m Buffer - Natural Areas & Habitat

PROJECT: Tuckombil

CLIENT: Ballina Shire Council

TITLE: Figure 16 - Natural Areas and Habitat Map

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PH: +61 7 3871 0411
WWW.GROUNDWORK.COM.AU

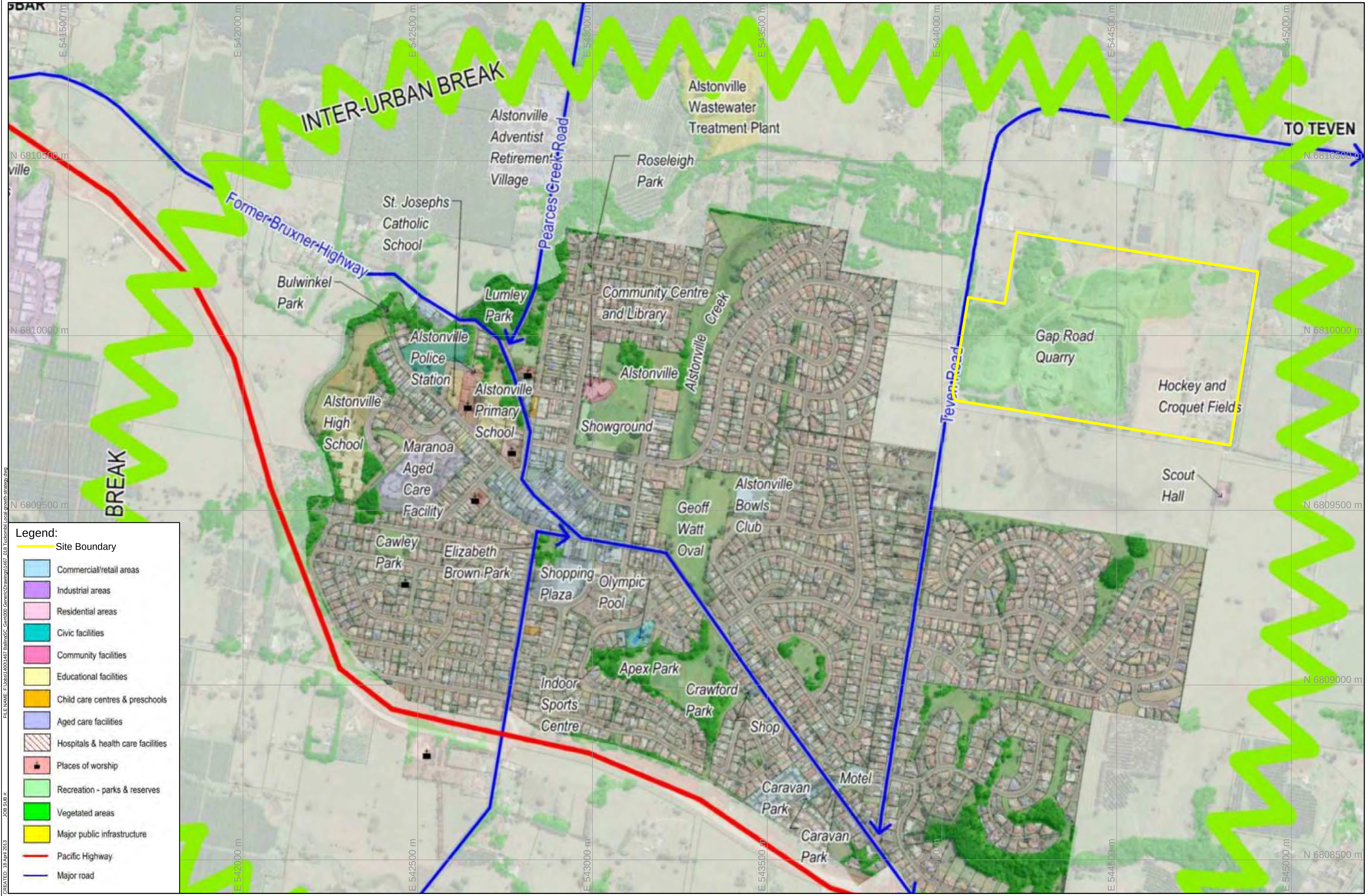
SCALE: 1:60,000 When Printed On A3 — 0 1.2km

DRAWING NUMBER: 1467.017

REVISION:

DATE: 18 April 2013 | DRAWN: LT
PRINTED: 18 April 2013 | CHECKED:

DATUM: HORIZONTAL / VERTICAL / ZONE
MGA / / 56



FILE NAME: E:\Jobs\1400\1467 BallinaSC_Gen\000 Generic\Drawings\1467_018 Tuckombil Local growth strategy.dwg

JOB SUB #:

CREATED: 18 April 2013

REV	DESCRIPTION	DATE	BY

Data Sources:
Photography:
Topography:
Cadastre:
Ecosystem:
Other:

N

PROJECT: Tuckombil

CLIENT: Ballina Shire Council

TITLE: Figure 17 - Alstonville Local Growth Management Strategy

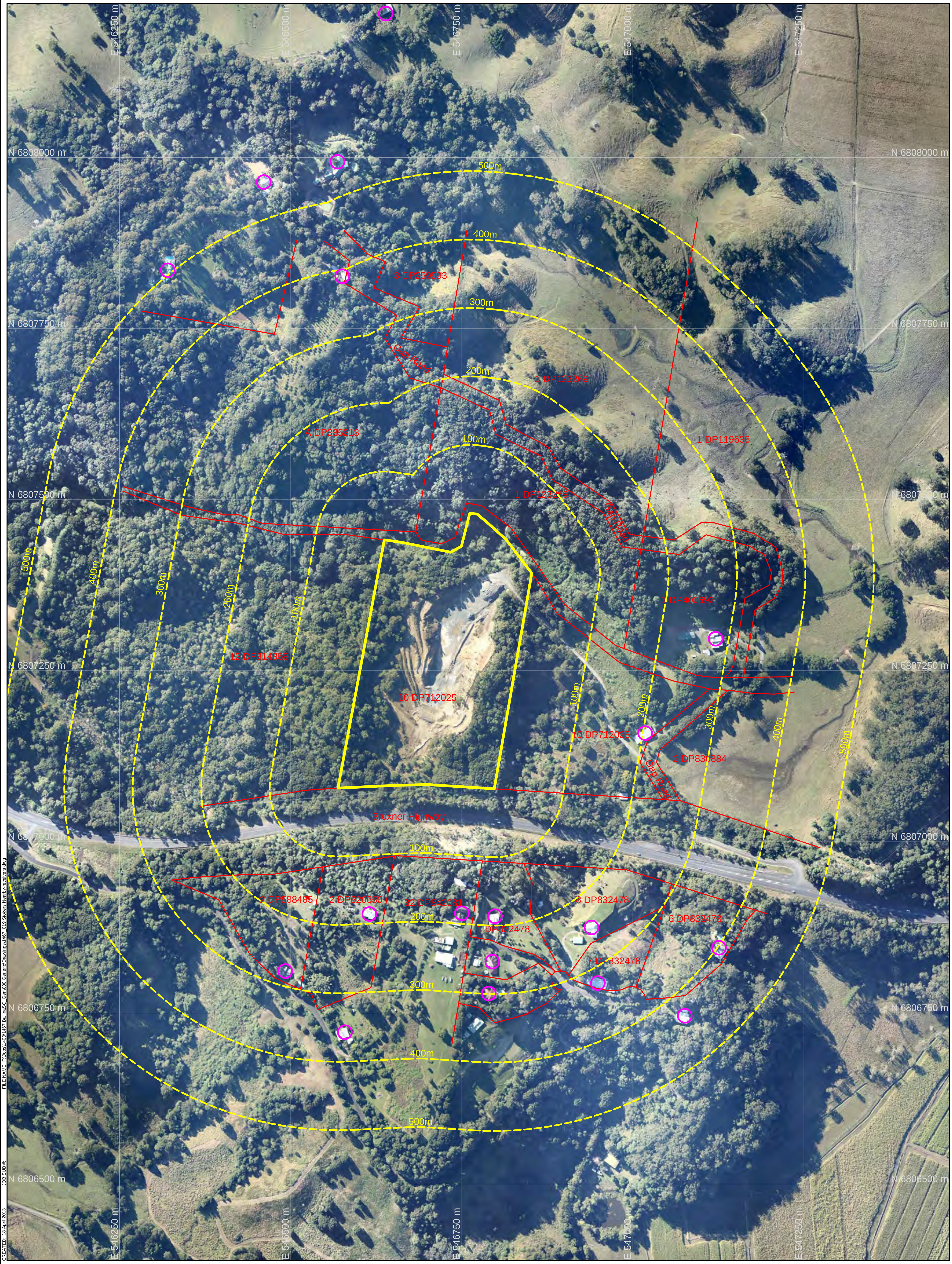
GROUNDWORK plus
PH: +61 7 3871 0411
WWW.GROUNDWORK.COM.AU

SCALE: 1:10,000 When Printed On A3 — 0 200

DATE: 18 April 2013 | DRAWN: LT
PRINTED: 18 April 2013 | CHECKED:

DRAWING NUMBER: 1467.018 | REVISION:

DATUM: HORIZONTAL / VERTICAL / ZONE
MGA / / 56



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Data Sources:
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Topography:
Cadastre:
Ecosystem:
Other:

Legend:
- Site Boundary
- Cadastral Boundary
- Nearby Residence
- Distance from Site

PROJECT: Stokers Quarry

CLIENT: Ballina Shire Council

TITLE: Figure 18 - Stokers Nearby Sensitive Receivers

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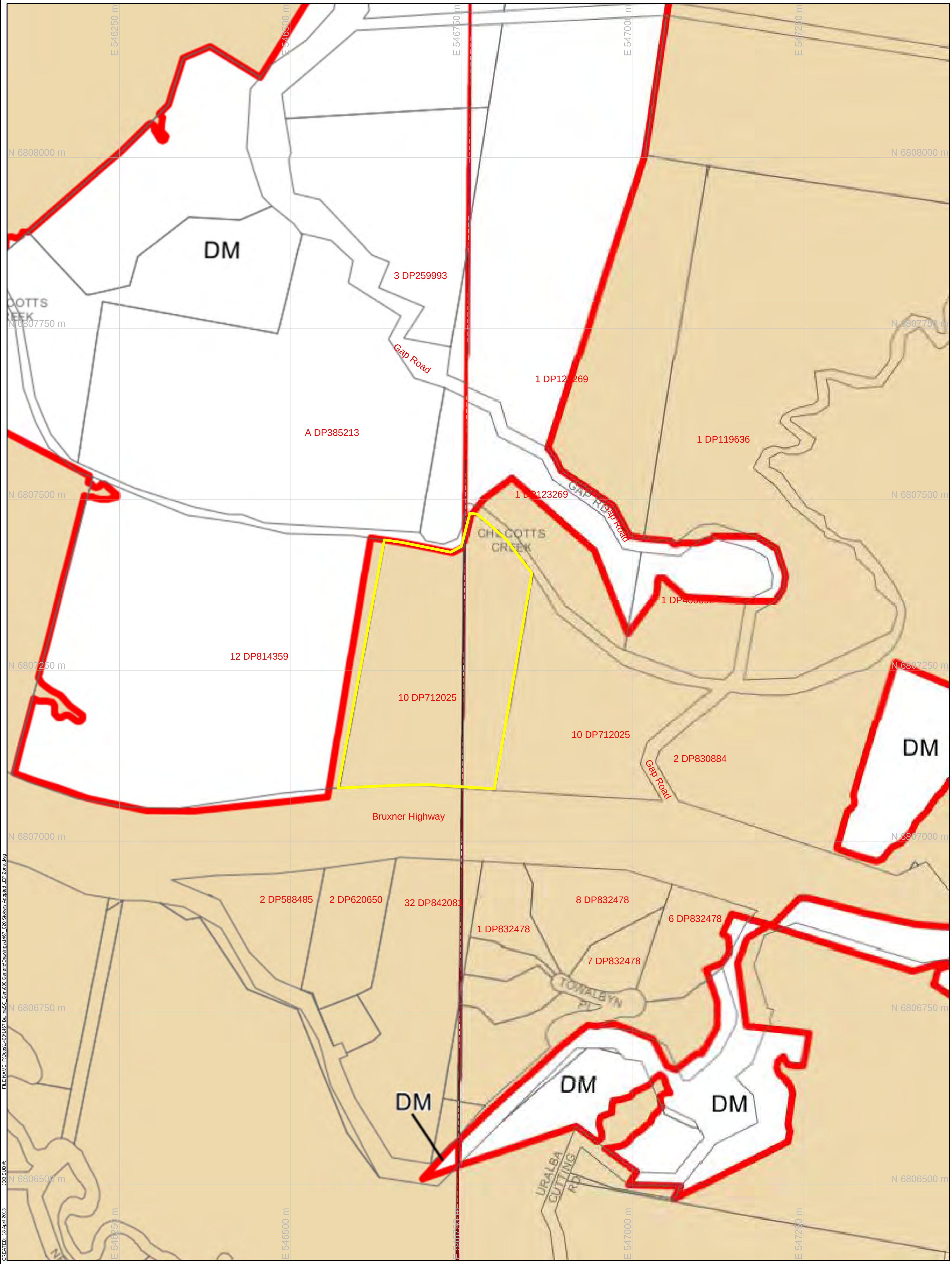
SCALE: 1:5,000 When Printed On A3 (0 – 100)	DRAWING NUMBER: 1467.019	REVISION:
DATE: 18 April 2013	DRAWN: LT	DATUM: HORIZONTAL / VERTICAL / ZONE
PRINTED: 18 April 2013	CHECKED:	MGA / / 56

CREATED: 18 April 2013



REV	DESCRIPTION	DATE	BY

Data Sources:
Photography:
Topography:
Cadastre:
Ecosystem:
Other: Ballina Local Environmental Plan 2011, Land Zoning Map - sheet LZN-002A / 006A

Legend:
Site Boundary
Zones:
Deferred Matter
RU1 Primary Production

PROJECT: Stokers Quarry

CLIENT: Ballina Shire Council

TITLE: Figure 19 - Stokers Adopted LEP Zone Plan

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SCALE: 1:5,000 When Printed On A3 (0 – 100)
DATE: 18 April 2013
PRINTED: 18 April 2013
DRAWN: LT
CHECKED:
DRAWING NUMBER: 1467.020
REVISION:
DATUM: HORIZONTAL / VERTICAL / ZONE MGA / / 56

CREATED: 18 April 2013
JOB SUB #:
FILE NAME: F:\Jobs\1400\1467 BallinaSC_Gen\000 Generic\Drawings\1467_020 Stokers Adopted LEP Zone.dwg

appendices

Appendix 1

PERCUSSION DRILLHOLE LOGS

TO

BE

FINALISED

PERCUSSION DRILL HOLE LOGS

Client: BALLINA SHIRE COUNCIL
Project: TUCKOMBIL QUARRY
Job: 1467

Drill Type: PERCUSSION
Date: FEBRUARY 2013
Logged by: RH

ballina shire council

GROUNDWORK plus
ABN 80 829 145 906 Level 2, 15 Lang Parade, Milton, Qld 4064 Ph: 07 3871 0411 Fax: 07 3871 0021

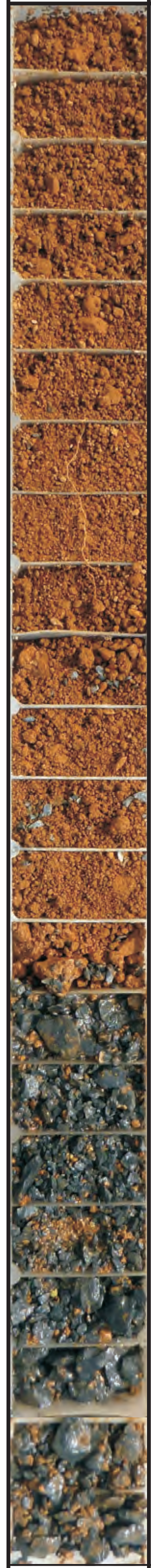
HOLE NO. **TP12-01**
Easting:
Northing:

EOH **10.00m**

HOLE NO. **TP12-02**
Easting:
Northing:

EOH **10.00m**

HOLE NO. **TP12-03**
Easting:
Northing:



EOH **22.00m**

HOLE NO. **TP12-04**
Easting:
Northing:

EOH **25.00m**

PERCUSSION DRILL HOLE LOGS

Client: BALLINA SHIRE COUNCIL
Project: TUCKOMBIL QUARRY
Job: 1467

Drill Type: PERCUSSION
Date: FEBRUARY 2013
Logged by: RH

ballina shire council

GROUNDWORK plus
ABN 80 829 145 906 Level 2, 15 Lang Parade, Milton, Qld 4064 Ph: 07 3871 0411 Fax: 07 3871 0021

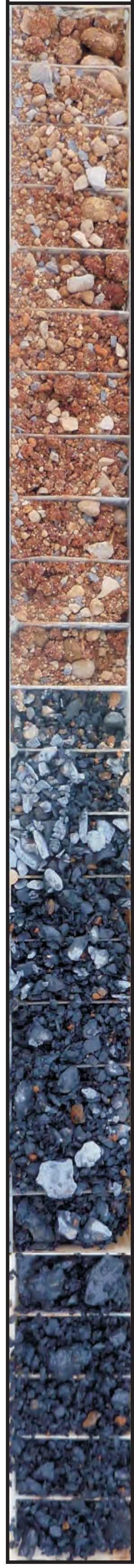
HOLE NO. **TP12-05**
Easting:
Northing:

EOH **25.00m**

HOLE NO. **TP12-06**
Easting:
Northing:

EOH **25.00m**

HOLE NO. **TP12-07**
Easting:
Northing:



EOH **25.00m**

HOLE NO. **TP12-08**
Easting:
Northing:

EOH **25.00m**

Appendix 2

GEOCHEMPET PETROGRAPHIC REPORT

TO

BE

FINALISED

Appendix 3

UNDERSTANDING YOUR REPORT

IMPORTANT INFORMATION ABOUT YOUR GEOTECHNICAL REPORT

These notes have been collated by Groundwork Plus. They are designed to help you in the interpretation of your Report.

Geological studies are commissioned to gain information about environmental conditions on and beneath the surface of a site. The more comprehensive the study, the more reliable the assessment is likely to be, but remember, any such assessment is to a greater or lesser extent based on professional opinions about conditions that cannot be seen or tested. Accordingly, no matter how much data is accumulated, risks created by unanticipated conditions will always remain. Work with your geological consultant to manage known and unknown risks. Part of that process should already have been accomplished, through the risk allocation provisions you and your geological professional discussed and included in your contract's general terms and conditions. This document is intended to explain some of the concepts that may be included in your agreement and to pass along information and suggestions to help you manage your risk.

Beware Of Change; Keep Your Geological Professional Advised

The design of a geological study considers a variety of factors that are subject to change. Changes can undermine the applicability of a reports findings, conclusions, and recommendations. Advise your geological professional about any changes as you become aware of them. Geological professionals cannot accept responsibility or liability for problems that occur because a report fails to consider conditions that did not exist when the study was designed. Ask your geological professional about the types of changes you should be particularly alert to. Some of the most common include:

- modification of the proposed development or ownership group;
- sale or other property transfer;
- replacement of or additions to the financing entity;
- amendment of existing regulations or introduction of new ones; or
- changes in the use or condition of adjacent property.

Should you become aware of any change, do not rely on an existing geological report. Advise your geological professional immediately; follow the professional's advice.

Prepare To Deal with Unanticipated Conditions

The findings, recommendations, and conclusions of a report typically are based on a review of historical information, interviews, a site 'walkover' and other forms of non-invasive research. When site subsurface conditions are not sampled in any way, the risk of unanticipated conditions is higher than it would otherwise be.

While borings, installation of monitoring wells, and similar invasive test methods can help reduce the risk of unanticipated conditions, do not overvalue the effectiveness of testing. Testing provides information about actual conditions only at the precise locations where samples are taken and only when they are taken. Your geological professional has applied that specific information to develop a general opinion about environmental conditions. Actual conditions in areas not sampled may differ (sometimes sharply) from those predicted in a report. For example, a site may contain an unregistered underground storage tank that shows no surface trace of its existence. Even conditions in areas that were tested can change, sometimes suddenly, due to any number of events, not the least of which include occurrences at adjacent sites. Recognize too, that even some conditions in tested areas may go undiscovered, because the tests or analytical methods used were designed to detect only those conditions assumed to exist.

Manage your risks by retaining your geological professional to work with you as the project proceeds. Establish a contingency fund or other means to enable your geological professional to respond rapidly, in order to limit the impact of unforeseen conditions. To help prevent any misunderstanding, identify those empowered to authorize changes and the administrative procedures that should be followed.

Do Not Permit Any Other Party to Rely On The Report

Geological professionals design their studies and prepare their reports to meet the specific needs of the clients who retain them, in light of the risk management methods that the client and geological professionals agree to, and the statutory, regulatory, or other requirements that apply. The study designed for a developer may differ sharply from one designed for a lender, insurer, public agency or even another developer. Unless the report specifically states otherwise, it was developed for you and only you. Do not unilaterally permit any other party to rely on it. The report and the study underlying it may not be adequate for another party's needs and you could be held liable, for shortcomings your geological professional was powerless to prevent or anticipate. Inform your geological professional when you know or expect that someone else - a third-party will want to use or rely on the report. Do not permit third-party use or reliance until you first confer with the Geological professional who prepared the report. Additional testing, analysis, or study may be required and in any event, appropriate terms and conditions should be agreed to so both you and your geological professional are protected from third-party risks. Any party who relies on a geological report without the express written permission of the professional who prepared it and the client for whom it was prepared may be solely liable for any problems that arise.

Avoid Misinterpretation of the Report

Design professionals and other parties may want to rely on the report in developing plans and specifications. They need to be advised, in writing, that their needs may not have been considered when the study's scope was developed and even if their needs were considered, they might misinterpret geological findings, conclusions, and recommendations. Commission your geological professional to explain pertinent elements of the report to others who are permitted to rely on it and to review any plans, specifications or other instruments of professional service that incorporate any of the report's findings, conclusions, or recommendations. Your geological professional has the best understanding of the issues involved, including the fundamental assumptions that determined the study's scope.

Give Contractors Access to the Report

Reduce the risk of delays, claims, and disputes by giving contractors access to the full report, providing that it is accompanied by a letter of transmittal that can protect you by making it unquestionably clear that: I) the study was not conducted and the report was not prepared for purposes of bid development and 2) the findings, conclusions and recommendations included in the report are based on a variety of opinions, inferences, and assumptions and are subject to interpretation. Use the letter to also advise contractors to consult with your geological professional to obtain clarifications, interpretations, and guidance (a fee may be required for this service) and that-in any event, they should conduct additional studies to obtain the specific type and extent of information each prefers for preparing a bid or cost estimate. Providing access to the full report, with the appropriate caveats, helps prevent formation of adversarial attitudes and claims of concealed or differing conditions. If a contractor elects to ignore the warnings and advice in the letter of transmittal, it would do so at its own risk. Your geological professional should be able to help you prepare an effective letter.

Do Not Separate Documentation from the Report

Geological reports often include supplementary documentation, such as maps and copies of regulatory files, permits, registrations, citations, and correspondence with regulatory agencies. If subsurface explorations were performed, the report may contain final boring logs and copies of laboratory data. If remediation activities occurred on site, the report may include; copies of daily field reports, waste manifests and information about the disturbance of subsurface materials, the type and thickness of any fill placed on site and fill placement practices, among other types of documentation. Do not separate supplementary documentation from the report. Do not permit any other party to redraw or modify any of the supplementary documentation for incorporation into other professionals' instruments of service.

Realize That Recommendations May Not Be Final

The technical recommendations included in a geological report are based on assumptions about actual conditions and so are preliminary or tentative. Final recommendations can be prepared only by observing actual conditions as they are exposed. For that reason, you should retain your geological professional to observe construction and/or remediation activities on site, to permit rapid response to unanticipated conditions. The geological professional who prepared the report cannot assume responsibility or liability for the report's recommendations if that professional is not retained to observe relevant site operations.

Understand That Geotechnical Issues Have Not Been Addressed

Unless geotechnical engineering was specifically included in the scope of professional service, a report is not likely to relate any findings, conclusions, or recommendations about the suitability of subsurface materials for construction purposes, especially when site remediation has been accomplished through the removal, replacement, encapsulation, or chemical treatment of on- site soils. The equipment, techniques, and testing used by geotechnical engineers differ markedly from those used by Geological professionals; their education, training, and experience are also significantly different. If you plan to build on the subject site, but have not yet had a geotechnical engineering study conducted, your Geological professional should be able to provide guidance about the next steps you should take. The same firm may provide the services you need.

Read Responsibility Provisions Closely

Geological studies cannot be exact; they are based on professional judgement and opinion. Nonetheless, some clients, contractors, and others assume geological reports are, or certainly should be, unerringly precise. Such assumptions have created unrealistic expectations that have led to wholly unwarranted claims and disputes. To help prevent such problems, geological professionals have developed a number of report provisions and contract terms that explain who is responsible for what and how risks are to be allocated. Some people mistake these for 'exculpatory clauses', that is, provisions whose purpose is to transfer one party's rightful responsibilities and liabilities to someone else. Read the responsibility provisions included in a report and in the contract you and your Geological professional agreed to.