



Subdivision Assessment Policy

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Contact details

Name: Kieran Black	Position: Technical Manager
Business Unit: Subsidence Advisory NSW	Division: Better Regulation Division
Phone: (02) 4908 4391	Email: kieran.black@finance.nsw.gov.au

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1. Introduction

1.1 Subsidence Advisory NSW

Subsidence Advisory NSW (SA NSW) is a NSW Government agency responsible for administering the *Coal Mine Subsidence Compensation Act 2017* (the Act). SA NSW has three primary functions:

1. To manage claims for compensation where surface developments are damaged by mine subsidence following extraction of coal or shale in NSW.
2. To regulate surface development within mine subsidence districts (districts) to minimise liabilities arising from mine subsidence.
3. To manage risk associated with mine subsidence including public awareness of mine subsidence.

1.2 Regulation of surface development

Districts are proclaimed in areas where there is potential for mine subsidence to impact surface development. Proposed development, including subdivision of land, within districts requires SA NSW approval.

As part of its approval, SA NSW may place conditions on proposed subdivision works to:

1. ensure all subdivision infrastructure is constructed in a way that helps prevent subsidence damage
2. to eliminate or minimise as far as is practicable the cost and type of engineering mitigation measures relating to mine subsidence hazards for future purchasers of subdivided land.

In active coal mining areas, this policy intends to:

1. effectively balance the interests of property owners, property developers and coal mine operators without sterilising coal resources

2. Policy Statement

This policy provides a framework for the assessment and determination of subdivision applications within districts.

2.1 Objectives

The key objectives of the policy are to:

- ensure compliance with all relevant statutory requirements
- ensure public safety
- establish a comprehensive, transparent and consistent process for assessing subdivision applications
- clearly define roles and responsibilities
- define the risk assessment objective and process
- establish a consultation process
- establish a dispute resolution process
- prevent unnecessary delays in SA NSW's assessment of subdivision applications.

2.2 Scope

This policy applies to all officers, consultants, contractors and outsourced service providers performing work for SA NSW. It also applies to all SA NSW activities that involve assessment of applications for proposed subdivisions on land overlying existing and future underground coal mine workings and the preparation of associated guidelines and procedures.

2.3 Ethical Conduct

All activities must be conducted in an ethical and transparent manner and comply with the values, principles and articles in the Code of Conduct.

Staff will ensure they are not, or are not perceived to be, in a conflict of interest with any stakeholders. Those staff who have, or may be perceived to have, a perceived conflict of interest in the outcome of a purchase or decision should disclose any perceived conflict to their manager and discuss whether they should exclude themselves from any role in the consideration of the application.

2.4 Roles and Responsibilities

Each of the following has specific assigned responsibilities under this policy:

- Chief Executive Officer (CEO)
- Technical Manager
- Senior Risk Engineer & Senior Advisor Residential Subsidence Regulation
- SA NSW officers

2.4.1 Chief Executive Officer

The CEO is responsible for:

- establishing a policy for the assessment of subdivision proposals within a district
- ensuring the delegations set out in the Instrument of Delegation are appropriate to the subdivision assessment process
- reviewing any determination of an application that is subject to an appeal by a stakeholder.

2.4.2 Technical Manager

The Technical Manager is responsible for:

- ensuring that their staff, including consultants, contractors and outsourced service providers, comply with this policy and associated procedures
- reviewing and updating this policy and the associated procedures and guidelines
- approving or refusing applications for proposed subdivision of land in line with SA NSW's Instrument of Delegations.

2.4.3 Senior Risk Engineer & Senior Advisor, Residential Subsidence Regulation

The Senior Risk Engineer and Senior Advisor, Residential Subsidence Regulation are responsible for:

- complying with this policy, the associated procedure and Instrument of Delegations.

2.4.4 SA NSW officers

SA NSW officers undertaking the assessment of Integrated Development referrals and applications are responsible for:

- complying with this policy, the associated procedure and Instrument of Delegations.
- referring any suggestions for improvement or queries to their respective Manager.

3. Subdivision applications

This policy applies to the assessment and determination of subdivision applications:

- made under section 22 of the Act
- referred to SA NSW as integrated development under section 91A of the *Environmental Planning and Assessment Act 1979*.

3.1 Application lodgement

Applications for the subdivision of land within a district may be submitted directly through SA NSW's online portal at www.subsidenceadvisory.nsw.gov.au or as an Integrated Development application through the relevant local council.

Applications should include detailed plans of the proposed subdivision layout including the proposed dimensions and layout and area extent of each lot. The proposed street names and details of whether the proposed subdivision is part of a larger staged subdivision should also be included.

3.1.1 Referral of Integrated Development

Integrated Development is development that requires consent under the *Environmental Planning and Assessment Act 1979* and one or more approvals under other Acts.

Integrated Development is referred to SA NSW by a local council. Referrals may occur online through the NSW Planning Portal or SA NSW's portal.

Integrated Development is referred when an applicant has indicated on a development application (DA) form submitted to council that the DA is to be assessed as Integrated Development.

3.2 Application process

After receiving a subdivision application, SA NSW will:

- register the application
- undertake a preliminary review and if necessary either (1) request more information from the applicant or (2) consult the relevant coal mine operator or the Division of Resources and Geoscience (DRG).
- Refer to **Attachment A** for an overview of the subdivision assessment process based on whether potential subsidence risk is due to existing mine workings or a current

*mining title. If additional information is required, SA NSW will notify the applicant within **14 calendar days** of receipt of their application.*

- make a determination based on its records and any other available information
- issue written notification advising the applicant of the outcome of the application.

SA NSW is to provide the applicant with a determination within **40 calendar days** of receipt, excluding any time lost due to requests for additional information or consultation with external parties.

3.3 Advisory services

SA NSW offers expert advice on matters relating to mine subsidence or the subdivision of land that may be subject to mine subsidence, whether or not the land is within a district.

Any interested party, including councils, can approach SA NSW for advice on mine subsidence matters, including requests for comment on subdivision proposals that are not Integrated Development.

4. Assessment process

4.1 Assessment overview

SA NSW's assessment process aims to manage the co-existence of surface development, public land use and mine subsidence through development controls to reduce the risk of damage to surface development and ensure public safety.

The risk of damage to development and risk to public safety should be eliminated or mitigated against as far as practicable. The tests for these include consideration of:

- Subsidence risk sources (hazards) and potential events
- Likelihood of mine subsidence
- Consequences of mine subsidence
- The certainty with which hazards, likelihood and consequences are known
- Ways to communicate and control the risk and associated costs.

The assessment process and required supporting documents will vary depending on:

- the size and nature of the proposed subdivision and associated surface development
- whether it is in an area of non-active, active or future underground mining
- depth of the mine workings beneath the site
- the nature of the mine workings including condition, extraction height and percentage of extraction
- history of subsidence at the site
- geotechnical characteristics of the site.

Refer to **Attachment A** for an overview of the assessment process.

The guideline assigned to a property includes information about whether the property is located above existing mine workings and / or within a current mining title. Applicants can find the SA NSW guideline assigned to a property through the NSW Planning Portal. Full copies of SA NSW's eight development guidelines are available at www.subsidenceadvisory.nsw.gov.au/development-guidelines.

4.2 Applications within a current mining title

4.2.1 Assessing mine subsidence risks within current mining titles

In assessing risks associated with mine subsidence for subdivision works within a current mining title, SA NSW will consider the available information at the time including:

- response from holder of the mining title detailing;
 - the current development approval or mining lease to extract coal under the site
 - any plans to extract coal under the site, including the likely timeframe and predicted ground surface subsidence impact
- potential consequences of predicted subsidence on proposed subdivision infrastructure and the appropriate engineering controls required to mitigate against subsidence damage
- current land-use zoning
- location of the subdivision within the mining or exploration lease

The following table summarises the main considerations undertaken based on the location of the site within a current mining title or exploration lease.

Site location	Up to 5 lots	Up to 10 lots	Greater than 10 lots
<ul style="list-style-type: none"> • Within coal exploration title 	SA NSW will consider approval taking into account: <ul style="list-style-type: none"> (1) proposed minimum lot size (2) response from mine operator 	SA NSW will consider approval taking into account: <ul style="list-style-type: none"> (1) proposed minimum lot size (2) response from mine operator 	Response from title holder is the main consideration in making determination
<ul style="list-style-type: none"> • Within coal exploration title held • Draft EIS on impact of proposed mine activity available. 	SA NSW will consider approval taking into account: <ul style="list-style-type: none"> (1) proposed minimum lot size (2) response from mine operator considered 	Response from title holder is the main consideration in making determination	Response from title holder is the main consideration in making determination

Site location	Up to 5 lots	Up to 10 lots	Greater than 10 lots
<ul style="list-style-type: none"> • Current mining or exploration lease, • Previously mined in at least one coal seam • SA NSW prior consultation with mine operator indicates future mining activity unlikely. 	SA NSW will consider approval	SA NSW will consider approval	SA NSW will consider approval
<ul style="list-style-type: none"> • current mining or exploration lease, • within area where underground development consent has been granted. 	Response from title holder is the main consideration in making determination	Response from title holder is the main consideration in making determination	Response from title holder is the main consideration in making determination
<ul style="list-style-type: none"> • current mining lease, • within area where secondary extraction plan has been granted. 	SA NSW will consider approval timed such that subsidence impact precedes development	SA NSW will consider approval timed such that subsidence impact precedes development	SA NSW will consider approval timed such that mining impact precedes development

SA NSW will request information from the relevant mine operator and/or the Division of Resources & Geoscience within **5 calendar days** of receipt of the application. If no response is received from the relevant party within **14 calendar days**, SA NSW may make its own reasonable determination on the subdivision application based on available information.

SA NSW does not require geotechnical desktop assessments to be submitted in support of subdivision applications in active or future mining areas. However, SA NSW may require a geotechnical investigation or desktop study to support large developments in active mining areas as part of its conditions of approval.

4.2.2 Consultation with the title holder

SA NSW is to consult the relevant title holder during the assessment of subdivision applications within a current mining title.

SA NSW is to consider the title holder's advice when making a determination. The title holder will be notified of any determination of a subdivision application in a current mining title that varies from the relevant advice. On request, SA NSW shall provide the title holder with an explanation for the decision.

There may be situations where a mine operator objects to proposed development in a current mining title. In these situations, SA NSW may request the mine operator and applicant to reach a co-existence agreement before making a determination.

4.2.3 Co-existence agreements

Co-existence agreements between the mine operator and applicant may include a subsidence liability and cost prediction assessment based on the likely mining plans and development of land.

There may be some instances, such as in areas where there is a high degree of certainty for coal extraction within a well constrained timeframe, where it is more appropriate for co-existence agreements to require mining to precede development.

SA NSW is able to encourage discussions on co-existence agreements between applicants, mine operators and the Department of Planning and Environment including the Division of Resources and Geoscience as necessary.

Refer to **Attachment A** for a flow chart summary of the process.

4.2.4 Previous mine workings within a current mining title

In areas where there are previous mine workings in a current mining title, SA NSW will also assess the mine subsidence risk in accordance with section 4.3 of this policy in addition to section 4.2 of this policy.

4.2.5 Areas of potential future mining

SA NSW will notify the Division of Resources and Geoscience (DRG) if required and seek advice on whether the land sits above any significant coal or shale resources.

In the situation that DRG confirms the presence of a significant resource, SA NSW may make a determination on suitable mine subsidence risk controls in consultation with DRG. These may include, but not be limited to, the nomination of subsidence design parameters and restrictions on lot numbers and size.

SA NSW will require a response from the DRG within **14 calendar days**. If no response is received within the nominated timeframe, SA NSW may make its own assessment and determination.

4.3 Mine workings outside a current mining title

Some districts cover areas where there are mine workings outside a current mining title, these include known or suspected historic underground mine workings.

Applicants planning to subdivide land in areas where there are mine workings outside a current mining title are encouraged to contact SA NSW in the preliminary stages of the project to ascertain whether geotechnical studies will be required.

4.3.1 Assessing mine subsidence risks outside a current mining title

In assessing the risk associated with mine subsidence for subdivision applications in areas where there are mine workings outside a current mining title, SA NSW will consider:

- type and condition of the mine workings beneath the site
- depth of the mine workings beneath the site and whether a credible sinkhole (pothole) hazard may be present.
- history of subsidence at the site
- estimated likelihood of subsidence occurring in the future
- geotechnical characteristics of the site
- the potential consequences of subsidence
- reliability of the information available to assess the above.

In instances where a credible sinkhole (pothole) hazard is identified, SA NSW generally requires the risk to be eliminated. This applies to all subdivisions including simple two lot subdivisions.

Should a trough subsidence risk be identified, SA NSW will generally conditionally approve the subdivision works subject to all infrastructure being designed to accommodate the estimated subsidence impact parameters.

Refer to **Attachment C** for further guidance on how SA NSW assesses subsidence risk and the type of engineering controls to apply based on geotechnical uncertainty, the estimated level of subsidence risk and the type of proposed surface development.

4.3.2 Requests for further information to facilitate assessment

SA NSW may require additional information to facilitate assessment of subdivision applications in areas where there are mine workings outside a current mining title. In instances where further information is required, SA NSW will notify applicants within **14 calendar days** of receipt of the application. In some cases, geotechnical investigations may be deemed necessary.

Where further information has been requested to facilitate assessment, SA NSW will place the application on hold until the information is received. If no response is received within **two months**, SA NSW will issue a reminder email to the applicant. If the applicant does not

provide a response within **one month** of the reminder, SA NSW will close the application and notify the applicant. The applicant can resubmit the application at any time.

4.3.3 Geotechnical investigations

In instances where geotechnical investigations are deemed necessary, SA NSW will outline the requirements including:

- the details of subsidence hazards to be considered in the assessment
- the scope, methodology and objectives of the investigations or assessments
- the required qualifications and experience of the person undertaking the investigation.

The types of geotechnical investigations SA NSW may require to facilitate assessment of a subdivision application include, but are not limited to:

- desktop studies
- ground surface observation and geotechnical mapping
- subsurface investigation
- stability and subsidence analysis
- risk assessment and development of risk treatments.

The extent and objective of the investigations required will depend on a site's subsidence risks. In areas with minimal and well-defined subsidence hazards, SA NSW may deem a simple desktop study to be sufficient. Subdivision applications in areas with a history of subsidence and complex ground conditions are more likely to require detailed and extensive desktop studies followed by further mapping, subsurface investigation and reporting.

All geotechnical studies and investigations must be undertaken by suitably qualified and experienced geotechnical, mining or engineering geology professionals. SA NSW can provide details of suitably qualified professionals on request.

Refer to **Attachment B** for SA NSW's standard for geotechnical analysis and reporting for mine subsidence.

5. Determination and approvals

SA NSW has the authority to refuse, approve with conditions or unconditionally approve any application for the subdivision of land within a district.

5.1 Section 22 Approval

For all applications lodged directly to SA NSW by the applicant, approval is granted by SA NSW under Section 22 (3) of the Act. Copies of this approval can be used to accompany a Development Application with the relevant council.

5.2 General Terms of Approval

For development applications lodged through council as an “integrated development”, council will lodge the application with SA NSW on behalf of the applicant under Section 91 of the *Environmental Planning and Assessment Act 1979* in order to obtain General Terms of Approval (GTAs).

SA NSW aims to process all GTAs within **21 calendar days** of receiving the development application from council. If an integrated referral cannot be returned within **21 calendar days**, SA NSW will notify council of the delay within the 21 working day timeframe.

In instances where SA NSW requires further information to assess a development application referred through council, SA NSW will request the additional information from council within **21 days of receiving the application**.

SA NSW will specify whether approval or conditional approval has been granted under section 22 of the Act when issuing GTAs. In instances where SA NSW grants conditional approval, the applicant is required to meet any applicable conditions before building works can be carried out.

If SA NSW does not grant approval, council is required to refuse the development application.

5.3 Refusals

SA NSW may refuse a subdivision application where the risks arising from mine subsidence are considered too high. Examples of subdivision applications that SA NSW may refuse include:

- Subdivision applications that SA NSW has determined present an unacceptable financial risk and the potential subsidence impact cannot be effectively mitigated against by engineering design.
- Applications in areas where the subsidence hazard has been assessed by SA NSW to present a credible and unacceptable public safety risk and an effective mitigation strategy is not feasible or credible.

In such cases, SA NSW officers are available to meet with the applicant to further explain the decision. If the applicant is not satisfied with the response, they may request a meeting with the CEO or commence the dispute resolution process in accordance with Section 6 of this policy.

6. Reviews and dispute resolution

SA NSW offers applicants the option to formally request a review if they are not satisfied with the determination of a subdivision application. The CEO is to be notified of all review requests and make the final determination on the outcome of reviews.

Prior to initiating the formal review process, SA NSW may suggest meeting with the applicant to attempt to reach a mutually agreeable solution.

6.1 Review process

To initiate a review, applicants are to submit a written request to SA NSW for a review of a determination on a subdivision application. The submission needs to outline the reasons for the request including justifying why there should be a review and what the applicant considers would be a reasonable determination. If applicable, details of the applicant's preferred review type should be included.

SA NSW is to acknowledge requests for reviews within **7 calendar days** and advise the applicant of timing and next steps, depending on the review type, within **14 calendar days**.

The findings and recommendations from external reviews are to be provided to the CEO for consideration. The CEO is to make the final determination on the outcome of the review. Once finalised, SA NSW is to advise the applicant of the outcome of the review with an explanation for the determination. SA NSW is to finalise reviews within **40 Calendar days** of the request.

6.1.1 Reviews of applications with workings outside a current mining title

Applicants disputing SA NSW's determination of applications in areas where there are mine workings outside a current mining title have the option for an internal review by a different SA NSW officer or a review by an external consultant. The CEO may use these subsequent reports to inform the final decision.

6.1.2 Reviews of applications in a current mining title

Applicants disputing SA NSW's determination of an application within a current mining title have the option for an internal review by an SA NSW Risk Engineer who was not involved in the original determination.

Note: There is no option for external reviews of applications within current mining titles as subsidence impacts in these locations have been previously agreed upon by coal mine operators and the Division of Resources and Geoscience.

6.2 Review of determination

6.2.1 Internal reviews

SA NSW offers applicants the option of an internal review of a determination on a subdivision application at no cost.

6.2.2 External reviews

External reviews of subdivision applications in areas with existing mine workings outside a current mining title are to be carried out by an independent expert consultant with extensive experience in mine subsidence studies and acceptable to SA NSW. SA NSW will use the report to reconsider the determination. If the review results in SA NSW's original determination on the application being overturned, SA NSW may re-imbursement the applicant for the cost of the review.

7. Key Performance Indicators

Key Performance Indicators are an important part of the strategic planning process and play a role in the measurement of SA NSW's progress towards achieving its planned goals. SA NSW's key performance indicators are outlined below:

- If the application is made under section 22 of the Act, SA NSW will notify the applicant if additional information is required to progress the application within **14 calendar days** of receipt.
- If the application is made under section 91 of the *Environmental Planning and Assessment Act 1979* as an integrated development, SA NSW will advise council if additional information is required to progress the application within **21 calendar days** of receipt unless additional information is requested by SA NSW in order to progress the application.
- All merit based approvals, including subdivisions, under section 22 of the Act will be determined within **40 calendar days** unless additional information is requested by SA NSW in order to progress the application.
- 90% of integrated development applications made under section 91 of the *Environmental Planning and Assessment Act 1979* will be determined within **21 calendar days** unless additional information is requested by SA NSW in order to progress the application.
- 10% of integrated development applications made under section 91 of the *Environmental Planning and Assessment Act 1979* will be determined within **40 calendar days**. SA NSW will notify council that additional time is required within **21 calendar days**.

Note: assessment durations don't include 'stop the clock' periods where SA NSW is waiting for additional information from the applicant or a third party to enable an assessment.

8. Related Policies and Documents

Issuer	Reference	Document Name
NSW Government	No 23	<i>Coal Mine Subsidence Compensation Act 2017</i>
NSW Government		<i>Coal Mine Subsidence Compensation Regulation 2017</i>
NSW Government	No 203	<i>Environmental Planning and Assessment Act 1979</i>
NSW Government		<i>Environmental Planning and Assessment Regulation 2000</i>
NSW Government		<i>State Environmental Planning Policy (Mining, Petroleum Production and Extractive Industries) 2007</i>
NSW Government	No 17	<i>State Records Act 1998</i> (regarding the creation, management and protection of records and public access to those records)
NSW Government	No 52	<i>Government Information (Public Access) Act 2009</i> (regarding public access arrangements to agency information)
NSW Government	No 133	<i>Privacy and Personal Information Protection Act 1998</i> (regarding the collection and protection of personal information)
NSW Government	No 35	<i>Independent Commission Against Corruption Act 1988</i> (regarding reporting of any matter suspected on reasonable grounds to involve corrupt conduct)
NSW Government	October 2015	NSW Integrated Mining Policy - <i>Indicative Secretary's Environmental Assessment Requirements for State Significant Development - Mining</i> (Hotlink)
NSW Public Service Commission	Direction No 1 of 2015	The Code of Ethics and Conduct for NSW government sector employees
Department of Finance, Services and Innovation	Hotlink	Code of Ethics and Conduct
Subsidence Advisory NSW	Hotlink	Instrument of Delegation: Version May 2017

9. Document Control

9.1 Document Approval

Name & Position	Signature	Date
Kieran Black Technical Manager		25 May 2018
Brendan Killen A/Chief Executive Officer		25 May 2018

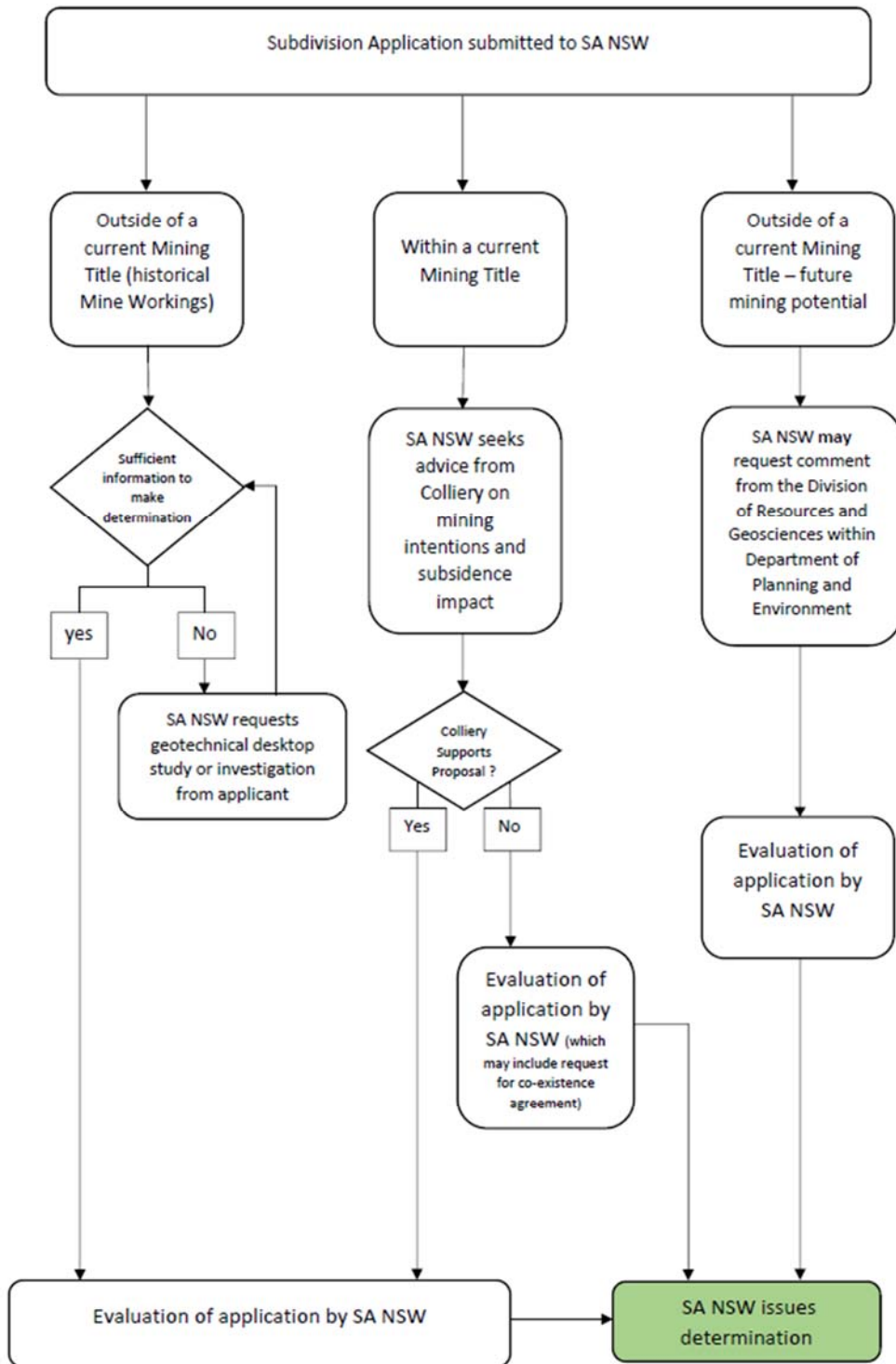
9.2 Document Version Control

Version	Status	Date	Prepared By	Comments
1.0	Draft	25 May 2018	Kieran Black	

9.3 Review Date

This policy will be updated as required and formally reviewed biannually. Feedback from applicants and other stakeholders will be considered during the review process.

Attachment A: Subdivision application assessment flowchart



Attachment B: SA NSW's minimum requirements for geotechnical reports

Geotechnical desktop study or investigation reports provided to SA NSW as part of a subdivision application should clearly address the following:

The likelihood of subsidence events affecting the site

The likelihood of mine subsidence affecting the site. An assessment of this should be clearly stated in the report. Include, if applicable, an assessment of:

- Pillar failure – (The UNSW pillar strength formula should not be used without providing a thorough assessment of the inputs used and the level of confidence in them. The formulae should not be used on selected isolated pillars, but rather averaged over an entire panel. An assessment should then be made if the panel is susceptible to a pillar run. Clear recommendations should be made on what further work the applicant could undertake to reduce the uncertainty.)
- Surface pothole formation.
- Migration of overlying soil into subsidence cracks or mine voids.
- Poorly or un-remediated mine openings such as drifts and shafts.
- Residual subsidence due to ongoing goaf consolidation and settlement of the overburden (superincumbent strata).
- The potential for variability in any assumptions used in the assessment (as described above) including:
 - Parametric Analysis: Identify the primary variables and provide their adopted values and expected variability.
 - Sensitivity Analysis: Assessment of how outcomes or risks are affected by variations in input values for a parameter.
 - Sources of information and their reliability, including discussion of perceived gaps in information with specific reference to a geotechnical model as defined in Australian Standard AS 1726-2017 Geotechnical site investigations.
- Recommendation on whether further geotechnical studies or investigations should occur in order to make a more accurate assessment.

The consequence of subsidence. Including, if applicable, predictions of:

- Surface deformations including;
 - Vertical subsidence (mm)
 - Horizontal displacement both tensile and compressive (mm/m)
 - Tilt (mm/m)
 - Radius of curvature (km)
- Anticipated nature and extent of damage to the proposed development

Additionally SA NSW may request that the applicant provide;

- An estimate of repair costs (including cost of re-housing of inhabitants during repair) of proposed development should a subsidence event occur
- An assessment of whether a credible safety risk exists should a subsidence event occur. This should include both structural failure and formation of subsidence features.

Recommendation on appropriate engineering controls (if applicable). All engineering controls should be accompanied by clear justification as to how and why the adopted methods are appropriate. The likelihood and consequence of a subsidence event with the controls in place should be assessed.

- Each report should, if applicable, include the following in assessing subsidence risk:
 - Seams worked (single or multi-seam, seam thickness and structure)
 - The class of mine workings (i.e. historical, operational or future)
 - The characteristics of mine workings (e.g. depth, extraction height, percentage of extraction, geotechnical conditions).
 - Mine workings type, age and level of confidence in accuracy (bord and pillar, pillar extraction, longwall/miniwall, mining height, 1st workings, 2nd workings)
 - Regional geology (stratigraphy/dip/faults/dykes)
 - Overburden properties (soil cover, rock strength, discontinuities, moisture sensitivity, water table, potential for time dependent strength and stiffness changes (i.e. creep)
 - Mine workings roof, seam and floor properties (as per overburden properties plus peak and residual strength and stiffness of coal pillars, strain hardening goaf)
 - Propensity for pillar geometry change (rib spall, roof collapse)

- Standing pillars factor of safety (FoS), goaf, bearing capacity of roof and floor, pothole development potential
- Justification for adopted parameters
- Mine subsidence parameters for systematic behavior (vertical subsidence, horizontal strain, tilt, curvature).
- Likelihood and allowance for non-systematic mine subsidence behavior (e.g. dependent on geological structure: faults, dykes, slip planes and / or topography, cuttings).
- **Clear recommendations** – The geotechnical consultant should clearly put forward their conclusions and recommendations and avoid the use of ambiguous language.

Attachment C: SA NSW considerations in assessing Subdivision Applications

The purpose of this procedure is to:

1. provide a consistent approach when assessing subdivision applications
2. provide guidance on the type of engineering mitigation measures and geotechnical reporting that may be required to facilitate assessment of a subdivision application.

Trough subsidence risk

In assessing trough subsidence risk, SA NSW will apply different conditions based on:

1. the assessed level of geotechnical uncertainty (uncertainty factor)
2. the assessed stability of remnant coal pillars based on calculated factors of safety and slenderness (or width to height ratio)
3. the estimated subsidence impact should pillar failure occur.

It should be noted that this is intended as a guide, and the conditions of approval may vary in areas that have a high level of geotechnical complexity. SA NSW will provide justification on request should the applicant dispute the outcome.

The uncertainty factor is used by SA NSW to determine the levels of conservatism and allowed assumptions required when assessing the likelihood of a trough subsidence event.

The level of geotechnical uncertainty is categorised as low, medium or high based on the level of confidence and understanding in;

- Geological environment (R1)
- Level of geotechnical investigation (R2)
- The type of coal mine plans and records (R3)
- Method used to assess stability and impact (R4).

The weighting applied to each factor is outlined below;

- R1 = 2
- R2 = 2
- R3 = 3

- R4 = 3

Refer to **Table C1** to determine the uncertainty value (U) that should be applied for each of the above. The uncertainty values (U) that can be applied to each of the above are as follows;

- Low uncertainty = 1
- Moderate uncertainty = 2
- High uncertainty = 3

Once these have been determined, the Uncertainty Factor can be determined by applying the following formulae;

$$\text{Uncertainty Factor (UF)} = (R1 \times U) + (R2 \times U) + (R3 \times U) + (R4 \times U) - 10$$

Table C1 – Factors used to determine the Uncertainty factor

	(Low Uncertainty)	Medium Uncertainty	High Uncertainty (U)
	U value = 1	U value = 2	U value = 3
Geological Environment (R1) value = 2	<ul style="list-style-type: none"> · A review of available mine plans and records indicate that faults, dykes or other adverse geological structures are likely not present. (ie should be regular layout - no evidence of limiting intersection spans, no significant patterns of truncated or miss-aligned roadways) · If borehole information is available, a review of geotechnical and geophysical logs indicate no anomalous geological structures or stratigraphy being present. · Records indicate seam dip is less than 10 degrees 	<ul style="list-style-type: none"> · A review of available mine plans and records, indicate that Faults dykes or other geological structures may be present. (ie evidence of limiting intersection spans, no significant patterns of truncated or miss-aligned roadways) · If borehole information is available, a review of geotechnical and geophysical logs indicate an anomalous high density of joints and/or small faults (ie less than 200mm throw) · Records indicate seam is dipping at between 10 and 20 degrees 	<ul style="list-style-type: none"> · An analysis of record tracings, indicates faults / dykes are present. Structures are either clearly marked on plan or immediately obvious from analysis of mine plan layout. · If borehole information is available, an analysis of core samples and geophysical logs indicates an anomalous high density and orientation of faults / dykes or other rock types that may contribute to magnitude of subsidence impact. · Borehole information indicates potential for soft floor or roof conditions resulting in foundation or roof punching failure. · Records indicate seam is dipping at greater than 20 degrees
Level of geotechnical investigation	<ul style="list-style-type: none"> · Geotechnical investigation sufficient to adequately assess; - depth of workings, - geo reference mine plans - void heights and widths - pillar plan dimension under site - material properties and slaking 	<ul style="list-style-type: none"> · Geotechnical investigation sufficient to confirm; - mine void dimensions - depth to seam - state of workings (failed or standing) roof and floor properties. 	<ul style="list-style-type: none"> · No site specific borehole data, or inferences made from boreholes located more than 50m from site

	(Low Uncertainty)	Medium Uncertainty	High Uncertainty (U)
	U value = 1	U value = 2	U value = 3
	<p>potential of overburden and roof and floor</p> <ul style="list-style-type: none"> - state of workings (failed or standing) <p>Note: this will likely require a minimum of two fully cored and geotechnically logged boreholes</p>	<p>Note: this will require a minimum of one borehole</p>	
Coal Mine Plans and Records (R3) Value = 3	<ul style="list-style-type: none"> · Mechanised mining showing 1st workings only · Mine workings record tracing based on post mining survey results with regular layout · Sufficient post mining geotechnical boreholes in area to confirm record tracings accuracy · Mine workings show previously extracted longwall panels · Multi-seam mining is a minimum of 100m between seams 	<ul style="list-style-type: none"> · Hand worked mines (welsh bords) with regular layout and sufficient borehole data to confirm dimensional accuracy. · Mechanised workings showing partial or full pillar extraction <p>Mechanised workings showing single gate road mini-wall panels.</p>	<ul style="list-style-type: none"> · Irregular mechanised or hand worked mining
Method used to assess stability and impact (R4) Value = 3	<ul style="list-style-type: none"> · Method used to assess stability of pillars and subsidence impact has been validated by use of another method - ie numerical modelling validated by empirical method OR peer review by relevant professional accepted by SA NSW · Pillar stability calculations are based on the average pillar FoS for panel. · Other potential pillar loading scenarios considered if applicable. · All variables and assumptions used in estimating both pillar stability and subsidence impact clearly outlined - in the absence of borehole data, credible worst-case assumptions have been made (ie assume 0.5m off plan dimensions, full seam extraction + 0.5m to allow for roof fall). · Pillar stability and subsidence impact assessment capable of being replicated from data published in report 	<ul style="list-style-type: none"> · single method used to assess stability of pillars and subsidence impact (note that in assessing pillar stability the average panel FoS should be used rather than assessment on isolated pillars) · Other potential pillar loading scenarios considered if applicable. · All variables and assumptions used in estimating both pillar stability and subsidence impact clearly outlined 	<ul style="list-style-type: none"> · No geotechnical report or analysis · Geotechnical analysis does not meet specified criteria · Internal estimation of subsidence risk based on available records carried out by SA NSW Risk Engineers.

The application of these can be divided up into low, medium and high uncertainty based on the following values;

- Low uncertainty - ≤ 5
- Moderate uncertainty > 5 and ≤ 10
- High uncertainty > 10

Using the Uncertainty Factor, in conjunction with **Table C2** the likely conditions of approval can be estimated.

Table C2 – Factors used to determine the Uncertainty factor

Uncertainty Factor	General Summary of likely approval conditions for sites where the pillar FoS (and W/h ratio's) greater than nominated values				General Summary of likely approval conditions for sites where the pillar FoS less than nominated values	
	FoS	W/h Ratio	Allowed assumptions for assessment of pillar stability	General Summary of approval conditions	Summary of design requirements	General summary of likely approval conditions (these may vary in accordance with the geotechnical environment and subsidence risk)
Low uncertainty (≤ 5)	>1.6	>3	Unless informed by adequate borehole data; 1) Pillars are full seam height 2) take 0.5m off pillar dimensions as shown on record tracings to allow for error	(1) Submit Site Classification report (AS2870) to SA NSW for our records Note: Nominal subsidence impact parameters may be applied at the discretion of the Risk Engineer dependant risks associated with subdivision works	Subdivision works must be designed to be "safe, serviceable and readily repairable" given the estimated subsidence impact parameters.	(1) Submit plans prior to construction along with sign-off from structural engineer that all infrastructure associated with subdivision works have been designed to accommodate estimated subsidence impact parameters. (2) Following construction, sign-off from qualified engineer that improvements have been constructed in accordance with plans submitted to SA NSW and in accordance with AS2870 and any other relevant codes and standards.
Moderate uncertainty (> 5 to ≤ 10)	>1.8	>3				
High uncertainty (> 10)	>2.1	>5				

Sinkhole (pothole) risk

The following table (**Table C3**) provides a guide as to how SA NSW will assesses and the likely conditions that will be applied for sinkhole prone areas. The evaluation is based on (but not necessarily confined) to the following:

1. cover depth
2. overburden characteristics
3. the nature of the workings
4. seam dip
5. previous history of pothole formation.

Applicants may engage geotechnical consultants to provide a more detailed analysis of the risk of sinkhole (pothole) formation for a site. In instances where a credible risk of sinkhole formation is identified, SA NSW generally requires the risk to be effectively eliminated. Refer to Table C3 for a summary of the conditions of approval.

Table C3 – Factors used to determine the Uncertainty factor

Sinkhole Risk	Summary of design requirements*	General summary of likely approval conditions*
<p>Low Risk</p> <ul style="list-style-type: none"> • Cover depth is less than 10 times the seam thickness, however on-site borehole evidence has been provided that workings have completely failed and risk is limited to piping of soil into pre-existing tension cracks and consolidation of goaf. • SA NSW risk engineers have assessed the risk of pothole formation as being low 	<p>In the absence of geotechnical advice accepted by SA NSW risk engineers, or the SA NSW risk engineer has assessed the potential for higher subsidence impact, or has assessed a credible risk of ongoing subsidence due to goaf consolidation, the subsidence design parameters will be applied to all infrastructure.</p> <p>SA NSW may allow only limited areas (such as building footprints) on individual lots to be grouted.</p>	<p>(1) Submit plans prior to construction along with sign-off from structural engineer that all infrastructure has been designed to accommodate estimated subsidence impact parameters accepted by SA NSW.</p> <p>(2) Following construction, sign-off from qualified engineer that all subdivision infrastructure has been constructed in accordance with plans submitted to SA NSW and in accordance with AS2870 and any other relevant codes and standards.</p> <p>(3) Submit a plan for acceptance by SA NSW prior to construction to remove the risk to individual lots or proposed building envelopes on individual lots by pressure grouting any mine voids.</p> <p>(3) Submit a grout verification report following grouting works for SA NSW acceptance that the risk of pothole formation on the site has been effectively eliminated such that any future surface improvements will remain “safe, serviceable and any damage from mine subsidence shall be limited to ‘slight’ in accordance with AS2870 (Damage</p>

Sinkhole Risk	Summary of design requirements*	General summary of likely approval conditions*
		<p>Classification), and readily repairable” if constructed in accordance with all relevant building codes and standards.</p> <p>(3) Following construction of any subdivision - works sign-off from qualified engineer that improvements have been constructed in accordance with plans submitted to SA NSW and in accordance with all relevant and applicable building codes and standards.</p>
<p>Moderate Risk</p> <ul style="list-style-type: none"> • Borehole confirmation that cover depth is 5 to 10 times the Seam Thickness • No previous history of pothole formation on current block or neighboring blocks with similar cover depths. • Records indicate the seam dip is less than 10 deg • SA NSW risk engineers have assessed the risk of pothole formation as being moderate 	<p>All proposed lots, roads and public spaces - removal of the pothole risk by a suitable means such as grouting.</p>	<p>(1) Submit a plan for acceptance by SA NSW prior to construction to remove the risk by the emplacement of grout into any mine voids.</p> <p>(2) Submit a grout verification report following grouting works for SA NSW acceptance that the risk of pothole formation on the site has been effectively eliminated such that any future surface improvements will remain “safe, serviceable and any damage from mine subsidence shall be limited to ‘very slight’ in accordance with AS2870 (Damage Classification), and readily repairable” if constructed in accordance with all relevant building codes and standards.</p> <p>(3) Following construction of any subdivision - works sign-off from qualified engineer that improvements have been constructed in accordance with plans submitted to SA NSW and in accordance with all relevant and applicable building codes and standards.</p>
<p>High Risk</p> <ul style="list-style-type: none"> · No borehole confirmation of cover depth and available records indicate cover depth is less than or equal to 10 x the Seam Thickness · Borehole confirmation of cover depth is less than or equal to 5 x the Seam Thickness, or less than 10m · Records indicate the seam dip is greater than 10 deg · Previous history of pothole formation on current block or neighboring blocks with similar cover depths. · Geotechnical environment allows for accelerated weathering and degradation of both pillars and overburden. · SA NSW risk engineers have assessed the risk of pothole formation as being high 		

Boundary adjustments

If a proposal is for a boundary adjustment in a previously approved and current conditional subdivision approval, SA NSW will re-issue the approval with the same conditions applied.

Subdivision infrastructure

If a credible trough subsidence hazard has been identified, SA NSW will generally require that all subdivision infrastructure be designed to accommodate the estimated subsidence impact as far is practicable. All buried services should be located for ease of repair if required.

Attachment D: List of methods and papers recognised for assessing likelihood and consequence of mine subsidence

Canbulat, I., Life of Coal Pillars and Design Considerations, 2010. Second Australasian Ground Control in Mining Conference / Sydney, NSW, 23 - 24 November 2010.

Galvin, J.M., Hebblewhite, B. K, M. D. G. Salamon and B. B. Lin, Establishing the Strength of Rectangular and Irregular Pillars, ACARP, 1998.

Healy, P.R. Head, J.M. Construction over Abandoned Mine Workings – CIRIA special publication, PSA Civil Engineering Technical guide 34, 1984.

Hill, D. Stone, R. Suchowerska, A and Trueman, R. Pillar Abutment Loading – New Concepts for Coal Mining Industry, 15th Coal Operators' Conference, University of Wollongong, The Australasian Institute of Mining and Metallurgy and Mine Managers Association of Australia, 2015, 204-211.

Holla, L. 1985, Surface subsidence prediction in the Southern Coalfield, New South Wales Department of Mineral Resources.

Holla, L. 1986, Evaluation of the surface subsidence characteristics in the Newcastle Coalfield of New South Wales, The Coal Journal 11, p11-22.

Holla, L. 1987, Surface subsidence prediction in the Newcastle Coalfield, New South Wales Department of Mineral Resources.

Holla, L. 1991, Surface subsidence prediction in the Western Coalfield, New South Wales Department of Mineral Resources.

Holla, L. 1997, Ground movement due to longwall mining in high relief areas in New South Wales, International Journal of Rock Mechanics and Mining Science 34 (5), p775-787.

Holla, L. and Barclay, E. 2000, Mine subsidence on the Southern Coalfield New South Wales, New South Wales Department of Mineral Resources, Sydney, 118p.

Piggott, R.J. Wardell, K and Eynon, P, "Ground movements arising from the presence of shallow abandoned mine workings Proc. Conf. on Large ground movements and structures at University of Wales," Pentech Press, London, Pages 749 to 780, 1977.