

Development Application – Subdivision Assessment Policy

Version number: 2
5 April 2023

Acknowledgement of Country

The NSW Department of Customer Service acknowledges the Traditional Custodians of the lands where we work and live. We celebrate the diversity of Aboriginal peoples and their ongoing cultures and connections to the lands and waters of NSW.

We pay our respects to Elders past, present and emerging and acknowledge the Aboriginal and Torres Strait Islander people that contributed to the development of this Policy.

We advise this resource may contain images, or names of deceased persons in photographs or historical content.

Development Application – Subdivision Assessment Policy

Published by the NSW Department of Customer Service

nsw.gov.au/subsidence-advisory

First published: March 2023

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1 Introduction

1.1 About Subsidence Advisory NSW

Subsidence Advisory NSW administers the *Coal Mine Subsidence Compensation Act 2017* (the Act) to provide a fair, efficient, and sustainable compensation framework.

Under the Act, Subsidence Advisory provides the following functions to communities of NSW:

- manages compensation claims for mine subsidence damage to homes and other structures
- manages and assesses subsidence risks by regulating development in Mine Subsidence Districts to protect homes and other structures from mine subsidence damage.

Development in Mine Subsidence Districts is assessed in accordance with Subsidence Advisory's development policy framework.

Active Coal Mining Areas

Predicted subsidence occurs in active coal mining areas. The Department of Planning and Environment (DPE) & Department of Regional NSW (DRNSW) assess mining proposals in NSW.

Historical Coal Mine Workings

Subsidence may also occur in areas where historical coal mine workings are present and may become unstable due to weathering of the rock over time.

1.2 Subdivision applications assessed under this policy

Any erection or alteration of an improvement or subdivision on land within a Mine Subsidence District (District) requires compliance with Subsidence Advisory's approval requirements.

Districts are a land zoning tool administered by Subsidence Advisory under the Act to help protect homes and other structures from potential mine subsidence damage.

Subsidence Advisory regulates building and subdivision works within Districts to ensure new homes and structures are built to an appropriate standard that reduces the risk of damage should subsidence occur.

Each property in a District is assigned a Surface Development Guideline (Guideline) that specifies the requirements for standard residential construction on a property based on applicable mine subsidence risks. The Guidelines can be accessed at: nsw.gov.au/subsidence-advisory/publications

To find out if a property is in a District and the Guideline that applies, please visit the NSW Planning Portal eSpatial Viewer. Further information is available at: nsw.gov.au/subsidence-advisory/districts#toc-nsw-planning-portal-eplanning-spatial-viewer

All applications for proposed subdivisions are assessed by Subsidence Advisory in accordance with this policy.

2 Policy Statement

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

2.1 Objectives

The objective of this policy is to:

- communicate to applicants the requirements for approval given the number of derivative lots and location of the proposed subdivision
 - provide a clear framework for assessing applications for land subdivisions
 - ensure conditions of approval for proposed subdivisions are commensurate with subsidence risks
 - provide clear timeframes for assessment of proposed subdivisions.
-

2.2 Scope

This policy applies to:

- all officers, consultants, contractors, and outsourced service providers performing work for Subsidence Advisory.
 - activities that involve assessment of applications for proposed subdivisions.
-

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 Department of Customer Service Code of Ethics & 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.

3 Lodging an Application

This policy applies to the assessment and determination of applications for subdivision and associated infrastructure in Mine Subsidence Districts:

- made directly to Subsidence Advisory under section 22 of the Act; or,
- referred to Subsidence Advisory as integrated development under Division 4.8 of the Environmental Planning and Assessment Act 1979.

Applications for subdivision within a District may be submitted directly through the online portal at nsw.gov.au/subsidence-advisory/portal or by integrated development referral from a local council using the NSW Planning Portal.

3.1 Application requirements

Applications must include the following requirements:

- detailed plans of the proposed subdivision, which include:
 - external dimensions of each lot
 - layout and area extent of each lot
 - proposed street names, proposed lot numbering and, if relevant, details of future planned stages.

3.2 Advisory services

Subsidence Advisory offers expert advice on mine subsidence considerations & matters relating to proposed development or subdivision of land, regardless of whether land is located within a District.

Any interested party, including councils, can approach Subsidence Advisory for advice on mine subsidence matters, including requests for comment on development and subdivision proposals that are not integrated development. Formal enquires should be lodged via Subsidence Advisory's online portal at nsw.gov.au/subsidence-advisory/portal.

3.3 Definitions

| | |
|-----------------------------------|---|
| Base Lot | A parcel of land that is proposed to be divided into a subdivision. |
| Subdivided Lot | A lot, parcel, or other division of land, that is a division of a base parcel. |
| Subdivision | The division of land into parts for separate occupation and/or disposition. The land may be subdivided either vertically or by stratum. |
| Improvement | As defined by the Coal Mine Subsidence Compensation Act 2017, refers to: <ul style="list-style-type: none">(a) any building or work erected or constructed on land,(b) infrastructure, whether above or below the surface of the land. |
| Subdivision Infrastructure | Refers to any proposed improvements (as above) related to the subdivision. |
| Structure | Refer to definition of 'Improvement'. |

| | |
|-------------------------------|--|
| Exploration Licence | includes Authorisations, Exploration Licences, Exploration (Prospecting) Licences and Assessment Leases. |
| Mining Lease | includes Consolidated Coal Leases, Coal Leases, Consolidated Mining Leases, Mining (Mineral Owner) Leases and Mining Leases. |
| Extraction Approval | includes areas that are subject to an extraction plan approved by the Department of Planning and Environment. |
| Licence or leaseholder | the authorised holder of an exploration licence, mining lease or extraction approval. |
| Active mining area | where an exploration licence, mining lease or extraction approval has been granted, or future mining is intended. |
| Historical mining area | where underground coal mining has occurred, abandoned workings exist and future mining is not intended. |

4 Assessment process

4.1 Assessment overview

The assessment process aims to consistently apply appropriate controls to eliminate or reduce applicable mine subsidence risks associated with the scale and location of proposed subdivisions.

As part of the assessment process for subdivision applications, Subsidence Advisory will consider the:

- likelihood that mine subsidence events will occur
- consequence of mine subsidence events on surface improvements, infrastructure and public safety
- reliability of information used to determine the above, including mine plans, assumed pillar and extraction dimensions, and assumptions regarding geotechnical modelling
- whether an appropriate guideline exists for the proposed subdivision.

The assessment process will vary depending on the size, number of proposed lots, potential repair cost of future development, and whether it is in an area affected by historical, current, or future mining.

Subsidence Advisory aims to determine applications under the policy within **40 calendar days** of receipt of the application, excluding time pending additional information or response from the applicant as may be requested by Subsidence Advisory.

Applications may be approved with conditions to better protect proposed structures/infrastructure from potential subsidence damage. Conditions of approval are based on design requirements.

Please refer to attachments A & B for detail on likely design requirements and conditions of approval.

- For subdivisions located in current mining areas, where underground coal mining is occurring or may occur in the future see **Attachment A: Assessment procedure for areas that are located within an active mining area.**
- For subdivisions located outside of current mining areas that are in proximity to historical coal mine workings see **Attachment B: Assessment procedure for historical coal mining areas.**

Note: Staged subdivisions will be assessed as the one subdivision.

Applications for infrastructure to support a subdivision will be assessed under this policy.

4.2 Preliminary assessment

Following receipt of a subdivision application, Subsidence Advisory will complete a preliminary assessment to determine whether:

- the application is within an active or historical mining area
- additional information is required from the applicant, a licence/leaseholder, or the Resources Regulator within the Department of Regional NSW (DRNSW).

Note: Subsidence Advisory will notify an applicant within **14 calendar days** of receipt of the application if additional information is required.

4.3 Active (current or future) Coal Mining Areas

This section applies to areas located within an active mining area or an area where DRNSW has indicated future mining may occur. Properties in these areas are assigned a Guideline 4, 5 or 6.

4.3.1 Assessment procedure

Subsidence Advisory assessment of subdivision applications within current or future coal mining areas is dependent on the likelihood of future land purchasers being impacted by predicted mining activity, and whether the estimated mine subsidence impact can be successfully mitigated by engineered design.

In assessing risks associated with mine subsidence for subdivision applications within an active mining area, Subsidence Advisory will consider advice from the coal leaseholder on the following criteria:

- the current exploration license, mining lease or extraction approval under the site
- any plans to extract coal under the site, including the likely timeframe and predicted ground surface subsidence impact
- the potential consequences of predicted subsidence on proposed subdivision and subsequent development, and the appropriate engineering controls required to mitigate against subsidence damage.

Subsidence Advisory may consult with the DRNSW to confirm timeframes and impacts advised by the licence/leaseholder.

Subsidence Advisory may also consult with the NSW Department of Planning and Environment (DPE). DPE's functions include strategic application of appropriate land-use zonings in addition to major project approvals for underground coal mine activity within NSW.

In areas that are outside of mining lease, or where an application to mine has not been lodged, Subsidence Advisory will conditionally approve subdivision applications that are consistent with the land use zoning and minimum lot size applied to the base lot. Consultation may be carried out with DRNSW if further information is required.

A detailed description of the assessment process and likely approval conditions is outlined in **Attachment A**.

4.3.2 Consultation with external parties

Subsidence Advisory will request consultation with the coal leaseholder and/or DRNSW within **7 calendar days** of receipt of the application.

Leaseholders can provide advice on the likely timeframe and predicted ground surface subsidence impacts of their operations relevant to the site. Any additional advice received through consultation is not required to facilitate the application assessment and will not be considered.

Where a response is not received within **7 calendar days** of the request, Subsidence Advisory will determine the application without leaseholder input, based on the information currently available.

Subsidence Advisory may also request additional information from the relevant local council, such as whether the application conforms with current land use zonings and minimum lot sizes.

In areas where there are previous mine workings in a current licence or lease, Subsidence Advisory will also assess the mine subsidence risk in accordance with section 4.4 of this policy.

4.4 Historical (non-active) Coal Mining Areas

Some Districts have been declared in areas where historical mine workings are present. Historical mine workings can become unstable due to ongoing weathering processes over time. When historical mine workings fail, they may cause mine subsidence. This may result in a depression over a broad area or a localised depression or sinkhole.

Applicants planning to subdivide land in areas where there are historical mine workings are encouraged to contact Subsidence Advisory in the preliminary stages of the project to establish whether geotechnical studies will be required.

4.4.1 Assessment procedure

The conditions that Subsidence Advisory applies to subdivisions located in historical mine areas are dependent on the scale of the subdivision, and the associated mine subsidence risks to subdivision infrastructure and future land purchasers.

As required, Subsidence Advisory may request additional information as outlined below in section 4.4.2.

A detailed description of the assessment process is outlined in **Attachment B**.

4.4.2 Requests for further information to facilitate assessment

Subsidence Advisory may require additional information to facilitate assessment of an application, including geotechnical studies or investigations into potential subsidence risk.

Subsidence Advisory will notify applicants when further information is required to progress the assessment of a subdivision application within **14 calendar days** of receipt. In instances where geotechnical investigations are required, Subsidence Advisory will outline the necessary scope and objectives of the investigations.

If further information has been requested from the applicant, the subdivision application will be placed on hold until the information has been received. If the applicant has not provided the requested information within three months of the request, Subsidence Advisory may close the application and notify the applicant by email. Applicants can resubmit their application at any time.

a) Geotechnical investigations

Subsidence Advisory may require an applicant to engage a geotechnical practitioner to investigate and report on the following site details and/or conditions:

- desktop studies of mining history, geological/geotechnical conditions, subsidence history
- ground surface observation and geotechnical mapping
- subsurface investigation
- stability and subsidence analysis
- risk assessment and development of risk mitigation measures.

The extent of investigation requirements will depend on anticipated subsidence hazards as well as the size and scale of the proposed subdivision.

In areas with minimal well-defined subsidence hazards, Subsidence Advisory may deem a desktop study to be sufficient.

Subdivision applications in areas with a high-risk or history of subsidence and complex ground conditions are more likely to require a subsurface investigation, analysis, assessment, and reporting.

The selection of investigation techniques and the evaluation of pillar stability and subsidence impacts should be well considered. The applicant may contact Subsidence Advisory technical staff

for advice on the adequacy of any investigation that has been proposed by their geotechnical practitioner.

Subsidence Advisory's standards and requirements for geotechnical analysis and reporting for mine subsidence are outlined in **Attachment C: Subsidence Advisory's Minimum Requirements for Geotechnical Reports**.

b) Subsidence Advisory – Suitably Qualified and Experienced Geotechnical Practitioners

Applicants must only engage suitably qualified and experienced geotechnical practitioners to provide services required under this Policy.

In order to be considered suitably qualified and experienced, geotechnical practitioners must:

1. Either:

- Have completed an accredited 4 year full-time or equivalent part-time undergraduate bachelor degree in:
 - Engineering with a major in geotechnical engineering or civil engineering or
 - Civil engineering, or
 - Geotechnical engineering

or

- Be eligible for registration as a 'design practitioner – geotechnical engineering' or a 'professional engineer – geotechnical' as defined in the *Design and Building Practitioners Regulation 2021*, and
- 2. Be indemnified under a professional indemnity insurance policy against any liability to which the geotechnical practitioner may become subject as a result of carrying out the relevant work, in compliance with the *Design and Building Practitioners Regulation 2021*, and
- 3. Have a minimum of three years' experience in preparing geotechnical reports and assessments relating to abandoned coal mines.

These requirements will be reviewed by Subsidence Advisory from time to time and evidence of compliance with them may be requested.

Subsidence Advisory maintains a list of suitably qualified and experienced geotechnical practitioners who meet the requirements listed above. The *Subsidence Advisory – Suitably Qualified and Experienced Geotechnical Practitioners List* (the Geotechnical Practitioners List) can be provided to applicants.

If an assessment or documentation is submitted by a geotechnical practitioner who is not listed on the Geotechnical Practitioners List, in addition to requiring evidence of compliance with the requirements listed above, Subsidence Advisory may also require that a peer review of the assessment or documentation be carried out by a suitably qualified and experienced geotechnical practitioner from the Geotechnical Practitioners List.

Geotechnical practitioners seeking to be included on the Geotechnical Practitioners List should submit a CV detailing their qualifications and experience and provide evidence that they meet the above requirements.

4.5 Designing for mine subsidence

Subsidence Advisory may require certification from an engineer to confirm that the subdivision infrastructure has been designed to the estimated mine subsidence ground movements in accordance with the relevant design performance criteria outlined below.

4.6 Design performance requirements

The following defines the design performance requirements outlined in this document.

4.6.1 Definition for Serviceable or Serviceability

The improvements shall be designed so that the materials used and their methods of utilisation must allow any damage caused by the prescribed mine subsidence ground movements to be repaired and replaced economically.

In addition to the above, the improvement shall remain continuously serviceable, fit for its approved use if subject to Subsidence Advisory prescribed mine subsidence ground movements, and that any damage that may occur due to mine subsidence can be repaired with minor disruption to the use and enjoyment of the improvement.

Example 1

Design for buried gravity sewer mains. The infrastructure must be designed such that the prescribed mine subsidence ground movements do not result in separation or out of level pipework causing major leaks or ponding of wastewater that may adversely impact its continued use.

Example 2

Design for gas services. The infrastructure must be designed such that the prescribed mine subsidence ground movements do not result in rupture of any gas line and that the service remains continuously useable.

4.6.2 Definition for Safe or Safety

The improvements shall be designed to accommodate the prescribed mine subsidence ground movements such that they will remain structurally sound, fully accessible, and safe following a mine subsidence event.

Note: Subsidence Advisory's safety requirements and definitions in no way abrogates developers' and/or leaseholders' duties, obligations and/or liabilities under other legislation or at common law, foremost the duty of care to not expose other persons to health and safety risks under Section 19(2) Work Health and Safety Act 2011.

4.6.3 Definition for Repairable or Repairability

Any damage due to mine subsidence is to be readily repairable, with mitigation measures incorporated into the design, so that any repair work would not exceed 10% of the capital cost of the approved infrastructure.

5 Determination and approvals

Subsidence Advisory has 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 applications lodged directly to Subsidence Advisory by the applicant, approval is granted by Subsidence Advisory under Section 22 (3) of the Act. Copies of this approval can be used to accompany a Subdivision or Development Application with the relevant local council.

5.2 Division 4.8 of the *Environmental Planning and Assessment Act 1979*

Applications lodged through the NSW Planning Portal under Division 4.8 of the Environmental Planning and Assessment Act 1979 will be processed within **21 calendar days** of referral to Subsidence Advisory, excluding where further information is required to assess the application.

If Subsidence Advisory requires further information to assess a Development Application, the additional information will be requested from council within **14 days of receiving the application**.

Subsidence Advisory will specify whether an approval or a conditional approval has been granted under section 22 of the Act.

In instances where Subsidence Advisory grants conditional approval, the applicant is required to meet all applicable conditions imposed by Subsidence Advisory in order for any improvements to be eligible for compensation under the Act in the event of subsequent damage arising from mine subsidence.

If Subsidence Advisory refuses to grant general terms of approval, the referring council is required to refuse the subdivision application.

5.3 Meeting Conditions of Approval

Applications that are assessed under this policy may require specific mine subsidence engineering measures to be incorporated into the design.

In certain circumstances, dependent upon the type of subdivision and the level of mine subsidence risk, the removal of the risk by the emplacement of grout into mine voids may also be required.

Evidence that approval conditions have been met must be submitted to Subsidence Advisory for acceptance as per the details set out in Subsidence Advisory's determination letter.

5.4 Refusals

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

- Subdivision applications that Subsidence Advisory has determined present an unacceptable mine subsidence risk to future owners of subdivided lots and the potential subsidence impact cannot be effectively mitigated against by engineering design.

- Applications in areas where the subsidence hazard has been assessed by Subsidence Advisory to present a credible and unacceptable public safety risk and an effective mitigation strategy is not feasible or credible.

In such cases, Subsidence Advisory officers are available to meet with the applicant to discuss options permissible under the Act and this policy.

6 Reviews and dispute resolution

Applicants who are not satisfied with the outcome of an application determined under this policy have the option to request a review of the determination.

6.1 Internal review process

Requests for reviews of a determination of a subdivision application are to be submitted in writing to subsidenceadvisory@customerservice.nsw.gov.au.

Submissions must outline why a review of the determination should occur, e.g. how the determination is not consistent with this policy and/or why an alternative determination would be appropriate.

Subsidence Advisory's Manager, Subsidence Risk Evaluation & Regulation will consider all submissions and may elect to complete a review to further investigate the concerns raised by the applicant.

Reviews will be undertaken by a Subsidence Advisory officer who was not involved in the initial determination. As part of this process, the officer will complete an independent review, consider all available information and the submission provided by the applicant. Review findings are to be submitted to the Manager, Subsidence Risk Evaluation & Regulation and Chief Executive, Subsidence Advisory NSW for approval.

The review findings and recommendations are to be finalised and shared with the applicant within **40 calendar days**.

7 Subsidence Advisory response to Land-use Rezoning Proposals

DPE is responsible for the strategic application of land-use rezonings to provide maximum benefit to the people of NSW.

Local councils receive applications for changes to land-use zonings within their local government areas.

As part of the rezoning assessment process, DPE or local council may seek advice from Subsidence Advisory for land located within a District.

Subsidence Advisory responses to rezoning enquiries will be consistent with the procedures outlined in this document.

Subsidence Advisory response to rezoning enquiries will include:

- the mine subsidence risks associated with the subject land based on a desktop assessment of Subsidence Advisory records
- whether an application that is consistent with the rezoning proposal would be approved
- whether Subsidence Advisory would likely require geotechnical investigations or consultation with other parties for future subdivision or development that conforms with the proposal
- recommendations on additional studies or consultation with other agencies or parties.

Subsidence Advisory will not object to rezoning proposals if subdivision applications consistent with the rezoning would be approved under this policy.

7.1 Active Coal Mining Areas

For rezoning enquires within active mining areas, Subsidence Advisory will consult with the relevant licence or leaseholder. If no response from the licence or leaseholder is received within **7 calendar days**, Subsidence Advisory will provide advice without input from the licence or leaseholder.

In its response, Subsidence Advisory will provide a copy or summary of the licence or leaseholder's advice regarding their future mining intent and projected timeframes for mining.

Subsidence Advisory will also provide its assessment of subsidence impacts to future users of the land if the proposal is approved.

If required, Subsidence Advisory will confirm timeframes and impacts provided by the license or leaseholder with DRNSW.

If the land is in an area outside of an active mining area but has had an active Guideline assigned to the lot due to a prior recommendation from DRNSW, then Subsidence Advisory will recommend that DPE consult with DRNSW.

7.2 Historical Coal Mining Areas

For rezoning enquires within historical mining areas, Subsidence Advisory will provide a summary of the potential risks and type of mitigation measures that may be required by Subsidence Advisory under its Surface Development Guidelines. The detail of the response will be dependent on the information available to Subsidence Advisory at the time of consultation.

Subsidence Advisory will also provide recommendation as to whether DPE should seek a mine subsidence risk assessment from the applicant to support their proposal.

8 Key Performance Indicators

Subsidence Advisory NSW operates under the following key performance indicators:

- If the application is made under section 22 of the Act or as an integrated referral via the NSW Planning Portal Subsidence Advisory will notify the applicant/council if additional information is required to progress the application within **14 calendar days** of receipt.
- All subdivision applications made under section 22 of the Act will be determined within **40 calendar days** unless additional information is requested by Subsidence Advisory to progress the application.
- Integrated development applications made under Division 4.8 of the *Environmental Planning and Assessment Act 1979* will be determined within the applicable statutory timeframes, unless additional information is required to process the application.

Note: assessment durations exclude periods where applications are placed on hold pending further information required for the assessment process.

9 Related Policies and Documents

| Issuer | Document Name |
|--------------------------------|--|
| NSW Government | <i>Coal Mine Subsidence Compensation Act 2017</i> |
| NSW Government | <i>Coal Mine Subsidence Compensation Regulation 2017</i> |
| NSW Government | <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 | <i>State Records Act 1998</i> (regarding the creation, management and protection of records and public access to those records) |
| NSW Government | <i>Government Information (Public Access) Act 2009</i> (regarding public access arrangements to agency information) |
| NSW Government | <i>Privacy and Personal Information Protection Act 1998</i> (regarding the collection and protection of personal information) |
| NSW Government | <i>Independent Commission Against Corruption Act 1988</i> (regarding reporting of any matter suspected on reasonable grounds to involve corrupt conduct) |
| NSW Government | NSW Integrated Mining Policy - Indicative Secretary's Environmental Assessment Requirements for State Significant Development - Mining (Hotlink) |
| NSW Public Service Commission | The Code of Ethics and Conduct for NSW government sector employees |
| Department of Customer Service | Code of Ethics and Conduct |

10 Document Control

10.1 Document Approval

| Name and Position | Signature | Date |
|---|--|---------|
| Joseph D'Ermilio Chief Executive Officer |  | 30/3/23 |

10.2 Review Date

The attachments to this policy will be reviewed and updated as required. A formal review will be undertaken every five years. Feedback from applicants and other stakeholders will be considered during the review process.

Attachment A: Assessment Procedure for Active Coal Mining Areas

1. Identification of Active Coal Mining Areas

Subsidence Advisory has applied a Surface Development Guideline 4, 5 or 6 to areas that may be at a risk of being impacted by future or current coal mining activity. Guideline 7 may also apply to properties within active mining areas.

To confirm whether a property is located in an active coal mining area, please lodge an enquiry with Subsidence Advisory through our online portal at nsw.gov.au/subsidence-advisory/portal.

2. Identification of site location relative to existing mining approvals

To determine whether the property is located in an area that is within an exploration licence, mining lease or extraction approval, refer to DPE and DRNSW websites here:

www.planningportal.nsw.gov.au/major-projects

minview.geoscience.nsw.gov.au

Alternatively, an enquiry can be lodged with Subsidence Advisory.

3. Request for information from external parties

Subsidence Advisory will consult with the leaseholder and/or DRNSW if the application is within an exploration licence or mining lease, or in an area where DRNSW has indicated future mining may occur. This is to identify subsidence risks.

Subsidence Advisory may also consult with external parties such as DPE or the relevant local council and consider their responses as part of the application assessment.

In making the determination, Subsidence Advisory will consider the following information if available:

- Response provided by the leaseholder - detailing the likely timeframe for mining and the estimated subsidence impact
- Response provided by DRNSW
- Existing approvals granted by DPE and/or DRNSW to the leaseholder, including subsidence impact assessments that were submitted in support of the relevant application(s) for approval.

Subsidence Advisory will consult with the leaseholder and/or DRNSW within **7 calendar days** of receiving the application. If no response is received by the leaseholder/DRNSW **within 7 calendar days**, Subsidence Advisory will make a determination on the basis of the information available at the time.

Note: Leaseholder responses that object to an application require justifiable supporting information which clearly outlines the relevant timeframes and subsidence impacts e.g., supporting EIS or proposed mine plan. This is to assist Subsidence Advisory's consideration of subsidence risk in its assessment of the application.

4. Determination outcome and likely approval conditions

In considering any conditions which may attach to an approval, Subsidence Advisory will assess the following information, if available:

- Submission provided by the leaseholder - detailing the likely timeframe for mining and the estimated subsidence impacts
- Response provided by the DRNSW
- Existing approvals granted by the DPE and DRNSW to the leaseholder, including subsidence impact assessments that were submitted in support of their approval.
- Existing land use zonings and minimum lot sizes applied to the land by local council and DPE. Subsidence Advisory may also consult with local council and/or DPE to determine whether an application is consistent with the current land-use zoning.

Refer to **Table A1** for approval conditions based on:

- If there is an approval by the leaseholder to cause subsidence; and
- whether the subdivision is consistent with the current land-use zoning; and
- the likelihood and extent of future mining impacts provided by the leaseholder and relevant government agencies.

Table A1 – Design requirements for subdivisions that are located within an active mining area.

| Site location | Design Requirements |
|---|--|
| <ul style="list-style-type: none"> • Located outside of an exploration licence or mining lease • Active Surface Development Guideline applied to base lot | <p>DRNSW response indicates that mining is not possible:</p> <p>No design requirements for future active mining</p> <hr/> <p>DRNSW response indicates that mining is possible:</p> <ul style="list-style-type: none"> • Subdivision infrastructure designed to be Serviceable and Repairable under the parameters consistent with the Surface Development Guideline assigned to the base lot (subdivision infrastructure incorporates kerb & gutter, drainage, services etc). • Pavements are either to be: <ul style="list-style-type: none"> - Flexible pavements as defined by Austroads "Guide to Pavement Technology Part 2: Pavement Structural Design" or - Bound / rigid pavements that are designed to be Repairable under the estimated subsidence ground movements. |
| <ul style="list-style-type: none"> • Within an exploration licence | <p>Subdivision is consistent with minimum lot size and land-use zoning applied to base lot:</p> <ul style="list-style-type: none"> • Subdivision infrastructure designed to be Serviceable and Repairable under the parameters consistent with the Surface Development Guideline assigned to the base lot (subdivision infrastructure incorporates kerb & gutter, drainage, services etc). • Pavements are either to be; <ul style="list-style-type: none"> - Flexible pavements as defined by "Austroads Guide to Pavement Technology Part 2: Pavement Structural Design". or - Bound / rigid pavements that are designed to be Repairable under the estimated subsidence ground movements. <p>Subdivision is not consistent with minimum lot size and land-use zoning applied to base lot:</p> <ul style="list-style-type: none"> • Contingent on advice provided by leaseholder, refusal of application until mining and active subsidence is complete. <p>Note: Staged subdivisions will be assessed as the one subdivision.</p> |

| Site location | Design Requirements |
|--|--|
| <ul style="list-style-type: none"> • Within a mining lease and: <ul style="list-style-type: none"> ○ There is no existing project approval to mine; or ○ No current application to mine. • This may include areas that have been previously impacted by mining in one seam and subsidence from previous mining is effectively complete. | <p>Referral response from DPE, DRNSW or the leaseholder does not object to the application:</p> <ul style="list-style-type: none"> • Subdivision infrastructure is to be designed to be Serviceable and Repairable under the parameters consistent with the Surface Development Guideline assigned to the base lot. (NB: subdivision infrastructure incorporates kerb & gutter, drainage, services etc). • Pavements are either to be; <ul style="list-style-type: none"> - Flexible pavements as defined by "Austroads Guide to Pavement Technology Part 2: Pavement Structural Design". or - Bound / rigid pavements that are designed to be Serviceable and Repairable under the subsidence ground movements assigned to the base lot. <p>Referral response from DPE, DRNSW or leaseholder objects to the application:</p> <ul style="list-style-type: none"> • Contingent on advice provided by leaseholder, refusal of application until mining and active subsidence is complete. <p>Note: Staged subdivisions will be assessed as the one subdivision.</p> |
| <ul style="list-style-type: none"> • Existing project approval to mine with planned mine subsidence impacts; or • Current SEARS application with supporting EIS showing planned subsidence impacts | <p>Referral response from DPE, DRNSW or the Leaseholder does not object to the application:</p> <ul style="list-style-type: none"> • Subdivision infrastructure is to be designed to be Serviceable and Repairable under the parameters outlined in the relevant EIS or provided by the relevant organisation following consultation. (NB: subdivision infrastructure incorporates kerb & gutter, drainage, services etc). • Pavements are either to be; <ul style="list-style-type: none"> - Flexible pavements as defined by "Austroads Guide to Pavement Technology Part 2: Pavement Structural Design". Or - Bound / rigid pavements that are designed to be Serviceable and Repairable under the parameters outlined in the relevant EIS or provided by the relevant organisation following consultation. <p>Referral response from DPE, DRNSW or the Leaseholder objects to the application:</p> <ul style="list-style-type: none"> • Contingent on advice provided by leaseholder, refusal of application until mining and active subsidence is complete. |

| Site location | Design Requirements |
|---|--|
| | Note: Staged subdivisions will be assessed as the one subdivision. |
| <ul style="list-style-type: none"> • Within mining lease where secondary extraction approval granted. | <p>All subdivisions:</p> <ul style="list-style-type: none"> • Contingent on advice provided by leaseholder, refusal of application until mining and active subsidence is complete. <p>Note: Staged subdivisions will be assessed as the one subdivision.</p> |

*Refer to Section 4.6 for Definition for Safety & Serviceability design requirements

Attachment B: Assessment Procedure for Historical Coal Mining Areas.

1. Request for additional information to assess Subdivision Applications

Subsidence Advisory may require additional information to assess a Subdivision Application. If required, Subsidence Advisory will make a written request within 14 calendar days of receipt of the application.

An enquiry can be lodged with Subsidence Advisory to determine the requirement for a geotechnical assessment or geotechnical investigation. It is recommended that the applicant provide sufficient detail regarding the proposed size and scale of the subdivision including staging, proposed lot numbering and clear boundary measurements.

2. Trough subsidence risk

Trough subsidence in historical mine workings is a result of pillar failures. Pillar failures occur when remnant coal pillars become unstable over time as a result of ongoing weathering effects or in some instances initiated by changes in the state of the abandoned mine workings that can occur due to flooding or dewatering.

Subsidence Advisory apply different conditions of approval depending on:

- The number of lots (including residual lots)
- The Geotechnical Risk Factor (GRF) outlined below and in Table B1
- The pillar panel Factor of Safety (FoS) that has been assessed for the site.

Once the above has been determined, the remediation/design requirements included as part of the conditions of approval are outlined in Table B2.

3. Anomalous subsidence impacts

Subsidence Advisory may require an assessment of the likelihood and magnitude of anomalous subsidence impacts associated with trough subsidence.

Anomalous subsidence can be expressed on the surface as a tension cracks, compression humps, localised areas of excessive tilt, block failure or abrupt scarps. The likelihood and magnitude of anomalous impact is elevated with decreasing mining depth, shallow soil cover, near surface blocky strata (massive sandstone or conglomerate), steep topography or the presence of a major geological structures such as major faults or dykes. A sedimentary boundary between geological units with different material properties can also be areas that experience anomalous subsidence impact.

If a significant risk of anomalous subsidence potentially impacting the site has been identified, Subsidence Advisory may require design or mitigation requirements to address these impacts in addition to those outlined for trough subsidence.

4. Geotechnical Risk Factor (GRF)

The GRF is a qualitative risk assessment that is based on the level of uncertainty regarding four risk factors; the geological environment (R1), level of geotechnical investigation (R2), coal mine plans and records (R3) and the method used to assess stability and subsidence impact (R4).

The weighting applied to each of these four risk variables (R1 to R4) and uncertainty value (U) that applies to each risk factor is outlined in Table C1.

Once these have been determined, the overall GRF can be calculated by application of these values into the following formulae.

$$GRF=(R1 \times U)+(R2 \times U)+(R3 \times U)+(R4 \times U)$$

The risk classifications used for the assessment of geotechnical risk are:

- Low Geotechnical Risk ≤ 16
- Moderate Geotechnical Risk 16 to 23
- High Geotechnical Risk ≥ 23

It should be noted that the above assessment and formulae will return a high geotechnical risk factor should the following be identified:

- irregular workings (see Table B1 for description),
- secondary extraction of pillars within 50m of site (excluding areas where pillars have w/h ratios of > 5 and FoS > 2.1 under abutment loading conditions);
- areas where the panel pillar dimensions indicate that the average pillar w/h ratio is < 2 .

Note: Depending on the type and scale of development, it is more likely that a geotechnical investigation will be required where 'high' geotechnical uncertainty exists.

5. Factor of Safety (FoS)

When assessing the Pillar Panel FoS, Subsidence Advisory requires the following:

- The pillar dimensions should assume a full seam thickness unless it can be demonstrated that intact coal is present in the floor.
- The average panel pillar FoS.
- The pillar loading environment should be carefully considered. Abutment loading should be applied if appropriate.

6. Remediation requirements

For a summary of Subsidence Advisory remediation requirements refer to **Table B2**.

For sites that have been assessed as having a low or moderate geotechnical risk factor, a minimum pillar system FoS has been applied that is dependent upon the geotechnical risk factor and the number of derived lots.

The conditions of approval for sites that have been assessed as having a high GRF are dependent upon the building type irrespective of the calculated FoS for the pillar system.

7. Mine openings, shafts and drifts

Shafts are vertical excavations that extend from the surface to the mine workings. Drifts are inclined tunnels that extend from the surface to the mine workings. Where a shaft or drift is present, Subsidence Advisory requires that the mine opening be fully remediated.

Subsidence Advisory will require that the risk to both public safety and surface infrastructure be removed by either fully remediating the mine opening by the emplacement of grout or the excavation and placement of engineered fill. This will include inspection of the mine entry by a Subsidence Advisory officer at time of remediation.

8. Sinkhole (pothole) risk

Subsidence Advisory classify sinkhole risk into low, medium or high based on:

- Assessment by Subsidence Advisory risk engineers or
- Assessment of sinkhole risk by a geotechnical practitioner with experience in shallow mine subsidence. This assessment must be accepted by Subsidence Advisory technical staff.

The assessment of risk considers the following characteristics:

- cover depth
- borehole information on state of the workings
- overburden characteristics
- seam dip
- the previous history of pothole formation on site or in surrounding areas
- the age and type of mine workings that are present.

The risk to infrastructure, future development and safety shall be addressed.

Subsidence Advisory can provide an assessment of a site's sinkhole risk and the likelihood of a sinkhole impacting the site. Requests can be made as a general enquiry prior to submitting an application. The level of sinkhole risk is based on the likelihood of sinkhole subsidence impacting the site over the lifetime of the structure and the consequence if it occurs.

The attached table (**Table B3**) provides an outline of conditions that Subsidence Advisory may apply in these areas. The table provides guidance on Subsidence Advisory remediation requirements.

9. Block failure risk

Block failures occur in areas where:

- the mine workings are relatively shallow (typically <50m),
- a competent material such as conglomerate or massive sandstone is present in the overburden
- areas of secondary extraction have occurred and the area of secondary extraction is greater than the cover depth
- boreholes indicate that the workings have not failed and a large void is present.

In areas that have been identified as possessing a potential block failure risk, Subsidence Advisory may require:

- a geotechnical investigation be carried out to determine the state of the workings and/or
- a geotechnical assessment of the spanning characteristics and likelihood of failure and/or
- an assessment of the potential impact.

Where a credible block failure risk has been identified, Subsidence Advisory require that the risk be effectively eliminated by a suitable means.

10. Boundary adjustments

If an application is received for a boundary adjustment to a previously approved and current subdivision application, or the application is for a similar number of derivative lots and the subsidence risk has not substantially changed, Subsidence Advisory will re-issue the approval with the same expiry date and conditions.

Table B1 – Geotechnical Risk Factor

| | | Low Uncertainty | Medium Uncertainty | High Uncertainty |
|--|-----------|---|---|--|
| | | U value = 1 | U value = 2 | U value = 3 |
| Geological Environment (R1) | Value = 3 | <p>Mine plans, published geological maps, borehole information or other published sources indicate that;</p> <ul style="list-style-type: none"> No significant geological structures are present within the mined panel that underlies the site. | <p>Mine plans, published geological maps, borehole information or other published sources indicate that;</p> <ul style="list-style-type: none"> A dyke (of any width) is present within the mined panel; or Faulting (single fault > 0.3m throw or more than one fault) is present within the mined panel; or The mine plan indicates that a geological feature consistent with a dyke or fault may be present within the mined panel (i.e. modified layout, truncated roadways etc.). | <p>Mine plans, published geological maps, borehole information or other published sources indicate that;</p> <ul style="list-style-type: none"> A dyke (of any width) is present within the mined panel and within 50m of the site; or Faulting (single fault > 0.3m throw or more than one fault) is present within the mined panel and within 50m of site; or The mine plan indicates that a geological feature consistent with a dyke or fault may be present within 50m of the site (i.e. modified layout, truncated roadways etc.); or Soft roof / floor conditions are present. |
| Level of Geotechnical Investigation (R2) | Value = 2 | <p>Geotechnical investigation sufficient to confirm;</p> <ul style="list-style-type: none"> Depth of all mine workings present below the site, and Confirmation of location of record tracing including void heights and widths, minimum pillar dimensions and any other pertinent information below site; and | <p>Geotechnical investigation sufficient to confirm;</p> <ul style="list-style-type: none"> Depth of all mine workings present below the site; and General information regarding void heights and widths, minimum pillar dimensions and other pertinent information; and state of workings (failed or standing). | <p>No site-specific borehole data, or boreholes located outside of the mined panel</p> |

| | | | |
|--|---|--|--|
| | <ul style="list-style-type: none"> • Material properties of overburden, roof and floor; and • State of workings (failed or standing) | | |
|--|---|--|--|

| | | Low Uncertainty | Medium Uncertainty | High Uncertainty (U) |
|----------------------------------|-----------|---|---|---|
| | | U value = 1 | U value = 2 | U value = 5 |
| Coal Mine Plans and Records (R3) | Value = 3 | <p>Regular workings</p> <ul style="list-style-type: none"> • Pillar width and length show little variation. Headings and cut throughs are aligned. Pillars are parallel along their long axis and no secondary extraction is present within same mined panel; or • Previously fully extracted longwall panel; or • Panel pillar dimensions indicate that the average pillar w/h ratio > 5. | <p>Semi regular workings</p> <ul style="list-style-type: none"> • pillar widths and lengths show some variation but show an approximate alignment along their long axis. Cut throughs and headings are not always aligned or cut in a straight line between pillar groups throughout panel. Pillars show similar shape in plan; or • Secondary extraction of pillars within same mined panel (excluding full extraction); or • Panel pillar dimensions indicate that the average pillar w/h ratio is > 2 but < 5. | <p>Irregular workings</p> <ul style="list-style-type: none"> • pillar widths, roadway widths and long axis of pillars show significant variation. Significant differences in pillar shape and size; or • Secondary extraction of pillars is shown within the mined panel and within 50m of site (excludes areas where pillars have w/h ratios of > 5 and FoS > 2.1 under abutment loading conditions, excluding areas of full extraction); or • Panel pillar dimensions indicate that the average pillar w/h ratio is < 2. |

| | Low Uncertainty | Medium Uncertainty | High Uncertainty (U) |
|---|--|---|---|
| | U value = 1 | U value = 2 | U value = 3 |
| Method used to assess stability and impact (R4) Value = 3 | <ul style="list-style-type: none"> Assumptions in geotechnical model based on results of geotechnical investigation (i.e. state of workings, overburden lithology, cover depth, pillar dimensions, propensity for roof / floor failure); and Method used to assess stability of pillars and subsidence impact has been validated by use of another method – i.e. numerical modelling has been validated by an empirical method; and Pillar Stability calculations are based on the average pillar FoS for panel; and Other potential pillar loading scenarios fully considered and accounted for in model; and All variables and assumptions used in estimating both pillar stability and subsidence impact clearly outlined with justification; and A sensitivity analysis has been carried out on all critical assumptions used in model. | <ul style="list-style-type: none"> Assumptions in geotechnical model partially validated by geotechnical data (i.e. state of workings, overburden lithology/properties, cover depth); and Pillar loading has been estimated using analytical / mechanistic methods; and Pillar Stability based on the average pillar FoS for panel | <ul style="list-style-type: none"> Geotechnical model not supported by any relevant geotechnical data; or The pillar loading environment is complicated by geological or geotechnical factors that have either not been or are not able to be accounted for. These may include; <ul style="list-style-type: none"> - geological structures or intrusions - areas of secondary pillar extraction - stiff units present in the overburden - interactions between multi seam workings. |

Table B2 – Subsidence Advisory design requirements for Trough Subsidence Risk

| Subdivision Size | Minimum FoS Allowable | | | Design Requirements if minimum FoS has been met | Design Requirements if minimum FoS has not been met |
|--|------------------------------------|---|--------------------------------------|---|---|
| | Low Geotechnical Risk Factor (<16) | Moderate Geotechnical Risk Factor (<23) | High Geotechnical Risk Factor (>=23) | | |
| <u>Small Scale subdivision (up to 5 lots)</u> | FoS >1.63 (1:1000) | FoS >1.8 (1:10,000) | N/A | No design requirements. | No design requirements. |
| <u>Medium scale subdivision (6 to 20 lots)</u> | FoS >1.8 (1:10,000) | FoS >1.95 (1:100,000) | N/A | No design requirements. | <p>Subdivision infrastructure is to be designed to be Serviceable* and Repairable* under the estimated subsidence ground movements (subdivision infrastructure incorporates kerb & gutter, drainage, services etc).</p> <p>Pavements are either to be flexible pavements as defined by “Austroads Guide to Pavement Technology Part 2: Pavement Structural Design” or Bound / rigid pavements that are designed to be Repairable* under the estimated subsidence ground movements.</p> |

| | | | | | |
|---|-------------------------------------|--|------------|--------------------------------|--|
| <p><u>Large Scale Subdivision</u> (>20 lots)</p> | <p>FoS >1.95 (1:100,000)</p> | <p>FoS >2.1 (>1:1,000,000)</p> | <p>N/A</p> | <p>No design requirements.</p> | <p>Subdivision infrastructure is to be designed to be Serviceable* and Repairable* under the estimated subsidence ground movements (subdivision infrastructure incorporates kerb & gutter, drainage, services etc).</p> <p>If it cannot be demonstrated that residential construction (in accordance with the Surface Development Guideline that has been applied to the base lot) will remain Serviceable*, mitigation or effective elimination of the risk of mine subsidence by grouting of the mine will be required. This will include a Grout Design, Implementation, Verification Plan completed in accordance with Attachment D, followed by a peer review as outlined in Attachment C.</p> <p>Pavements are either to be flexible pavements as defined by “Austroads Guide to Pavement Technology Part 2: Pavement Structural Design” or Bound / rigid pavements that are designed to be Repairable* under the estimated subsidence ground movements.</p> |
|---|-------------------------------------|--|------------|--------------------------------|--|

*Refer to Section 4.6 for Definition for Serviceable and Repairable design requirements

Table B3 – Subsidence Advisory design requirements for Sinkhole Risk

| Sinkhole Risk | Summary of design requirements |
|---------------|--|
| Low | <ul style="list-style-type: none"> Subdivision infrastructure is to be designed to be Repairable* under the estimated subsidence ground movements (i.e. differential subsidence due to goaf consolidation or estimated sinkhole diameter). It must be demonstrated that future development is consistent with Surface Development Guideline 1A or 2 and will remain Serviceable* if subjected to differential mine subsidence ground movements. If this cannot be demonstrated, mitigation or effective elimination of the risk of mine subsidence by grouting will be required. This will include a Grout Design, Implementation, Verification Plan completed in accordance with Attachment D, followed by a peer review as outlined in Attachment C. |
| Moderate | <ul style="list-style-type: none"> Effective elimination of the risk of mine subsidence via grouting will be required. This will include a Grout Design, Implementation, Verification Plan completed in accordance with Attachment D, followed by a peer review as outlined in Attachment C. Effective elimination of the risk is not required for the following lots subject to controls being implemented to ensure that the public safety risk managed effectively; <ul style="list-style-type: none"> Any residual lot/s until a further subdivision application is made Lots with existing Subsidence Advisory approved residential structures constructed on them Lots where current land zoning does not allow for development |
| High | <ul style="list-style-type: none"> Effective elimination of the risk of mine subsidence via grouting will be required. This will include a Grout Design, Implementation, Verification Plan completed in accordance with Attachment D, followed by a peer review as outlined in Attachment C. Removal of the risk is not required for the following lots subject to controls being implemented to ensure that the public safety risk is low; <ul style="list-style-type: none"> Any residual lot/s until a further subdivision application is made Lots with existing Subsidence Advisory approved residential structures constructed on them in compliance with Surface Development Guideline 1 Lots where current land zoning does not allow for development |

*Refer to Section 4.6 for Definition for Serviceable and Repairable design requirements

Attachment C: Subsidence Advisory's minimum requirements for Geotechnical Reports

Geotechnical reports submitted to Subsidence Advisory as part of a subdivision application should clearly address the following:

1. The likelihood of mine subsidence affecting the site

An assessment of this should be clearly stated in the report, including, where applicable, an assessment of:

- Pillar failure
- Surface pothole formation
- Non-systematic subsidence events e.g. block failure, tension cracks etc.
- Migration of overlying soil into subsidence cracks or mine voids
- Susceptibility of drifts and shafts to fail
- Residual subsidence due to ongoing goaf consolidation and settlement of the overburden
- 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
 - The sources of information on which the assessment is based and their reliability, including a discussion of geotechnical data and perceived gaps, if any, in information with reference to the geotechnical model as defined in AS1726-2017 Geotechnical site investigations
 - Comment on potential changes in state of the workings over time.

The geotechnical practitioner should provide recommendations on geotechnical investigation requirements to confirm that the assumptions made in the assessment are suitable and remove any perceived gaps in geotechnical data (i.e. where assessment identifies parametric sensitivity, variable or poor geological conditions, poor confidence in mine records, condition/layout/state of the workings is unknown.)

2. The consequence of subsidence

Including, where applicable, predictions of:

- Surface deformations including
 - Vertical subsidence (mm)
 - Horizontal displacement both tensile and compressive (mm/m)
 - Tilt (mm/m)
 - Radius of curvature (km⁻¹)
- Potential for non-conventional subsidence events and estimated type and impact.

- Potential for block failure.

3. 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.

4. Reporting

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)
- Georeferencing of the mine workings to surface cadastre and level of confidence in accuracy
- 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), panel (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)
- Potential for block failure
- Clear recommendations – The geotechnical practitioner is to clearly put forward their conclusions and recommendations and avoid the use of ambiguous language.

5. Geotechnical Investigation

Subsurface investigation requirements:

- All subsurface investigations (borehole, test pit, etc) are to be logged in accordance with AS1726-2017: Geotechnical site investigation observed by suitably qualified and experienced geotechnical engineer or engineering geologist.
- A log is to be provided for each test location. Pertinent investigation details should also be recorded on the log (details of mine workings including depths of voids, rubble and mine/seam floor, drilling methods and depths, casing types and depths, groundwater observations, drill fluid/air loss etc).

- Core photos and point load strength testing results are to be provided for cored boreholes. Test pit photos are to be provided.
- The test locations should be surveyed, and the coordinates and surface level recorded on the log. A test location plan is to be provided showing the test locations with respect to the proposed development and the mine record trace.
- The number of test locations and the investigation methods (non-cored or cored) should be sufficient to develop a geotechnical model of the site and reduce uncertainty in the layout (dimensions) and condition of the workings.
- The subsurface investigation method is to be suitable for the site considering geology, groundwater and contamination aspects. The method is to be appropriate so as to not introduce new or increase existing site risks considering the investigation may encounter mine workings (i.e. increase the potential for subsidence or investigation related events e.g. surface depression/sinkhole, in-seam fires etc). Methodology should include sealing of boreholes with grout following investigation, appropriate backfilling of test pits, suitable drilling, and casing methods for geological conditions at the site, etc.
- Additional investigation methods such as downhole camera, sonar and geophysical logging tools are to be undertaken to support the assessment where a poor level of confidence in the mine records and current condition of the workings is identified. The test location plan is to be marked up showing the results of the camera and sonar investigations.

6. Modelling

In some instances, numerical modelling may be required to assess the risk and magnitude of subsidence impacts for a proposed development.

Subsidence Advisory requires that the appropriate modelling package is selected for the intended use.

All inputs and assumptions are to be clearly defined (including supporting references) to allow assessment by Subsidence Advisory and potential peer reviewer/s.

Any assumptions applied to the numerical modelling are to be fully justified in the report.

A sensitivity analysis should also be carried out using worst case assumptions.

An electronic copy shall be provided to Subsidence Advisory on request so that the model can be reverse engineered in the event that mine subsidence occurs.

7. Peer Review

Peer reviews of geotechnical reports, numerical models and/or grouting/remediation plans may be requested by Subsidence Advisory. Peer reviews are to:

- Be conducted by a practitioner with appropriate expertise in the area in which the report was written (geotechnical, numerical modelling or subsidence remediation/prevention measures) and who are considered acceptable by Subsidence Advisory
- Review the report in its entirety
- Comment on whether the assessment conforms with Subsidence Advisory policy requirements as described above. If not, the reviewer is to outline the areas that the assessment is lacking for the author to address.

The reviewer is to confirm the method and outcomes of the initial assessment. If the reviewer determines the assessment outcomes are based on insufficient or inaccurate information, the reviewer is to outline the areas that the assessment is lacking for the author to address.

Provide any additional information, comment, or analysis that the reviewer considered pertinent to the assessment.

Attachment D: Grouting/Remediation Plans, Verification and Reporting Requirements

The following outlines minimum requirements for grout/remediation plans.

1. General

- The grout designer is to develop a remediation strategy specific to the site that will remove the subsidence risk. The strategy is to outline the methodology for grouting/remediation and provide a framework for verifying the works.
- The plan is to be prepared by a qualified geotechnical practitioner who is familiar with the site conditions and experienced in the development and writing of grout/remediation plans and the supervision of grouting/remediation projects.
- The plan should provide clear roles and responsibilities for all who are involved in the works (e.g. drilling contractor, grouting contractor and site verification engineer).
- The plan should provide a summary of expected ground conditions at the site, i.e. overburden, coal seam depths, mined seams at the site, depth to the workings, condition of the workings etc.
- The plan is to clearly describe any geotechnical risks specific to the site and risks associated with the proposed grouting/remediation method. The plan is to outline controls required to mitigate these risks (e.g. appropriate casing materials and seating requirements for ground conditions). During the works, the site verification engineer is to ensure the controls are adequate and have been implemented.

2. Drilling

- The plan must show the location of the proposed bores and give sufficient information for bore set out (e.g. dimensions shown on plan, survey coordinates).
- The plan is to describe the minimum drilling requirements including: drilling methods (e.g. rotary mud, air percussion etc); bore diameter; casing material types and depths; and give bore termination criteria (e.g. 1 m below seam level).
- The bores are to be logged by either the driller or a suitably experienced person. The drilling log is to record (at a minimum): Bore number; date drilled; bore inclination/azimuth; driller; casing details and depths; strata – depth of soil, top and bottom of any coal seams, voids, rubble/goaf and seam floor; bore end depth; drilling water/air loss; and any other notable observations.
- The condition and layout of the workings should be confirmed using downhole camera, sonar and/or geophysical tools. At a minimum, downhole camera inspection is to be undertaken to confirm the condition of the workings. In instances where wide bore spacing is proposed, the dimensions and layout of the mine workings are to be confirmed with measurement tools such as sonar or laser. The results of the bores, camera and sonar are to be compared with the geo-referenced mine record traces.
- Include a procedure to assess the potential to impact to the grout design intent should the ground conditions differ to that assumed during design (e.g. allowance for hiatus in program to review conditions and confirm bore spacing/grout sequence is appropriate, redrilling bores at an offset for bores that encounter coal, etc).
- Bore spacings are to be suitable for the condition of the workings and for the proposed grout mix.

- Each bore location and collar RL is to be surveyed and recorded.

3. Grouting

- The plan is to provide requirements for the design grout mix (UCS strength, proposed mix constituents, desired flowability characteristics – high or low mobility grouts, etc). The proposed design grout mix is to be suitable for the current state of the mine workings (e.g. in flooded or dry workings, open void or collapsed/goafed conditions etc) and require evidence be provided to show the mix does not segregate. The site verification engineer is to confirm the suitability of the proposed grout mix/es prior to use.
- The plan is to provide quality control and assurance requirements that are appropriate for the grout mix/es (e.g. sampling and testing regime undertaken to recognised standard, nominate target UCS strengths for standard curing ages – noting that at a minimum a 7 day test should be carried out, consistency testing range for desired flow characteristics and any other criteria specific to the works). A procedure is to be provided in the plan should QA requirements not be met.
- A grout volume estimate is to be provided.
- The plan is to outline a sequence in which the bores will be grouted.
- The plan is to state grout tremie pipe requirements (e.g. tremie at the base of the workings and raised as progressively as the workings fill).
- All bores drilled should be grouted to the surface. Consideration is to be given where surface assets (public or private) are to be reinstated (e.g. footpaths, road pavements, concrete slabs etc). If not, for example where a bore is to be plugged, a robust procedure is to be provided detailing how the borehole will be plugged/backfilled, including a method to test and confirm the bore has been adequately sealed prior to removal or grouting of the bore casing. The site verification engineer is to confirm that the borehole plug/backfill works were completed satisfactorily and that there is no risk of failure of the borehole seal.
- The plan is to outline rectification measures should the grout not meet the grout plan objectives/design intent (e.g. inadequate grout strengths, permeation of rubble etc).

4. Verification Methodology

Clearly outline the method or framework by which the verification engineer and grouting contractor is to confirm works have been completed satisfactorily.

The method/framework is to include:

- Monitoring requirements during drilling and grouting activities (e.g. site observations, borehole dip levels, review of borehole logs/conditions encountered in boreholes, monitoring grout flow with borehole camera etc).
- Requirement for camera/sonar inspection of mine workings during the works for verification of mine layout and to confirm satisfactory grouting.
- Requirement for check testing of or supervision of grouting contractor QA/QC testing by site verification engineer.
- Provision of QA/QC results in timely manner to site verification engineer.
- Provide minimum requirements for bores drilled to verify the works (e.g. drilling method cored/non-cored, downhole camera / sonar / laser inspection, number of bores etc). Video footage should be available to Subsidence Advisory for viewing when submitting the grout verification output report for approval.
- Where practicable, sampling and testing of installed grout to confirm in-situ grout strengths.

- Any other requirements specific to the grouting/remediation methodology or to confirm grout design/numerical modelling assumptions.

The Grout Verification Output Report is to include:

- A summary of drilling and grouting works undertaken at the site.
- A summary of evidence provided to confirm suitability of utilised grout mix/es including comment on segregation.
- Confirmation that the grouting works were undertaken in accordance with the grout plan including any additional measures that were required to achieve the grout design intent. The grout designer is to confirm the completed grouting works achieve the design intent.
- Confirmation of post grouting subsidence design parameters, if applicable.
- Confirmation of any other related conditions set out in Subsidence Advisory's Notice of Determination/General Terms of Approval.
- A copy of grout records per borehole, tremie depths, QA/QC results, bore logs, camera/sonar/laser interpretation logs, geophysical tool logs, borehole collar survey results, grout volume records such as delivery docket/weighbridge docket etc.

Drawings are to include:

- The location of the bores with identifier to show if the bore intersected workings or coal. Where the bores are inclined, the surface and at seam level locations are to be shown.
- For both mapped and unmapped workings, show an interpretation of the layout of the workings based on drilling, camera, sonar/laser results. Include interpretation on overlay of mine record trace, if available.
- The location of the grout areas and grout volumes per bore.
- Outline of proposed development.
- Any variation to the grout plan is to be submitted to Subsidence Advisory for review and not undertaken until consent is given.
- Alternate remediation/preventative measures may be considered. The measures must achieve the same design intent as grouting (i.e. removal of subsidence risk) and must provide evidence showing proof of concept for assessment by Subsidence Advisory.

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