MALABAR

# MAXWELL UNDERGROUND MINE

## Technical Report 3

### Surface Water Review

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# MEMORANDUM

| | |
|---|---|
| **Date** | 11 May 2026 |
| **Attention** | Donna Tiananga |
| **Company** | Malabar Resources c/- Resource Strategies |
| **WRM ref.** | 1383-19-B1 |
| **Subject** | Woodlands Hill Seam Extraction Plan Amended Layout - Surface Water Assessment - Technical Review Memo |

Dear Donna,

# 1 INTRODUCTION

## 1.1 BACKGROUND

WRM Water & Environment Pty Ltd (WRM) has previously provided surface water advice on extraction plans for the Maxwell Underground Mine (Maxwell Mine). Maxwell Mine is owned and operated by Maxwell Ventures (Management) Pty Ltd (Maxwell). Maxwell is a wholly owned subsidiary of Malabar Resources Limited (Malabar).

Most recently, WRM undertook a surface water technical review in support of the first Extraction Plan (EP) for Woodlands Hill seam longwalls 1 to 4 (WRM report reference 1383-14-B3, dated January 2025) (WRM, 2025). For the EP review, WRM considered the Subsidence Assessment Report prepared by Mining Subsidence Engineering Consultants (MSEC) in January 2025 (MSEC report number MSEC1454) (MSEC, 2025). The EP was approved in September 2025.

Maxwell proposes to amend the EP layout for the Woodlands Hill seam longwalls 1 to 4 (the Amended Layout). MSEC has prepared a further Subsidence Assessment considering the predicted incremental and ultimate predicted subsidence from underground workings from the Amended Layout (MSEC report number 1554, Revision A, dated March 2026) (MSEC, 2026).

## 1.2 SCOPE OF WORKS

Maxwell has requested WRM to review the MSEC Subsidence Assessment Report for the Amended Layout and provide advice on:

- Whether the conclusions of the EP Surface Water Technical Report (WRM, 2025) remain valid and applicable; or
- Where relevant, identify where previous conclusions are not valid, and whether changes to surface water monitoring and management measures should be recommended.

Key scope tasks include:

- Review of the Subsidence Assessment Report for the Amended Layout (MSEC, 2026);
- Prepare a letter report reporting the findings and recommendations (if any) of the review.

## 2 CHANGES TO PREDICTED SUBSIDENCE

Figure 1 shows the Amended Layout for the Woodlands Hill seam longwalls compared to the current EP layout (reproduced from MSEC (2026)). Note, the EP layout is also referred to as the 'MOD2 layout' or the 'Approved layout' in MSEC (2026).

Figure 2 shows the Amended Layout overlaid on existing natural features at the site, including unnamed local drainage lines reporting to Saddlers Creek.

Key changes to the Woodlands Hill seam longwalls (WHLW1 to WHLW4) in the Amended Layout include:

- WHLW1 – no changes;
- WHLW2 – no changes to longwall, but decrease in tailgate chain pillar width from 30 metres (m) to 24 m;
- WHLW3 – increase in longwall void width from 150 m to 255 m and decrease in tailgate chain pillar width from 30 m to 28 m; and
- WHLW4 – increase in longwall void width from 150 m to 255 m, increase the tailgate chain pillar width from 30 m to 32 m, and extend the finishing (i.e. eastern) end by approximately 110 m.

We understand that no changes in dimensions are proposed for the remaining Woodlands Hill longwalls (WHLW5 to WHLW17), although the longwall panel locations are changing due to changes in void width at WHLW3 and WHLW4.

Figure 3 and Figure 4 show the predicted change in vertical subsidence between the Amended and EP layouts, for WHLW1 to WHLW4 and WHLW1 to WHLW17, respectively.

Figure 5 and Figure 6 show the maximum predicted subsidence contours due to the extraction of WHLW1 to WHLW4 for the EP and Amended layouts, respectively

**Figure 1** **EP (Approved / MOD2) and Amended layouts for the Woodlands Hill seam longwalls (Source: Figure 1.2, MSEC (2026))**

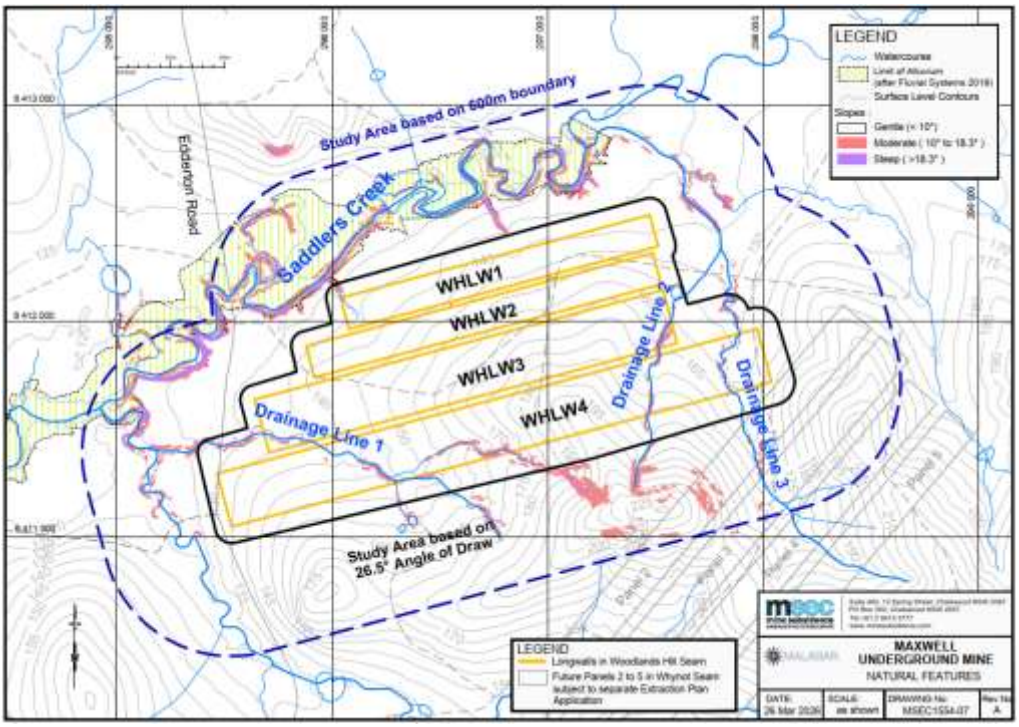


**Figure 2** **WHLW1 to WHLW4 for the Amended Layout relative to existing natural features (Source: Drawing no. MSEC1554-07, MSEC (2026))**

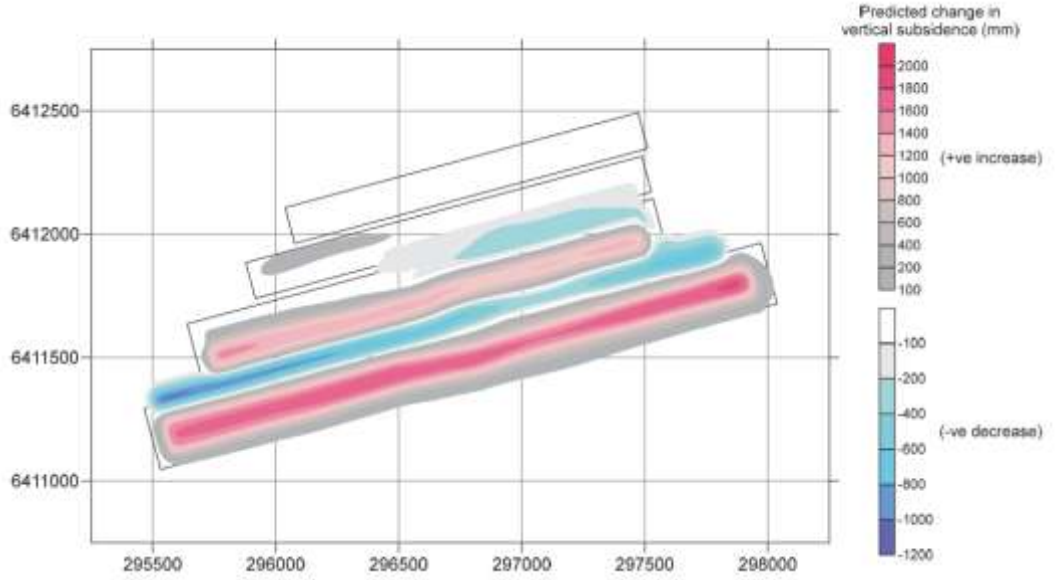


**Figure 3** **Predicted changes in vertical subsidence for WHLW1 to WHLW4, Amended Layout compared to EP Layout, (Source: Figure 4.1, MSEC (2026))**

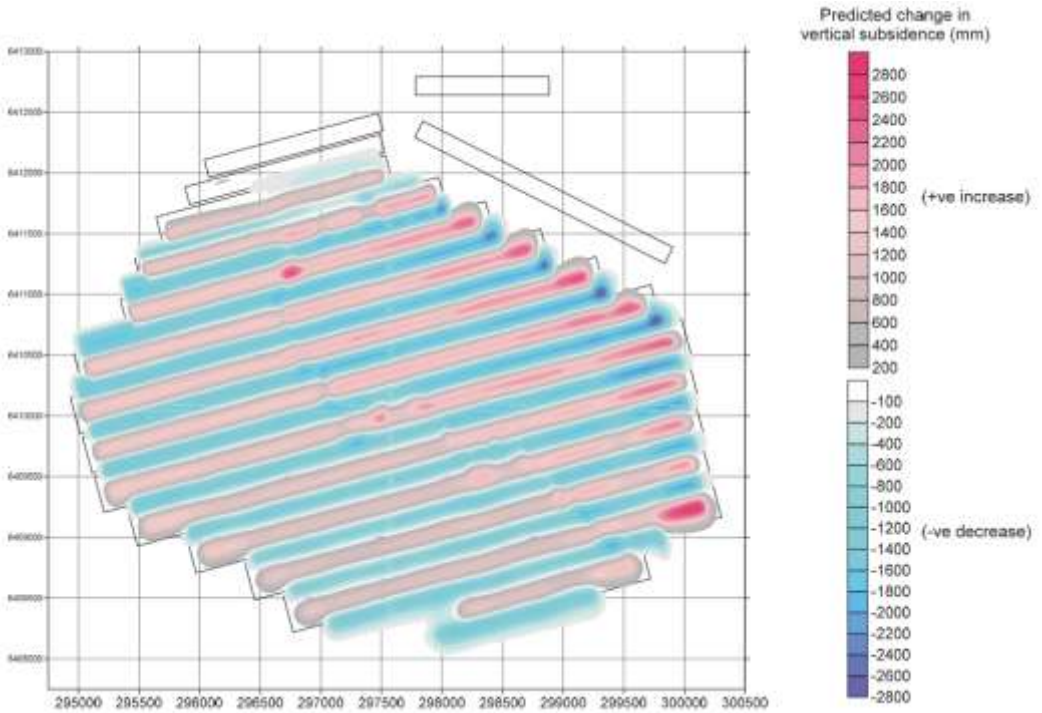


**Figure 4** **Predicted changes in vertical subsidence for WHLW1 to WHLW17, Amended Layout compared to EP Layout, (Source: Figure 4.2, MSEC (2026))**

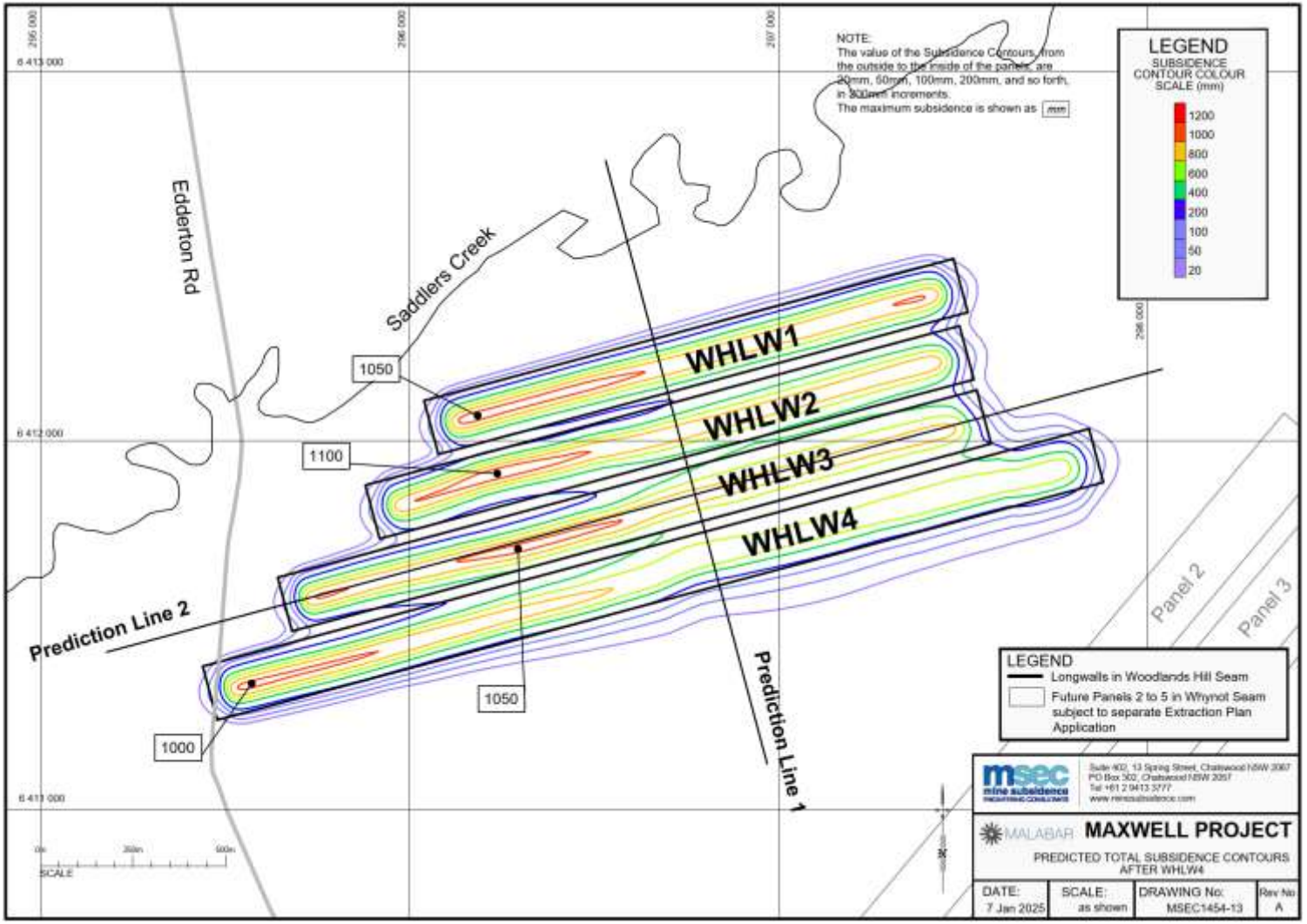


**Figure 5** **Maximum predicted subsidence contours for WHLW1 to WHLW4, EP Layout (MSEC, 2025)**

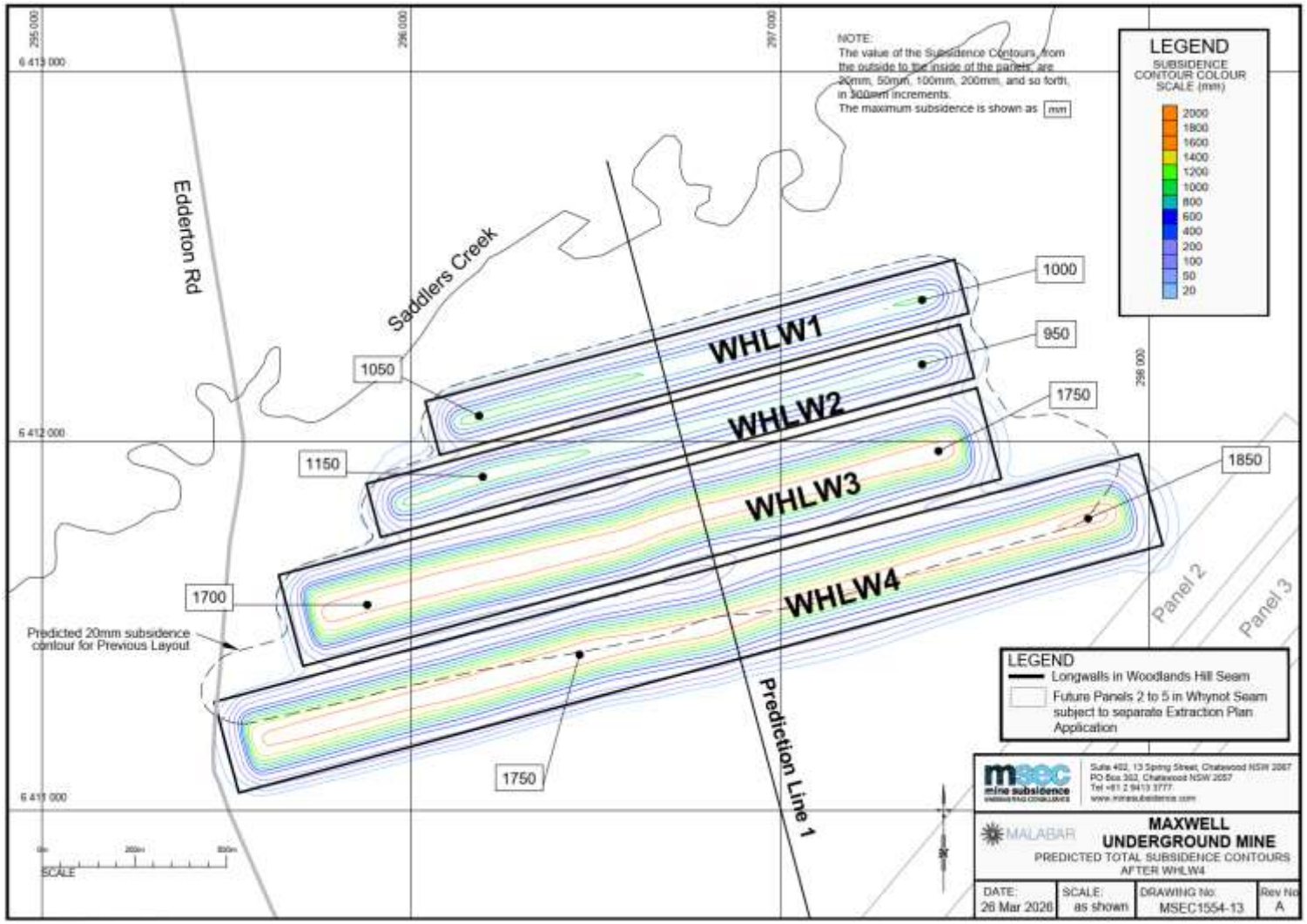


**Figure 6** **Maximum predicted subsidence contours for WHLW1 to WHLW4, Amended Layout (MSEC, 2026)**

Table 1 shows the maximum predicted subsidence effects for the Woodlands Hill seam for both the EP Layout and Amended Layout, for extraction of WHLW1 to WHLW4, and WHLW1 to WHLW17 (i.e., the entirety of Woodlands Hill seam).

**Table 1 Maximum predicted subsidence effects for the extraction of longwall panels in the Woodlands Hill Seam, EP and Amended layouts.**

| Layout | Maximum predicted total vertical subsidence (mm) | Maximum predicted total tilt (mm/m) | Maximum predicted total hogging curvature ($km^{-1}$) | Maximum predicted total sagging curvature ($km^{-1}$) |
|---|---|---|---|---|
| EP Layout (WHLW1 to WHLW4) | 1100 | 25 | 0.7 | 1.2 |
| Amended Layout (WHLW1 to WHLW4) | 1850 | 30 | 1.0 | 1.5 |
| EP Layout (WHLW1 to WHLW17) | 3300 | 35 | 1.5 | 1.5 |
| Amended Layout (WHLW1 to WHLW17) | 3300 | 35 | 1.5 | 1.5 |

The predicted subsidence data shows that:

- For WHLW1 to WHLW4, the predicted subsidence effects are greater for the Amended Layout than for the EP Layout, in the short term.
- As extraction continues to WHLW5 and beyond, the subsequent predicted subsidence effects moderate the predicted increased subsidence effects from WHLW1 to WHLW4.

Consequently, the magnitude of the predicted maximum subsidence effects for the entirety of the Woodlands Hill seam (i.e., WHLW1 to WHLW17) is no worse for the Amended Layout than for the EP Layout.

# 3 CHANGES TO POTENTIAL IMPACTS

The EIS (WRM, 2019) and Modification 2 (WRM, 2022) surface water assessments identified the following key potential subsidence impacts for the Maxwell Mine:

- Direct subsidence impacts on the Hunter River and/or Saddlers Creek;
- Loss of catchment flow due to increased ponding caused by subsidence on existing drainage lines; and
- Surface cracking leading to loss of surface water flows.

The MSEC (2026) subsidence assessment of predicted subsidence impacts is as follows:

- The Hunter River:
  - Is not predicted to experience measurable vertical subsidence, far-field horizontal movements or valley-related effects due to the mining of WHLW1 to WHLW4.

- Is therefore not expected to experience adverse physical impacts due to the mining of the Woodlands Hill seam (WHLW1 to WHLW17) based on the Amended Layout.

- Saddlers Creek:
  - Maximum predicted subsidence effects based on the Amended Layout are the same as the predicted impacts based on the EP Layout.
  - Is not expected to experience adverse physical impacts due to the mining of WHLW1 to WHLW4 based on either the EP or Amended layouts.

- Drainage lines 1, 2 and 3 (see Figure 2):
  - Maximum predicted subsidence effects based on the Amended Layout are greater than predicted for the EP Layout, for WHLW1 to WHLW4.
  - However, the maximum predicted subsidence effects based on the Amended Layout are similar to those predicted for the EP Layout, for WHLW1 to WHLW17.
  - Potential physical impacts on the drainage lines for WHLW1 to WHLW4 include a reduction in grade (drainage lines 1 to 3) and potential for increased ponding (drainage line 3).
  - Potential for increased ponding on Drainage line 3 for WHLW1 to WHLW4 is less than 0.5 m deep and less than 100 m long. This is small compared to the predicted increased ponding potential under the EP Layout for all seams (up to approximately 3 m deep and approximately 500 m long).

Based on the assessment of predicted maximum total subsidence impacts presented in MSEC (2026), extraction of the Woodlands Hill Seam under the Amended Layout is therefore expected to result in potential surface water impacts that are comparable to, and no worse than, those assessed for the EP Layout, including:

- No direct subsidence impacts on the Hunter River or Saddlers Creek, including flooding impacts;
- Negligible reduction in Saddlers Creek flows resulting from subsidence-related ponding. Any ponding depressions are expected to progressively infill with sediment over time, thereby reducing the extent of surface ponding;
- Negligible diversion of surface flows into underlying strata during low-flow conditions within Saddlers Creek tributary drainage lines; and
- No measurable change to flooding behaviour within Saddlers Creek tributary drainage lines because of subsidence impacts under the Amended Layout.

# 4 SUBSIDENCE MONITORING AND MANAGEMENT

Based on the above assessment, no amendments to the approved monitoring and management measures are proposed. Ongoing monitoring, together with adaptive management, would provide a framework for identifying, assessing, and addressing unforeseen subsidence-related surface water impacts.

Table 2 summarises the surface water monitoring activities previously recommended for inclusion in the Water Management Plan (WMP). Walkover inspections with photographic documentation remain the primary means of identifying surface cracking, erosion or ponding.

Ongoing monitoring and application of an adaptive management framework remain appropriate to verify predicted outcomes and to respond to any unanticipated conditions identified during mining, consistent with accepted industry practice (MSEC, 2026).

Table 3 summarises the relevant performance indicators, trigger events and response actions for managing potential impacts on drainage lines. This framework provides a structured and proportionate mechanism for investigating and responding to any impacts identified through monitoring, without the need for pre-emptive amendments to the approved monitoring program.

Where monitoring indicates subsidence-related impacts, supplementary assessment and targeted management or remediation measures would be implemented as required. Such measures may include refinement of monitoring frequency or methods, or site-specific remediation works, and would be undertaken in accordance with the Australian GeoGuides for Slope Management and Maintenance (AGS, 2007), MSEC (2026) guidance, and WRM (2025). Remediation would be proportionate and designed to avoid causing impacts greater than those resulting from subsidence itself.

# 5 SUMMARY OF FINDINGS

Based on the MSEC (2026) subsidence assessment and the WRM (2025) surface water review:

- Maximum predicted subsidence impacts from the extraction of the Woodlands Hill seam under the Amended Layout are not predicted to be greater than those assessed for the EP Layout;
- The location and extent of potential impacts are not expected, based on current predictions, to be materially altered; and
- The existing surface water monitoring and management measures are considered appropriate, having regard to the level of predicted impact.

**Table 2 – Proposed monitoring for surface water impacts**

| Monitoring task | Methodology | Timing |
|---|---|---|
| Water quality & stream health monitoring | As per Surface Water Management Plan | As per Surface Water Management Plan |
| Walkover visual inspection and photographic record of drainage lines | Identify and mark the upstream and downstream limits of Woodlands Hill Seam Longwalls 1 to 4 on drainage lines | Prior to undermining of drainage lines |
| | Undertake a baseline inspection by walking along the drainage lines over Woodlands Hill Seam Longwalls 1 to 4 and noting the condition of vegetation in the channel and any areas of active erosion, sediment deposition, water ponding or streambed cracking | Prior to undermining of drainage lines |
| | Collect photographic record of channel condition along drainage lines over Woodlands Hill Seam Longwalls 1 to 4 | Prior to undermining of drainage lines |
| | Undertake periodic walkover inspection along drainage lines over Woodlands Hill Seam Longwalls 1 to 4 and update photographic record | Within 3 months of undermining of drainage lines<br>Ongoing inspections every 6 months for one year after undermining |

**Table 3 – Surface water response actions – subsidence drainage impacts**

| Issue | Performance indicator | Trigger event | Action |
|---|---|---|---|
| Drainage lines | Change in visible bed or bank erosion | Noticeable new areas of erosion or expansion of existing erosion | Obtain specialist advice on appropriate remediation works. Disturbance of existing vegetation increases the risk of erosion. Hence, machinery access for remediation works can potentially cause greater impacts than those caused by subsidence. |
| | Development of, or change in headcut erosion along drainage lines | Initiation of headcut or noticeable upstream advance of existing headcut | Obtain specialist advice on appropriate remediation works. Preferred management strategies would include slope stabilisation, revegetation and bed control using natural materials such as local rock and large woody debris. |
| | Extent and duration of water ponding | Development of new pools or drainage of existing pools | Obtain survey of ponded area to identify ponding depth and extent.<br>Investigate potential drainage works to restore existing drainage characteristics. |

Regards,

**Daniel Sheehy**

Principal Engineer

**References**

**References**


| Citation | Reference |
|---|---|
| AGS, 2007 | Australian Geomechanics Society (AGS) (2007). The Australian GeoGuides for Slope Management and Maintenance. Australian Geomechanics, Vol. 42, No. 1, March 2007. |
| MSEC, 2025 | Mine Subsidence Engineering Consultants (MSEC) (2025). Extraction Plan – Subsidence Assessment. Report in support of extraction plan application, January 2025. |
| MSEC, 2026 | Mine Subsidence Engineering Consultants (MSEC) (2026a). Amendment of Extraction Plan – Subsidence Assessment. Report in support of extraction plan application, March 2026. |
| WRM, 2025 | WRM Water & Environment (2025). Woodlands Hill Panels 1 to 4 Extraction Plan – Surface Water Assessment – Technical Review Memo. January 2025. |

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# MEMORANDUM

| | |
|---|---|
| **Date** | 13 January 2025 |
| **Attention** | Donna McLaughlin |
| **Company** | Malabar Resources c/- Resource Strategies |
| **WRM ref.** | 1383-14-B3 |
| **Subject** | Woodlands Hill Panels 1 to 4 Extraction Plan - Surface Water Assessment - Technical Review Memo |

Dear Donna,

This memorandum presents the results of our review of the predicted subsidence and potential surface water impacts for the secondary extraction of the first four longwalls in the Woodlands Hill Seam at the Maxwell Underground Mine.

# 1 BACKGROUND

## 1.1 OVERVIEW

The Maxwell Underground Mine (Maxwell Mine) is an underground coal mining operation located in the Upper Hunter Valley of New South Wales (NSW), east-southeast of Denman and south-southwest of Muswellbrook. The Maxwell Mine is owned and operated by Maxwell Ventures (Management) Pty Ltd (Maxwell), a wholly owned subsidiary of Malabar Resources Limited (Malabar). Maxwell has approval to extract bord and pillar panels (with partial pillar extraction) in the Whynot Seam, and extract longwalls in the Woodlands Hill, Arrowfield and Bowfield Seams.

Malabar submitted an Environmental Impact Statement (EIS) for the Maxwell Mine in July 2019 (SSD 9526). Development Consent State Significant Development (SSD) 9526 for the Maxwell Mine was granted by the NSW Independent Planning Commission (IPC) on 22 December 2020. The Maxwell Mine was subsequently approved under the Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act) on 10 March 2021 (EPBC 2018/8287).

Malabar sought to modify Development Consent SSD 9526 under section 4.55(1A) of the *Environmental Planning and Assessment Act 1979* (EP&A Act) for a minor extension to the mine entry area (MEA) (Modification 1). Modification 1 was subsequently approved on 19 November 2021, and EPBC 2018/8287 was varied on 14 December 2021.

The development consent was further modified (Modification 2) on 19 October 2022 to allow for:

- Re-orientation of the longwall panels in the Woodlands Hill, Arrowfield and Bowfield Seams resulting in a minor increase in the approved underground mining extent.
- Reduction in the width of some of the longwall panels in the Woodlands Hill Seam.
- Repositioning of the upcast ventilation shaft site and associated infrastructure.
- Other minor works and ancillary infrastructure components (e.g. access road and ancillary water management infrastructure for the repositioned ventilation shaft site).

### 1.2 SCOPE OF WORKS

Malabar is currently preparing an Extraction Plan for Woodlands Hill Seam Longwalls 1 to 4 (referred to as the EP). Malabar has engaged WRM Water & Environment (WRM) to:

- Review the subsidence reports associated with the EP;
- Identify the locations of predicted subsidence relevant to the EP, as well as any potentially impacted surface infrastructure and/or watercourses; and
- Prepare a memorandum presenting the results of the review and outlining a recommended surface water monitoring programme and Trigger Action Response Plan (TARP) measures.

This memorandum presents the methodology and results of the above tasks.

## 2 PREDICTED SUBSIDENCE

### 2.1 OVERVIEW

Predicted subsidence due to underground mining includes vertical displacement (subsidence), changes in slope (tilt), and rate of change of slope (curvature, both hogging and sagging).

Figure 2.1 shows the general layout of proposed Maxwell Mine underground workings for the Whynot, Woodlands Hill, Arrowfield and Bowfield seams, reproduced from the EIS Subsidence Assessment prepared by Mining Subsidence Engineering Consultants Pty Ltd (MSEC) (MSEC, 2019). This layout is referred to as the EIS layout.

Figure 2.2 shows the general layout of proposed revised Maxwell Mine underground workings for the Whynot, Woodlands Hill, Arrowfield and Bowfield seams, reproduced from the Modification 2 Subsidence Assessment prepared by MSEC (2022). This layout is referred to as the Modified layout. The Modified layout allowed for reorientation of the Woodlands Hill, Arrowfield and Bowfield seams longwall panels (resulting in a minor increase in the approved underground mining extent), and a reduction in the width of some of the Woodlands Hill Seam longwall panels.

Figure 2.3 shows the proposed layout of Woodlands Hill Seam Longwalls 1 to 4, for the EP, reproduced from the EP subsidence predictions and impact assessment prepared by MSEC (2025). This layout is referred to as the EP layout. The EP layout for Woodlands Hill Seam Longwalls 1 to 4 and the Modified layout are the same.

Malabar previously submitted an Extraction Plan for the first four bord and pillar panels in the Whynot Seam (Panels 2 to 5). The Woodlands Hill Seam EP Layout is located outside the extent of the Whynot Seam Panels 2 to 5 layout (Figure 2.3).

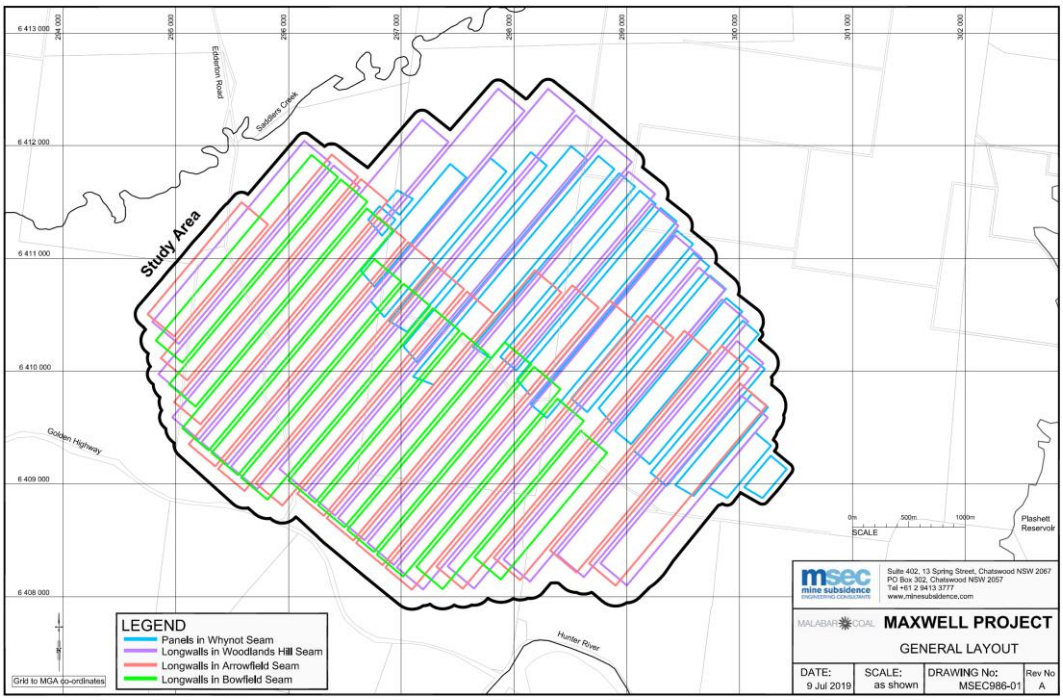


**Figure 2.1 Proposed Maxwell Mine workings, EIS Layout (MESC, 2019)**

**Figure 2.2 Proposed Maxwell Mine workings, Modified Layout (MSEC, 2022)**

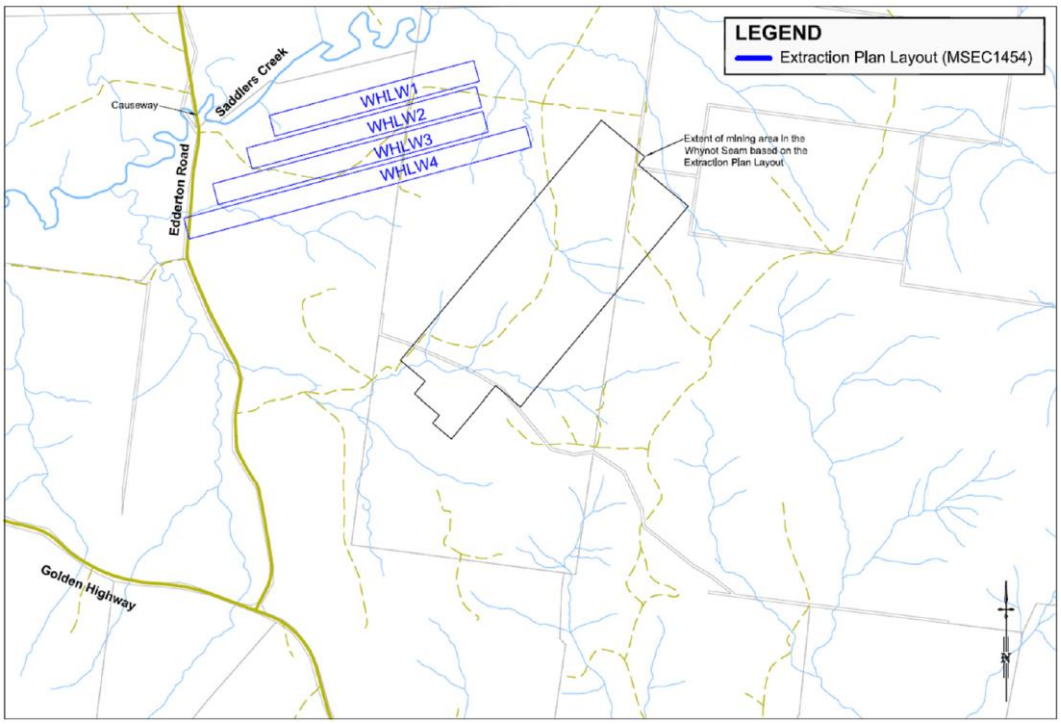


**Figure 2.3 Extraction Plan layout for Maxwell Mine Woodlands Hill longwalls 1 to 4 workings, EP Layout. Reproduced from MSEC (2025).**

## 2.2 PREDICTED EXTRACTION PLAN LAYOUT SUBSIDENCE

MSEC (2019, 2022) provides estimates of predicted subsidence for each seam, as well as cumulative total subsidence after extraction of each seam.

MSEC (2025) provides updated subsidence estimates for Woodlands Hill Seam Longwalls 1 to 4, based on the EP layout, and updated assumptions on extraction methods and maximum depth of cover.

Table 2.1 presents the maximum predicted subsidence due to extraction of longwalls in the Woodlands Hill Seam for the Modified layout and EP layout. It also includes the approved cumulative predicted subsidence due to the Maxwell Mine, for context.

The predicted subsidence data (MSEC, 2022 & 2025) shows that:

- The EP longwall layout for Woodlands Hill Seam extraction is generally the same as the Modified longwall layouts.
- Predicted EP layout subsidence from Woodlands Hill Seam extraction is unchanged from the predicted Modified layout subsidence from Woodlands Hill Seam extraction.
- Overall, the extent and magnitude of predicted subsidence for the EP layout extraction from Woodlands Hill Seam is unchanged from the approved predicted subsidence for the Modified layout.
- Predicted Woodlands Hill Seam subsidence for extraction of Longwalls 1 to 4 contributes a third of the predicted ultimate subsidence for the Woodlands Hill Seam, which itself contributes a little over half (approximately 51%) of the predicted ultimate subsidence for the Maxwell Mine underground workings.

- Subsidence impacts above Longwalls 1 to 4 could include:
  - Surface cracking with crack widths up to 100 mm in about 80% of cases, and greater than 100 mm in about 20% of cases; and
  - Compression heaving and stepping, with deformation heights typically less than 100 mm.

**Table 2.1 Maximum predicted subsidence effects for extraction of longwalls in the Woodlands Hill Seam**

| Layout | Maximum predicted total vertical subsidence (mm) | Maximum predicted total tilt (mm/m) | Maximum predicted total hogging curvature ($km^{-1}$) | Maximum predicted total sagging curvature ($km^{-1}$) |
|---|---|---|---|---|
| EP Layout (longwalls 1 to 4) | 1,100 | 25 | 0.7 | 1.2 |
| Modified Layout (longwalls 1 to 4) | 1,100 | 25 | 0.7 | 1.2 |
| Modified Layout (all longwalls) | 3,300 | 35 | 1.5 | 1.5 |
| Modified Layout (Max. cumulative for all seams) | 6,500 | 50 | 2.0 | 2.0 |

# 3 POTENTIAL IMPACTS

## 3.1 OVERVIEW

Figure 3.1 shows the maximum predicted subsidence contours due to extraction of Woodlands Hill Seam Longwalls 1 to 4 for the EP layout.

The EIS (WRM, 2019) and Modification 2 (WRM, 2022) surface water assessments identified the following key potential subsidence impacts for the Maxwell Mine:

- Direct subsidence impacts on the Hunter River and/or Saddlers Creek;
- Loss of catchment due to increased ponding caused by subsidence; and
- Surface cracking leading to loss of surface water flows.

The EIS and Modification 2 Surface Water Assessments (WRM, 2019 & 2022) concluded that:

- The Hunter River and Saddlers Creek are located outside the Maxwell Mine underground mining area and would not be subject to direct subsidence effects. There could, however, be potential subsidence impacts on the unnamed (Saddlers Creek tributary) drainage lines;
- The Geomorphology Assessment (EIS Appendix D) found that ultimate predicted subsidence would increase the surface area of depressions in drainage lines across the Maxwell Mine underground area. However, these depressions would also naturally fill with sediment over time, thus reducing the predicted surface area ponding. The potential reduction in Saddlers Creek flows due to ultimate predicted subsidence is negligible.

- Some fracturing of exposed bedrock and bedrock beneath the soil beds of drainage lines is predicted as a result of the project (MSEC, 2019). However, as the drainage lines within the Maxwell Mine underground area are ephemeral, surface water flows only occur during and for short periods after rainfall events. In times of heavy rainfall, the majority of the runoff would flow over the natural surface soil beds and would not be diverted into the dilated strata below (MSEC, 2019). In times of low flow, however, surface water flows could be diverted into the dilated strata below the beds where the bedrock is shallow or exposed (MSEC, 2019). Consequently, given the ephemeral nature of the drainage lines overlying the Maxwell Mine underground area, the potential diversion of flows into the underlying strata during low flow events would be negligible.

MSEC (2025) subsidence predictions also show that:

- The Hunter River is not expected to experience measurable subsidence effects;
- Saddlers Creek is predicted to experience less than 20 mm of vertical subsidence and the creek channel is not expected to experience cracking; and
- For the Saddlers Creek tributary drainage lines, there are no predicted reversals of stream grade due to the mining of Woodlands Hill Seam Longwalls 1 to 4, and crack widths are estimated to be typically between 25 mm to 50 mm, but could exceed 150 mm in some locations.

## 3.2 PREDICTED EXTRACTION PLAN SUBSIDENCE IMPACTS

Figure 3.2 shows the EP layout subsidence study area, overlaid on natural features in the Project area, including watercourses.

Potential subsidence impacts from Woodlands Hill Seam extraction for the EP layout remain similar to and no greater than, the potential impacts identified for Modification 2 including:

- Loss of catchment due to increased ponding caused by subsidence; and
- Surface cracking leading to loss of surface water flows.

However, as discussed in Section 2 above:

- The extent of predicted subsidence impacts remains consistent with the extent of predicted Modification 2 subsidence impacts for Woodlands Hill Seam extraction; and
- The magnitude of predicted subsidence impacts for the proposed extraction of Woodlands Hill Seam Longwalls 1 to 4 are unchanged from the predicted Modification 2 impacts for the Maxwell Mine.

Consequently, Woodlands Hill Seam extraction for the EP layout will have, consistent with Modification 2:

- No direct subsidence impacts on the Hunter River or Saddlers Creek (including flooding impacts);
- Negligible reduction in Saddlers Creek flows due to increased ponding from subsidence. Note, ponding depressions will naturally fill with sediment over time, thus reducing the predicted surface ponding area;
- Negligible diversion of flows into the underlying strata during low flow events in the Saddler Creek tributary drainage lines; and
- Negligible change in Saddler Creek tributary drainage lines flooding as a result of subsidence impacts for the EP layout.

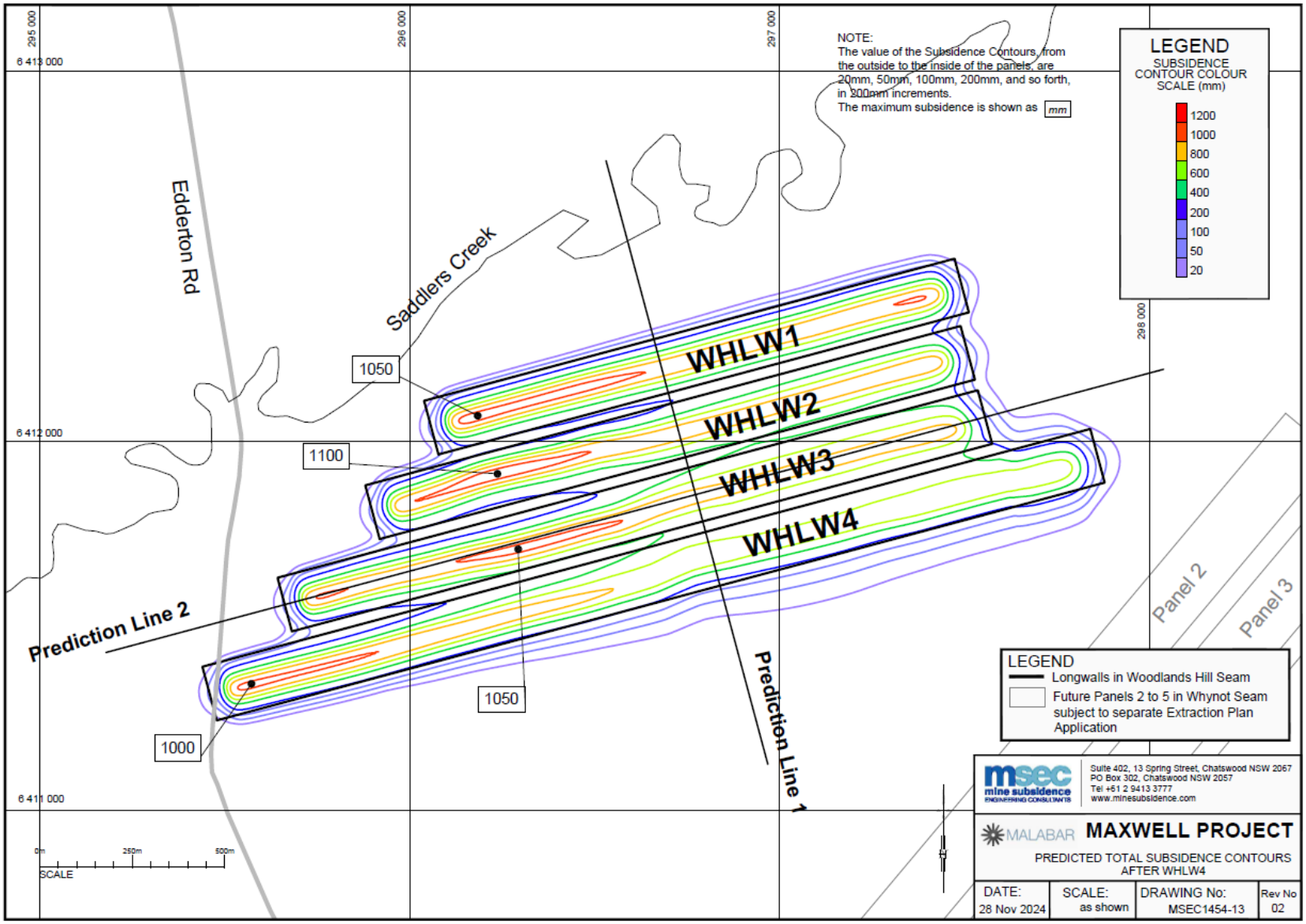


**Figure 3.1 Maximum predicted subsidence contours for Extraction Plan layout extraction from Woodlands Hill Seam Longwalls 1 to 4. Reproduced from MSEC (2025).**

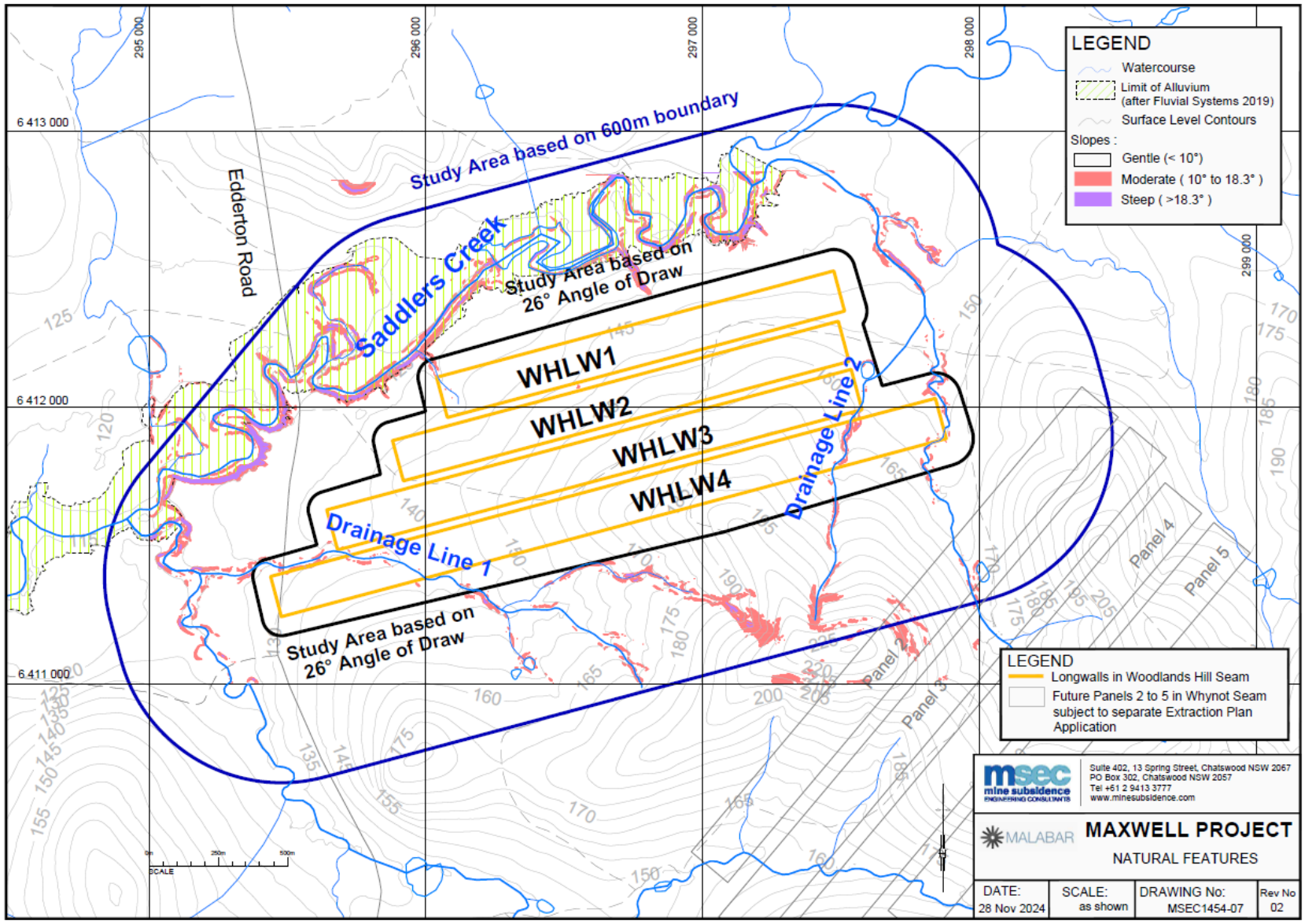


**Figure 3.2 Predicted subsidence extent for Extraction Plan layout extraction from Woodlands Hill Seam Longwalls 1 to 4. Reproduced from MSEC (2025).**

# 4 MONITORING AND MANGEMENT MEASURES

## 4.1 OBJECTIVES AND PERFORMANCE INDICATORS

Development Consent SSD 9526 sets out specific environmental conditions for underground mining, comprising a set of subsidence impact performance measures, as well as requiring a Subsidence Monitoring Program (SMP) as part of any extraction plan for second workings.

Table 4.1 shows key surface-water-related subsidence impact performance measures from Part C of Development Consent SSD 9526.

**Table 4.1 Surface-water-related subsidence impact performance measures**

| Feature | Performance measures |
|---|---|
| All watercourses within the subsidence area | No greater subsidence impacts or environmental consequences to water quality, water flows (including baseflow) or stream health (including riparian vegetation), than predicted in the document/s listed in condition A2(c) (i.e., the EIS, EAs, Modification 1 report and Modification 2 report). |
| All land within the subsidence area | No greater subsidence impacts or environmental consequences than predicted in the document/s listed in condition A2(c) |
| All land outside the subsidence area | Negligible subsidence impacts or environmental consequences |

## 4.2 MONITORING OF IMPACTS

As discussed in Section 2 and Section 3, surface water impacts for extraction of Woodlands Hill Seam Longwalls 1 to 4 are likely to be limited in magnitude and spatial extent. To verify the extent and magnitude of subsidence impacts, Development Consent SSD 9526 requires the development of an SMP and an updated Water Management Plan (WMP) as part of the EP.

As part of the Extraction Plan for Whynot Seam Panels 2 to 5, Malabar prepared a SMP and WMP. It is recommended the existing monitoring programs are continued and additional recommendations outlined below are implemented, where reasonable and practicable.

The SMP will describe the monitoring program, which will provide data to assist with subsidence risks and validate subsidence predictions.

The WMP will describe management measures for potential impacts of the underground workings on watercourses, including via baseline monitoring, a surface water monitoring program and the development of specific trigger levels for acting on potentially adverse impacts.

Table 4.2 shows the monitoring activities recommended to be included in the WMP. Surface water quality monitoring will continue to be done as part of the WMP, but it is unlikely to be sensitive to potential subsidence impacts. The primary monitoring activity recommended for surface water subsidence impacts will be visual inspection, including the collection of photographic records to confirm changes over time along key drainage paths.

Table 4.3 shows the recommended performance measure trigger events, as well as the response measures required to manage the potential impacts.

A key principle for the remediation of surface water impacts due to subsidence is to minimise land disturbance associated with intervention measures. Hence, once an issue is identified, it is recommended that specialist advice be obtained to ensure that any proposed intervention is effective. Wherever possible, proposed remediation works should be undertaken using soft engineering measures that minimise land disturbance and maximise vegetative cover.

**Table 4.2 – Proposed monitoring for surface water impacts**

| Monitoring task | Methodology | Timing |
|---|---|---|
| Water quality & stream health monitoring | As per Surface Water Management Plan | As per Surface Water Management Plan |
| Walkover visual inspection and photographic record of drainage lines | Identify and mark the upstream and downstream limits of Woodlands Hill Seam Longwalls 1 to 4 on drainage lines | Prior to undermining of drainage lines |
| | Undertake a baseline inspection by walking along the drainage lines over Woodlands Hill Seam Longwalls 1 to 4 and noting the condition of vegetation in the channel and any areas of active erosion, sediment deposition, water ponding or streambed cracking | Prior to undermining of drainage lines |
| | Collect photographic record of channel condition along drainage lines over Woodlands Hill Seam Longwalls 1 to 4 | Prior to undermining of drainage lines |
| | Undertake periodic walkover inspection along drainage lines over Woodlands Hill Seam Longwalls 1 to 4 and update photographic record | Within 3 months of undermining of drainage lines<br><br>Ongoing inspections every 6 months for one year after undermining |

**Table 4.3 – Surface water response actions – subsidence drainage impacts**

| Issue | Performance indicator | Trigger event | Action |
|---|---|---|---|
| Drainage lines | Change in visible bed or bank erosion | Noticeable new areas of erosion or expansion of existing erosion | Obtain specialist advice on appropriate remediation works. Disturbance of existing vegetation increases the risk of erosion. Hence, machinery access for remediation works can potentially cause greater impacts than those caused by subsidence. |
| | Development of, or change in headcut erosion along drainage lines | Initiation of headcut or noticeable upstream advance of existing headcut | Obtain specialist advice on appropriate remediation works. Preferred management strategies would include slope stabilisation, revegetation and bed control using natural materials such as local rock and large woody debris. |
| | Extent and duration of water ponding | Development of new pools or drainage of existing pools | Obtain survey of ponded area to identify ponding depth and extent.<br><br>Investigate potential drainage works to restore existing drainage characteristics. |

Regards,

**Daniel Sheehy**

Principal Engineer

**References**


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