Narrabri Coal Operations

NARRABRI COALFIELDS CHARACTERISTICS

NARRABRI, AUSTRALIA
JUNE 2018

WHITEHAVEN COAL

Introduction

Mitchell Nipperess

- Bachelor of Mining Engineer (UQ)
- 3 Years at Narrabri Coal Operations
- Gas drainage Coordinator Since May 2017
- Graduate Program
  - SIS Gas Drainage
  - Development
  - Mine Optimization

Agenda

- *Background Information*
- *Coal Seam Characteristics*
- *What sets us apart*
- *UIS Gas Drainage*
- *SIS Gas drainage*
- *Goaf Drainage*

Background Information

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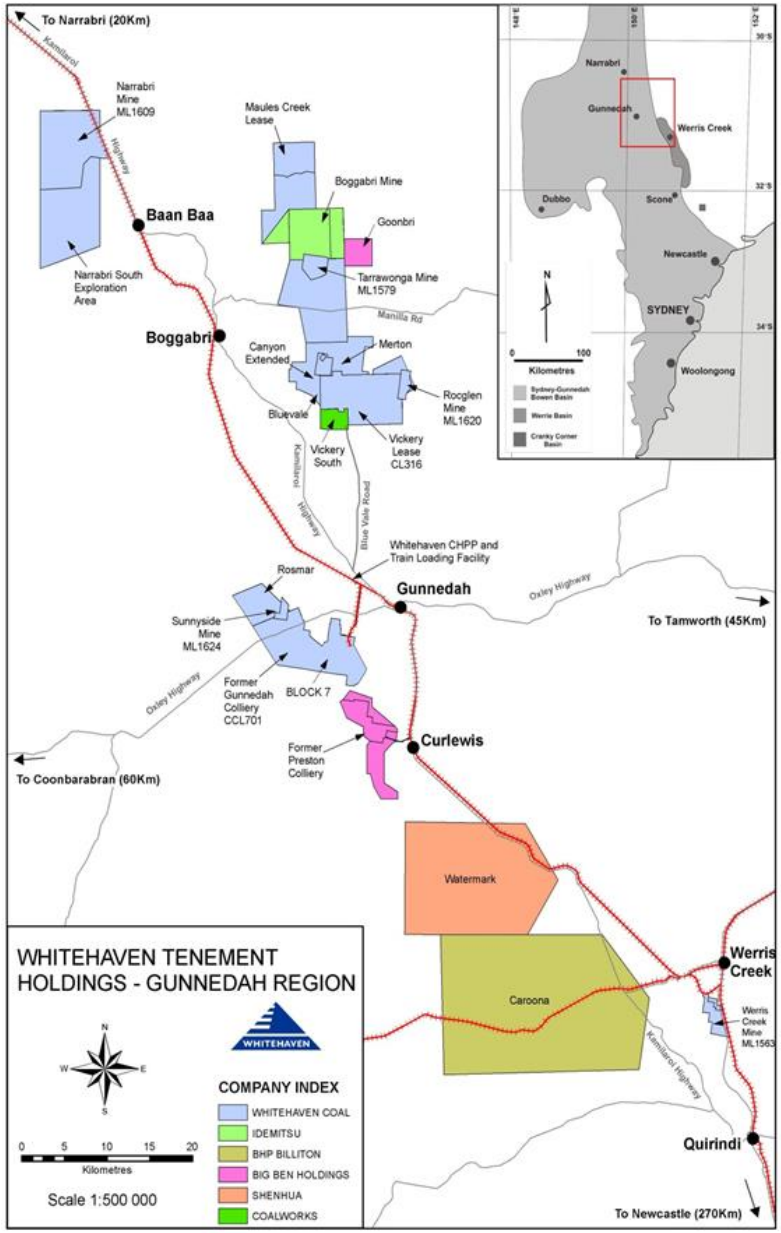
Narrabri Coal Operations

- Located 28km south of Narrabri
  - 550 km North west of Sydney
- Producing:
  - High energy export thermal coal
  - A low ash, low sulphur, low phosphorus, mid volatile PCI coal
- First development coal was produced in FY2011
- Full commercial production from the longwall achieved in October 2012.



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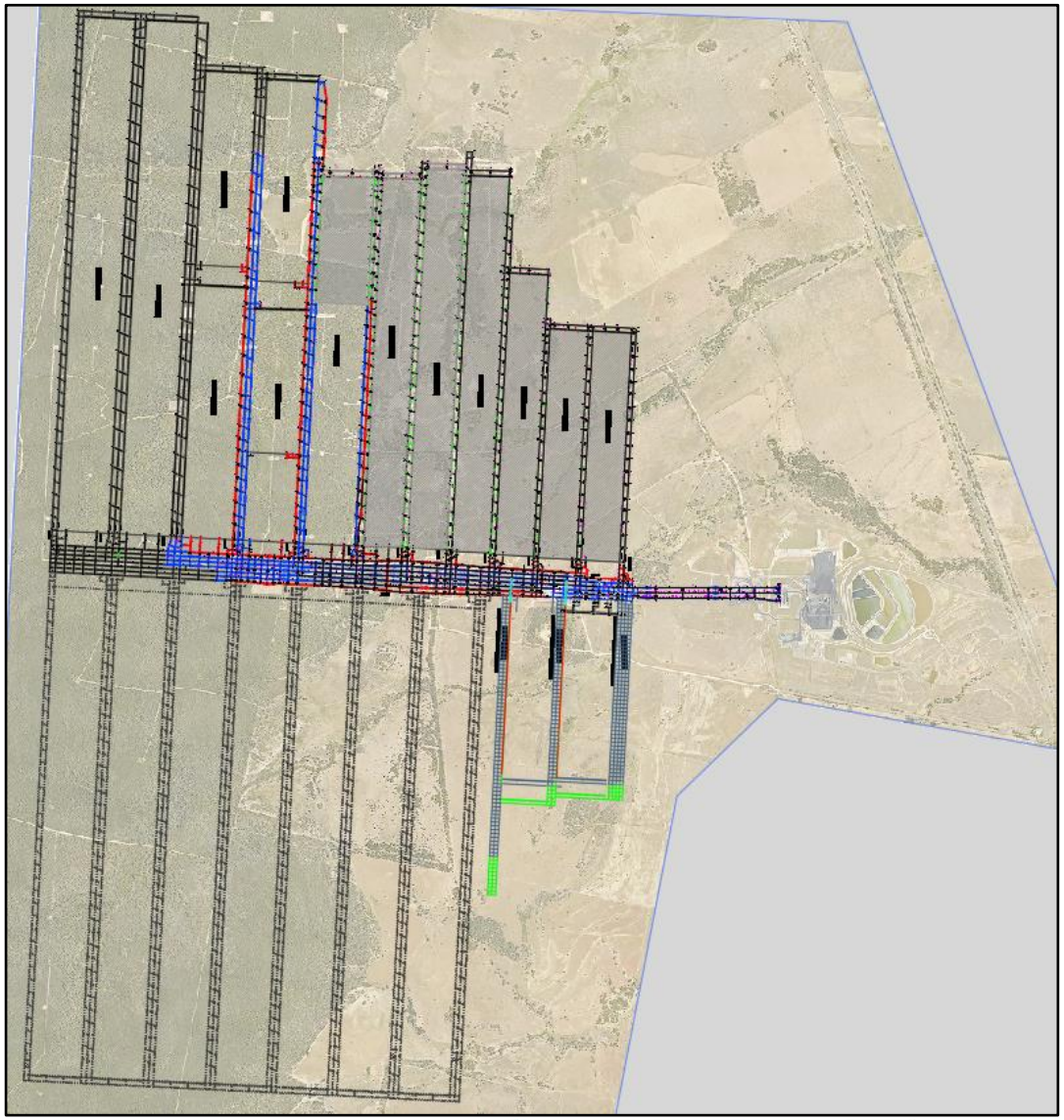
Narrabri Mine Plan

- Seam thickness ~ 9m
- 20 longwall panels planned
- Panel length up to 4,000 m
- Longwall 7 commenced April 2017. First 400 m face.
- 7 Heading Mains
- 3 Heading Gateroad
- MG106 First 3 heading gateroad
- Cut and flit operation on southern side – Commenced January 2018



Production Equipment

Longwall

- 400 metre wide face
- The face is 196 shields wide and is operated at a mining height of 4.30m

Development:

- 4 x Joy 12CM12 continuous miners
- 1 x Joy 12CM30 continuous miner
- Joy 12SC32 shuttle cars
- 2 Super panels run
- FY2017 = 22’000 m

Cut & Flit Project:

- Joy 12CM12 continuous miner
- Joy Multi-bolter – RT137

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Coal Seam Characteristics

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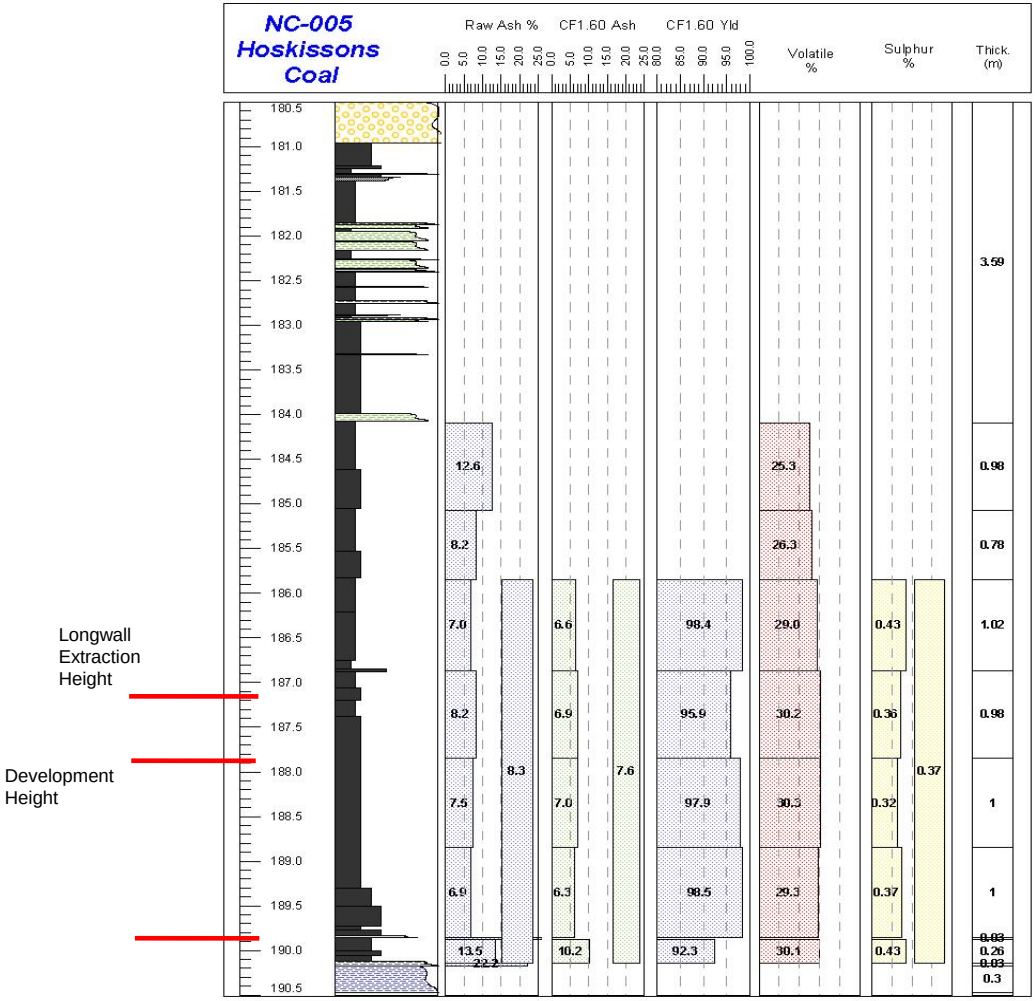
Hoskissons Seam

- Raw Ash 11 %
- Volatiles 28 – 30 %
- Sulphur 0.37 %
- Calorific Value (gad) of 6,950 kcal/kg
- Full Seam Thickness 9m
- Development Mining Section

  Mains = 3.50 m

  Gateroad = 3.70 m
- Longwall mining section = 4.3 m



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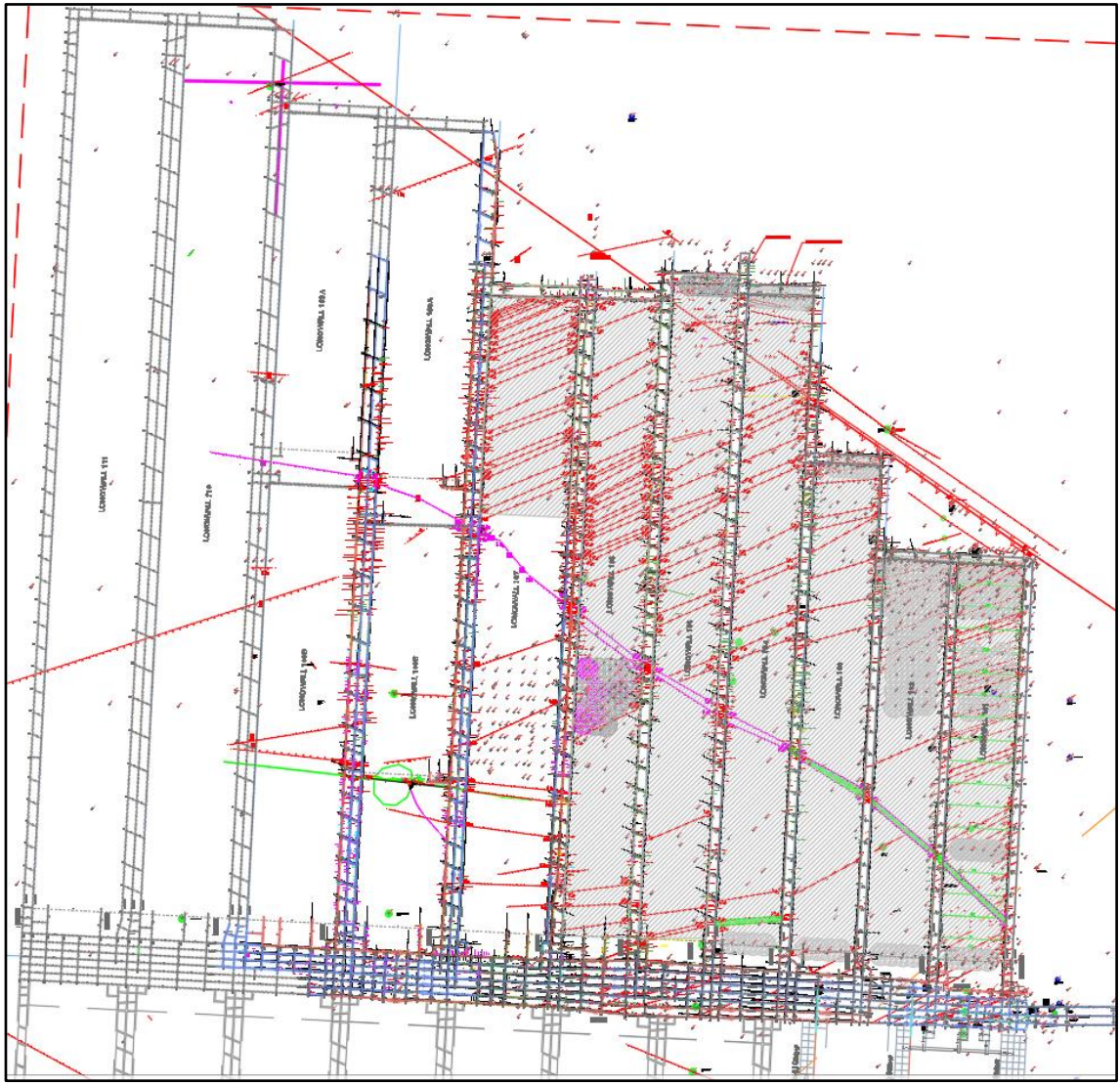
Geology

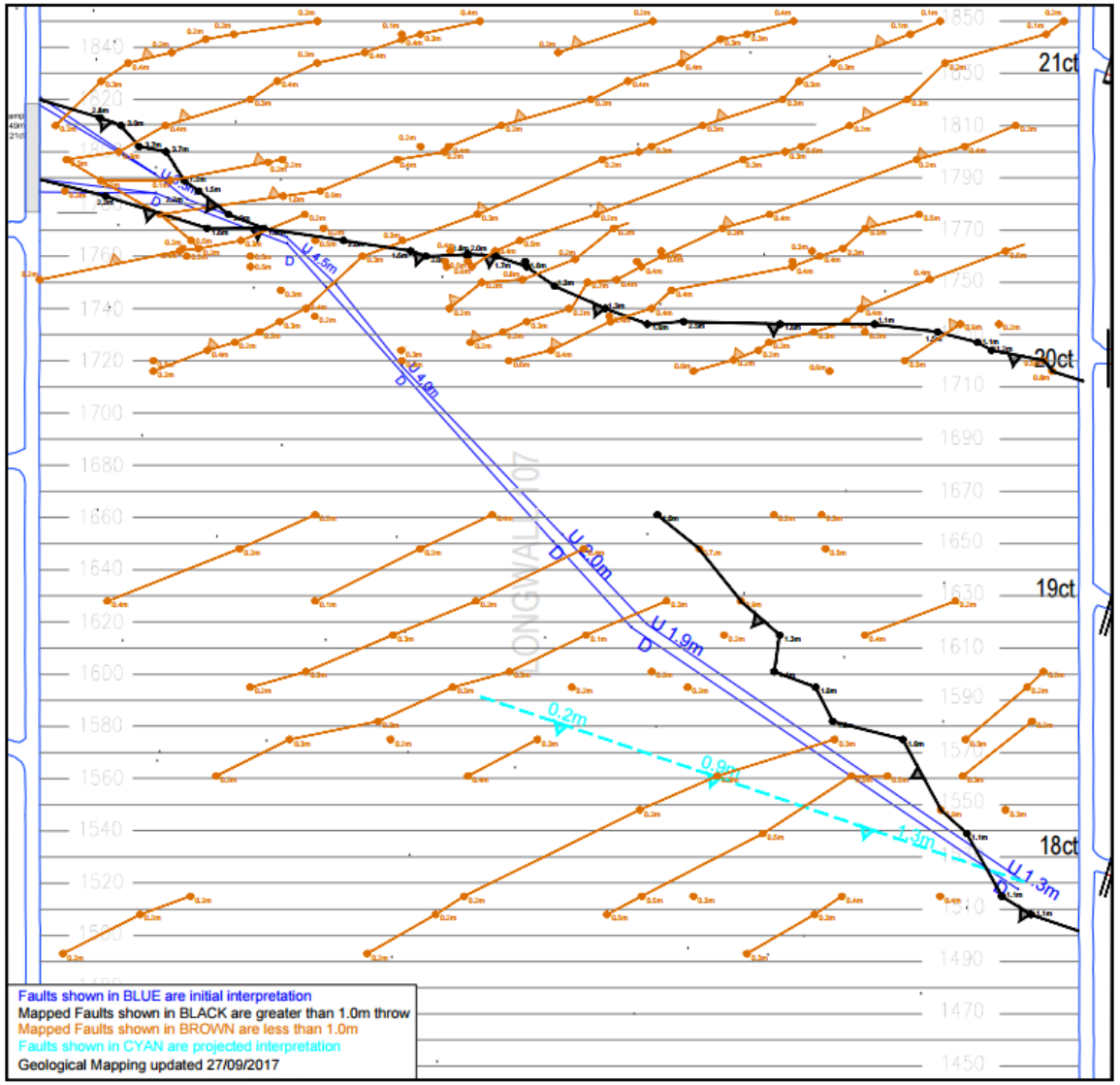
Major fault runs almost perpendicular to normal fault plane



Outburst Prone Structure – Fault

LW107

- Predicted fault mapped in blue
- Actual fault mapping from LW face in black



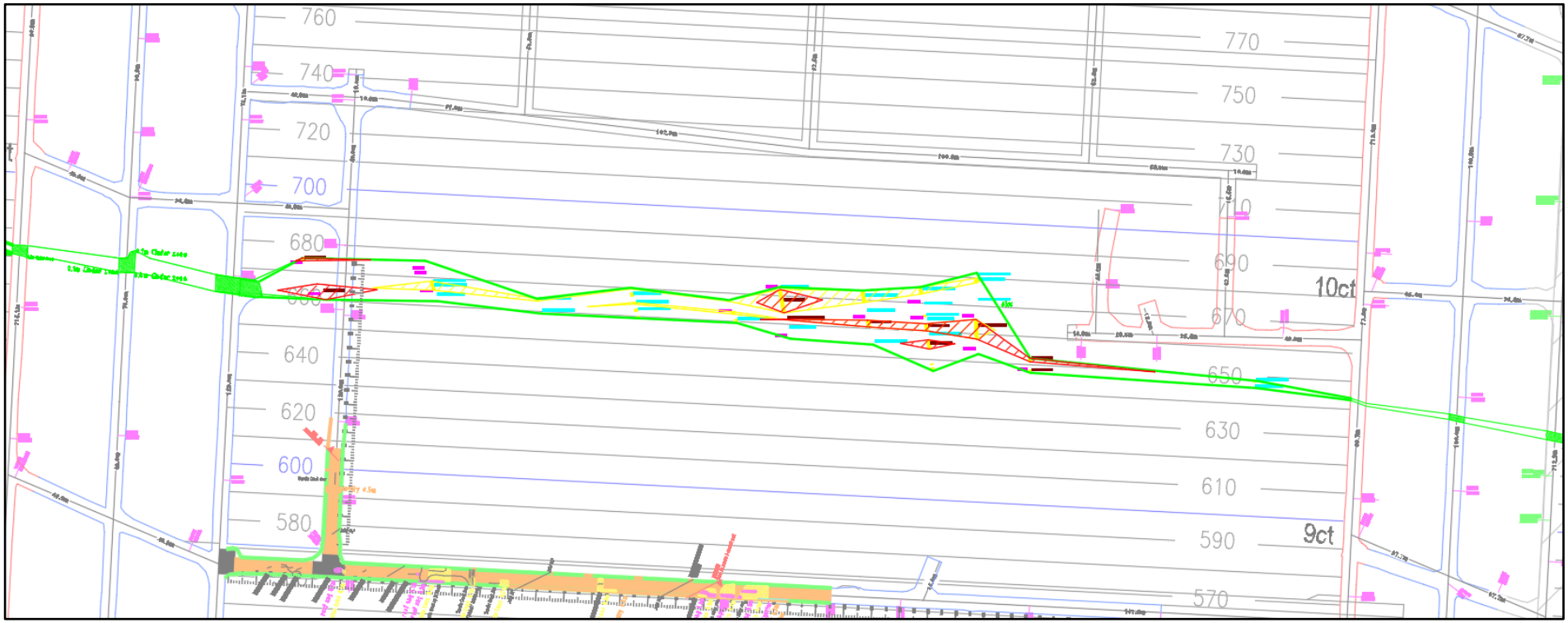
Dyke – LW108

Development

- 7 Headings driven through it so far

Longwall

- Stepping around in LW108



Dyke – MG108

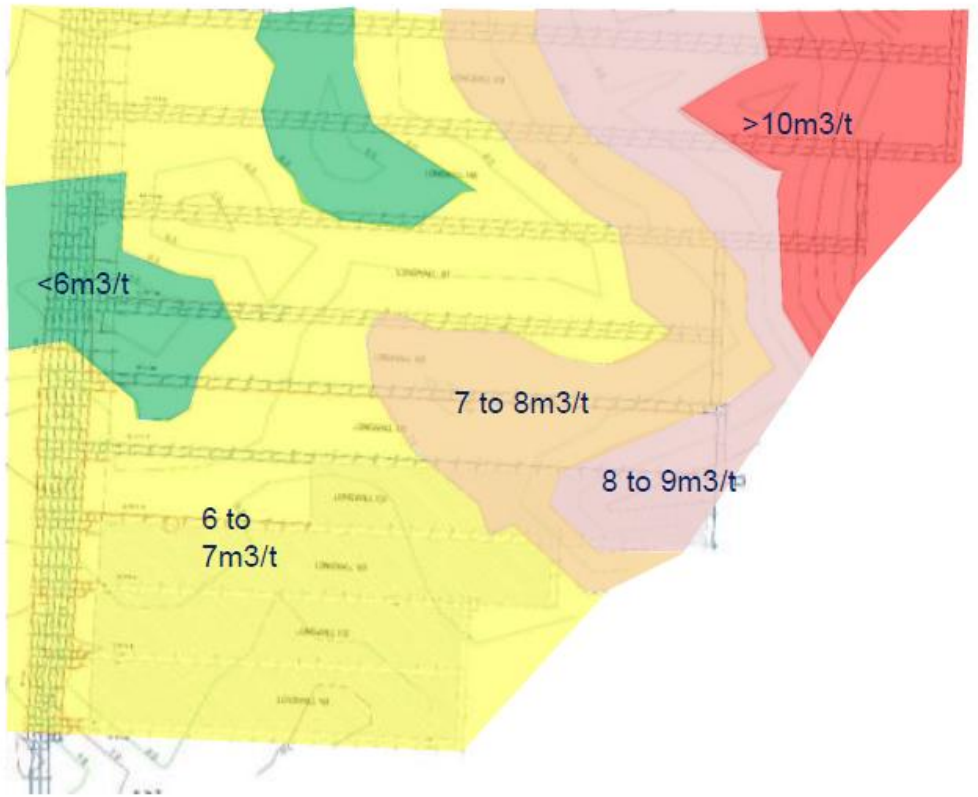
Conditions extremely variable

Shotfired in places

Concreted the floor in other spots

Gas Contents

- The Hoskisson's Seam is potentially outburst prone.
- The seam gas content is predominantly carbon dioxide (CO2) (approximately 90%).
- Insitu gas contents in current mining areas range from 5 m^3/t to 10m^3/t
- Future mining areas have insitu contents >10m3/t
- Seam is liable to spontaneous combustion
- Permeability is 3 to 30 milliDarcy
- Issues;
  - Outburst risk
  - Gas emissions in LW return



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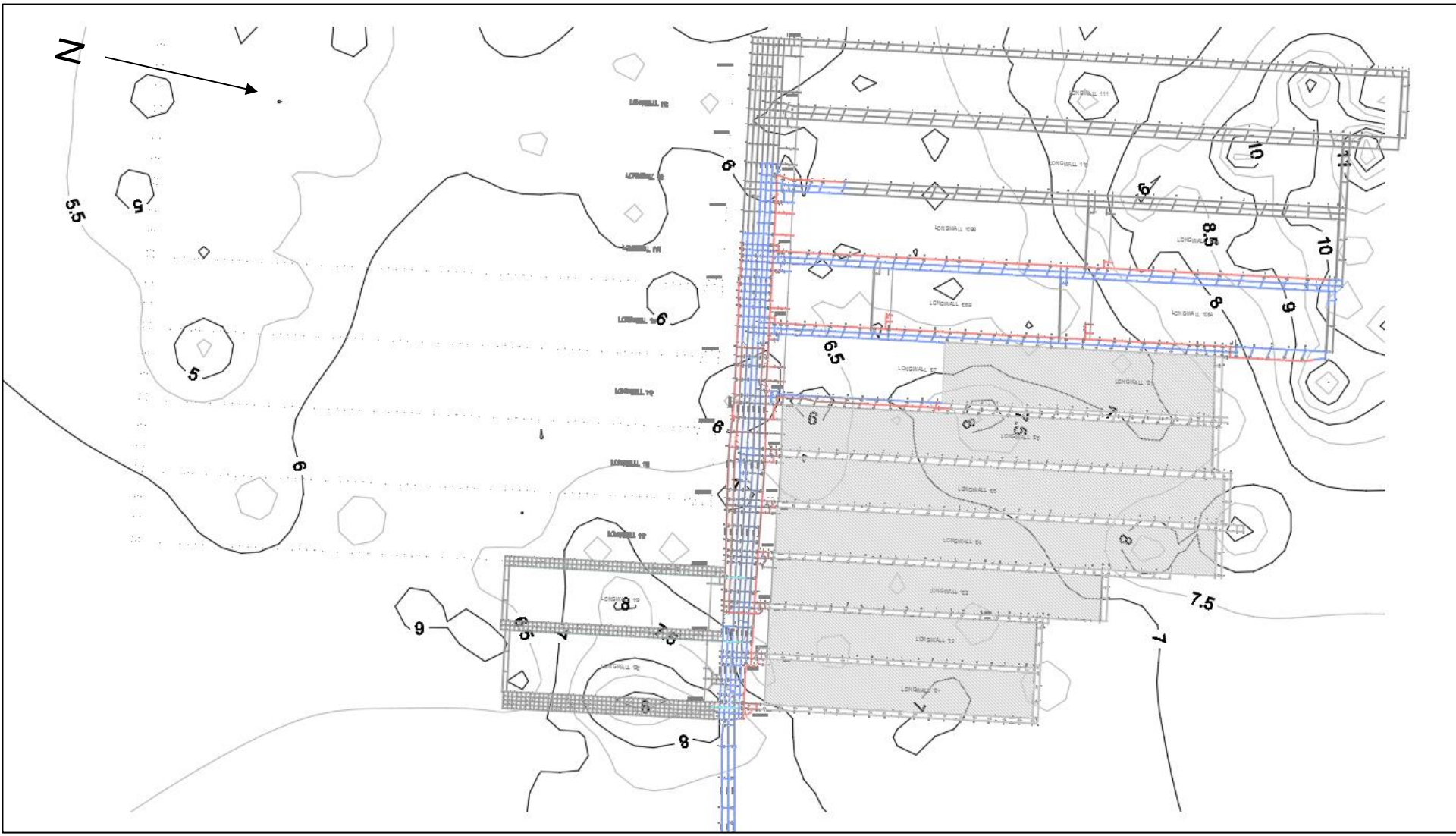
Gas Contents



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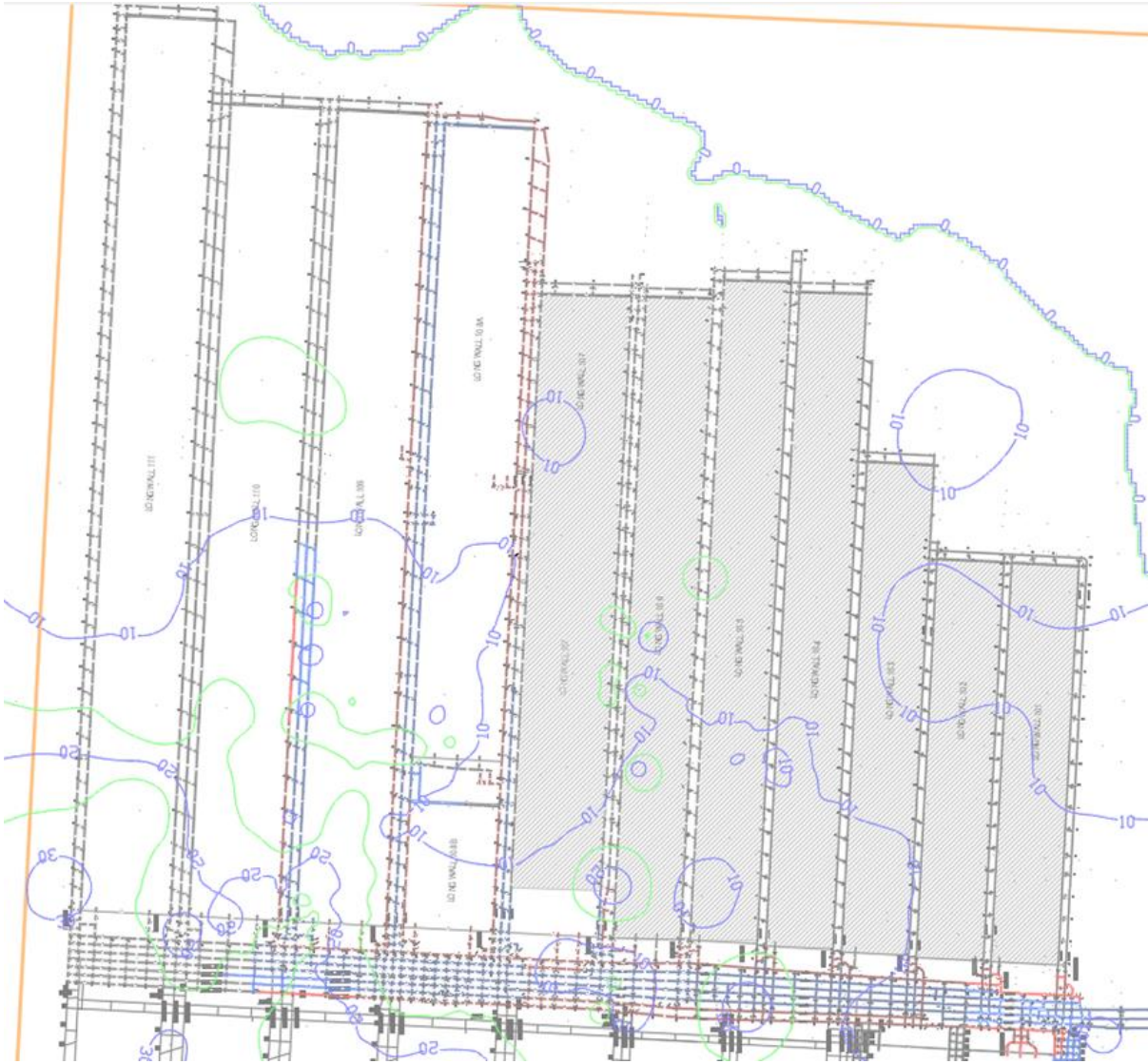
Gas Composition

Predominantly CO_2

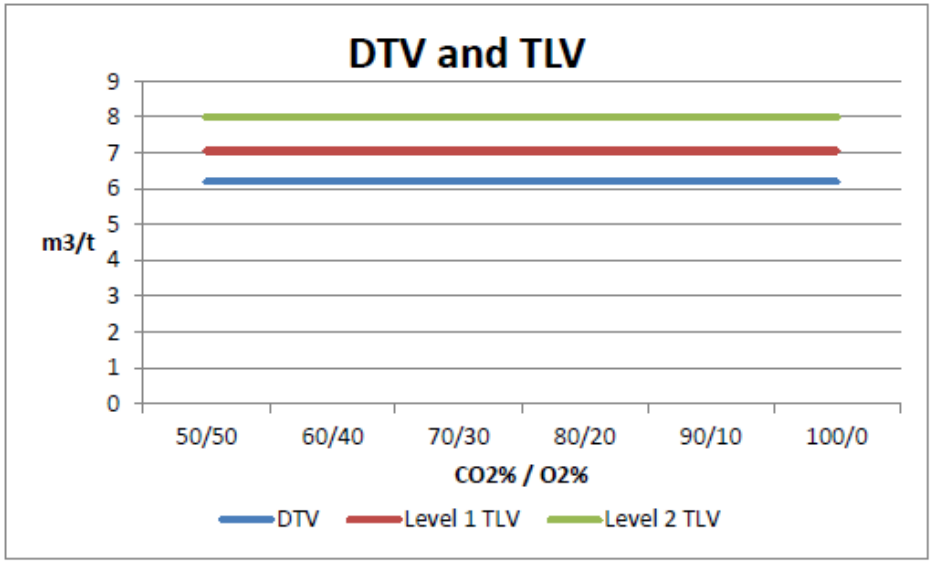
After drainage has occurred CH_4 is typically 3-5%

Southern side of mine increases to 30+ % as move SE



Outburst Thresholds

- DTV = 6.20 m³/t
- Level 1 TLV = 7.05 m³/t
- Level 2 TLV = 8.0 m³/t



Restrictions above Level 1 include:

- Restrictions on mining rate
- maximum borehole spacing in flanking or cross block pre drainage patterns
- exploration drilling to identify presence of outburst prone structure or to disprove projected or predicted structures
- additional sampling to confirm gas content and the extents of the outburst control conditions area

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What Makes Narrabri Different?

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We Are The Unknown

- All outburst benchmark data is from seams other then ours.
- No gas drainage experience in the Hoskisson seam
- The big question is:

  Are the outburst levels we are working to correct?

- History sais yes as we have not had an outburst incident.

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GAS DRAINAGE CASE STUDY

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UIS Gas Drainage

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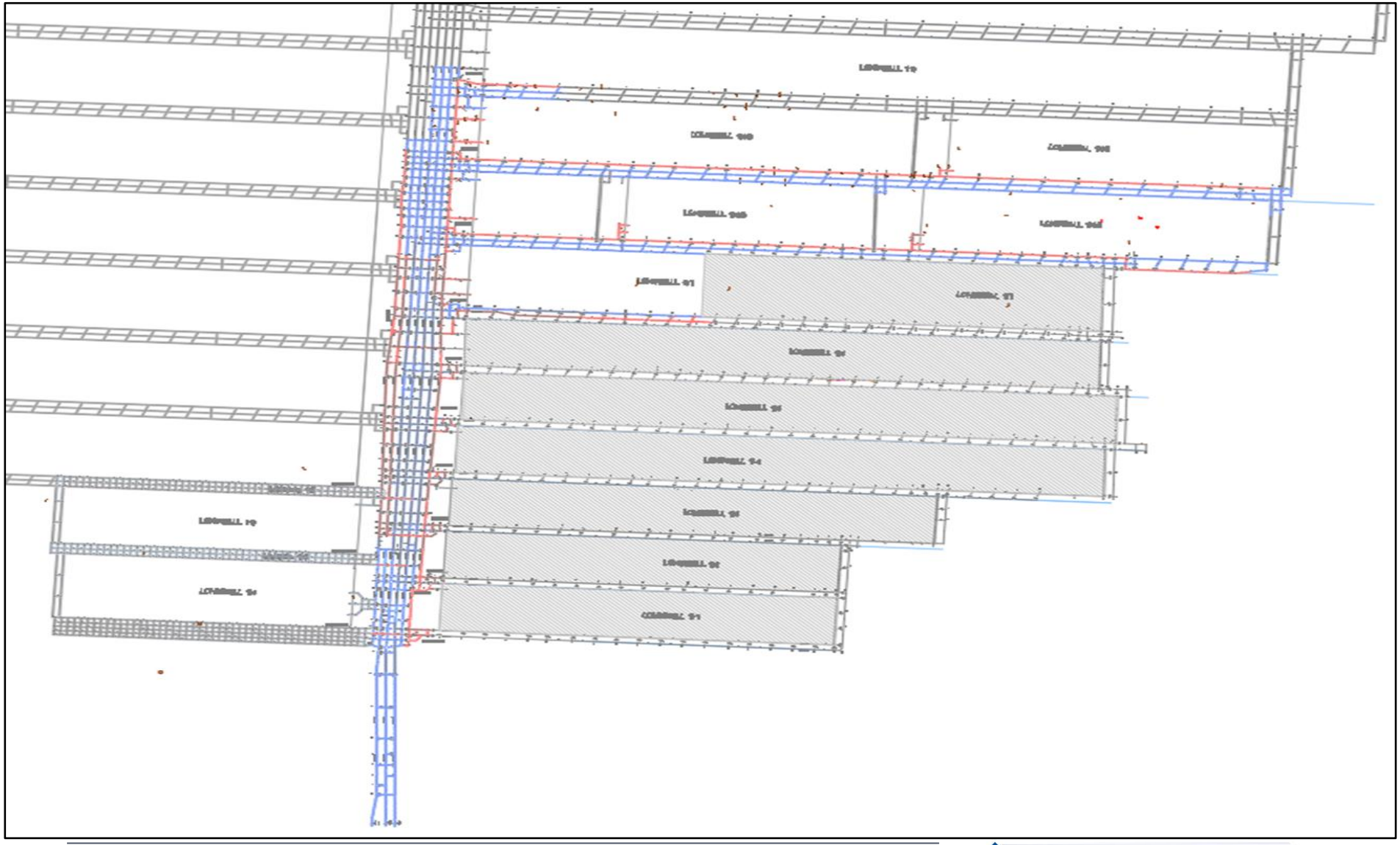
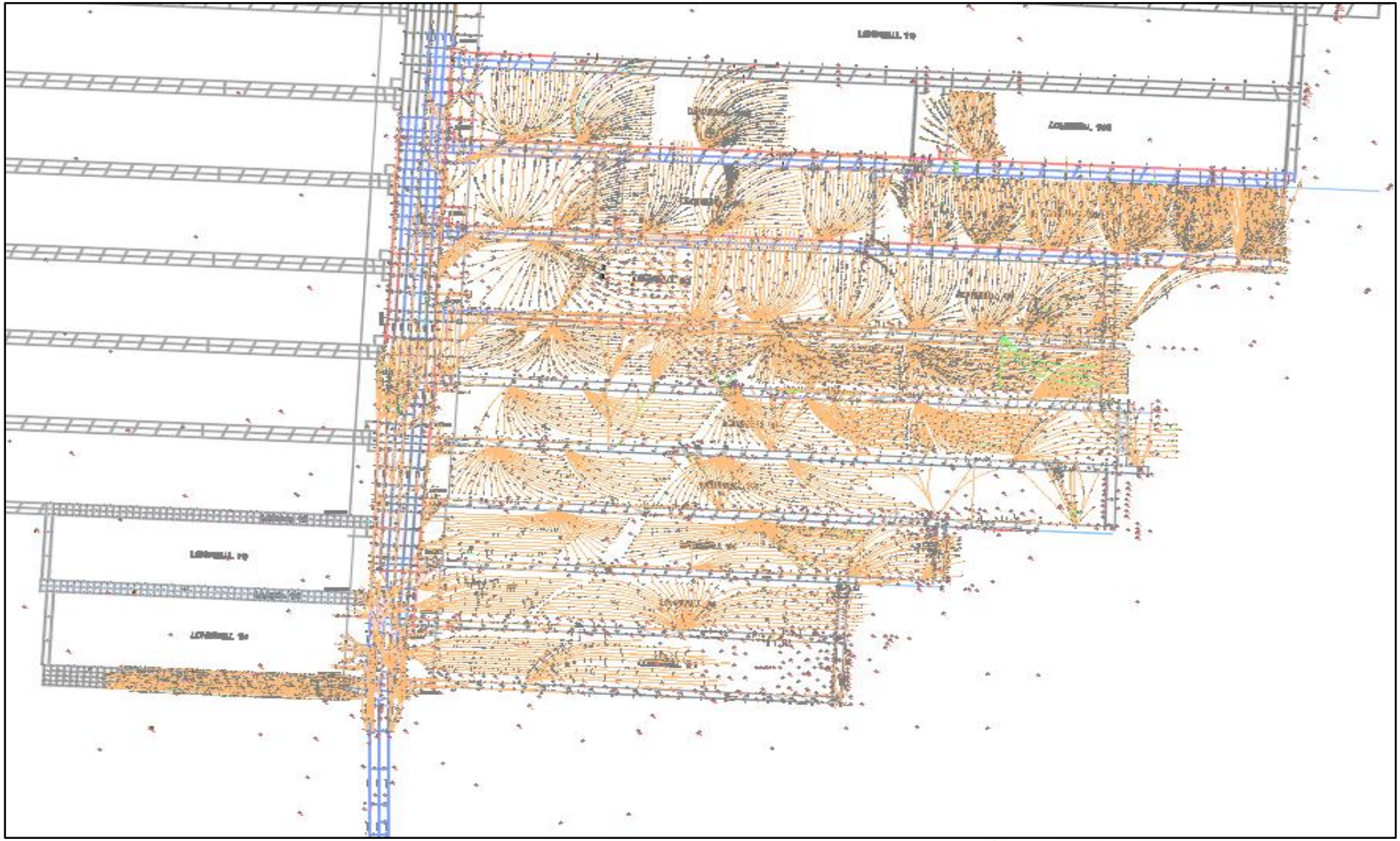
Mine Plan



UIS Gas Drainage



UIS Drilling – ADS Drilling

Project Commencement	Current Situation
2012	**2018**
➢ 2 rigs ➢ 1 Rig 24/7 & 1 x Rig 12/7 ➢ Contracted for 30,000m per year ➢ Holes spacing 20-40m ➢ Minimal gas infrastructure running 2” hose from drill sites to nearest SIS holes for gas drainage	➢ 3 rigs 24x7 ➢ 250,000m per year ➢ Hole spacing ranges from 5 to 20 metres depending on gas levels ➢ Standardised setups and infrastructure at each drill site ➢ Gas from each site now vented through pipe system to designated surface risers

UIS Drilling

EQUIPMENT

- DGS survey system
- Fibreglass composite standpipes
- Gas / water separators
- Fish tanks / Fines bins
- Air Pumps
- Drilling 17 to 22km per month total (250 km in past 12 months)

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Underground Infrastructure

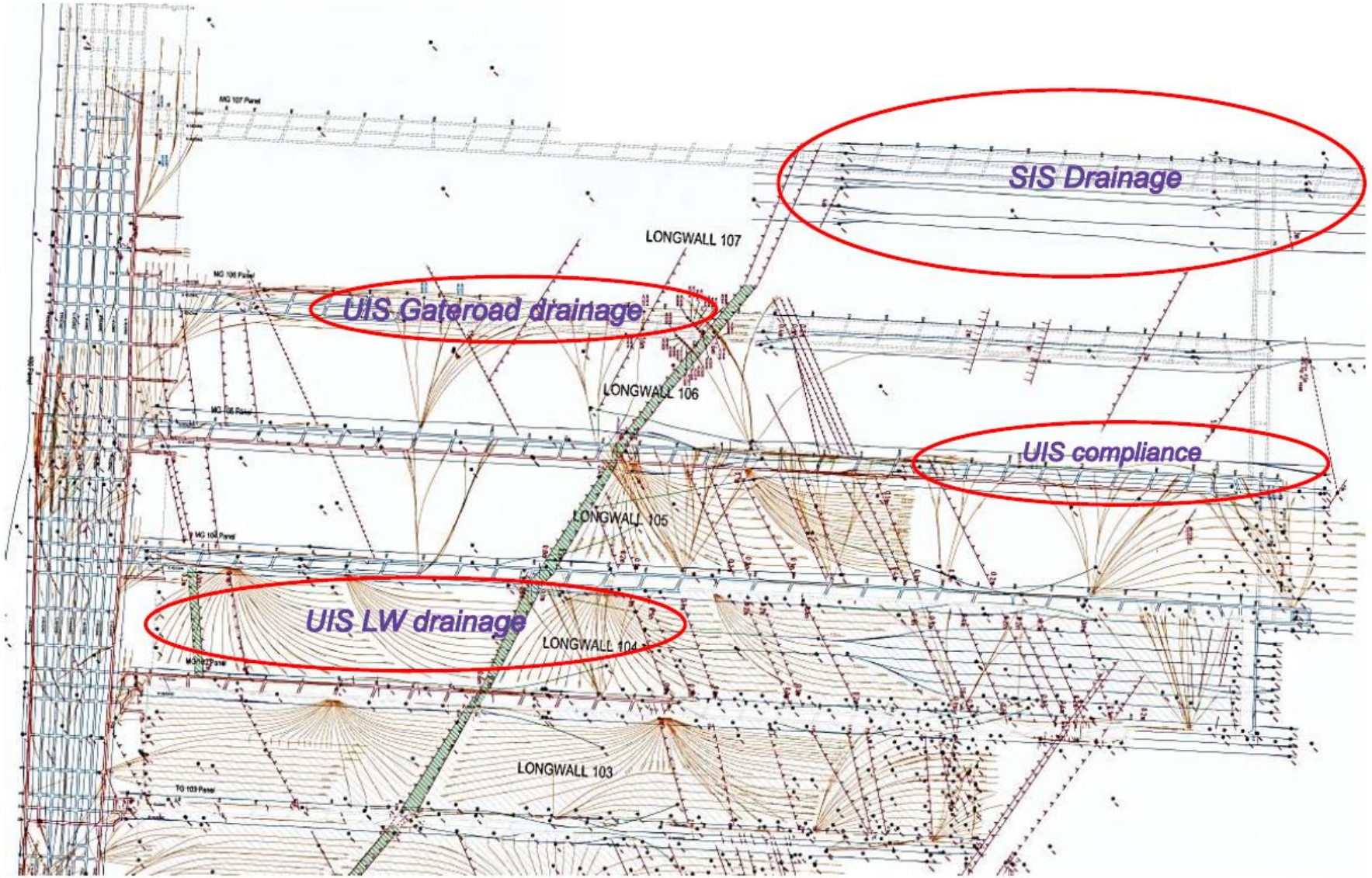
MG107 & Earlier:

- Service bore shared between 2 – 3 patterns
- 6” Pipework
- Small expansion chambers
- Non standard site setups

MG108 & Future:

- Service bore for every significant pattern
- 10” Pipework
- Standardised pipework setup for every pattern

Gas Drainage Design



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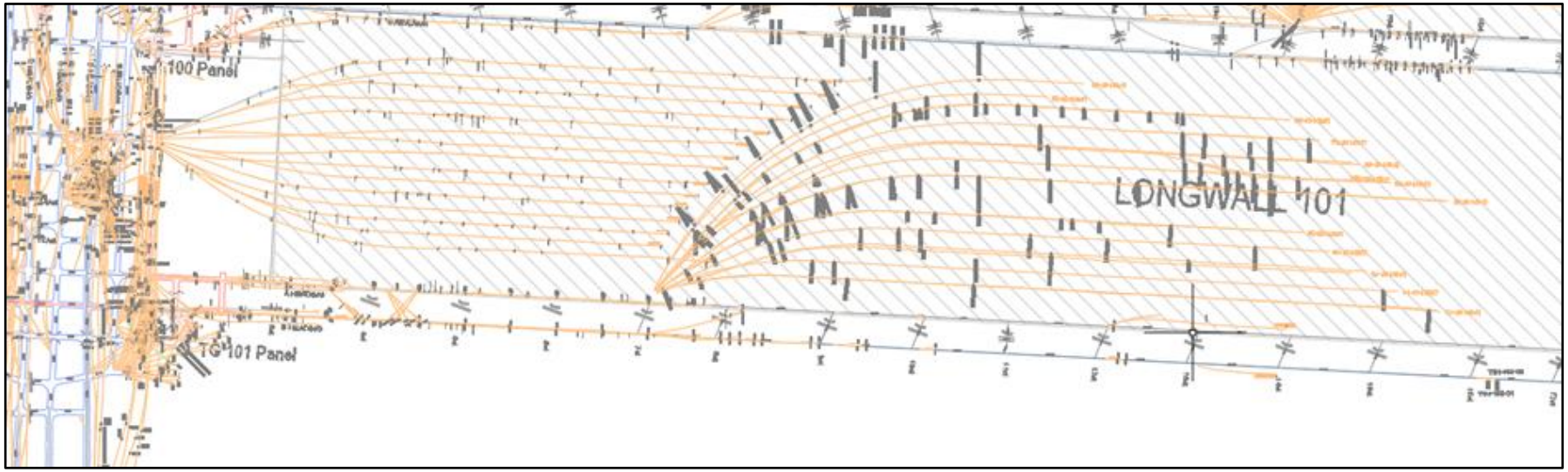
UIS Gas Drainage Design

- Initial design done by gas drainage coordinator
- It covers requirements of developing roadways and LW block drainage
- Any known geological features
- Design includes location to be drilled from and services available etc
- Favourable drainage hole direction
- Management plan

- This is reviewed by the outburst committee for any comments

- Cores taken initially to determine pattern design and hole spacing
- Core is taken and analysed.
- Gas cores confirm predicted virgin gas content
- Design modified as necessary

Gas Drainage Design – Initial



- Long holes
- Drilling down dip
- Dewatering issue

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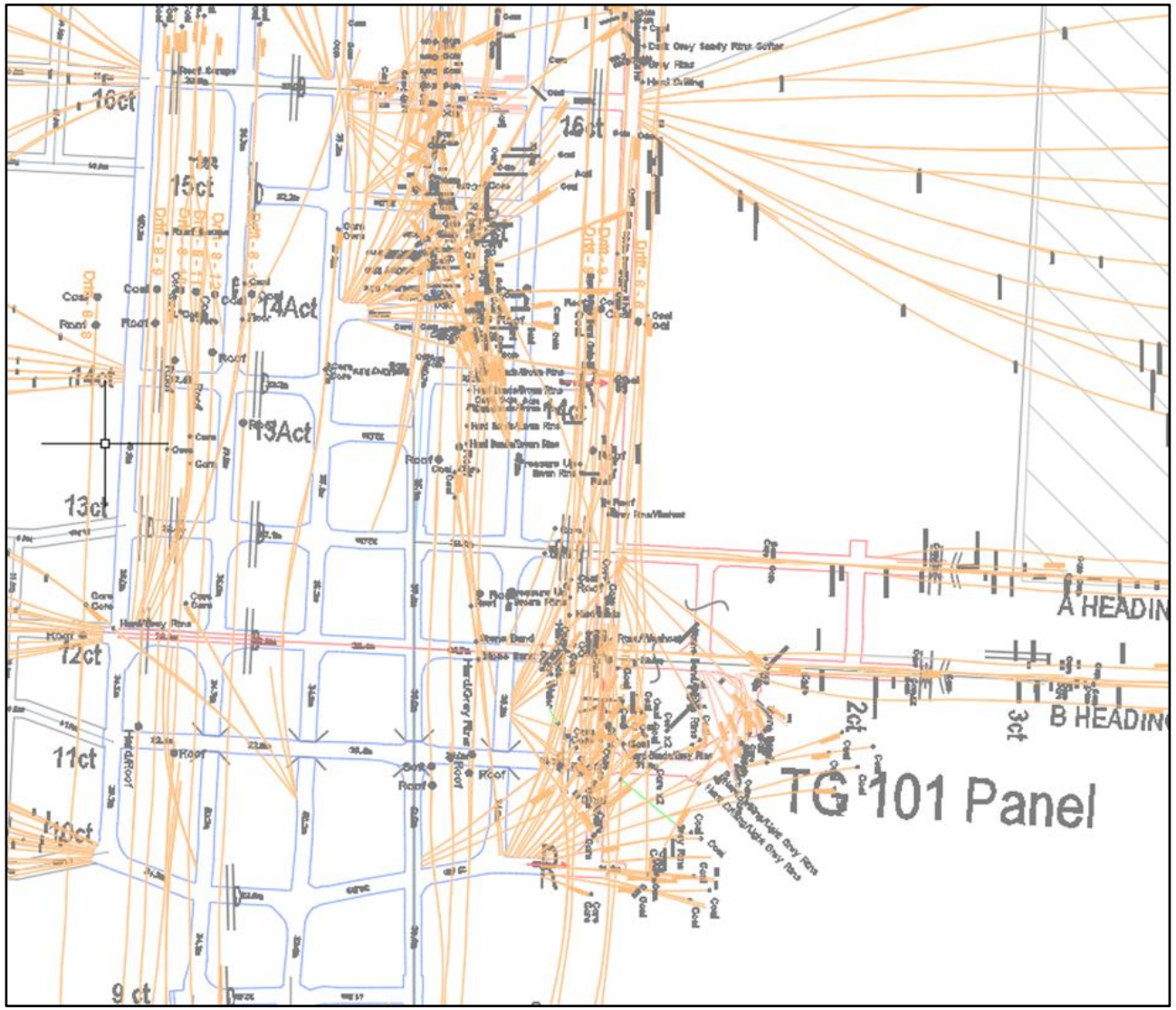
Gas Drainage Design – Initial

Not enough information gathered

Tight spots in the mains



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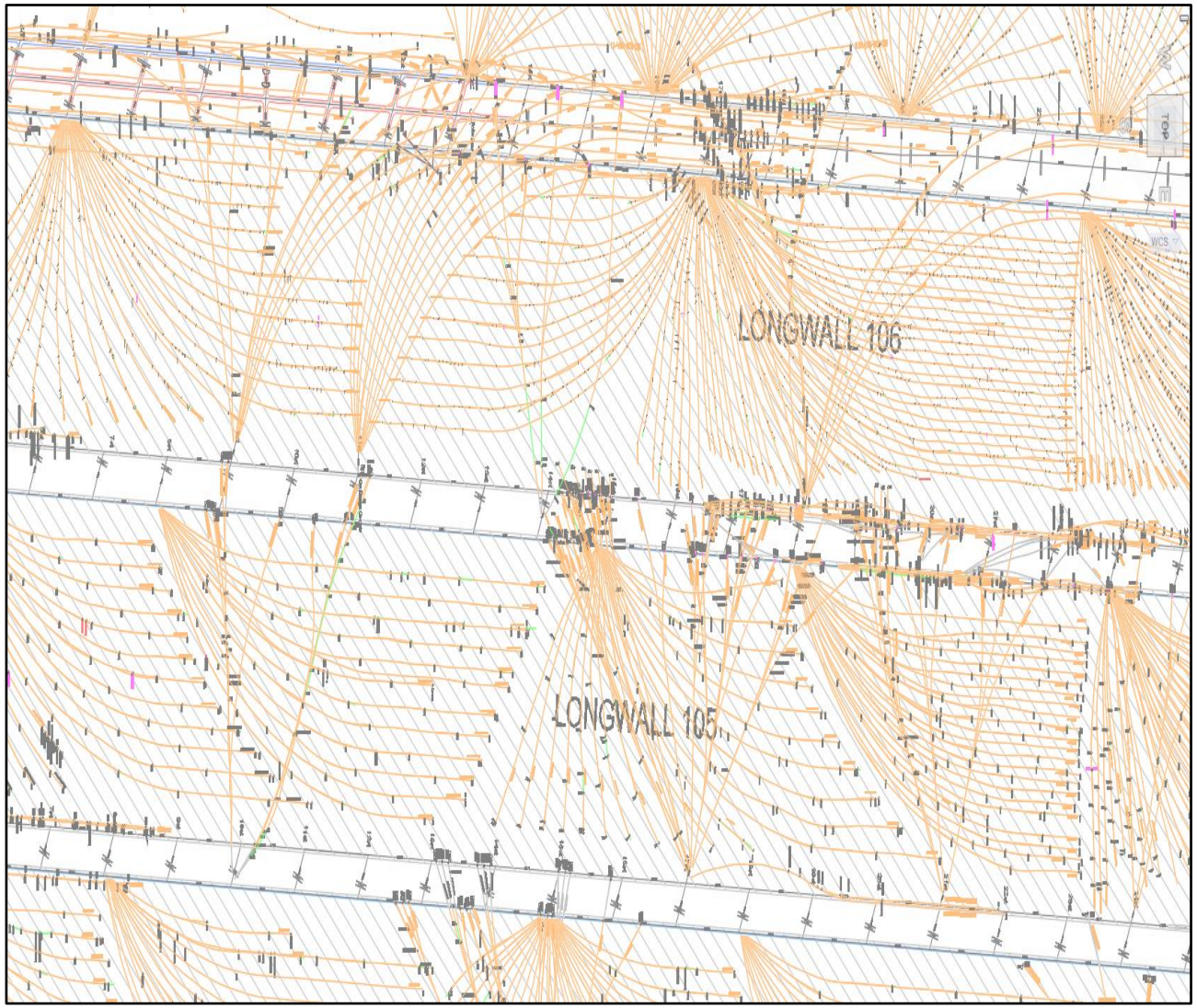
Gas Drainage Design – Intermediate

Holes drilled from the maingate (Drilled up dip)

Drainage efficiency increased – Time restrain too great



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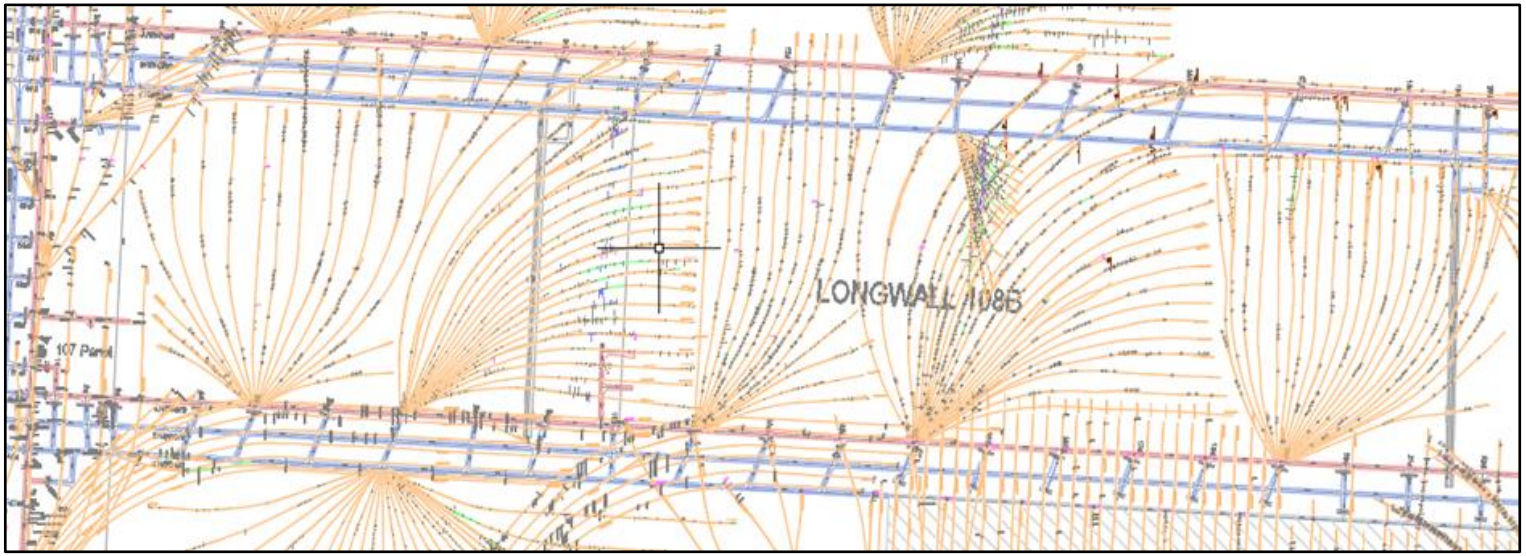
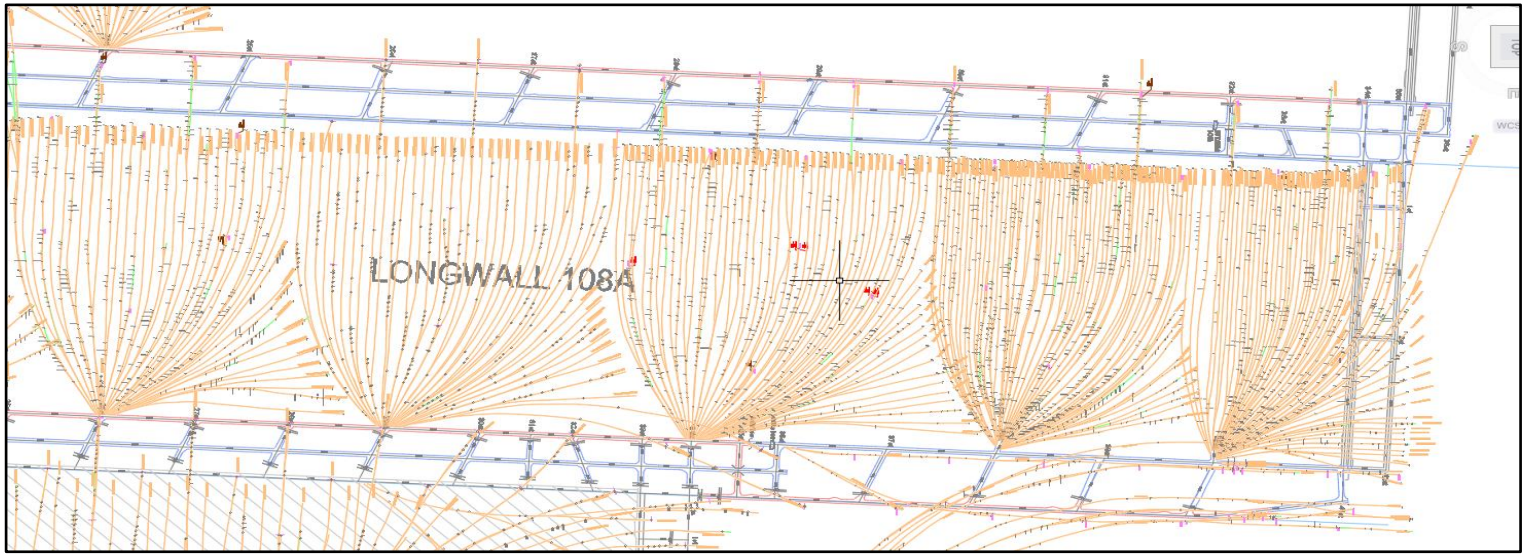
Gas Drainage Design – Now

Structure Identification



Gas Drainage



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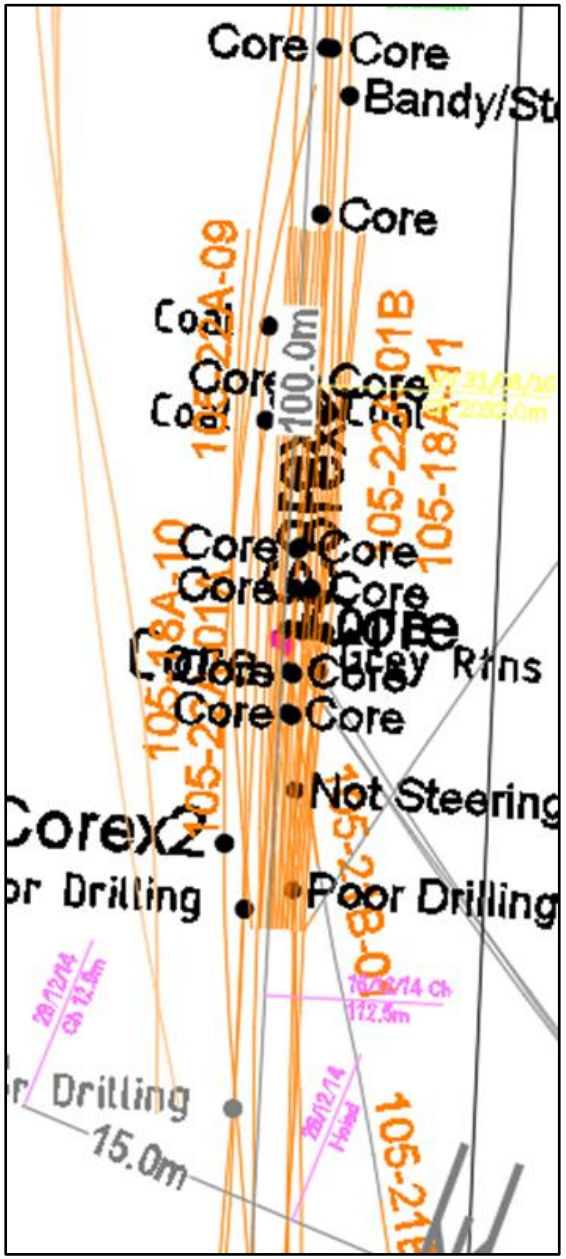
Issues – Non-Draining Areas

MG105

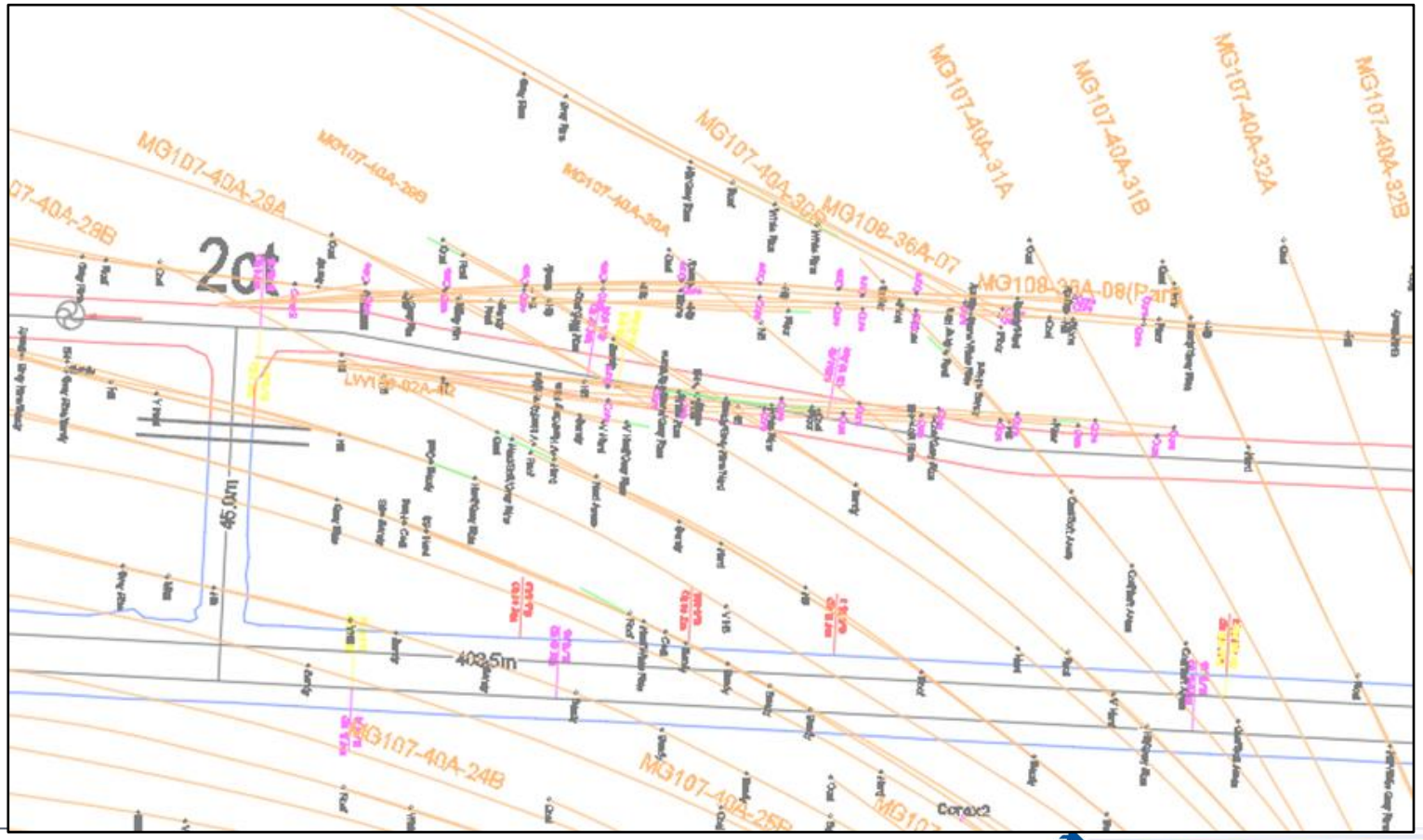
- Very localised
- Multiple holes in face
- No gas make from boreholes
- Mined through with no issues



Issues – Non-Draining Areas

LW108 Bleeder road

- Face road drained to below 4 m3/t
- No gas from open holes in face
- Realigned roadway
- ROS pod
- Mined through with no issues



Issues – Non-Draining Areas

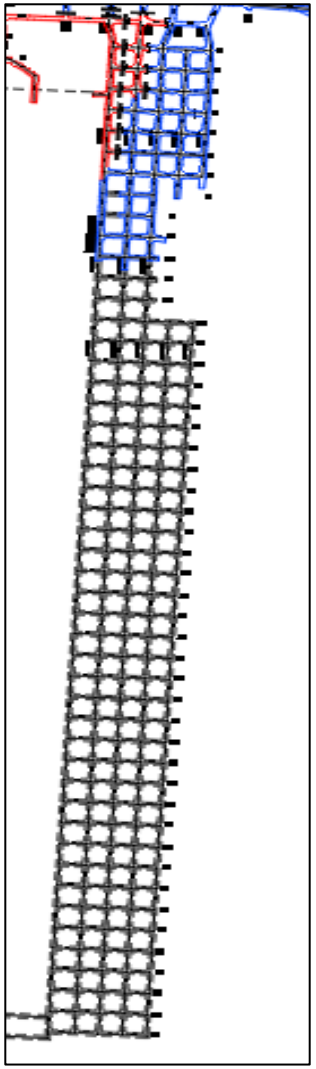
TG201

- 100 metre core spacing initially
- Drainage in place for 6 months

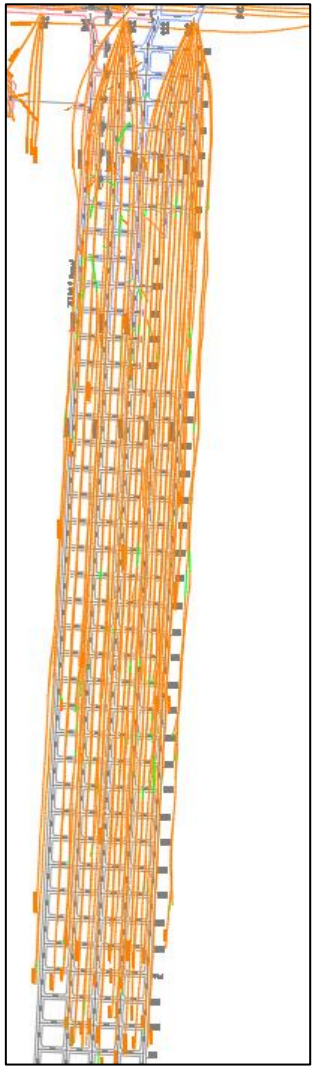
- 3 “hot” spots
- Washouts & faulted ground in the area

- Large differences between upper and lower cores

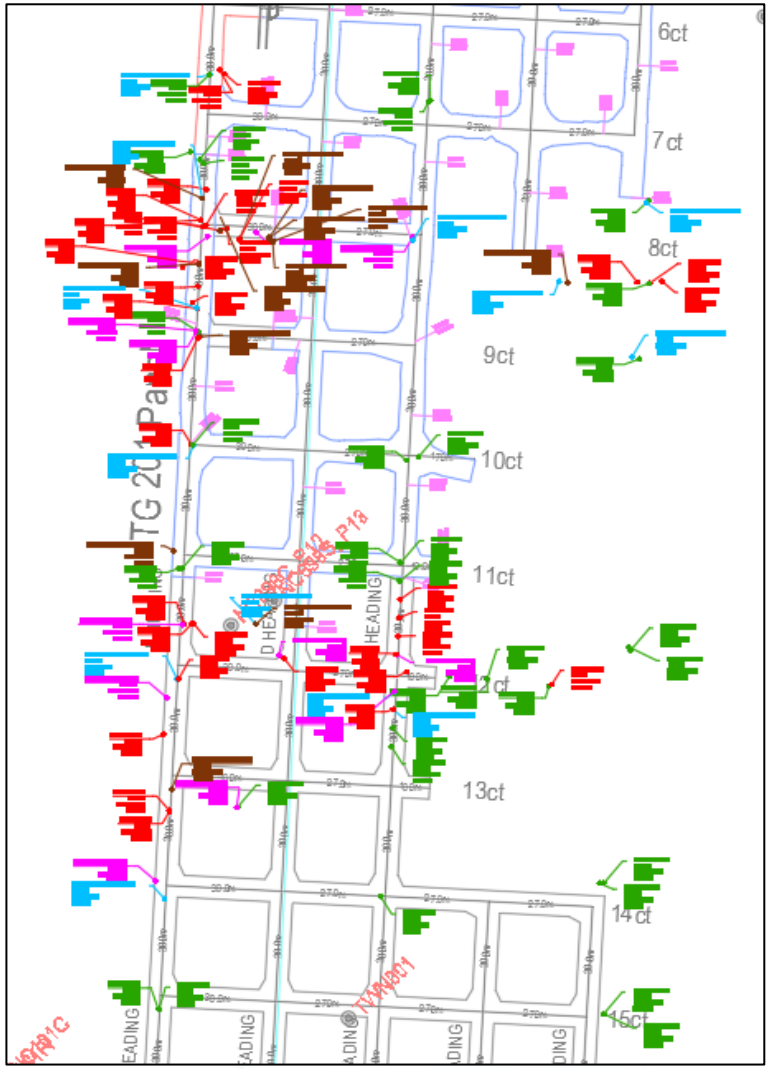
Panel Layout



Drainage



Compliance Cores



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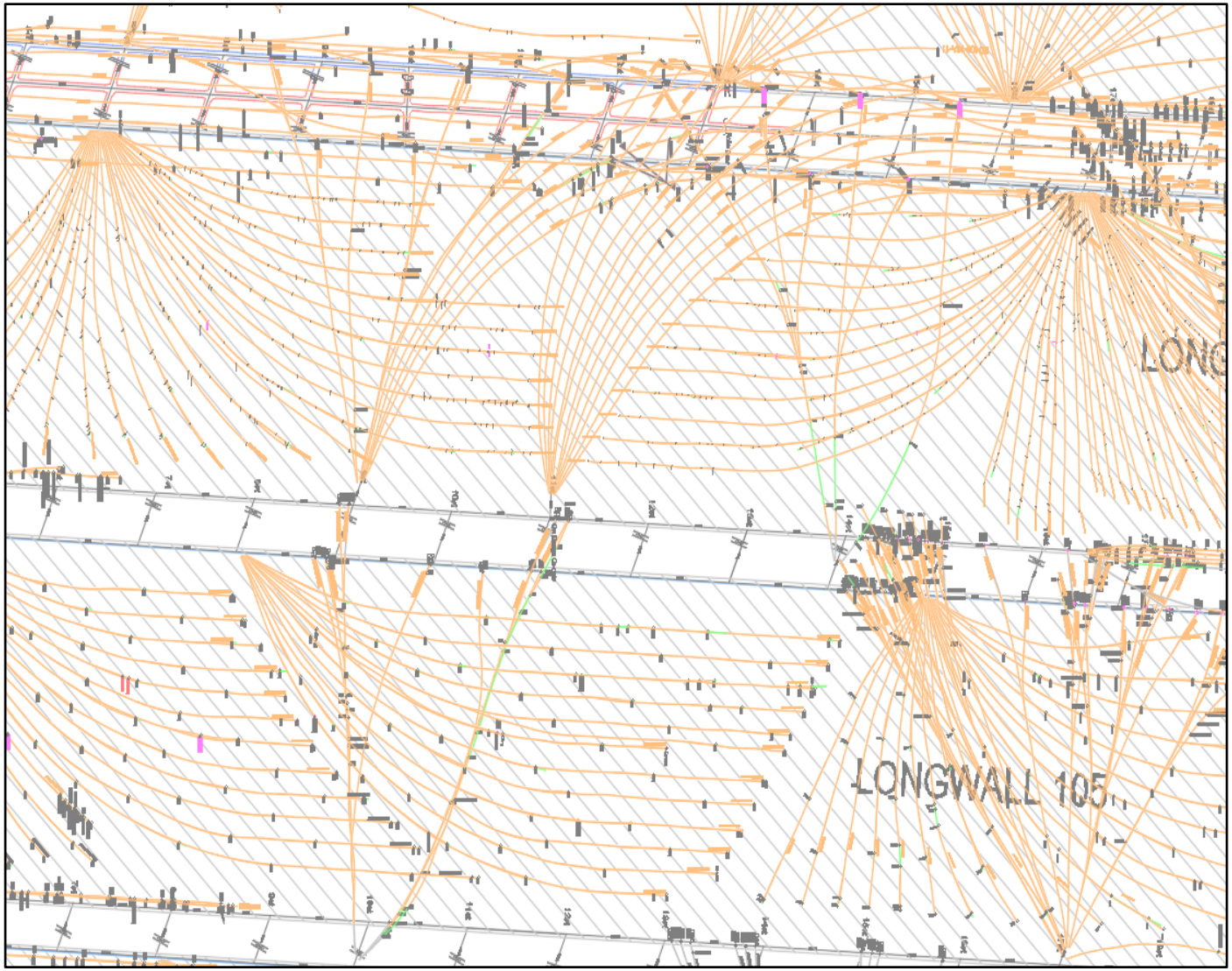
Issues – Spontaneous Combustion

- UIS drill patterns drilled from the gateroad both side of a longwall block
- Lead to CO form a pattern
- Pattern repeatedly flooded with water until problem subsided



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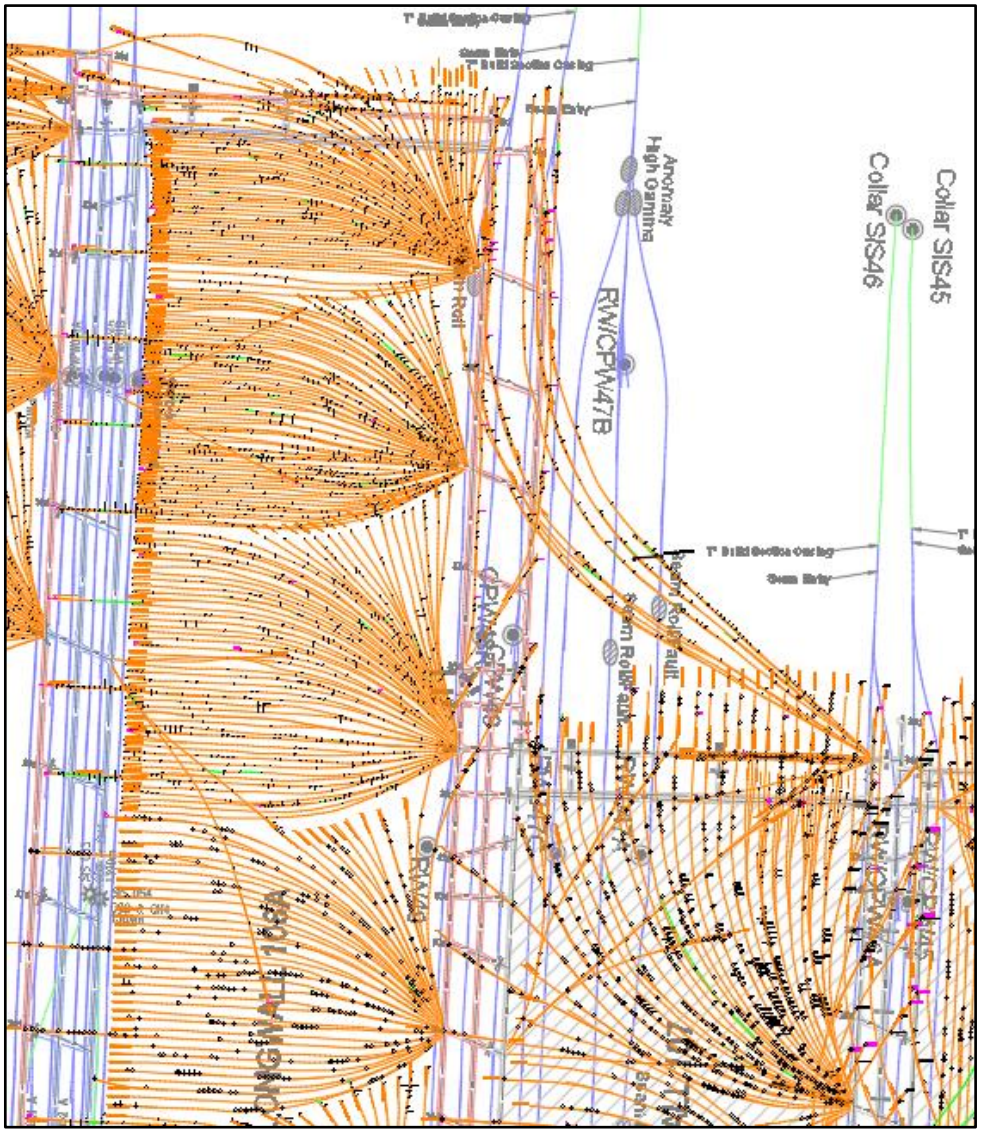
Issues – Spontaneous Combustion

CO found in several UIS drainage patterns

Several Possible Reasons

- UIS & SIS drilled perpendicular to patterns
- Many development intersection points on the MG108 faceroad
- Stop / Start drainage



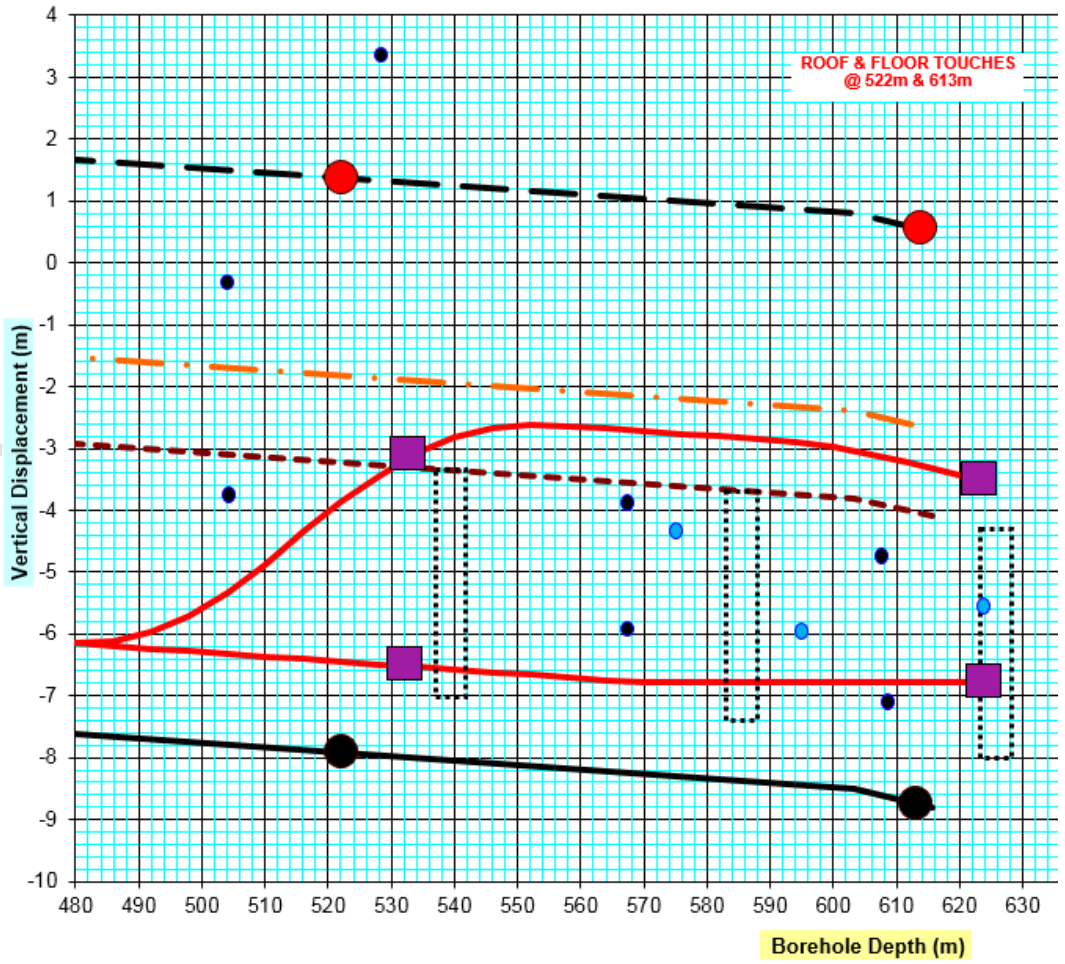
Core Sampling

Position In Seam

- Where the virgin gas content is greater than 8.0m3/t then an additional compliance core will be taken in the upper portion of the seam (Hsk 3)

Density Correction

- Standard:
  - CO2 > 65%
  - Ash = 9%
  - Relative Density (RD) = 1.41g/cc.
- Coal samples that do not meet this criteria have there gas content corrected.
- Majority of upper cores are corrected



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Hole Maintenance

- Monitoring requirements have increased proportionally with the drilling regime
  - Started with 12 Hour coverage – Operators
  - Now 24 Hour coverage – Deputies
- Following the completion of a hole it is connected to the gas drainage reticulation system.
- Each hole is then measured for gas flow on a regular basis
  - Pattern – Daily
  - Individual hole – Weekly to Monthly
- Gas range gas composition is constantly monitored by tube bundle system and flow measurements are taken
- Regular gas bags taken for gas ranges to verify tube readings
- Pressure monitoring of gas range – Suction location and strength
- Maintaining
  - Inspections of gas drainage sites, gas drainage ranges for any damages
  - Empty water along gas ranges regularly

UIS Drilling – Future Challenges

Coring / Drilling Distance

- Currently restricted to 650 metres for compliance
- Up to 1’100 metres for exploration

Time constraints

- Getting Deeper in the pit – Running fines bins in and out

Higher gas contents

- Longer standpipes
- Increased size of infrastructure
- Improving pressure grouting of ribs

More vigilance on safety

- Resampling in a higher density to provide a more comprehensive view of how the gas drainage has performed & in an attempt to not miss any tight spots
- Reviewing the data more in depth to identify problem drainage areas

Surface Infrastructure

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Gas Drainage Plant

3 Liquid Ring Pumps

- Capacity of 3 m^3/s
- Currently running only one pump due to demand
- Gas plant will be fully utilised when drilling on the southern side of the mains
(LW201 – LW206)

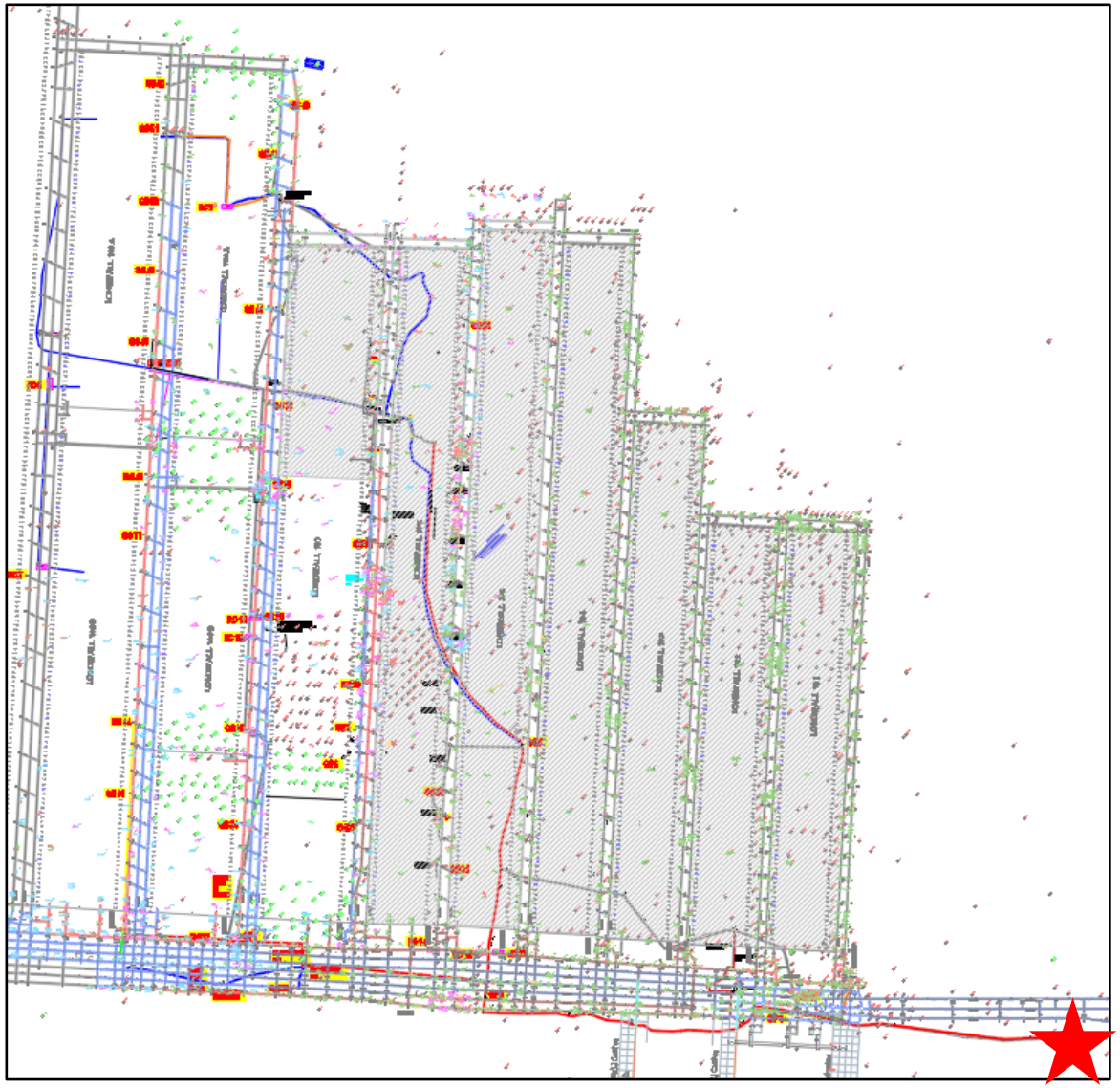
Surface Gas Lines

Current Setup

- Running 5 mobile extraction units
- Due to the fact that the distance to the plant is too great (> 10km)
- Each gateroad is segregated

Future

- 1 Big network
- Provides flexibility for maintenance
- Provides the ability to manipulate pressure where required



Mobile Extraction Unit (MEU)

HOWDEN CD10 1100 PADDLE BLADED FAN

- Capacity = 2000 L/s
- Pressure = - 30 kpa
- Remote monitoring

Generator **“Blower”** **Monitoring Skid**

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Future Plan

8 Mobile Units

- 5 For Goaf extraction
  - 4 Active
  - 1 Leap frogged onto next hole
- 3 For UIS Drainage
  - 1 For each gateroad on active drainage

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SIS Drainage

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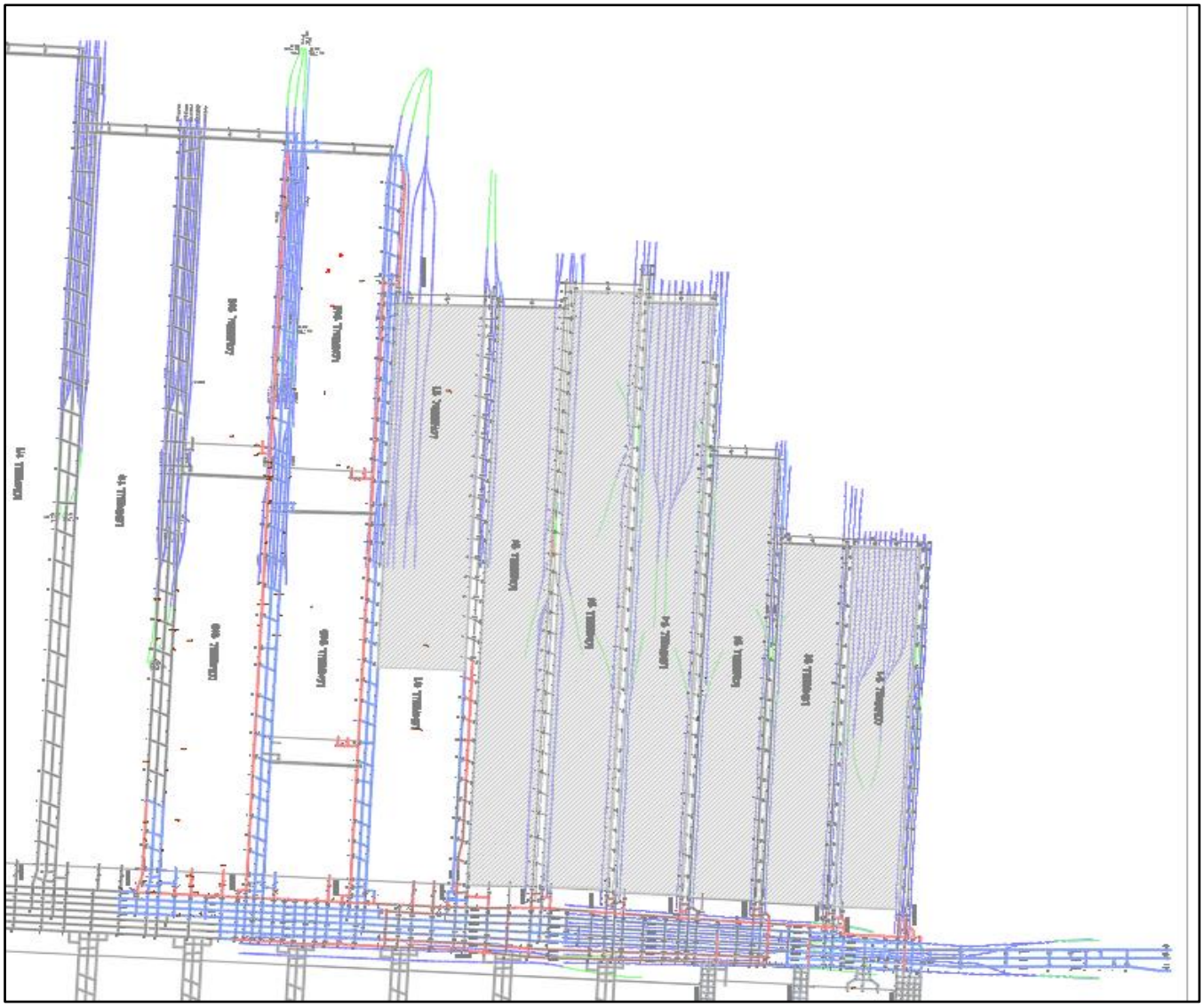
SIS Drainage – Overview

Have performed LW block drainage in earlier blocks

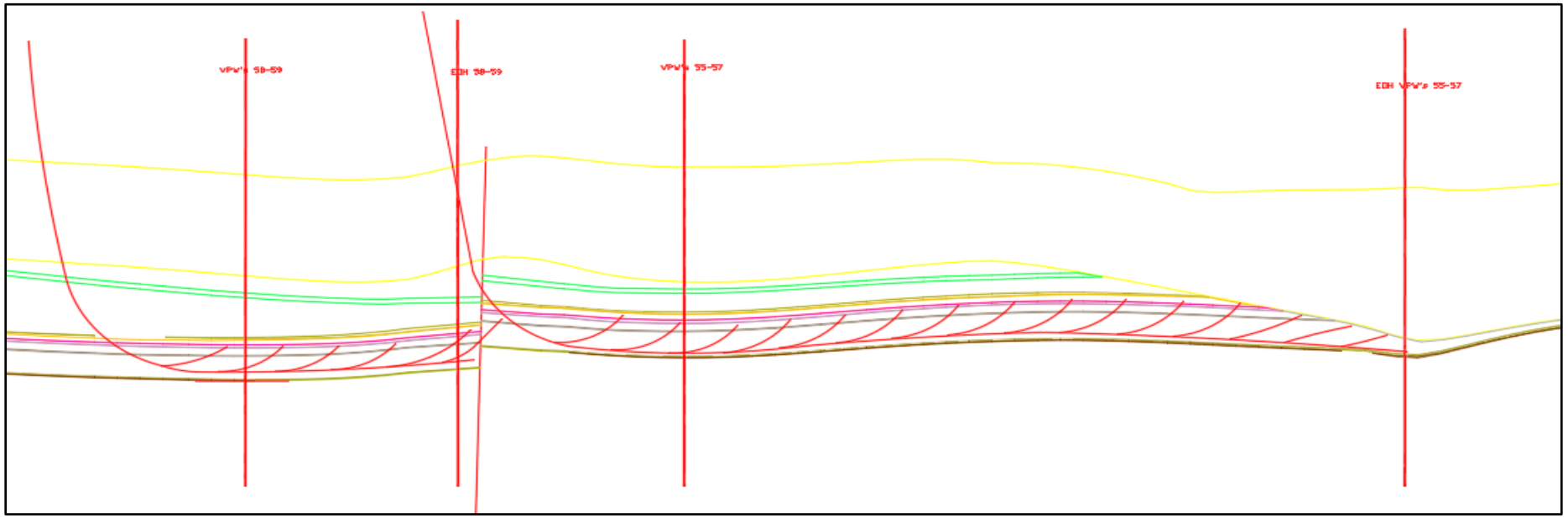
All gateroads have SIS drainage

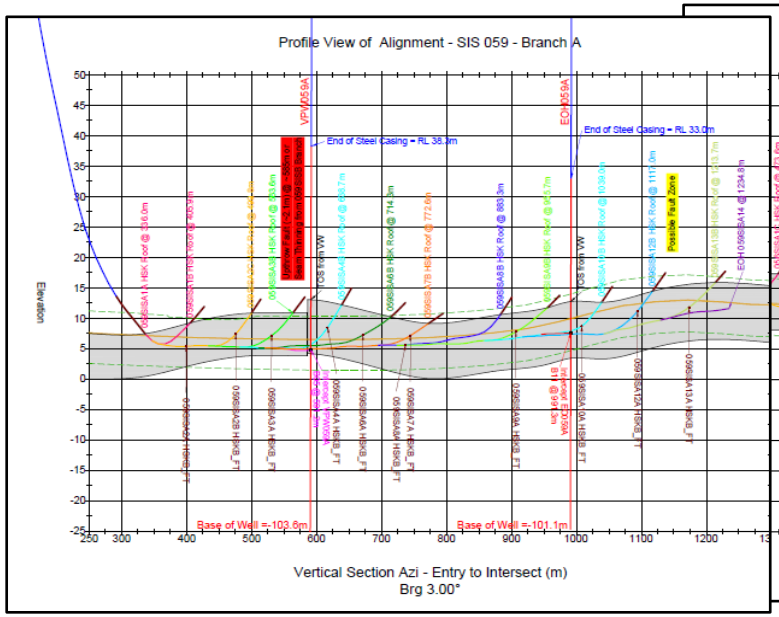
Issues:

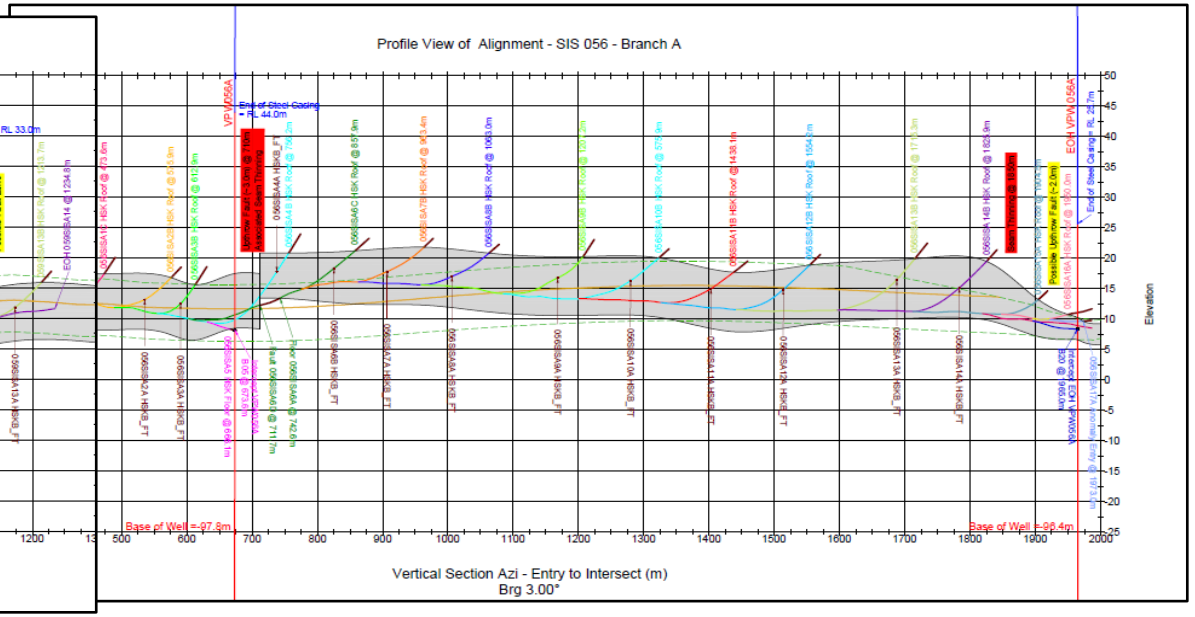
- Drilling distance Laterals in excess of 2’200 m
- Development intersection
- Drilling accuracy: Tolerance is now 200 mm



SIS Drainage – MG109







SIS Drainage – Surface VPW

Issues:

- Remote monitoring issues in dense bushland

  This requires labour to go and check each station regularly and download information

- Disposal of water – extensive surface pipework

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Goaf Drainage

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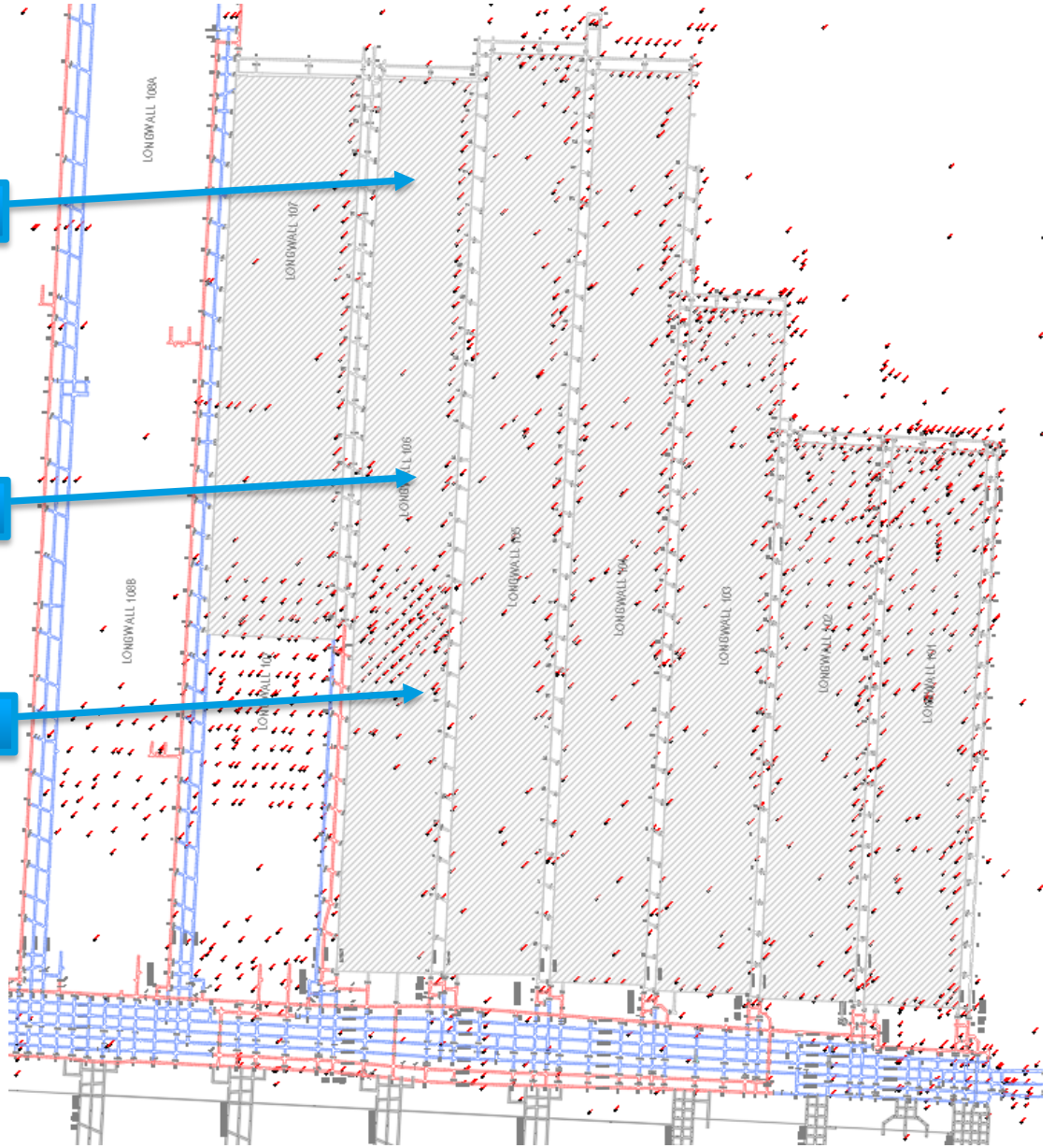
Goaf Drainage

50 Metres Spacing

100 Metres Spacing

200 Metres Spacing



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Goaf Drainage – Infrastructure

Venturi

Goaf Trailer

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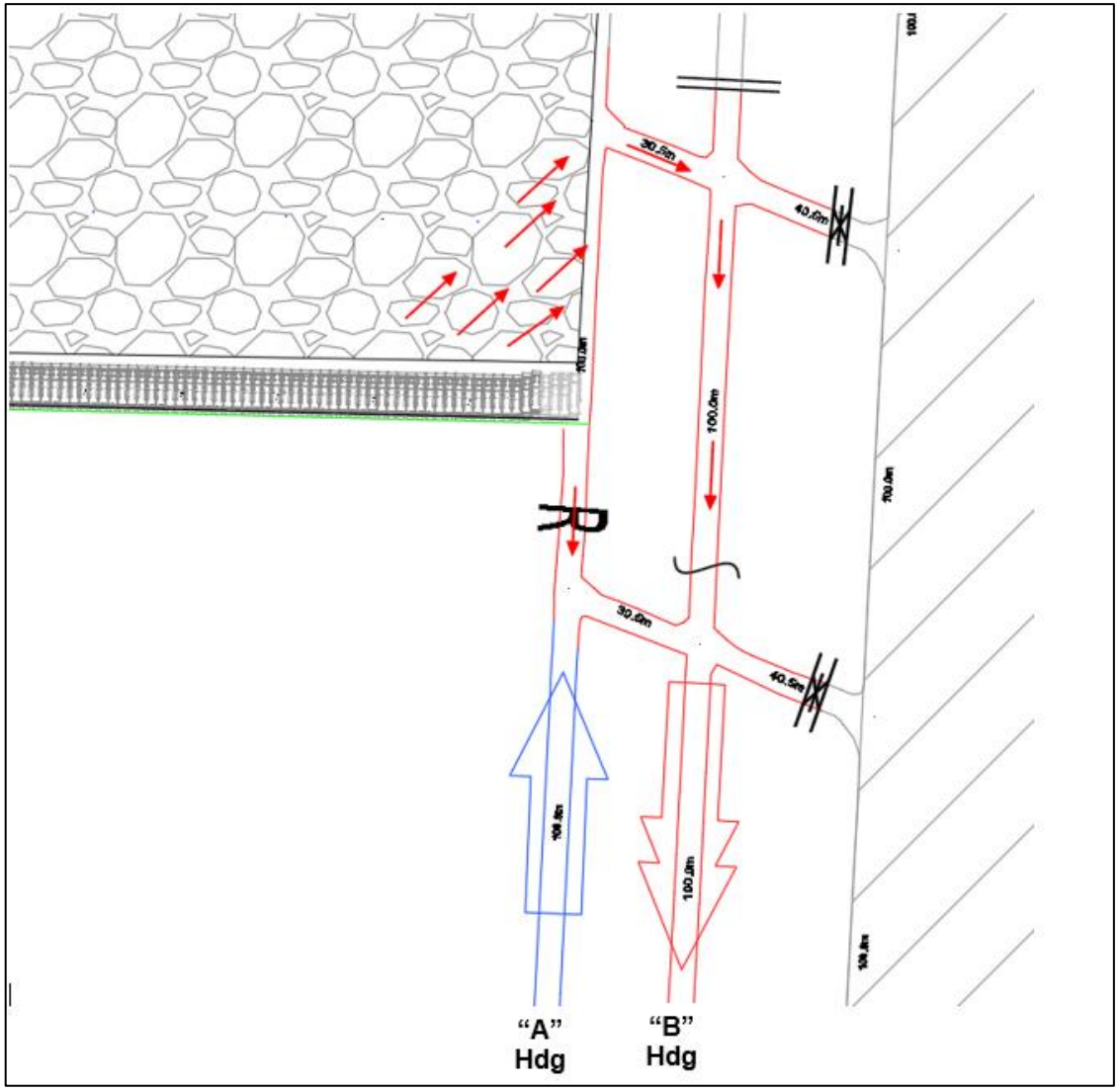
Goaf Drainage – Challenges

- Finding a balance with underground ventilation setups
- Back over bleed ventilation setup to keep the gas away form the tailgate drive and off the face
- This limits the efficiency of goaf drainage near the face
- As underground ventilation and mining practices change goaf drainage will adapt to follow
- Use of sliders
- Goaf holes moved closer to the middle of the block



THANK YOU

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Questions???

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