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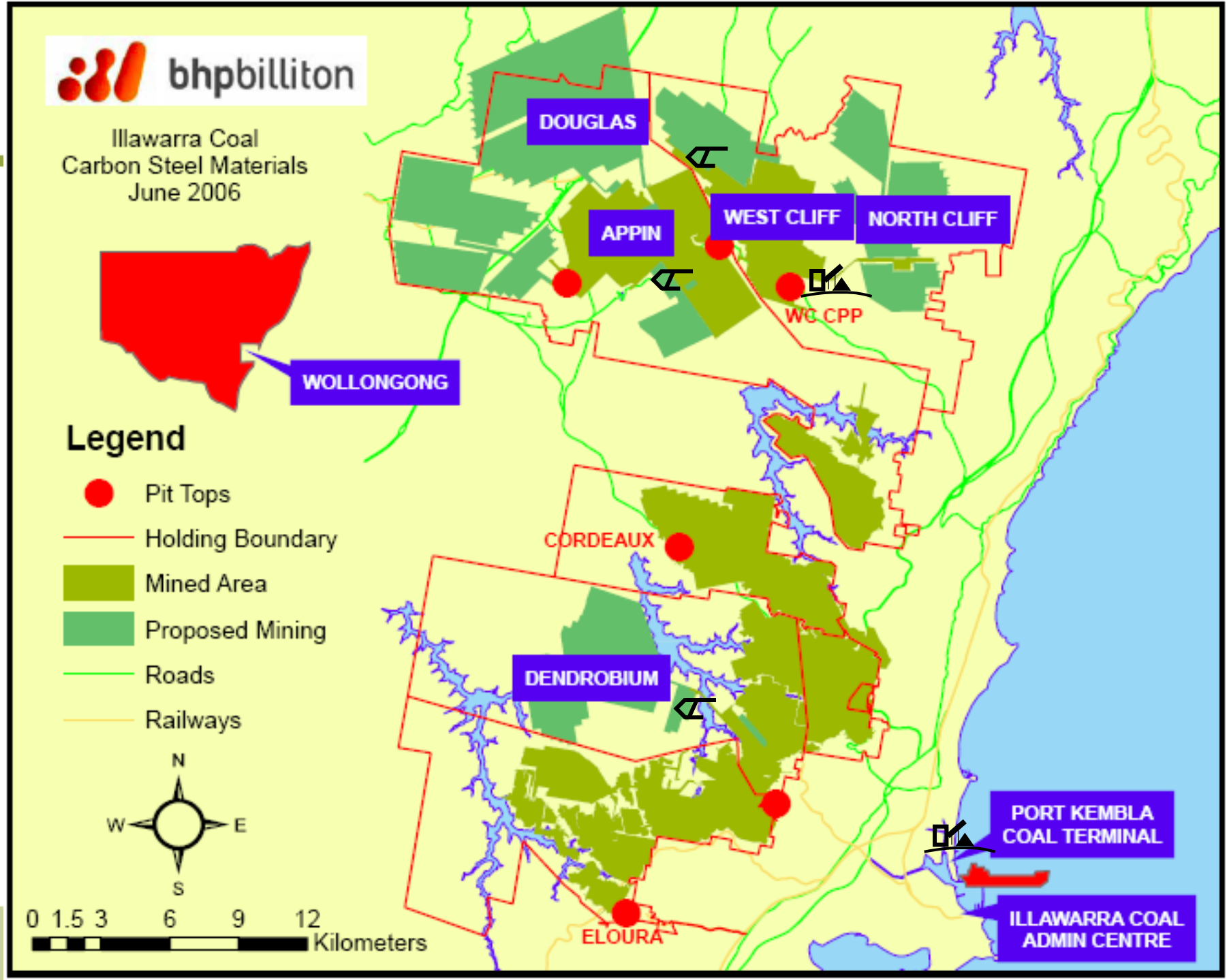
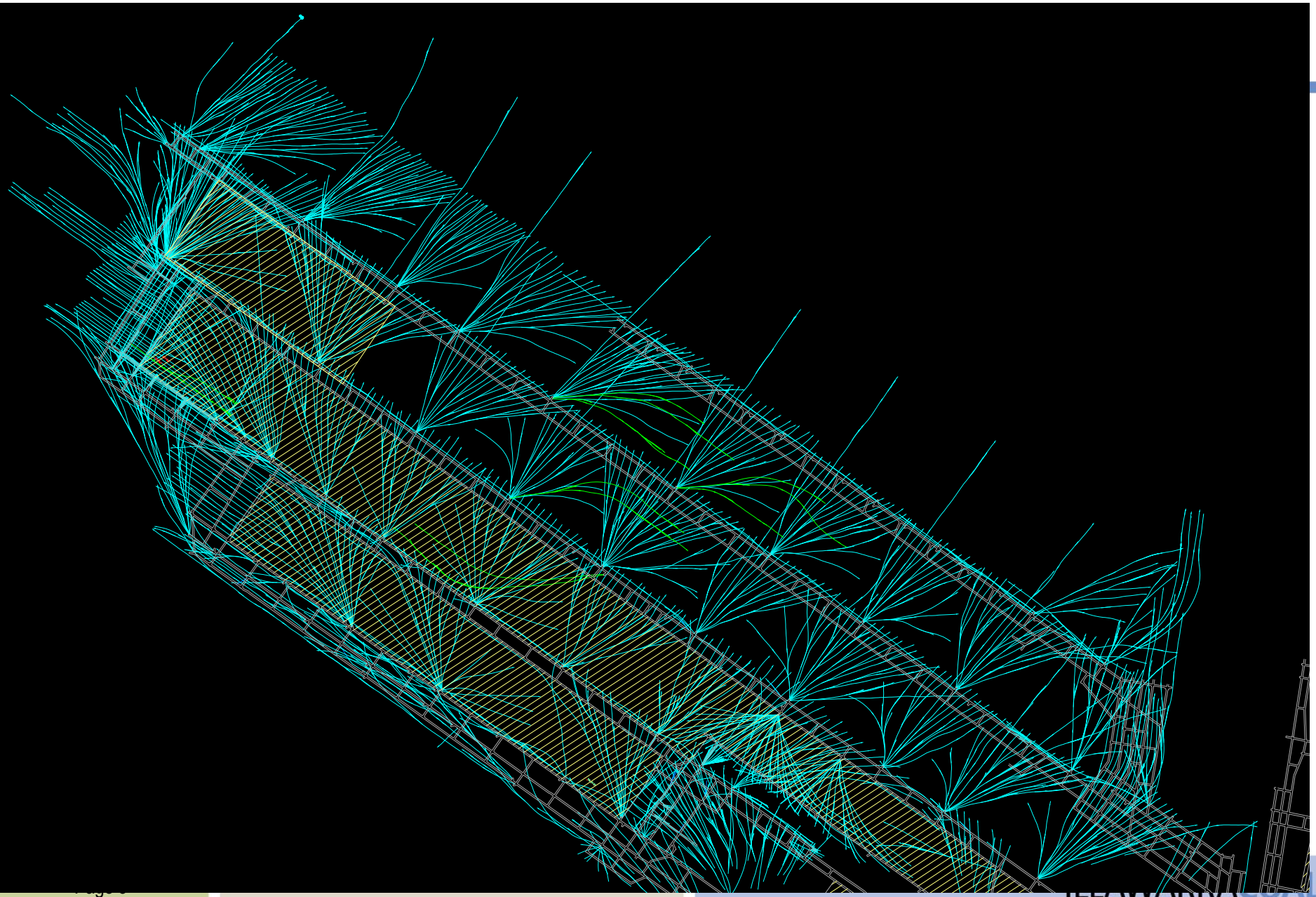
Gas Management Challenges at West Cliff colliery

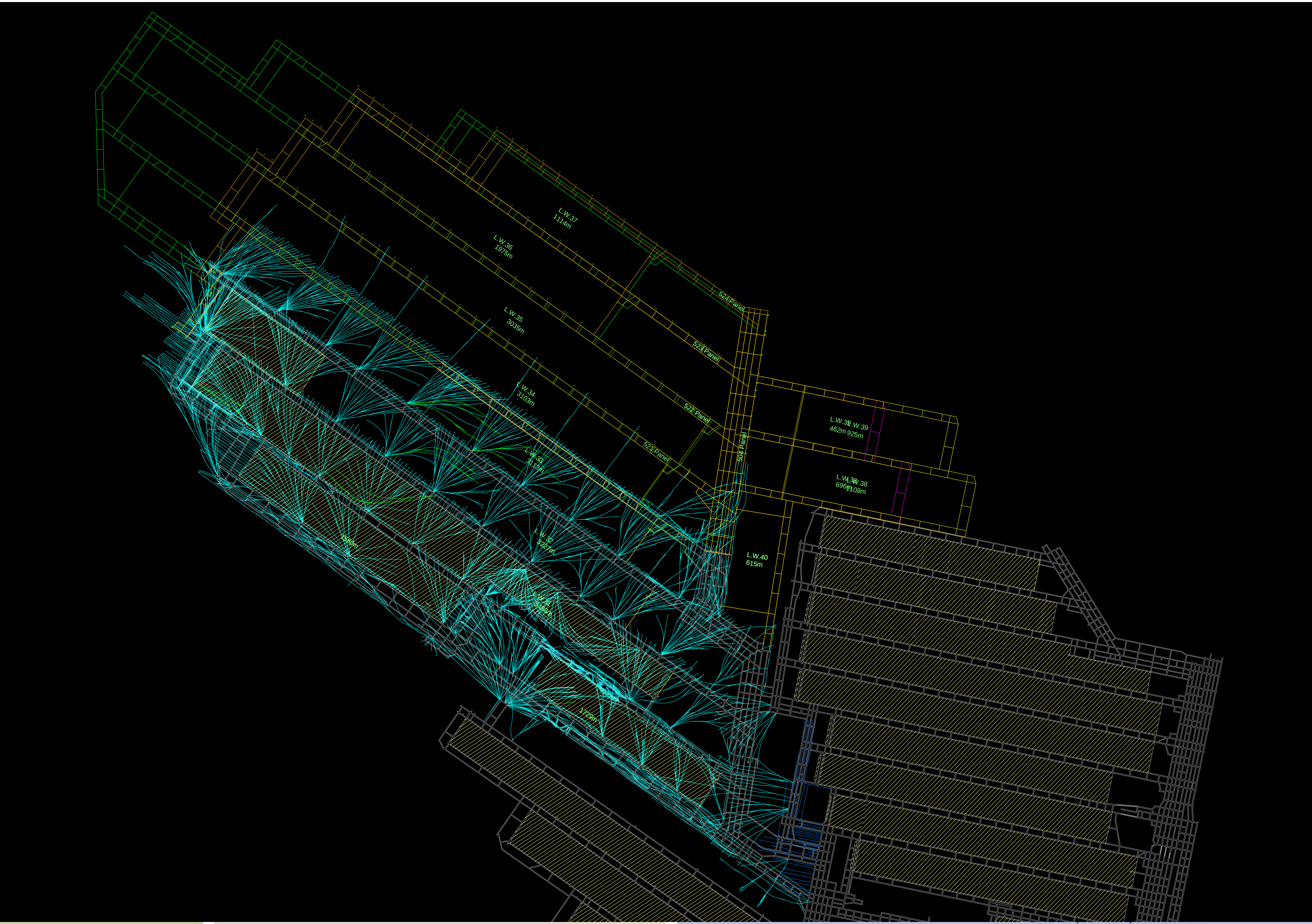
June 2007


bhpbilliton
Illawarra Coal
Carbon Steel Materials
June 2006
DOUGLAS
APPIN
WEST CLIFF
NORTH CLIFF
WC CPP
WOLLONGONG
Legend
Pit Tops
Holding Boundary
Mined Area
Proposed Mining
Roads
Railways
CORDEAUX
DENDROBIUM
ELOURA
PORT KEMBLA
COAL TERMINAL
ILLAWARRA COAL
ADMIN CENTRE
N
W
E
S
0 1.5 3 6 9 12
Kilometers

Background

- Typically the Bulli seam UG operations of Illawarra Coal have been conducted in areas that have been of relatively low CO2 composition (<40% CO2)
  - Generally due to higher inherent risks associated with outburst proneness of CO2 areas.
  - Relative ease and lower costs associated with draining gas to below threshold limits from CH4 zones.
  - Extensive degassing conducted ahead of mining operations
- Given the long history of working the Bulli seam a good deal of the favourable mining areas (gas) have been extracted.
- Operations are now progressing into more challenging areas.




L.W.37
1114m
L.W.36
1975m
L.W.35
3035m
L.W.34
3103m
524 Panel
523 Panel
522 Panel
521 Panel
504 Panel
L.W.39
925m
L.W.38
1108m
L.W.40
615m

Challenge & Opportunity

- Demonstrate methods to reduce the impact of CO2 on mine layouts
- Develop a robust case to support extending the mine plan beyond the current shortened length

Knowledge & Understanding

- CO2 has been assumed to be the primary cause of the poor drainage performance
  - Is this assumption reasonable / true?
  - Are there other contributing factors? If so, what impact do they have on drainage performance?
  - How can we successfully access these difficult zones?
  - What are the best tools / methods to use to treat these various factors to stimulate drainage improvement?

- Undertake detailed site based and laboratory investigations to determine the factors and relationships which exist between a broad range of coal properties and mine specific conditions
- Aim is to determine the factors, and their relative significance, which impact gas drainage performance
- This will in part be achieved through the development of a reservoir model

Process

A comprehensive analysis of factors that impede gas drainage and the assessment of methods to improve drainage performance – West Cliff mine program.

COAL PROPERTY ANALYSIS

Collect a range of coal samples to cover the range of gas compositions and drainability encountered throughout the mine

Analyse coal samples to determine coal properties associated with the coal samples collected from these various locations

MINE CONDITIONS & GAS DRAINAGE PERFORMANCE

Collect and Analyse inseam drilling and gas drainage performance data

Determine borehole drainage performance, including liberated gas composition and rate, relative to Hole orientation, Hole location and Drainage time.

DEVELOP UIS GAS DRAINAGE DATABASE

Analyse and evaluate the results of Coal Property Analysis in conjunction with Borehole Analysis to identify relationships between the two which impact drainage performance.

Determine the relative significance of each 'Factor' in terms of impact on drainage performance.

DEVELOP RESERVOIR MODEL

Undertake sensitivity analysis on the coal properties and mine conditions in the Reservoir Model to determine the relative significance and impact of each parameter on gas drainage performance

DRILLING & GAS DRAINAGE IMPROVEMENT INITIATIVES

Evaluate potential drainage improvement initiatives through either site based trial and demonstration OR computer based modelling and simulation to determine the relative impact and potential of each to address the key Gas Drainage Inhibitors to improve gas drainage performance

DEVELOP GAS DRAINABILITY INDEX

Based on the results obtained during the course of the project develop a Gas Drainability Index for the trial mine based on the current available knowledge of the Location & Significance of the various key Gas Drainage Inhibitors

Testing & Analysis of Site and Laboratory data

UIS hydraulic fracturing

Borehole pressurisation

Borehole dewatering

SIS hydraulic fracturing

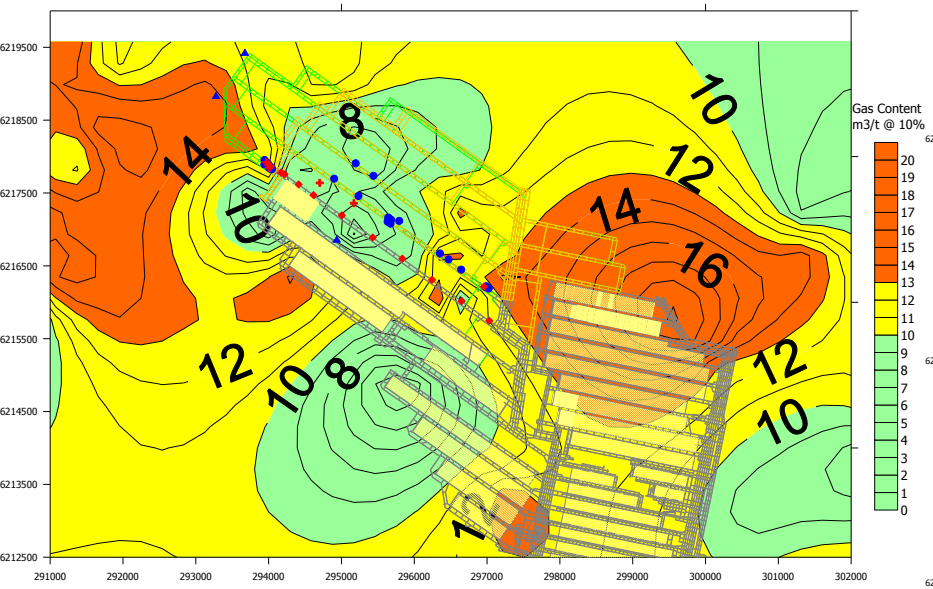
Medium radius drilling

(inc treatments to deal with the Drainage Inhibitors)

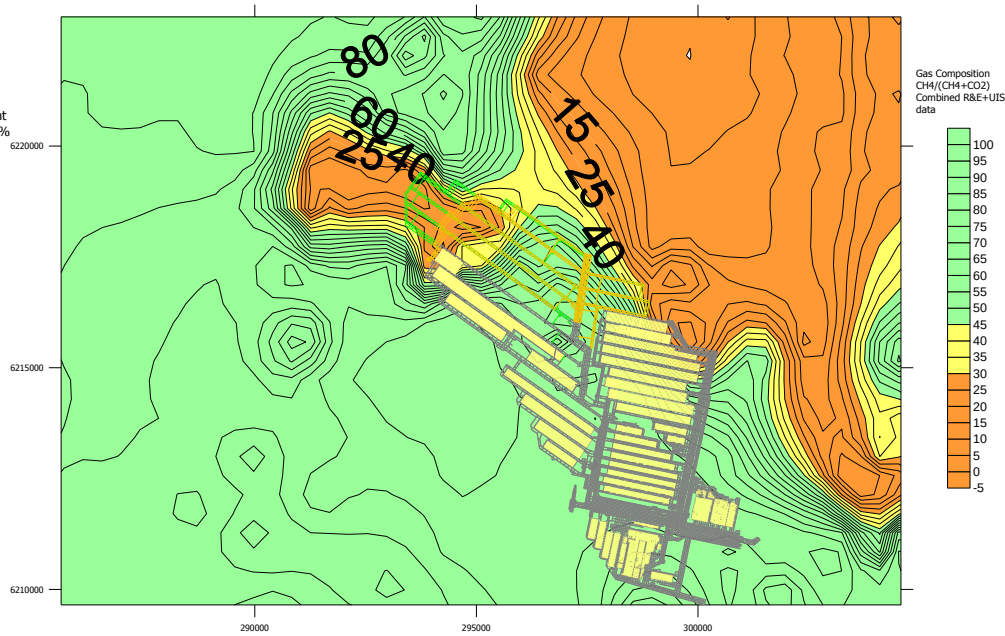
Testing & Analysis

- Investigating differences in coal properties
- Relate coal properties and mine conditions to the recorded gas drainage flow data from the current mining domain
- Coal properties to be considered include:
  - Gas content;
  - Gas composition
  - Permeability
  - Mineralisation
  - Rank
  - Strength
  - Shrinkage
  - Sorption
  - Desorption rate
- Mining conditions to be considered include:
  - Borehole orientation relative to Cleat
  - Borehole orientation relative to Stress
  - Borehole orientation relative to Seam Dip

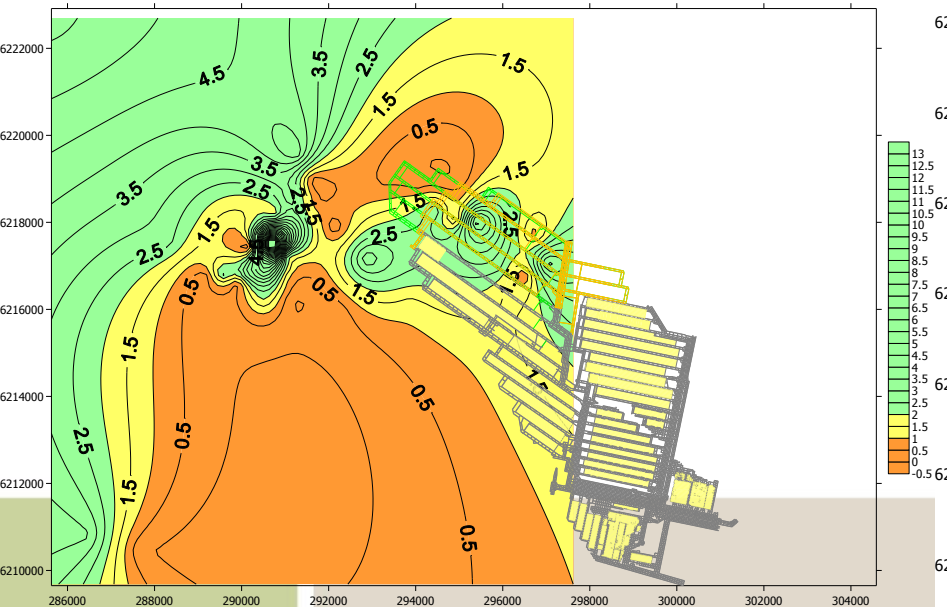
Gas Content - m3/t @ 10%



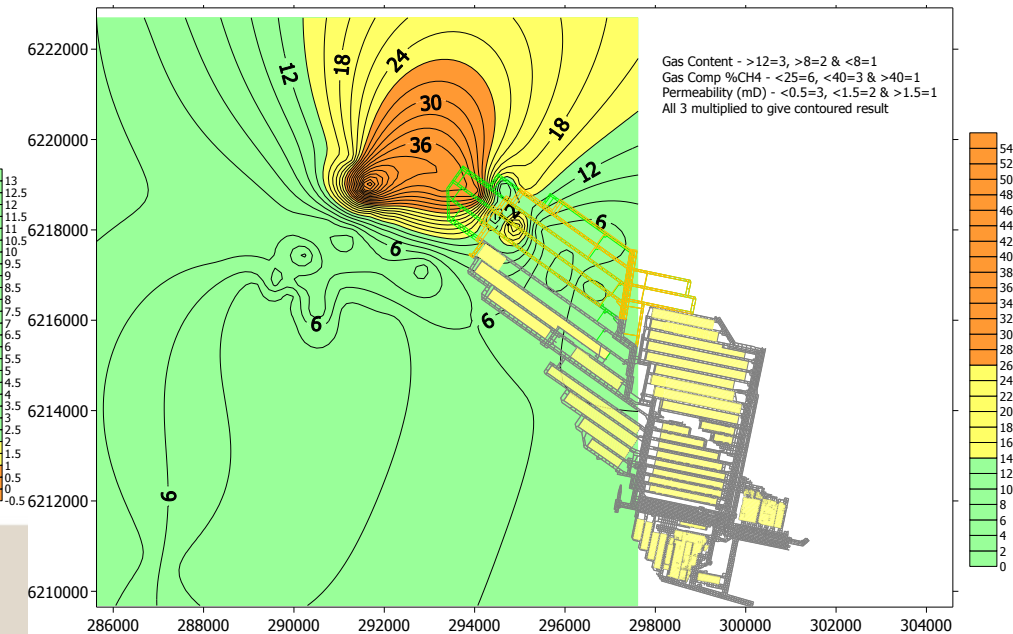
GAS COMPOSITION [CH4/(CH4+CO2)] Combined R&E+UIS data



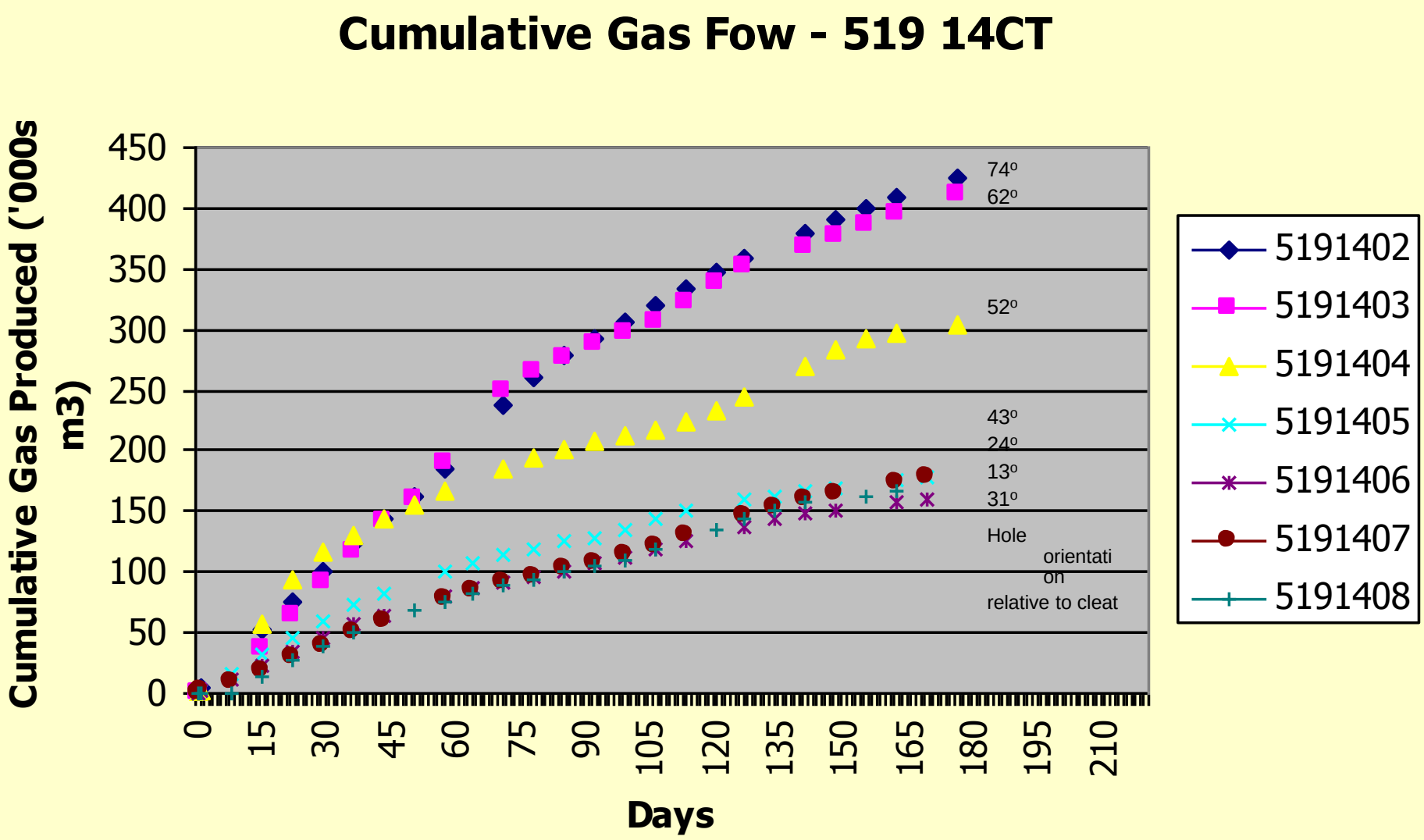
BULLI SEAM PERMEABILITY (mD)

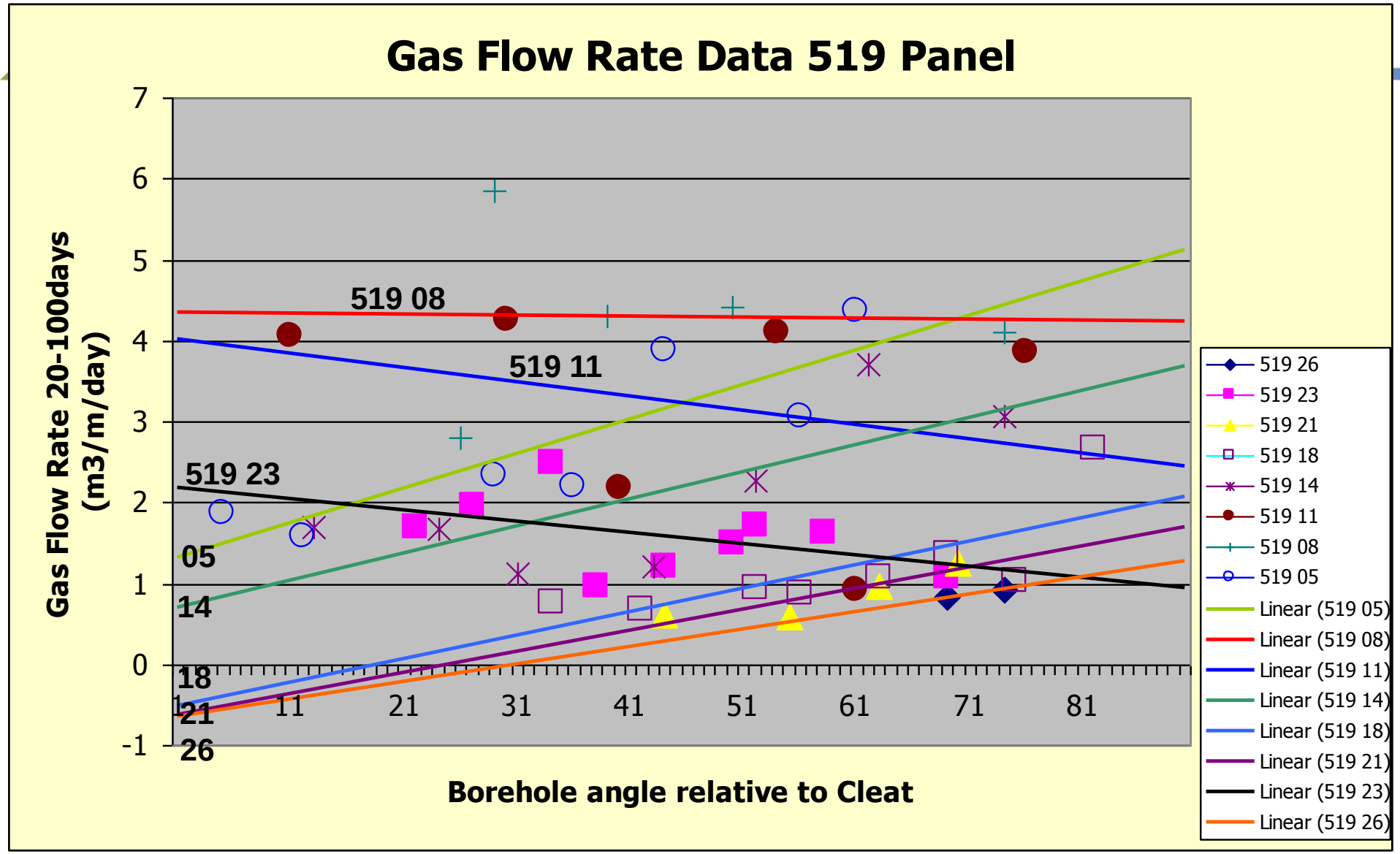


COMBINATION EVALUATION - Gas Content, Gas Composition & Permeability



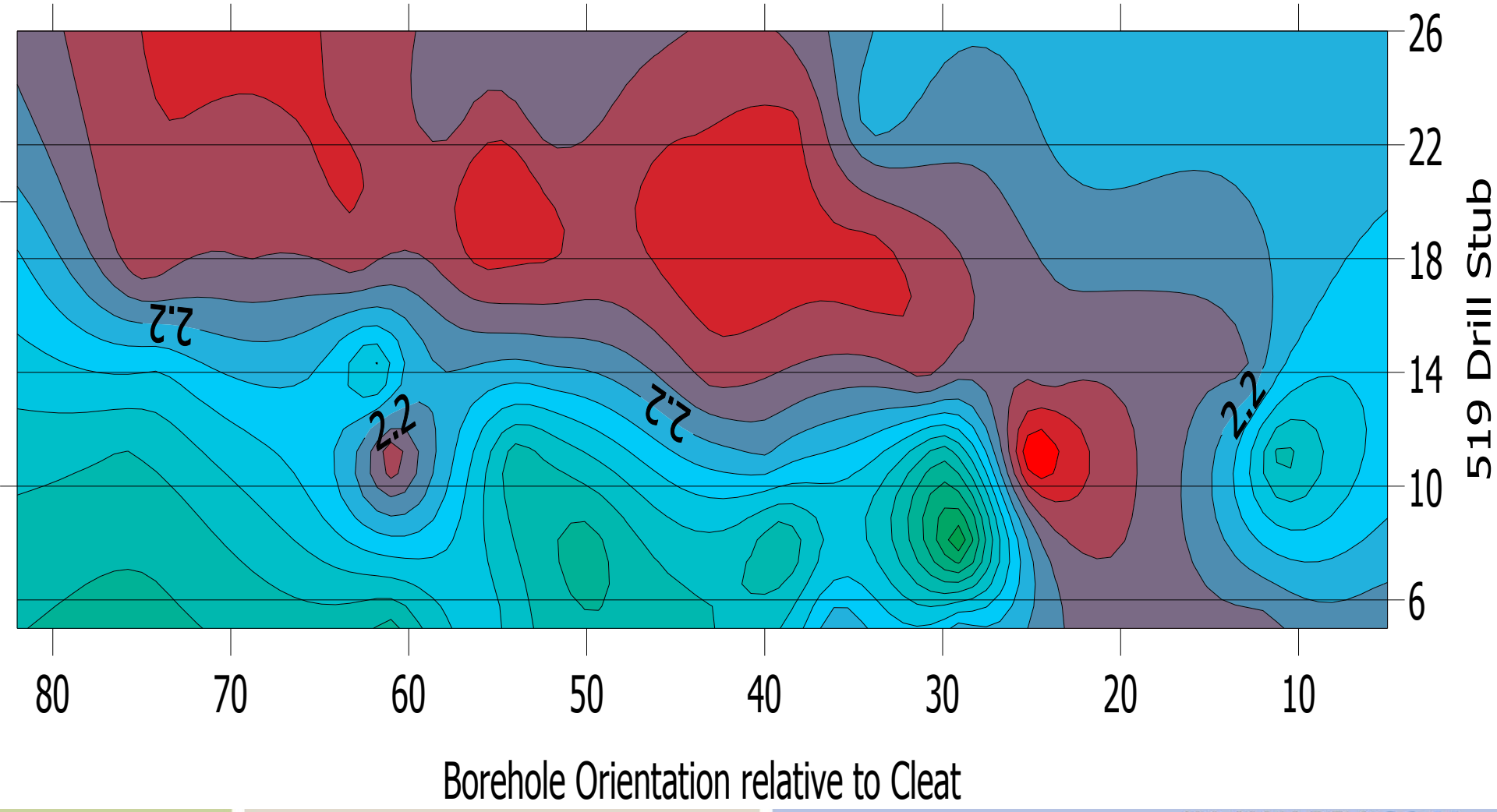
Impact of hole orientation on gas flow





GAS FLOW RATE (m3/metre/day)

Data: 20–100 days of drainage time



Application

- Gas drainage can have a significant impact on UG mine productivity.
  - This has been demonstrated within BHP Billiton as well as in many other companies.

- Providing a range of drainage improvement techniques which are appropriate to the **specific conditions** (coal properties & mine layout) in a given area will be a significant advance in our ability to plan an effective and timely response.

- Financial support is being sought from ACARP to assist with the development of the Reservoir Model and the Gas Drainability Index.