Appendix 4 Outcrop and Near Surface Geological Interpretation

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BICKHAM COAL EL 5306 & 5888

Outcrop and Near Surface Geological Interpretation

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PLANS and FIGURES

1. INTRODUCTION.

A detailed map of the geology has been prepared for that part of the area of Bickham EL 5306 where the coal seams, especially the 'G' horizon, intersect the course of the Pages River. The detailed map is supported by a number of cross sectional diagrams and placed as a window within a more regional geological map.

This document post dates all previous interpretation and reporting of surface and near-surface geology in the Bickham EL areas. It should be noted that earlier reporting placed a reliance on interpretation of sub-surface data by way of modeling, and projected that data to infer outcrop locations. The current detailed field mapping data has refined that interpretation and while shifting outcrop positions by only relatively short distances has in particular substantially reduced the zone where the course of the Pages River and the G Seam outcrop coincide.

2. STRATEGY.

An interpretation of the surface and near-surface geology of part of the Bickham area was made based on a computer model of the deposit, supplemented by detailed surface mapping observations. The model provided the trends of coal seam occurrence which were then subject to some modification based on detailed observations of seam occurrences on or near the surface. This work was supplementary to earlier regional mapping and interpretation over the general EL areas.

3. OUTCROPS.

3.1 Coal Seams.

There is very limited surface expression of coal seams in the region. By far the greater part of the interpreted limits of the coal seams has been derived by projecting the seam structures to intersect the surface topography; i.e. the theoretical seam outcrop projection. Except for minor zones of outcrop in the vicinity of a relatively limited section of the course of the Pages River there is no natural surface exposure of coal. Over by far the greater part of the region, coal seams are apparently limited some distance down-dip from the projected subcrop line by a combination of seam weathering and in-situ seam combustion.

Only in the extreme nor-nor-east of the area of current economic interest within the ELs, in the general vicinity of the old Bickham underground mine entries, is there some limited exposure of coal at outcrop. The coal outcrop is interpreted to be of partial sections and discontinuous extents of the G Seam horizon. Reliance still needs to be made on borehole data to place the very limited exposures of what is usually partially weathered coal outcrop into a coherent structural and stratigraphic context. We have located no other confirmed seam outcrops in the region with the possible exception of several 'chocolate' soil zones which might be extremely weathered expressions of coal / carbonaceous horizons.

There was observation of coal outcrops at two locations along the course of the Pages River; along the western bank of the river (see Figure 1) both above and below the present water level of the river, and in an outcrop on the north eastern bank of the river just above water level (see Figure 2). Both outcrops can be confidently identified as the G Seam, although at only one location can structural control of the G Seam be established; this was for an (x,y,z) of the seam structural roof (see Figure 3).

Western Bank Outcrop - coal in this vicinity can be seen both below and above the surface water level of the Pages River. The coal is observed as generally fresh below the (approx.) low-flow water level of the Pages River, while above the water level the coal is variably fresh to weathered along the strike of the exposed coal. Trenching down to the top of the coal exposed a contact between the G Seam roof and an overlying shale unit from which the survey pick-up of the structural roof was taken.

Eastern Bank Outcrop (adjacent to northern bend). Although exposure of coal at this location can be observed over a distance of some 25 metres along the river bank, no definite stratigraphic horizon and hence no structural data could be established.

Gravelly Alluvium masks much of the immediate bedrock along the river bed and its immediate flanks. Consequently much of the interpreted position of the G Seam outcrop in the northern part of the area (from about 6,475,800 mN northward to 6,475,930 mN) is obscured. If the alluvium were removed then it is projected that the exposure of bedrock would show a G Seam outcrop lying generally to the west and predominantly a little above average river water level. This hypothesis is supported by exposures in the old Bickham mine entries.

Other Seams - while there is sound evidence from borehole data interpretation to conclude that the full sequence of the seams above G, i.e. A to F inclusive, should intersect the Pages River in the approximately 200 – 250 metre interval upstream from the point where the stream course swings to the west (approx. 305,850 mE to 306,100 mE), no surface outcrop of coal could be located. It is assumed that the seams must have been markedly reduced by weathering at subcrop and the seam remnants masked beneath alluvials and soil accumulation in the river and on the banks. This pinching out of weathered (smut) is suggested to create an effective seal to water movement in / out of the fresh coal seam further from the course of the river.

3.2 Burnt Seam Remnants.

East of the course of the Pages River, both in the immediate bank / cliff and in the hilly country immediately to the east, there is irrefutable evidence of removal of G Seam coal by in-situ combustion. Regionally there is an overwhelming correlation between 'red-rocks' and sub-surface combustion, the heat having initiated oxidation of iron minerals within the sediments. This is nowhere more apparent than in the east bank of the Pages River, in the northern part of the area under review, where broken red strata irregularly overlies what is interpreted to be G Bottoms. The G Bottoms have been identified in adjacent boreholes as an interbedded carbonaceous and clay shale unit which immediately underlies the G Seam and which in turn unconformably overlies the Permian Werrie basalt basement (see Figure 4).

Similarly, in the south of the area subjected to detailed mapping, the high western bank of the Pages River (S of 6,475,600 mN) shows clear evidence of 'red rocks' a short distance south of the limit of mappable coal. Again the G Bottoms and basement basalt occur stratigraphically below the burnt G Seam horizon (see Figure 5).

Also present within some of the boulders of the river course are melt agglomerates of sedimentary rocks. These vary over the full range of somewhat heat affected through an increasingly heat affected range to apparently fully liquefied slaggy material (technically a mix of igneous and metamorphosed materials; see Figure 8). The presence of these agglomerates commences at the northern bend of the river and they may be found for several kilometres down stream from this point, albeit in boulders of decreasing size. The start of the occurrence of melt rock boulders in the stream bed corresponds with the appearance of red rocks much higher in the river bank above this same point.

3.3 Basement Basalt.

Outcrops of basement basalt can be observed at several locations along the river course (See Map / plates). The basalt is highly weathered and altered but can be identified from its colour, lack of sedimentary structure and remnant pillow structure. A distinct lithological boundary can be observed between the basalt and the overlying G Bottoms.

3.4 Dykes.

A thin (approximately 20cm) NNE-trending basalt dyke can be observed in the river course (see Figure 6). The dyke is highly weathered and altered and has been propagated within a sheared zone of closely spaced joints trending NNE. Both joints and dyke are near vertical.

4. STRUCTURES.

4.1 Joints.

At least two distinct joint sets can be observed in the field area; a series that strike north south and are near vertical, and a second series striking approximately east-west. No timing relationship could be established. Joint spacing is highly dependent on the rock type being penetrated – the more massive sandstone / siltstone sequence above the G Seam in sparse observations is generally fractured at 1 – 3 metre spacing while shales are more closely jointed. In the immediate area of mapping, joints are tight with no evidence of an association with ground water movement.

Further joint observations were made in the gorge of the river some 800 metres west of the detailed study area; strata at this location are in the Middle Marines of the Permian sequence, stratigraphically well above the Lower Coal Measures. Orientations were 170° and 102° (mag.) - again joints were tight and dry. Further jointing was observed in the north-south oriented gully located at approximately 305,425 mE and 6,475,800 mN and striking at 005° - these joints showed minor water seepage.

The exception to the above observation of spacing and tightness of joints are the areas where the overburden has been affected by underlying in-seam fires. There are some locations in the area where burning has resulted in very substantial opening of joints and deep surface cracking but in a regional context these are considered as relatively localized phenomena.

4.2 Shears.

A discrete NNE-trending shear zone can be observed in the river course (see Figure 6). No concrete sense of movement can be established, although a left lateral sense of movement is suggested in some of the field evidence. The zone is best observed in the fine-grained material that constitutes the G Bottoms and is delineated as closely spaced parallel joints that become widely spaced further from the shear zone.

4.3 Faults.

Thrust faulting is evident in the eastern bank of the river, opposite the old Bickham mine. The structure is relatively minor within the overall regional setting (see Figure 7). Displacement appears to be less than 5 metres on a plane which dips some 40^0 approximately to the north. The feature occurs in the shaly G Bottoms strata which are weathered and broken in this vicinity. This fault appears to be a unique structural occurrence within the area.

There is weak evidence of some form of structural dislocation trending almost due north-south positioned at about 306,100 mE. The principal evidence is bedding dip; to the west of the river, dips are in the order of 20^0 - 25^0 to the NW as observed in the bulk sample pit, while to the east of the river the mapping of burnt rock, inferred to be at about the G Seam floor horizon, evinces sub-horizontal to gently westerly-dipping bedding in that area.

These dips are supported by the computer structural model of borehole data. It has been suggested that the river and alluvium may mask a significant strike slip dislocation in this vicinity. Whether such a structure exists is considered relatively academic as the area to the east of the projected plane appears to have no relevance to the economic or groundwater geology of the deposit to the west of the river.

5. CONCLUSIONS.

Detailed mapping of surface geology in and about the area where the course of the Pages River and the predicted outcrop of the G Seam occur in relatively close proximity has refined an understanding of points of concurrence. This data should assist interpretation of the groundwater regime of the area, and consequently, prediction of the interrelation, if any, between surface water and groundwater aquifers.

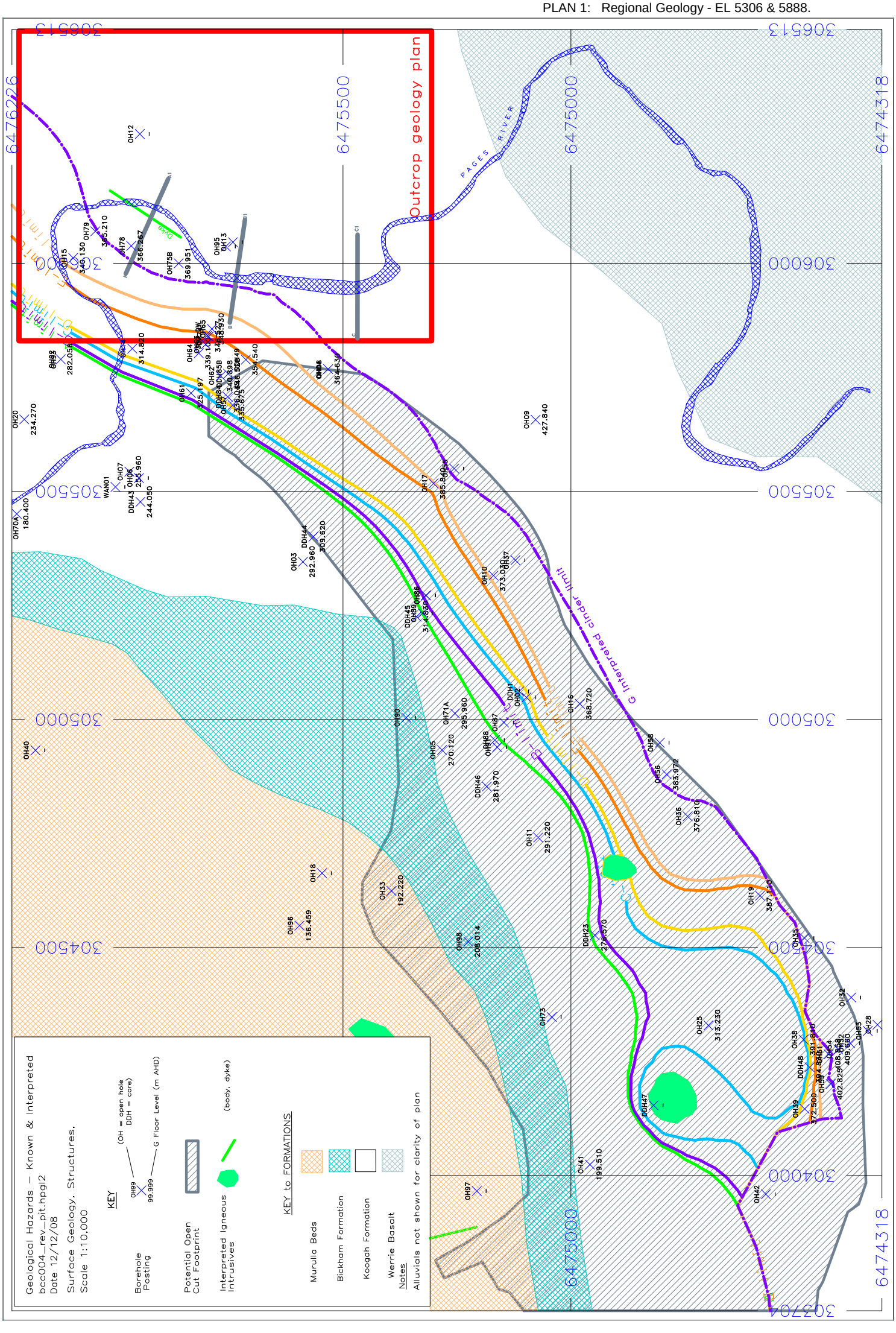
Outcrop exposures of the coal seams which occur in the area are limited and variable in nature; at no single location is there an exposure where the full G Seam stratigraphic section may be observed. By far the greater part of the expected extent of seam outcrop has been removed by in-seam fires while a secondary portion has been removed by weathering or simply masked by alluvium.

Final interpretation of the geologically-related information in the locality, both from modeling of borehole data and from surface mapping observations, has concluded that there is a zone of less than 200 metres north-south extent where the outcrop of at least a part of the G Seam is below the average water level of the Pages river at that location. There is a further in-river outcrop length of about 25 metres in the extreme north of the area.

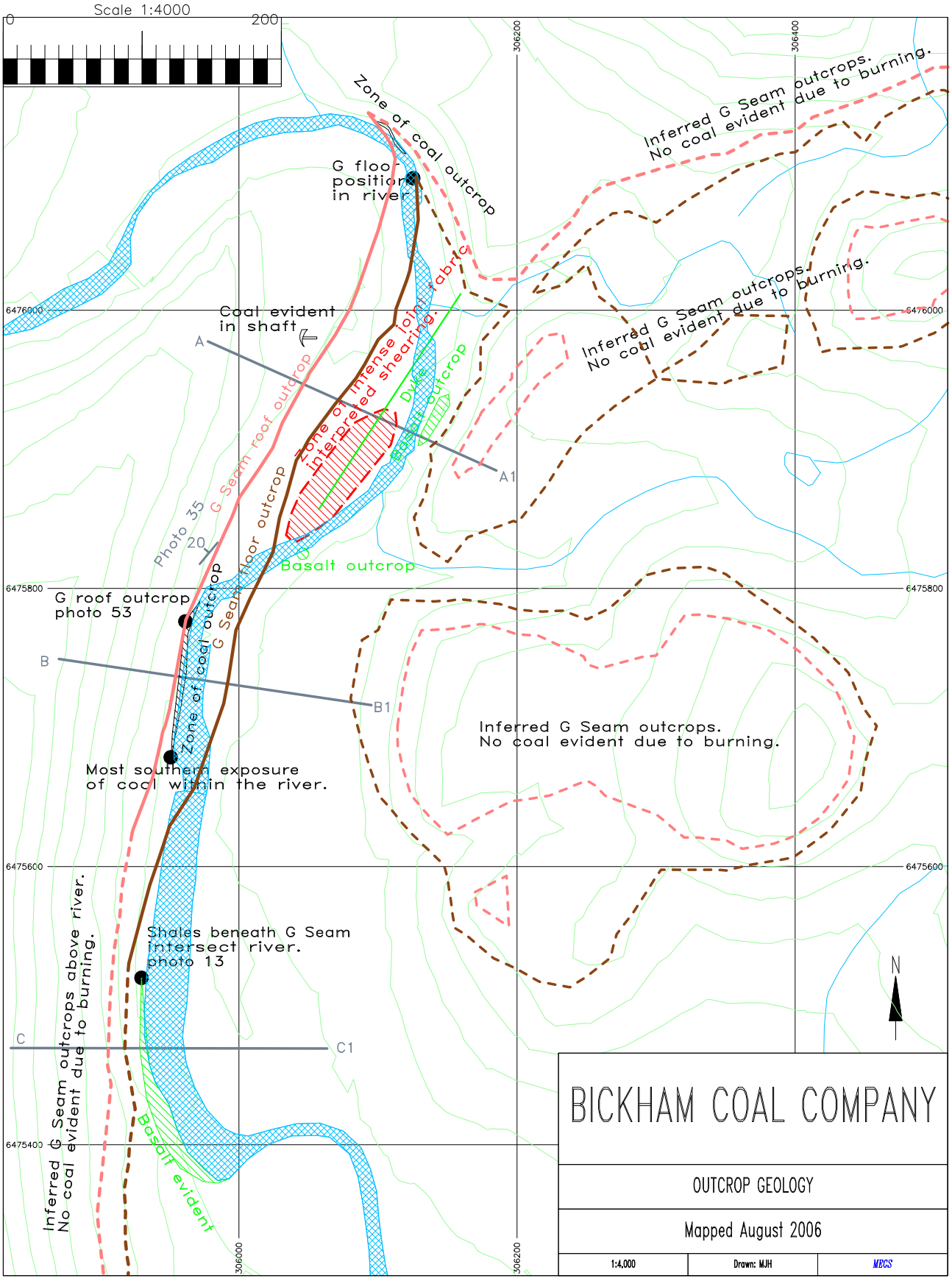
In addition there is a zone of some 300 metres where the G Seam outcrop is beneath alluvium flanking the river, but above the usual water level. This is the geological configuration in which the old Bickham underground operated, entering the seam below the alluvium but above river water level. Finally the occurrence of G Bottoms and basaltic basement has been recognized in the south; there is ‘red rock’ associated with combustion of the G Seam well above-river in this area. No outcrop evidence of the overlying seams crossing the course of the river could be found, and it must be assumed that they have been weathered and pinched out as they approached outcrop.

It appears reasonable to conclude that faults, jointing and shearing play relatively minor parts in the creation of water conduits in this area. This conclusion is based about the sparse evidence of major faulting or fault systems observable in outcrop. Jointing is generally widely spaced and tight with the exception of overburden of in-seam fire affected strata.

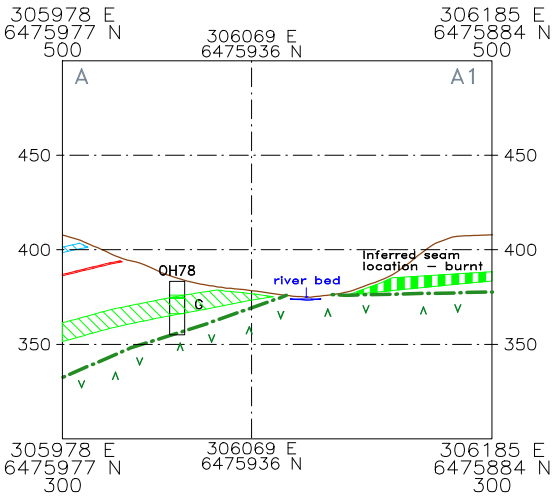
PLAN 1: Regional Geology - EL 5306 & 5888.

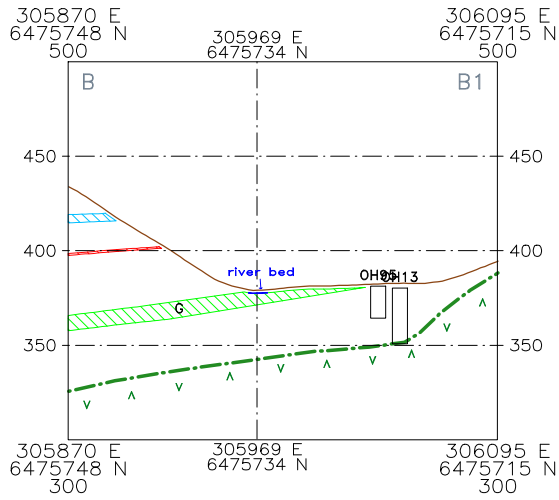


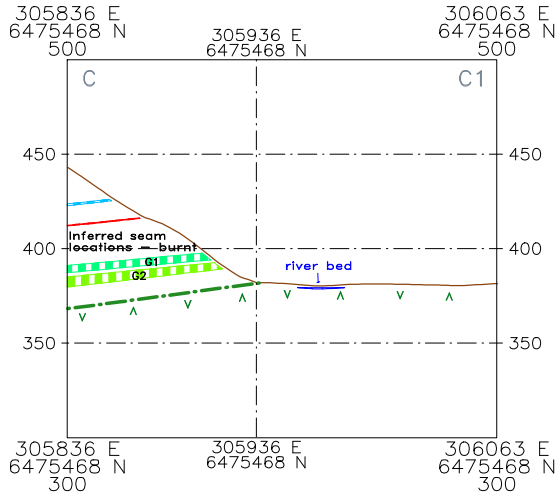
PLAN 2: Outcrop Geology - Vicinity of the Pages River.



PLAN 3: Geological Cross Sections across Pages River.







BICKHAM COAL COMPANY

SECTION GEOLOGY

August 2006

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Coal(G-Seam) Exposed in Western Bank above Creek Line

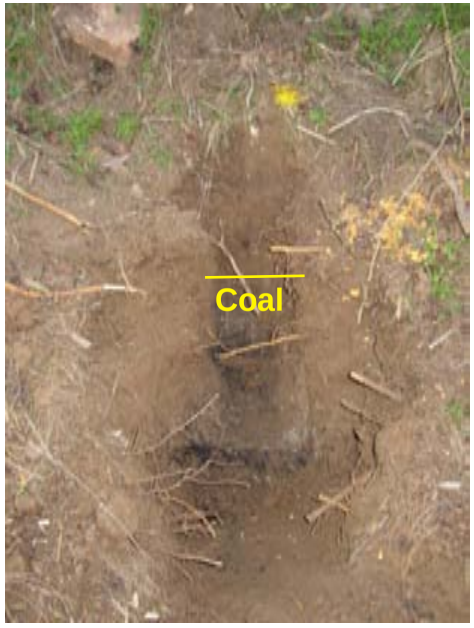


FIGURE 1: G Seam Exposures in Pages River West Bank.

West

Coal Exposed in Eastern Bank of Pages River in Northern Bend of river

East

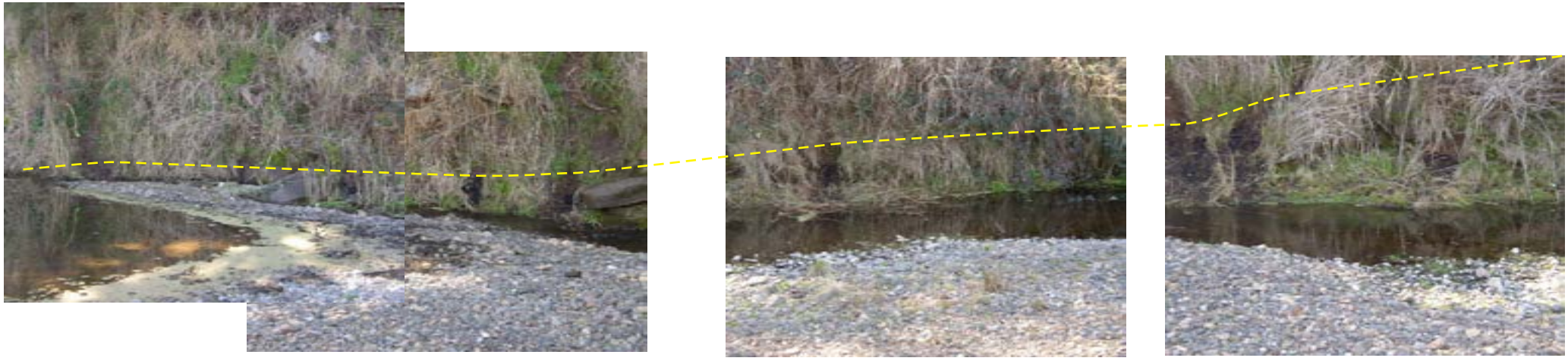
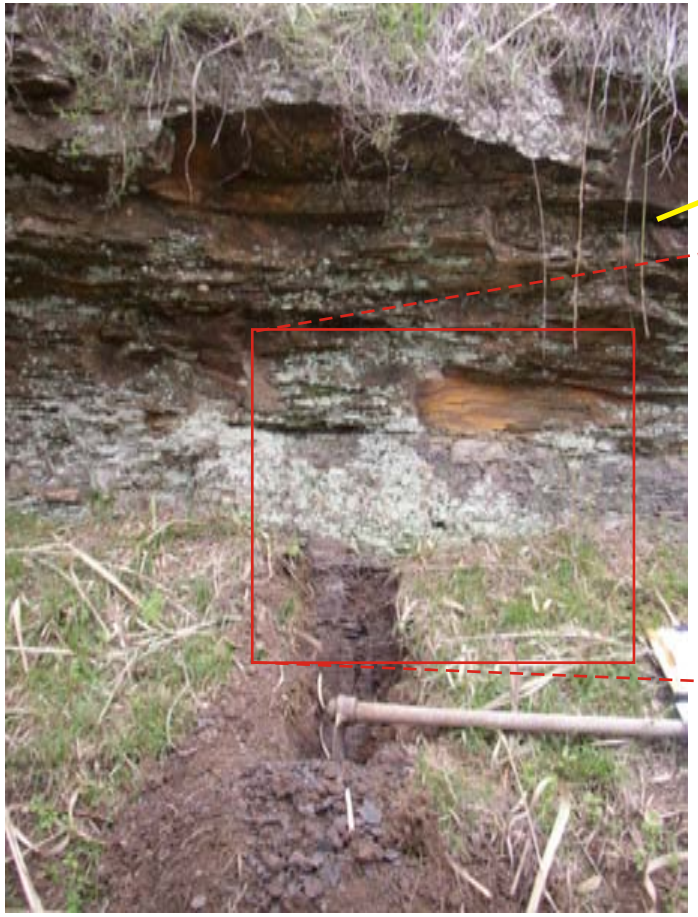


FIGURE 2: G Seam Exposure on Eastern Bank of Pages River.

Top of G seam exposed in Western Bank of Pages River at 305961.6E 6475776.3N 374.83 RL



Top of coal (G seam SR) at 374.83 RL

FIGURE 3: G Seam Exposure at 305,961.6 mE / 6,475,776.3 mN

FIGURE 4: Weathered Basalt Underlying G Bottoms.

Basalt G_bottoms contact on West side of Pages River

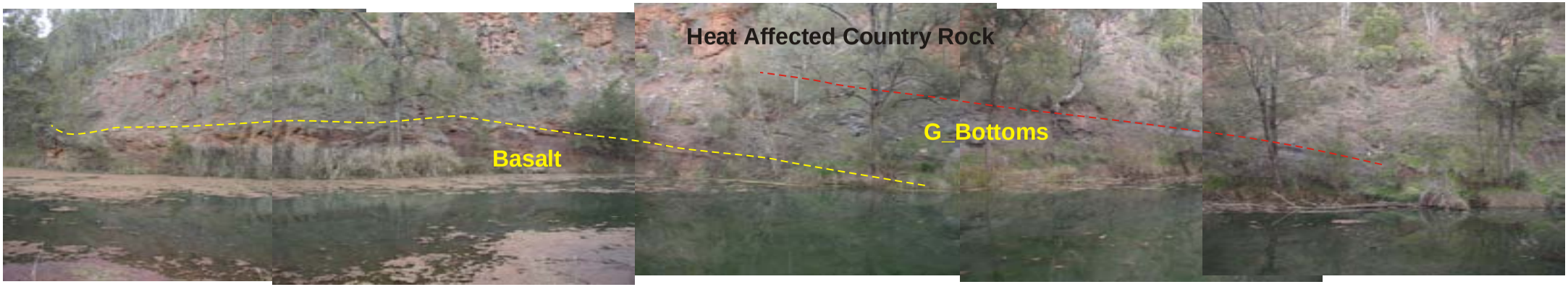


FIGURE 5: Basalt and G Bottoms West Side of Pages River.

North East trending shear zone suggested by increasing frequency of joints in a discrete zone bounded by like trending widely spaced joints.

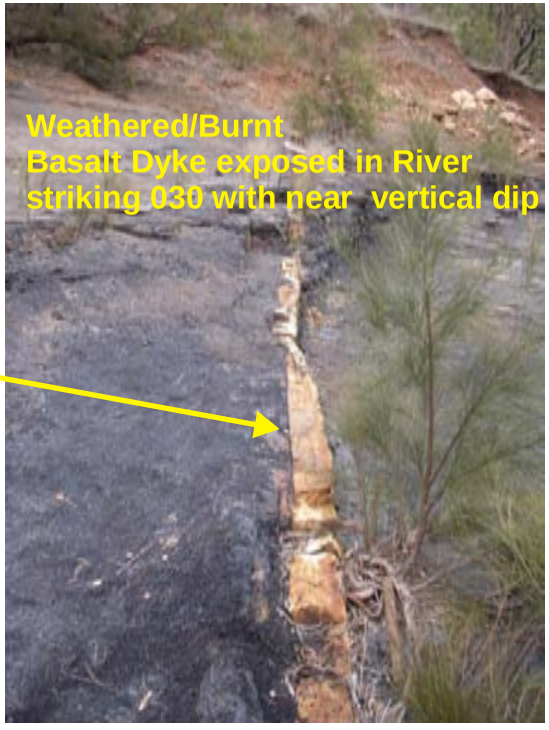


FIGURE 6: NE Trending Dyke and Shear Zone.

FIGURE 7: Thrust Fault on Eastern Side of Pages River.

FIGURE 8: Burnt Rock Agglomerate.