

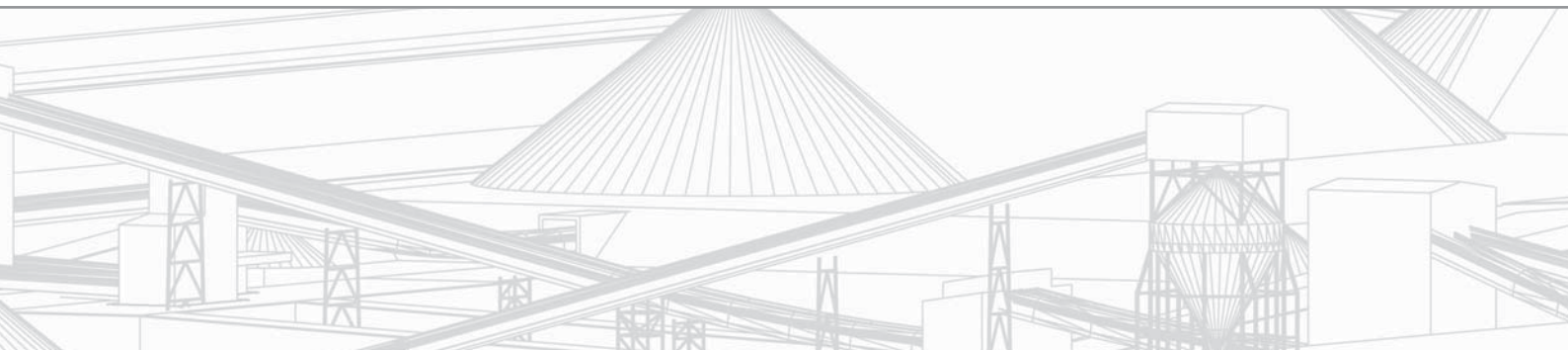
**6. HOLLOWS INSTALLATION COMMENTS/REPORT**  
 (see GEN-HSE-PRO-0006, Salvage of Tree Hollows)

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**7. REPORT SIGN OFF**

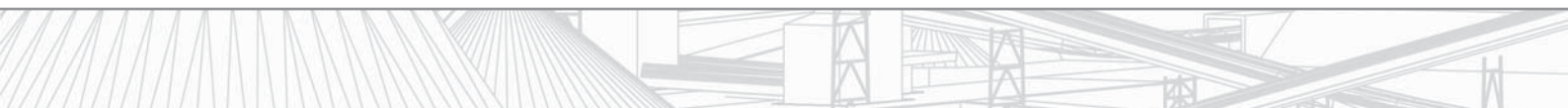
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# **APPENDIX C**

## **TRAFFIC IMPACT ASSESSMENT**



# Anvil Hill Mine Modification to Project Approval Traffic Impact Study

March, 2008

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Hansen Bailey Pty Ltd

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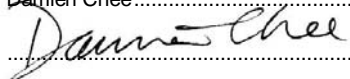
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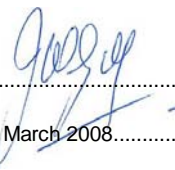
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Appendix A Hourly Traffic Volumes

## Executive summary

Project Approval 06\_0014 was granted by the Minister for Planning on 7 June 2007 to construct and operate the Anvil Hill open cut coal mine (Anvil Hill Mine). The Project Approval is supported by the “Anvil Hill Project Environmental Assessment” (Umwelt, 2006) dated August 2006 (Anvil Hill EA).

Ultimately, access to the mine will be provided via a new road, Bengalla Link Road (Stage 2) which will connect Denman Road (to the south of Muswellbrook) to Wybong Road (to the east of the mine). At the time of writing, this road has not yet been constructed.

Xstrata Mangoola Pty Ltd (Xstrata) is applying for a modification to the Project Approval (06\_0014\_MOD2) to allow an adjustment of the timing of the construction and operation of Early Works so that they may be conducted in parallel with the Wybong Road upgrade. The Early Works include:

- the commencement of development work on the mine access road
- the establishment of a site office and compound
- the establishment of a construction pad for the Coal Handling & Preparation Plant (CHPP)
- excavation of a borrow pit for the supply of earth material for civil works associated with the Early Works and Wybong Road upgrade and disposal of unwanted material.

During the Early Works, an alternate, short term access strategy has been identified as follows:

- a predominantly light vehicle access route via Kayuga Road and Wybong Road
- a heavy vehicle access route via the Golden Highway and Wybong Road.

This traffic impact study has examined the traffic, safety and maintenance issues associated with these proposed alternative access routes.

From an inspection of the proposed alternate light and heavy vehicle access routes, the following potential issues were identified:

- capacity issues at the Aberdeen Road/ Kayuga Road intersection, including the capacity of the Kayuga Road Bridge to cater for the full traffic loads while operating as a one-lane bridge
- capacity issues at the Wybong Road/ Kayuga Road intersection
- maintenance and safety issues on Wybong Road, between Kayuga Road and the mine access road, including the high operating speed of the road, road geometry and road user guidance
- capacity issues with the Golden Highway/ Crinoline Street/ Palace Street intersection at Denman
- capacity issues with Golden Highway/ Wybong Road intersection at Sandy Hollow.

This report will form an Appendix to the Modification EA being compiled by Hansen Bailey.

Following assessment of these issues, the following mitigation measures are recommended to manage the traffic impacts associated with the Early Works:

- Aberdeen Street/ Kayuga Road intersection: PB proposes that an access route be designated for employee-generated traffic which accesses the New England Highway via Aberdeen Street rather than via Brook Street. This should minimise traffic impacts on the one-lane bridge on Kayuga Road, and on the intersection of Kayuga Road and Aberdeen Street
- Wybong Road/ Northern Access Road: from a traffic perspective, a tee intersection with one lane per direction in each approach (type A - BAR) would be able to cater for all demand turning volumes. However, consideration could be given to a type B (AUR) intersection which provides an auxiliary passing lane as an added safety treatment, to allow following vehicles to pass around other vehicles that have slowed or stopped to turn right. This could be constructed at the same time as the Early Works if temporary access via Limvardy Road could be provided
- Reedy Creek, Mangoola and Roxburgh Roads: it is recommended that load or length restriction signage be considered to restrict heavy vehicle access into these roads. Appropriate signage could be considered to advise of the preferred interim heavy vehicle route via the Golden Highway/Wybong Road intersection.



# 1. Introduction

## 1.1 Background

Project Approval 06\_0014 was granted by the Minister for Planning on 7 June 2007 to construct and operate the Anvil Hill open cut coal mine (Anvil Hill Mine). The Project Approval is supported by the “Anvil Hill Project Environmental Assessment” (Umwelt, 2006) dated August 2006 (Anvil Hill EA).

Anvil Hill Mine is owned by Xstrata Mangoola Pty Limited (Xstrata) and is located near Wybong, approximately 20 kilometres (km) west of Muswellbrook and approximately 10 km north of Denman in the Muswellbrook Local Government Area.

The Anvil Hill Mine will extract coal from an undeveloped coal reserve of approximately 150 million tonnes (Mt). Up to 10.5 Million tonnes per annum (Mtpa) run of mine coal will be extracted and processed for a period of up to 21 years from the granting of a mining lease.

Access to the mine will be provided via a new road, Bengalla Link Road (Stage 2) which will connect Denman Road (to the south of Muswellbrook) to Wybong Road (to the east of the mine). At the time of writing, this road had not been constructed.

## 1.2 Project description and modification

Xstrata proposes to apply to the Minister for Planning for a modification to its Project Approval under section 75W of the *Environmental Planning & Assessment Act 1979* (EP&A Act) to allow the following preliminary activities to occur in parallel with the planned upgrade of the Wybong Road prior to the completion of the Bengalla Link Road (Stage 2):

- Early Works generally comprising: (Figure 1-1)
  - the commencement of development work on the Northern Access Road and associated intersection
  - establish a site office and compound
  - establish a construction pad for the CHPP
  - excavate a borrow pit for the supply of select material for civil works and disposal of unsuitable material.

Following the construction of the Bengalla Link Road (Stage 2), the remainder of the construction and operation of the Anvil Hill Mine will access site via this road.

During this interim period prior to the completion of the Bengalla Link Road (Stage 2), an alternate, short term access strategy has been identified as described below.

- a predominantly light vehicle access route via Kayuga Road and Wybong Road; and
- a predominantly heavy vehicle access route via the Golden Highway and Wybong Road.

This report assesses the traffic impacts of the Early Works modification and the interim access strategy.



**Figure 1-1 Anvil Hill Early Works Layout Plan**

(Source: Hansen Bailey 2008)

## 1.3 Objectives

The purpose of this study is to assess the traffic impacts associated with the proposed Early Works activities on Anvil Hill Mine site as described in Section 1.2 and the interim access arrangements via the nominated light and heavy vehicle access routes.

## 2. Existing route conditions

### 2.1 The interim light vehicle access route

There are two alternative light vehicle access routes from Muswellbrook to the Anvil Hill mine site. The primary route is via Kayuga Road, to the east of Wybong Road and Northern Access Road (or Limvardy Road during initial construction stage) into the Anvil Hill Mine site. This route would be the predominant light vehicle access route.

The second proposed route is via the Golden Highway, to the west of Wybong Road and Northern Access Road. This is expected to accommodate the remaining light vehicle traffic volumes generated by the Early Works construction program. This would comprise private vehicle traffic of employees to and from the site each day.

Of the local workforce, the expected workers would be drawn from Muswellbrook (48%), Denman (8%), Scone (12%), Singleton (14%), Aberdeen (6%), Cessnock (1%), Maitland (2%), and Newcastle (1%) (TPK & Associates, 2006). Approximately 8% of the workforce is expected to be brought in from outside the region. As such, the proposed designation of the route via Kayuga Road as the light vehicle access route is appropriate, as this would be the most direct route to access the mine for around 84% of employees (i.e. all employees except for the Denman and possibly those categorised as “outside the region”). These localities are shown in Figure 2-1.



**Figure 2-1 Locality plan of employment areas**

(Source: TPK & Associates, 2006)

A description of the existing conditions of various intersections and road sections along the proposed light vehicle access route are provided in Sections 2.1.1 to 2.1.7. These are discussed in sequential order from Muswellbrook to the Anvil Hill Mine. These observations were made during PB's inspection of the route on September 2007 during fine weather conditions.

### **2.1.1 New England Highway/ Aberdeen Street intersection**

Aberdeen Street meets the New England Highway as a tee intersection to the north of Muswellbrook (see Figure 2-2). The intersection is a type C (CHR) configuration with Aberdeen Street as the western and terminating leg. The intersection currently provides a left turn deceleration lane in the southern approach, and a right-turn lane for the northern approach. One approach lane is provided for the northern and southern approaches on the New England Highway. The Aberdeen Street approach has one lane in each direction.

As seen in Figure 2-2, there are two departure lanes for southbound traffic despite only one southbound lane being provided on the approach side of the intersection. As such, any right-turning traffic from Aberdeen Street (i.e. heading towards Muswellbrook town centre) would be effectively absorbed into the southbound traffic, as no merging is required immediately downstream of the intersection.

The indented left-turn lane would also ensure that any northbound vehicles decelerating to turn left into Aberdeen Street will have minimal impact on northbound through movements.

This intersection appears to have appropriate facilities to safely and efficiently cater for turning movements associated with the additional traffic generated by the Early Works activities. The impacts of the additional traffic are also expected to be minimal.



**Figure 2-2 Looking north on New England Highway towards Aberdeen Street, Muswellbrook**



### **2.1.2 Aberdeen Street**

Aberdeen Street is a two lane, two way road which connects the New England Highway, north of Muswellbrook to Kayuga Road. The road has a local character which caters for low speed travel. Immediately west of the New England Highway, Aberdeen Street has a low radius curve to counter the considerable elevation differences between the New England Highway (which is in a fill section) to normal ground level.

### **2.1.3 Aberdeen Street/ Kayuga Road intersection**

The intersection of Aberdeen Street and Kayuga Road is a tee intersection with Kayuga Road as the western and terminating leg. One lane is provided in each direction of Aberdeen Street. Kayuga Road is a two lane two way road which connects Aberdeen Street to Wybong Road.

### **2.1.4 Kayuga Road**

Immediately west of Aberdeen Street, a one-lane heritage-listed bridge crosses the Hunter River (see Figure 2-3).



**Figure 2-3 Looking west on one-lane bridge on Kayuga Road across Hunter River**

As a one-lane bridge, the bridge does not permit passing or overtaking, so traffic approaching the bridge gives way to traffic entering the bridge from the other side, as well as to traffic on the bridge. Motorists are required to wait until the traffic on the bridge has made a complete crossing before entering the bridge. In this regard, any queue back in the eastbound direction due to Aberdeen Street/ Kayuga Road intersection could restrict access onto the bridge for westbound traffic. Kayuga Road has a local road character and generally provides for low speed travel.

Furthermore, as a one-way bridge where no passing or overtaking is permitted, the capacity of the bridge would need to be considered to ensure it is sufficient to cater for additional traffic generated by the Early Works. This has been further discussed in Section 3.4.1.

The Roads and Traffic Authority, NSW (RTA) (the owners of the bridge asset) has confirmed that there is no posted load limit on this bridge and that the bridge can support a semi-trailer load of up to 45.5 tonnes. There are also no vertical restrictions on the bridge. As such, this bridge would be appropriate for use as part of the light vehicle access route for the Early Works employees between Muswellbrook and Anvil Hill Mine.

### **2.1.5 Wybong Road/ Kayuga Road intersection**

The intersection of Kayuga Road and Wybong Road is also a give way controlled tee intersection with Wybong Road as the southern and terminating leg. All approaches have one lane per direction as shown in Figure 2-4. The capacity of this intersection would need to be demonstrated as sufficient for the additional traffic generated by the Early Works. This has been further discussed in Section 3.4.2.



**Figure 2-4 Looking east-bound on Kayuga Road towards Wybong Road**

### **2.1.6 Wybong Road, from Kayuga Road to Anvil Hill Mine**

Wybong Road is a collector road which connects Muswellbrook to Sandy Hollow and carries an average of 500 vehicles/day<sup>1</sup>. The eastern section between Kayuga Road and Anvil Hill Mine is proposed as part of the interim light vehicle access route.

Wybong Road is generally a two lane, two way road, although long road sections do not have centre or edge lines. The route has a posted speed limit of 100km/h. The road traverses moderately undulating country with some low radius curves having signposted advisory speeds as low as 55km/h. The surrounding land use is predominately rural, with a number of vineyards and other mine sites adjacent to the route.

<sup>1</sup> All traffic volume figures in this report are representative of two directions of traffic unless otherwise stated.

The road has a seal width which varies between 6-8m. In general, there are no sealed shoulders provided, which has lead to gradual degradation of the edge of seal and consequent narrowing of the road width (see Figure 2-5). The narrowed road offers minimal lateral clearance between passing vehicles which (by observation) has led to some driver discomfort, especially for those motorists travelling at the 100km/h speed limit. To counter their discomfort, many drivers were observed to keep as far to the left as possible or reduce their speed. By keeping to the far left, the left wheel path is at risk of traversing into the unsealed shoulder which increases the run-off-road crash risk.



**Figure 2-5 Degradation of edge of seal on Wybong Road, east of Mangoola Road**

At the time of the inspection, this route also showed signs of pavement failure with potholes and a mix of minor and heavy patching works. (see Figure 2-6).



**Figure 2-6 Excessive patching on Wybong Road**

The route also has a number of culvert and bridge crossings. Due to short culvert lengths, these often result in localised squeeze points, with narrowed road formation and clear zones. This has caused significant vertical drop-offs and culvert headwalls within close proximity to the road. Near Kayuga Road, a watercourse crosses Wybong Road as a causeway rather than as a subsurface culvert (see Figure 2-7). As a result, a sudden sag vertical curve has been created.



**Figure 2-7 A causeway across Wybong Road near Kayuga Road**

### **2.1.7 Wybong Road/ northern access road intersection**

The northern access road into the Early Works site would be a new road meeting Wybong Road at a tee intersection. The new intersection is proposed approximately 2km west of Limvardy Road (see Figure 2-8). This section of Wybong Road is generally of straight or very large radius alignment, at a level grade. No crest vertical curves were observed and road side vegetation is generally well setback from the edge of the road. As such, most locations in this area would have adequate entering and safe intersection sight distances.





**Figure 2-8     Residences on the southern side of Wybong Road, 1.5km west of Limvardy Road**

## **2.2     The interim heavy vehicle access route**

The alternative heavy vehicle access route proposed is from the New England Highway to the Anvil Hill mine site via the Golden Highway (Sandy Hollow Road) and township of Denman, along Wybong Road and the northern access road into the Early Works site. This route would accommodate all heavy vehicles and small number of light vehicle traffic required for the Early Works activities.

A description of the existing conditions of various intersections and road sections along the proposed heavy vehicle access route are provided in Sections 2.2.1 to 2.2.7. These are in sequential order from the New England Highway to Anvil Hill Early Works site. These observations were made during PB's inspection of the route on September 2007, during fine weather conditions.

### **2.2.1     The New England Highway/ Golden Highway intersection**

The New England Highway is an Auslink route (former National Highway) which provides an alternate inland link between Sydney and Brisbane. It passes through the regional centres and towns of Maitland, Singleton, Muswellbrook, Scone, Tamworth, Armidale, Glenn Innes and Tenterfield. In 2004, the section to the north of Branxton (south of the Golden Highway intersection) carried approximately 17,700 vehicles/day, while the section south of Singleton (north of the Golden Highway intersection) carried approximately 12,000 vehicles/day (RTA, 2005a).

The New England Highway/ Golden Highway intersection is located south of Singleton. It is currently configured as a seagull tee intersection, with the Golden Highway as the western and terminating leg (see Figure 2-9). The northbound approach on the New England Highway has one through lane and a left-turn deceleration lane. The southbound direction has a deceleration lane for right-turns into the Golden Highway, an acceleration lane for right-turns out of the Golden Highway and one through lane. The Golden Highway approach has one lane per direction.



**Figure 2-9 Looking north on the New England Highway towards the Golden Highway turnoff**

The sight distances appear to be sufficient at this intersection due to the high radius alignment of the New England Highway and the provision of unobstructed sight benches between the main road and minor road traffic.

The indented left-turn and right-turn lanes for traffic turning into the Golden Highway will ensure that any vehicles decelerating to turn will have minimal impact on through traffic. Furthermore, the acceleration lane for right-turn traffic from the Golden Highway reduces the gap acceptance requirements for entering traffic and offers a good standard of safety and traffic performance.

## **2.2.2 The Golden Highway**

The Golden Highway is a State Highway providing a link between Singleton and Dubbo. Between the New England Highway and Sandy Hollow, the highway carried between 2,500 and 6,000 vehicles a day in 2004 (RTA, 2005a).

The Golden Highway is generally a two lane, two way road with a posted speed limit of 100km/h for most of this section, with 80km/h speed zones in the approaches to towns. The road has a good alignment, with horizontal geometry consisting of straight or high radii curved sections and level grades.

The road is appropriate for use by heavy vehicles offering a wide sealed width with pavement in good condition, good line marking and delineation, sealed shoulders, and reasonable clear zones (see Figure 2-10). The route has a heavy vehicle checking station approximately 30km west of the New England Highway. Heavy vehicle rest areas have been provided at the intersection with New England Highway, 1km east of Denman, 15km east of Merriwa and 10km east of Dunedoo.



**Figure 2-10 Looking west on Golden Highway to the west of Putty Road**

Between the New England Highway and Wybong Road, the route passes through Jerrys Plains and Denman. Jerrys Plains is a rural village, with European settlement dating back to the early 1800s. Through this village, the Golden Highway has a more local character with a 60km/h speed limit, kerb and guttering, residential driveways and the surrounding environment is generally built-up. However, the lanes have adequate width for heavy vehicles (see Figure 2-11).

Denman is a rural town to the west of Sandy Creek which acts as a service centre to nearby agricultural industry including dairy farms, vineyards and cattle studs. The earliest European settlement dates back to the 1820s. The Golden Highway enters the eastern side of the town as Crinoline Street and then extends north as Palace Street. Further details on the Golden Highway route through Denman are provided in Section 2.2.4.



**Figure 2-11 Wide lanes along the Golden Highway through Jerrys Plains village**

### **2.2.3 The Golden Highway/ Denman Road intersection**

This is a tee intersection with the Golden Highway as the southern (terminating) and western legs. Denman Road is the eastern leg and provides a link from Denman to Muswellbrook and carries approximately 4,000 vehicles/day. As shown in Figure 2-12, the intersection is a type B (AUR) configuration with an eastbound auxiliary lane for through traffic to pass vehicles turning right into the Golden Highway (south).



**Figure 2-12 The western approach of the Golden Highway/ Denman Road intersection**

A short acceleration taper has been provided for left-turning traffic from the Golden Highway south to the western approach. The intersection flaring in the eastern approach provides adequate space to allow through vehicles to pass around other vehicles decelerating to turn left. In general, the intersection has good facilities with adequate capacity and an appropriate standard of safety for heavy vehicle traffic.

#### **2.2.4 The Golden Highway/ Crinoline Street/ Palace Street intersection, Denman**

This is a four-way intersection with the Golden Highway as the eastern and northern approaches. The local names of the east-west and north-south roads are Crinoline Street and Palace Street respectively. The western and southern approaches, as well as part of the northern approach are all STOP controlled to give priority to the westbound right-turn and southbound left-turn movements. The Golden Highway has a speed limit of 60km/h through the town. The local road sections of Crinoline Street and Palace Street, to the east and south of the intersection, respectively, are part of a 50km/h local area. Immediately north of the intersection, there is a 40km/h school zone on the Golden Highway.

A left-turn slip lane is provided for the southbound direction to cater for this priority movement from north to east (see Figure 2-13).

In the eastern approach to the intersection, a bridge crosses Sandy Creek. A crest vertical curve located between the bridge and the intersection provides stopping sight distance of approximately 80m, which meets the minimum requirement for a 70km/h design speed and is suitable for the posted speed limit of 60km/h.

The capacity of this intersection would need to be considered in terms of its ability to cater for the additional traffic generated by the Early Works. This is particularly the case for traffic from the southern and eastern approaches as these would need to give way to the priority movement from east to north. This has been further discussed in Section 3.4.4.





**Figure 2-13 Looking west on the Golden Highway towards the intersection with Palace Street, Denman.**

### **2.2.5 Reedy Creek / Mangoola / Roxburgh Roads**

Condition 52 of Project Approval 06\_0014 states that no project related traffic shall use Reedy Creek Road, Mangoola Road or Roxburgh Road.

### **2.2.6 The Golden Highway/ Wybong Road intersection**

This is a four-way intersection with the Golden Highway as the east-west route and Wybong road as the northern approach. The southern approach is Goulburn Drive, a loop road providing access to Sandy Hollow and a railway facility. The speed limit for the Golden Highway approaches is 100km/h, although the speed limit drops to 60km/h on the approach to Sandy Hollow (to the west of the intersection). Goulburn Drive is currently part of a 50km/h local area. There appears to be a lack of speed zone signposting in Wybong Road, so this would operate under a default speed limit of 100km/h according to rule 25 of the Australian Road Rules (1999).

The current configuration of the intersection includes one lane per direction on all approaches (see Figure 2-14). The two Golden Highway approaches have edge and centre line marking, whilst the two side roads (Wybong Road and Goulburn Drive) do not contain line marking.

The capacity of this intersection would need to be confirmed in terms of its ability to cater for the additional traffic generated by the construction of the Early Works activities. This is particularly the case for westbound traffic turning right into Wybong Road. This has been discussed further in Section 3.4.4.



**Figure 2-14 Looking west on the Golden Highway towards the intersection with Wybong Road (right) and Goulburn Drive (left)**

### **2.2.7 Wybong Road, from the Golden Highway to Anvil Hill Mine**

The western section of Wybong Road, between Kayuga Road and Anvil Hill Mine is proposed as the interim heavy vehicle access route for the Early Works. The road is generally a two lane two way road although long sections are not furnished with centre or edge lines. The route has a speed limit of 100km/h. The road follows moderately undulating country with some low radius curves having advisory speeds as low as 55km/h. The surrounding land use is predominately rural.

Although there are no sealed shoulders, the road appears to be maintained in a better condition than the eastern section. In some locations the carriageway width narrows to 6-7m. The limited road width offers minimal lateral clearance between passing vehicles which is similar to the eastern section and (by observation) has led to some driver discomfort, especially in travelling at the 100km/h speed limit. To address their discomfort, many drivers were observed to keep as far left as possible or reduce their speed. By keeping to the far left, the left wheel path is at greater risk of traversing into the unsealed shoulder which increases the run-off-road crash risk.

The route also has a number of culvert and bridge crossings. Short culvert lengths often result in localised squeeze points with narrowed road formation and clear-zones widths. Significant vertical drop-offs and culvert headwalls may then be encountered in close proximity to the road. There are also a number of causeways allowing runoff from neighbouring land to flow across the road surface rather than underneath it (see Figure 2-15). This has resulted in a sudden sag vertical curve.



**Figure 2-15 A causeway on Wybong Road to the north of the Golden Highway**

## **2.3 Alternate access routes - summary**

A summary of potential issues with the proposed light and heavy vehicle access routes is provided below and are further examined in Section 3.4.

### **2.3.1 Light vehicle access route**

In summary, the following potential issues were identified in relation to the proposed light vehicle access route:

- capacity issues at the Aberdeen Road/ Kayuga Road intersection including (i) the capacity of the Kayuga Road Bridge for full traffic loading and satisfactory operation as a one-lane bridge and (ii) the risk of queuing in the Kayuga Road approach to the intersection which could restrict westbound access onto the bridge;
- capacity issues at the Wybong Road/ Kayuga Road intersection;
- maintenance and safety issues on Wybong Road between Kayuga Road and the mine access road including (i) excessive pavement patching, (ii) narrow seal widths and (iii) degradation of seal edge
- other safety concerns on Wybong Road between Kayuga Road and Anvil Hill Mine including (i) the high operating speed of the road, (ii) vertical geometry at causeways, (iii) squeeze points at culverts, (iv) safety at curved sections of road, and (v) adequacy of guidance and delineation.

### **2.3.2 Heavy vehicle access route**

In summary, the following issues were identified in relation to the heavy vehicle access route:

- capacity issues with the Golden Highway/ Crinoline Street/ Palace Street intersection at Denman
- capacity issues with Golden Highway/ Wybong Road intersection at Sandy Hollow
- other safety concerns on Wybong Road between Sandy Hollow and Anvil Hill Mine including (i) the high operating speed of the road, (ii) vertical geometry at causeways, (iii) squeeze points at culverts, (iv) safety at curved sections of road, and (v) adequacy of guidance and delineation.



## 3. Traffic generation impacts and assessment

### 3.1 Background traffic

The term *background traffic* is used in this report to refer to the known or projected traffic volumes across the road network before the addition of any forecasted additional traffic generated by the Early Works.

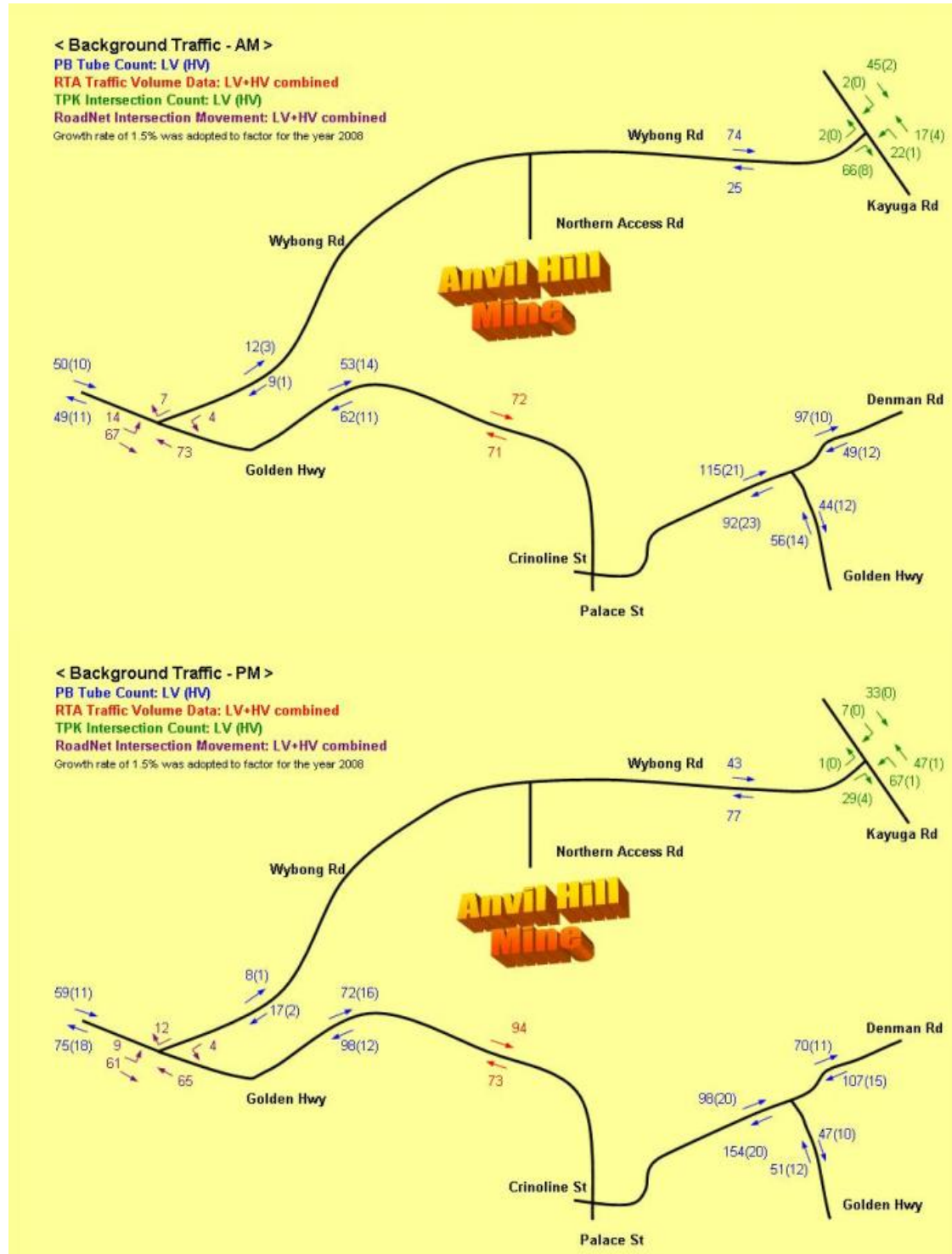
Several sources of traffic data as detailed in Figure 3-1 were used to calculate appropriate background traffic volumes across the network of roads which includes:

- the Golden Highway south of Denman Road
- Denman Road, east of the Golden Highway
- the Golden Highway, west of Denman Road
- the Golden Highway, either side of Denman town
- Crinoline Street (east) and Palace Street (north)
- the Golden Highway east and west of Wybong Road
- Wybong Road between the Golden Highway and Anvil Hill Mine
- Wybong Road between Anvil Hill Mine and Kayuga Road
- Kayuga Road north and south of Wybong Road.

These data sources were:

- average annual daily traffic volumes from RTA counting stations as obtained from the RTA's 2005a publication *Traffic volume data – Northern and Hunter Regions*. Counts were available for the Golden Highway between Denman and Sandy Hollow via count station 05.223.
- vehicle classification surveys obtained for PB's *Traffic Impact Assessment of Bengalla Link Road Stage 2* in May 2006. These were for the mid-block section of Wybong Road between Kayuga Road and Anvil Hill Mine.
- additional vehicle classification surveys obtained in September 2007. These were for mid-block locations on: (i) the Golden Highway south of Denman Road, (ii) the Golden Highway west of Denman Road, (iii) Denman Road, east of the Golden Highway, (iv) the Golden Highway between Reedy Creek Road and Mangoola Road, (v) the Golden Highway west of Wybong Road, (vi) Wybong Road, north of the Golden Highway and (vii) Ridgeland Road, north of Yarraman Road.
- traffic data obtained for TPK's *Traffic Assessment for the intersection of Kayuga Road and Wybong Road* (2006).
- traffic data obtained for Roadnet's draft *Concept Layouts Report* (2007) for the intersection of the Golden Highway and Wybong Road.

Data count locations are all shown in Figure 3-1. A growth factor of 1.5% per annum was used to convert all traffic counts to a 2008 equivalent. This is consistent the Muswellbrook Western Roads Strategic Study and advice from RTA in other projects in the region.



**Figure 3-1 Background peak traffic volumes (NB. All volumes have been converted to 2008 equivalents)**

Among these various data sources, the 2007 mid-block counts (shown in Figure 3-1 as “PB tube counts”) were used to calculate the turning volumes at the Golden Highway/Crinoline Street and the Golden Highway/Wybong Road intersection. In addition to being the latest traffic data available, these counts also provided light and heavy vehicle volumes. To calculate the turning volumes at the nearby intersections, PB used the traffic distribution assumptions described in Section 3.3 cross referenced with turning volumes from the other sources of traffic data shown in Figure 3-1.

For the Wybong Road/Kayuga Road intersection, the traffic counts from TPK's traffic assessment (2006) were adopted.

To ensure a conservative analysis, it was assumed that the peak traffic volumes from the background (8:00-9:00am and 3:00-4:00pm) would coincide with the peak traffic volumes generated by the Early Works. Although in reality, these would not be likely to occur at the same time, this approach would account for the network's “worse case condition”.

## **3.2 Traffic generation**

The traffic generation during the Early Works was estimated from employment trips and service and delivery traffic generated by the development. Xstrata provided an estimate of the light and heavy vehicle volumes and number of employees required during the construction period. The peak period for light vehicle traffic is likely to be the last week of month 2, when up to 35 light vehicles would need to access the site each day (i.e. 35 light vehicle movements inbound at the start of work and 35 light vehicle movements outbound at the end of the work). The peak construction period is likely to be the first week of month 5, when up to 51 heavy vehicles and 20 light vehicles would need to access the site each day (This figure also indicates the number of inbound trips at the commencement of work/service and hence the number of outbound trips following the conclusion of the work/service). Table 3-1 shows the peak number of construction light and heavy vehicles.

The following assumptions were made regarding traffic generation during the Early Works:

- all construction vehicles and equipment (i.e. excavator, grader and roller etc) would be parked on construction site in Limvady Road/ Northern access Road or at the site office. As such these construction vehicles would not generate any regular daily trips on the public road network (there may be the occasional trip needed to transport a vehicle for servicing and maintenance). This will result in minimal volumes of construction vehicles on the public road network including traffic generation through Denman
- during the morning peak period, all construction employees would be entering the Anvil Hill mine site and hence there would be no outbound trips
- similarly, all construction employees would be leaving the Anvil Hill mine site and there would be no inbound trips during the afternoon peak period.

**Table 3-1 Estimated number of light and heavy vehicles accessing the site during the construction period**

Item	Task	Resource	Month 1				Month 2				Month 3				Month 4				Month 5				Month 6					Month 7			
Week			1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	1	2	3	4	5	1	2	3	4
1	Wybong Road Upgrade	HV	1	1	1				5	5	5	5	5	5	5	5	5	5	5	5	8	8	5	5	8	5	8	5	5	3	
		LV	1	1	1				4	4	4	4	4	4	4	4	4	4	4	4	8	8	4	4	8	4	8	4	4	4	
2	Northern Access Road	HV					5	12	26	25	25	25	25	20	20	16	16	12	9	6	3										
		LV	2	4	2	2	4	8	16	14	14	14	14	11	11	9	9	9	7	4	3										
3	Establish Site Office and Compound / CHPP Pad	HV							4	10																					
		LV							2	6																					
4	Borrow Pit	HV												5	5	5	5	5	5	5	5	11	11	11							
		LV												3	3	3	3	3	3	3	3	7	7	7							
5	Construction Management Team	HV																													
		LV	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
6	Equipment and Material Delivery and Maintenance Crew (7am to 6pm)	HV			15	19	11	18	28	11	8	20	1	2	1	1	1	1	51	9	4	1	6	1	6	6	1	6	1	1	1
		LV					3	5	8	8	8	8	5	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3	3
	Total daily visits	HV			15	19	11	18	28	11	8	20	1	2	1	1	1	1	51	9	4	1	6	1	6	6	1	6	1	1	1
		LV	6	8	6	5	10	16	33	35	29	29	26	24	24	22	22	22	20	17	20	21	17	17	14	10	14	10	10	10	6
		TOTAL	6	8	51	62	43	70	117	68	53	89	29	30	27	25	25	25	173	44	32	24	35	20	32	28	17	28	13	13	9

Notes: All figures indicate the number of vehicles accessing or visiting the site, that is, one visit is equivalent to one inbound trip followed by one outbound trip at the completion of the work/ services. Some visits have short (i.e. 30 minutes) turn around such as the delivery of materials. Others have longer (i.e. 12 hours) turn around such as any employees arriving at the site to commence a 12 hour shift.

During the construction phase, it has been assumed that approximately 12% of the daily heavy vehicle trips (material delivery trucks) would arrive and leave the site between 9:00-10:00am and 5% would enter and leave the site between 3:00-4:00pm. The remaining 83% of heavy vehicle trips would be made throughout the day, and would be equally distributed across the seven hour period from 10:00am to 3:00pm.

This equates to 12 delivery truck visits during the AM peak period, or six visits for the one-hour period between 9:00-10:00am. For the last one hour, this equates to six delivery truck visits or three visits 3:00-4:00pm. Each visit would generate both an inbound and outbound trip due to the return trips (i.e. six visits is equivalent to six inbound trips and six outbound trips within the same hour). As stated above, the construction vehicles and equipment would be stored on site and hence would not generate any trips on the public road network.

Table 3-2 shows the number of trips generated by the proposed Early Works construction activities.

**Table 3-2 Inbound (IB) and outbound (OB) trips generated during the peak construction period**

	Morning peak hour			Afternoon peak hour		
	IB	OB	Total	IB	OB	Total
<b>Light vehicles</b>						
employees	20	0	20	0	20	20
<b>Heavy vehicles</b>						
Construction vehicles	0	0	0	0	0	0
Material delivery vehicles	6	6	12	3	3	6

### 3.3 Traffic distribution

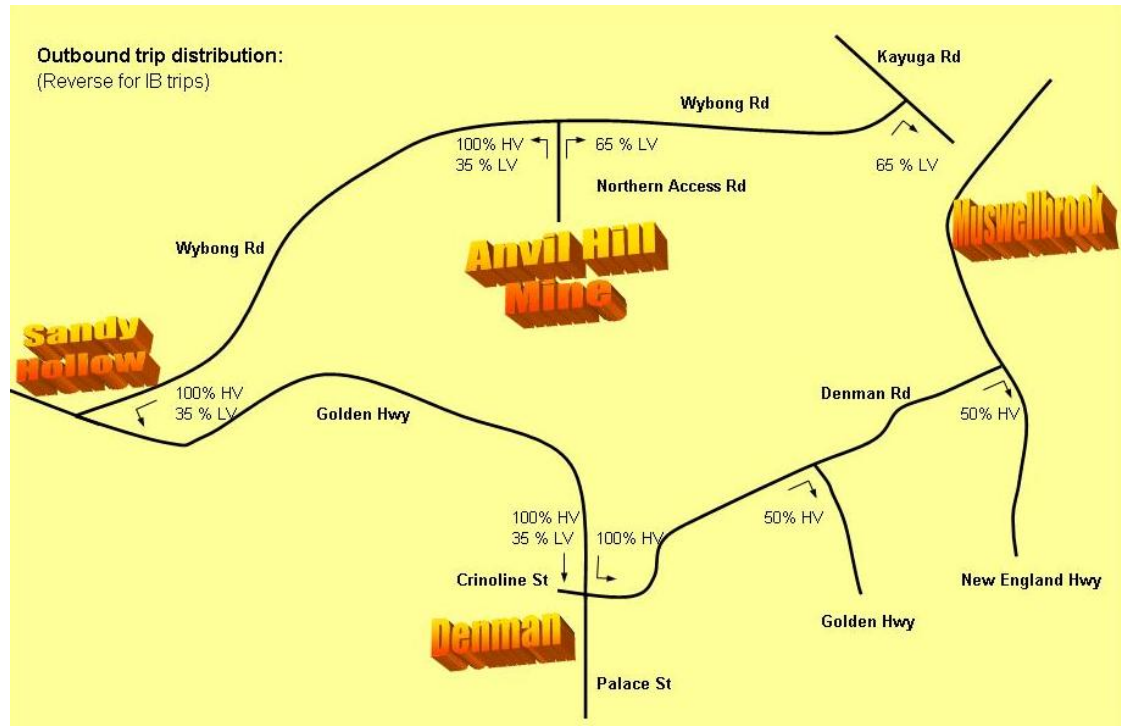
For the construction period, the following assumptions were made regarding the distribution of the workforce trips in and out of the various activities of Early Works.

The trips would be made up of:

- 65% of employee generated light-vehicle traffic would use the Kayuga Road-Wybong Road route to/from Muswellbrook area
- 35% of employee generated light-vehicle traffic would use the Golden Highway-Wybong road route to/from Denman area
- all heavy vehicles for material delivery would use the Golden Highway-Wybong Road route. 50% of heavy vehicle traffic would travel to/from the south via the Golden Highway and Wybong Road. Other 50% of heavy vehicles would travel from/to east via the New England Highway, Denman Road, Golden Highway and Wybong Road
- at the intersection of Wybong Road and Kayuga Road, 100% of generated traffic would travel via Aberdeen Street.
- at the intersection of the Golden Highway and Wybong Road, 100% of generated traffic would travel via Denman

- at the intersection of the Golden Highway and Palace Street, all of the generated light traffic from the north would have an origin/destination on the southern side of the intersection and all of the generated heavy traffic would use the Golden Highway (i.e. Crinoline Street east-Palace Street north route).

In summary, the assumed distribution of trips (shown for the outbound trips) has been shown in Figure 3-2.



**Figure 3-2 Indicative distribution of outbound (generated) trips**

### 3.4 Assessment of impacts – Intersection capacity issue

This section assessed the likely traffic performance at key intersections for the alternative light and heavy vehicle routes. Mitigation measures have been recommended to manage the potential traffic impacts.

The predicted peak hour generated traffic volumes during the morning and afternoon peak are shown in Figure 3-2. As shown, the generated traffic volumes due to the Early Works would be very low compared to background levels, and unlikely to result in any significant impact from a network capacity perspective.

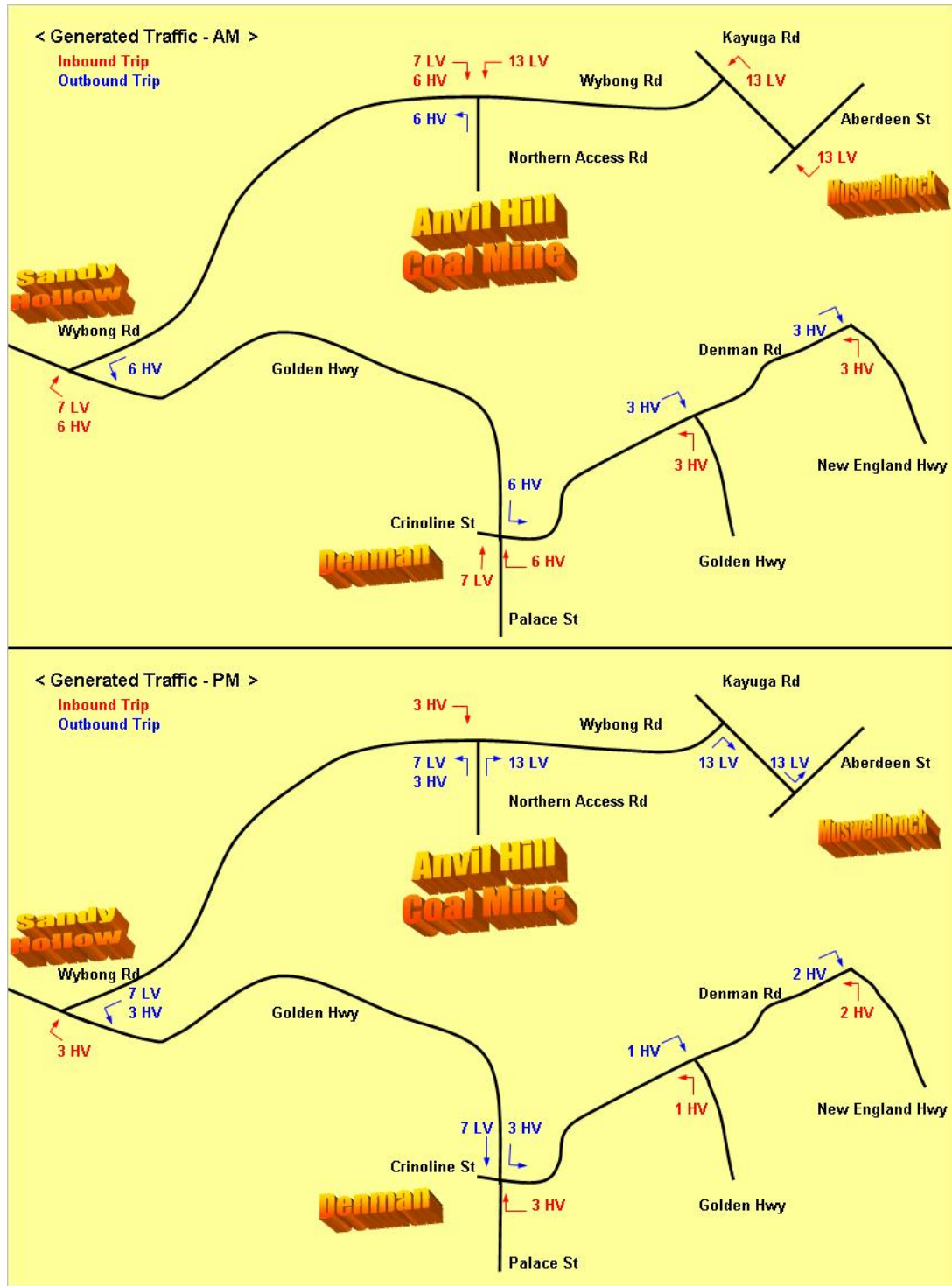
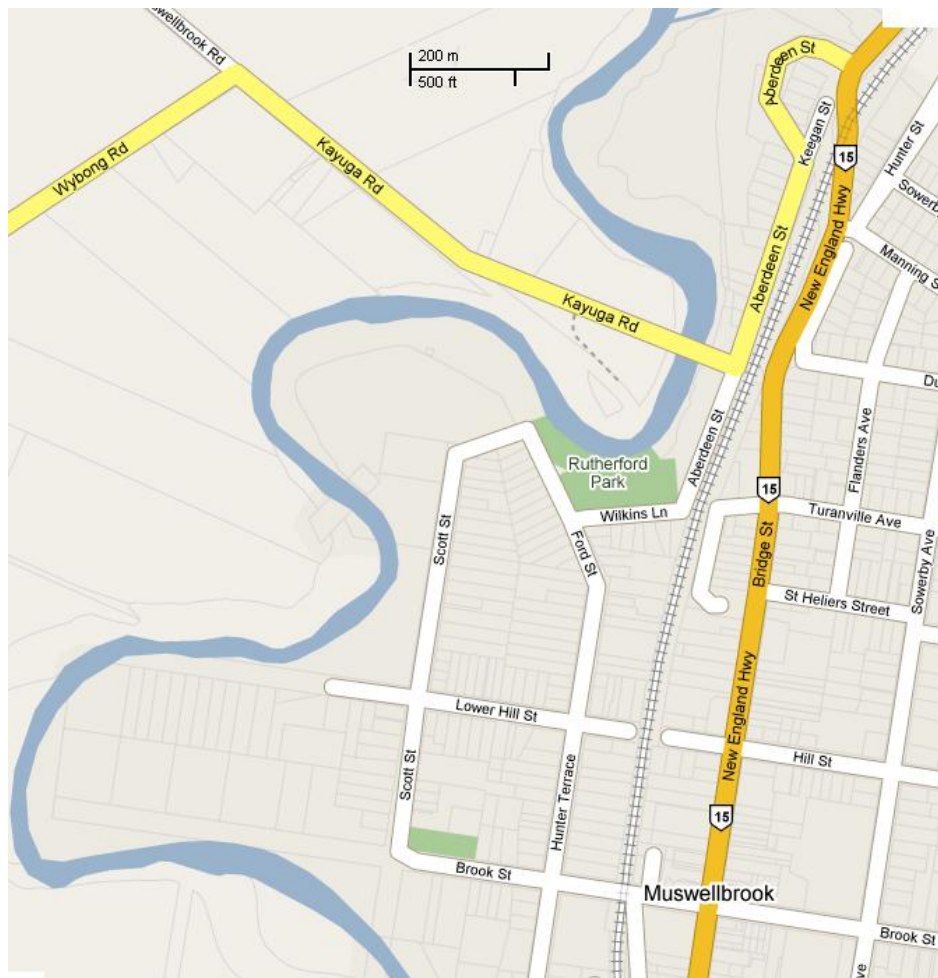


Figure 3-3 Predicted peak hour generated traffic (vehicles/hour)



### 3.4.1 Aberdeen Street/ Kayuga Road intersection

All traffic with a destination of Maitland, Singleton and Newcastle (i.e. regional traffic south of Muswellbrook) would tend to use access the New England Highway via Aberdeen Street due to the reduced travel time. The traffic assigned with Muswellbrook as an origin/destination could also use either Aberdeen Street or Brook Street to access the New England Highway depending on their destination in Muswellbrook. (See Figure 3-3) Although the New England Highway/Brook Street intersection is signalised and could possibly provide safer conditions for right-turning traffic, it does however require the drivers to pass through three additional intersections, as well as a railway level crossing. As such, most traffic is expected to use the New England Highway/ Aberdeen Street intersection.



**Figure 3-4 Access routes into Muswellbrook from Kayuga Road**

(Source: Google Maps Australia, 2007)

Based on the relative gravity of each of the towns as described in Section 2.1, and the route conditions, most through traffic from Wybong Road would be expected to access the New England Highway via Aberdeen Street rather than Brook Street. As such, the dominant movements at the Aberdeen Street/ Kayuga Road intersection are likely to be (i) the right-turn from Aberdeen Street (north) to Kayuga Road and (ii) the left-turn from Kayuga Road to Aberdeen Street.



From the traffic generation and distribution analysis, the traffic volumes generated for the alternative light vehicle route and hence the traffic that would be expected to use the Aberdeen Street/ Kayuga Road would be approximately 13 vehicles/hour. When added to the background traffic volumes in Figure 3-1 the combined impact on the intersection from a traffic capacity perspective would not be significant. Furthermore, as discussed above, the dominant movements at this intersection would be the left turn from Kayuga Road to Aberdeen Street and the right turn from Aberdeen Street north to Kayuga Street. As these two movements are complimentary, it is unlikely that any of the intersection movements would incur significant delays for other traffic.

Despite this low potential risk, mitigation measures could be put in place to ensure minimal traffic impact. All of the Early Works employees accessing the site in private vehicles should be briefed to use the Aberdeen Street route rather than the Brook Street route. This would also minimise the potential for any queues in eastbound traffic, so access onto the Kayuga Bridge for westbound traffic is not impeded.

### **3.4.2 Wybong Road/ Kayuga Road intersection**

As described in Section 2.1.5, the intersection is currently a tee intersection with Wybong Road as the western and terminating leg. One lane has been provided for each direction in each approach.

Based on predicted peak hour volume, the Early Works would generate 13 left-turning light vehicles from Kayuga Road (south) to Wybong Road during the morning peak and 13 right-turning light vehicles from Wybong Road to Kayuga Road during the afternoon peak. As such, the intersection is not expected to experience capacity constraints as the two movements are complimentary.

No mitigation measures would be required as a result of the traffic generated by the Early Works.

### **3.4.3 Wybong Road/ Northern Access Road intersection**

The proposed configuration of this intersection was a type A (BAR) tee intersection with the Anvil Hill Coal Northern Access road as the southern and terminating leg. This configuration includes one lane in each direction in each approach. A nominal width sealed shoulder would be provided on the side of the through road opposite the side road to allow following vehicles to pass around a slowed or stationary vehicle waiting to turn right.

Based on predicted peak hour volume, generated traffic of the Early Works construction activities would be as follows:

- during the morning peak
  - 13 left-turning light vehicles from Wybong Road (east) to Northern Access Road,

- seven light vehicles and six heavy vehicles would turn right from Wybong Road (west), to Northern Access Road
- six left-turning heavy vehicles from northern Access Road to Wybong Road (west)
- during the afternoon peak
  - 13 right-turning light vehicles from Northern Access Road to Wybong Road (east)
  - seven light vehicles and three heavy vehicles would turn left from Northern Access Road to Wybong Road (west)
  - three right-tuning vehicles from Wybong Road (west) to Northern Access Road.

As such, the intersection is not expected to experience capacity constraints as generated traffic volumes are not significant during these peak periods.

In these respects, the assessment indicates that from a traffic operational perspective, the tested type A (BAR) tee intersection layout would be appropriate in catering for all traffic demands. However, TPK's report (2006) states that a type B (AUR) layout (with an auxiliary passing lane) could be beneficial from a road safety perspective. This is based on the high (100km/h) operating speed of the road. This could be constructed at the same time as the Early Works if temporary access via Limvardy Road could be provided.

#### **3.4.4 Golden Highway/ Wybong Road intersection, Sandy Hollow**

As described in Section 2.2.6, the intersection is currently a four-way intersection with the Golden Highway as the east-west route and Wybong Road as the northern leg. The southern leg is Goulburn Drive, a local access road and alternate route to Sandy Hollow. One lane is currently provided for each direction on each approach.

Based on predicted peak hour volumes, the Early Works would generate six left-turning heavy vehicles from Wybong Road to the Golden Highway, and seven right-turning light vehicles and six right-turning heavy vehicles from the Golden Highway to Wybong Road during the morning peak period. Similarly, during the afternoon peak period, the generated traffic would include seven light vehicles and three heavy vehicles turning left from Wybong Road to the Golden Highway, and three heavy vehicles would turn right from the Golden Highway to Wybong Road.

Due to these low numbers in addition to the low background traffic volumes, the intersection is not expected to experience capacity constraints. Furthermore, the two turning movements undertaken by the generated traffic would be complimentary and hence would have minimal impacts with regard to intersection delays. Therefore, no mitigation measures would be required as a result of the traffic generated by the Early Works.

#### **3.4.5 Golden Highway/ Palace Street/ Crinoline Street Intersection, Denman**

As described in Section 2.2.4, this is a four-way intersection with the Golden Highway as the eastern and northern approaches. The local names of the east-west and north-south roads are Crinoline Street and Palace Street respectively. The western and southern approaches, as well as part of the northern approach are all STOP controlled to give priority to the westbound right-turn and southbound left-turn movements.

Based on the scheduling of works, traffic volumes generated by the Early Works would include;

- during the morning peak
  - seven through light vehicles from Palace Street to the Golden Highway (north)
  - six right-turning heavy vehicles from the Golden Highway (east) to the Golden Highway (north),
  - six left-turning heavy vehicles from the Golden Highway (north) to the Golden Highway (east)
- during the afternoon peak
  - seven through light vehicles from the Golden Highway (north) to Palace Street,
  - three right-turning heavy vehicles from the Golden Highway (east) to the Golden Highway (north)
  - three left-turning heavy vehicles from the Golden Highway (north) to the Golden Highway (east).

Due to these low numbers of vehicles as well as the low background traffic volumes presented in Figure 3-1, it is unlikely that this intersection will experience capacity constraints due to the traffic generated by the Early Works.

As such, no mitigation measures have been proposed for this intersection.

## 4. Other potential impacts and mitigation measures

Section 2.3 outlined potential impacts with the proposed alternate light and heavy vehicle access routes to the Anvil Hill mine site. These have been assessed below, and mitigation measures have been recommended where appropriate.

### 4.1 Capacity issues with the Kayuga Road Bridge

As stated above, this is a one lane bridge that does not permit overtaking or passing. One of the potential traffic impacts associated with the proposed light vehicle access route is the ability of this bridge to cater for any additional traffic generated by the Early Works construction.

The traffic modelling for the Wybong Road/ Kayuga Road intersection suggests that the peak demand for this bridge would be the PM peak (between 1500-1600h) during the peak week of construction. During this period, a forecasted 79 vehicles/hour eastbound and 116 vehicles/hour westbound would cross this. This is a total of 195 vehicles/hour.

Assuming that the length of the one-way restriction is 50m with a design speed of 50km/h (i.e. 14m/s), the time for one vehicle to cross the bridge would be round-up to 6 seconds (i.e. 4 second crossing time and a 2 second follow up time). Assuming only one vehicle can use the bridge at any one time (which is conservative as more than one driver in the **same** direction could theoretically use the bridge at the same time), then the two-way capacity of the bridge would be no less than 600 vehicles/hour.

As such, the bridge appears to have ample spare capacity to be adequate to meet the additional traffic generated by the Early Works and no mitigation measures are proposed.

### 4.2 Maintenance and safety issues on Wybong Road

A brief description of the current maintenance and geometric conditions of this route was provided in Sections 2.1.6 and 2.2.7. The primary concerns with this route are as follows:

- narrow seal width
- lack of edge lines, centrelines and poor delineation
- curves and crests
- poor surface condition with excessive patching
- squeeze points with culverts and vertical geometry of causeways.

These safety issues are exacerbated by the 100km/h speed limit.

A sealed width of less than 7m is provided in many sections along this road. Section 3 of the RTA's *Road Design Guide* states that the minimum lane widths for a two-lane, two way rural road with less than 500 vehicles/day should be 3.0m. For a road carrying more than 500 vehicles/day, the lane widths should be between 3.0-3.5m. The Guide also states that for a road with a speed limit greater than 80km/h, or one that carries more than 100 heavy vehicles per day, a minimum lane width of 3.5m is recommended.

The Road Design Guide also states that a minimum sealed shoulder of 0.5m should be provided when the daily traffic volume is less than 2000 vehicles/day. Therefore, the minimum width of seal recommended is 8.0m, if a speed limit of 100km/h were to be retained.

The narrow seal width and lack of sealed shoulders has led to degradation of the sealed edge further narrowing of the carriageway. The provision of sealed shoulders would not only provide a higher standard of safety (in reducing the likelihood of run-off-road and head-on crashes) but would better protect the road surface from further damage.

The lack of centre and edge lines is a safety concern for existing traffic, as well as additional traffic generated by the Early Works construction. Without centreline guidance, opposing motorists experience difficulty in positioning their vehicles to minimise the head-on crash potential, especially since the speed limit allows for travel up to 100km/h. Also, the lack of edge lines may lead to encroachment over the sealed edge increasing the likelihood of run-off-road crash.

In addition, the poor maintenance condition of the pavement is also a concern which affects existing traffic, as well as the traffic generated by the Early Works construction.

However, as the Early Works Program is only likely to generate (at most) 12 heavy vehicles and 20 light vehicles per peak hour, the individual exposure to these safety risks would be low and can be mitigated through management procedures (i.e. staff inductions on safe driving practices, reducing speed limit, and nominated heavy and light vehicle access routes etc). These management strategies would be recommended rather than sealing road for short period of time required for Early Works.

It should be noted that at the time of writing, Xstrata had commissioned detailed design work for the upgrade of Wybong Road to include widening works to allow for two 3.5m lanes and two 1.0m sealed shoulders as well as line marking.

### **4.3 Reedy Creek, Mangoola and Roxburgh Roads**

To satisfy Condition 52 of Project Approval 06\_0014, no project related traffic is permitted to use Reedy Creek Road, Mangoola Road or Roxburgh Road. In the case of light vehicle traffic generated by the Early Works construction, this would be difficult to enforce as it would not be easy to differentiate whether the traffic would be using the road as an alternate route or whether they would actually need to use these routes to access residential properties along the route.

It is recommended that all employees and goods/service providers be briefed about the designated routes and that a series of spot audits could be conducted to ensure compliance.

Reedy Creek Road has been identified as being particularly vulnerable since it is accessible from the proposed alternate heavy vehicle access route and could be used by heavy vehicles. In these regards, as well as the designation of the light and heavy vehicle access routes and the spot auditing, PB also recommends that consideration be given to installation of signage at both ends of this route to restrict entry by all heavy vehicles associated with the Early Works.

## 5. Summary and conclusions

Project Approval 06\_0014 was granted to construct and operate the Anvil Hill Mine, located near Wybong, approximately 20km west of Muswellbrook.

The planned construction of the Bengalla Link Road (Stage 2), a section of public road linking Denman Road to Wybong Road, has been delayed and is unlikely to be available for the required Early Works. As such, a proposed alternate access arrangement is required to be implemented for the interim period to facilitate the commencement of an Early Works program. This alternate access arrangement is proposed as follows:

- a predominantly light vehicle access route via Kayuga Road and Wybong Road; and
- a heavy vehicle access route via the Golden Highway and Wybong Road.

Following an inspection of the proposed alternate light and heavy vehicle access routes, the following areas for investigation were identified:

- capacity issues at the Aberdeen Road/ Kayuga Road intersection including the capacity of the Kayuga Road bridge to cater for all traffic loading and still operate as a one-lane bridge
- capacity issues at the Wybong Road/ Kayuga Road intersection
- maintenance and safety issues on Wybong Road between Kayuga Road and Northern Access road
- safety issues on Wybong Road between Kayuga Road and Anvil Hill Mine including the high operating speed of the road, geometric and guidance issues
- capacity issues with the Golden Highway/ Crinoline Street/ Palace Street intersection at Denman
- capacity issues with Golden Highway/ Wybong Road intersection at Sandy Hollow.

Following assessment of each of these potential impacts, the following mitigation measures as presented in Table 5-1 are recommended:

**Table 5-1 Summary of recommended mitigation measures**

Location	Mitigation measures proposed
Aberdeen Street/ Kayuga Road intersection	Although this intersection is expected to perform adequately with future traffic loads, a designated route is recommended for all Early Works employees accessing the site with privately owned vehicles. They could be briefed to use the New England Highway/ Aberdeen Street intersection rather than the New England Highway/ Brook Street intersection. This would also minimise the potential for any queues in eastbound traffic, so access onto the Kayuga Bridge for westbound traffic is not impeded.
Wybong Road/Northern Access road	A Type A (BAR) tee intersection layout would be appropriate in catering for all traffic demands and a type B (AUR) layout (with an auxiliary passing lane) could be also considered from a road safety perspective. However, this could be constructed at the same time as the Early Works if temporary access via Limvardy Road could be provided.
Wybong Road	Staff and heavy vehicle operators should be briefed on the designated (interim) light and heavy vehicle access routes and that heavy vehicle travel would not be permitted for Reedy Creek, Mangoola and Roxburgh Roads. The site induction could also cover safe driving practices.
Reedy Creek, Mangoola and Roxburgh Roads	To satisfy Condition 52 of the Project Approval (06_0014), signage should be installed at each end of Reedy Creek road to restrict access by Anvil Hill Early Works construction traffic.

## 6. References

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## Appendix A      Hourly Traffic Volumes

Hourly traffic volumes (vehicles/hour) for each of the surveyed midblock locations.

