Queensland Hunter Gas Pipeline

Biodiversity Assessment

QUEENSLAND – HUNTER GAS PIPELINE

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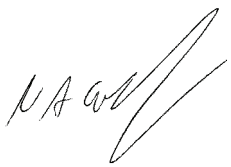
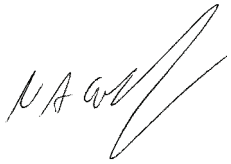
		name		name		name	
Final	18.11.08						

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1 INTRODUCTION

1.1 APPROACH OF THIS STUDY

The preparation of the Biodiversity Assessment for the Queensland to Hunter Gas Pipeline (QHGP) took a staged assessment approach. The initial desktop and screening phases were undertaken as part of the concept approval. The Biodiversity assessment undertaken for the concept approval included a screening process that incorporated desktop research, two aerial field reconnaissance, consultation with people with local and specialist knowledge, data analysis, significance assessment and report compilation (**ngh**environmental September 2008). This report builds on the Biodiversity Assessment for the prepared for the Concept Environmental Assessment, clarifying key findings through fieldwork, and outlining the necessary avoidance and mitigations required to ensure that the proposal avoids significant impacts on biodiversity values, as part of the Submissions Report for the proposal. Provided below is an overview of the assessment process to date.

1.1.1 Assessment conducted to date and the basis for this report

Information was sourced on threatened species, populations, and communities having potential to be present at the subject site and in the wider study area. A range of reference books, research papers, conference papers, web tools and publications were sourced, focusing on relevant species and the study area. Several experts were contacted, and vegetation mapping was obtained from the Department of Environment and Climate Change (DECC) (Parks and Wildlife Group).

Phase 1 – Desktop review and validation (nghenvironmental September 2008)

- A desktop review was undertaken targeting a corridor, 200m wide (100m either side of the proposed centreline) for the length of the proposal.
- The desktop review included a review of relevant literature, previous studies, interpretation of aerial photos, DECC Wildlife Atlas data, predicted species lists from CMA sub-regions and EPBC Act Matters of National Environmental Significance and validation of existing vegetation maps based on the results of the desktop review. The desktop review looked at a minimum area 10km either side of the study area. In some areas, owing to the poor quality of data, the lack of previous impact assessment documentation (including biodiversity surveys), and where the homogeneity of the landscape permitted, searches extended beyond 10km. This provided a greater regional snapshot of the biodiversity conditions of the existing environment. This desktop review identified areas that potentially pose biodiversity constraints for the proposal. Species list from search results are provided in Appendix 1 of the Biodiversity Assessment for the Concept Environmental Assessment (**ngh**environmental September 2008)
- Following the desktop review, two aerial reconnaissances were undertaken. The first identified significant constraints along the route and as such the route was modified and a second aerial reconnaissance was undertaken. This included a validation component employing a flyover of the route with fixed wing aircraft. The objective of the work was to validate the field maps, with a particular focus on the extent and potential condition of areas within the corridor containing native vegetation. This risk based approach allowed the validation of sections of the corridor that do not contain native vegetation and give confidence that these areas are low risk and as such do not require detailed field assessment.

The screening process undertaken and presented in the Biodiversity Assessment for the Concept Environmental Assessment (EA) (**ngh**environmental September 2008) is summarised below. This screening process provided the field survey team with the target species and EEC list in addition to biodiversity constraint areas.

Phase 2 - Analysis of data and impact screening assessment.

Following completion of the desktop review and field validation, a biodiversity assessment was prepared and included the following:

- Identification of potentially significant and minor risk areas (to guide the assessment and continual adaptive management approach).
- Determination of the level of impact on biodiversity likely to be associated with the proposal route.
- Identification of areas where, owing to identified potential significant impacts, detailed field assessment was required to refine the proposal route and acceptably manage potential adverse impacts.

Note, detailed field assessment was not undertaken as part of the Biodiversity Assessment for the Concept EA (**ngh**environmental September 2008). The desktop assessment undertaken during this phase was considered adequate in relation to identifying likely impacts at the Concept Stage

The significance of impacts on the biodiversity has been undertaken through a screened assessment approach, using the significance criteria as outlined in **Table 1-1** below. The screening assessment was based on the principles of both the 7-Part Test (Section 5A of the NSW EP&A Act), as well as the EPBC Act Policy Statement 1.1 – Significant Impact Guidelines.

Table 1-1 Biodiversity impact significance criteria

Significance criteria	
Significant	**Minor/ not significant**
Threatened Flora and fauna	
• Have an adverse effect on the life cycle of a viable local population and place it at risk of extinction. • Fragmentation or isolation of habitat from other areas of habitat to a level that would impact on a viable population. • Remove a significant area of habitat.	• Unlikely to impact on the life cycle of a viable population • Unlikely to fragment or isolate habitat from other areas of habitat.
Endangered populations	
• Have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction.	• Unlikely to have an adverse effect on the life cycle of the species that constitutes the endangered population such that a viable local population of the species is likely to be placed at risk of extinction.
Endangered Ecological Communities or critically endangered ecological communities	
• Work that is likely to place a local community at risk of extinction. • Work that is likely to substantially and adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction.	• Work that is unlikely to place a local community at risk of extinction.
ROTAP species Biogeographical Forest Ecosystems and protected species	

Significance criteria	
Significant	**Minor/ not significant**
• Work likely to place a local forest ecosystem, ROTAP species or protected species at a risk of extinction.	• Works would have only a minimal impact on attribute.

Note: For the purposes of this criteria, "local" was determined during the assessment based on the habitat, lifecycle, and / or distribution for each relevant species, community or population.

An initial screening process was undertaken to look for areas along the route that comprise the following groups:

- scattered trees
- grazing
- cropping/ploughed

Initially, areas along the proposal that comprised grazing land, cropping or ploughed land, or scattered trees with no records or potential for threatened species, populations or communities were identified low risk areas. In these areas, the implementation of mitigation measures and an overarching adaptive management approach would assist in ensuring impacts are not likely to be significant.

For each section of the pipeline the above significance criteria was applied to life cycle groups[1] below:

- Woodland & forest birds, hollow dependent birds and ground dwelling birds
- Burrowing amphibians
- Non-burrowing amphibians
- Saxicolous (rock dwelling) reptiles
- Fossorial (burrowing) reptiles
- Arboreal mammals
- Hollow dependent fauna
- Terrestrial mammals
- Wetland birds
- Aquatic fauna
- Endangered ecological communities and threatened flora species

The potential for significant impact for each of these groups across the whole pipeline was assessed. For example where a section of the pipeline does not contain exposed rock, then saxicolous (rock dwelling) reptiles would be excluded from further assessment. If the answer is yes there is 'potential for significant impact', then the assembly (all species potentially utilising this habitat) of threatened flora or fauna within that group would be tested against the significance criteria based on the habitat requirements for each threatened species, population or EEC.

To validate the desktop assessment and screening process undertaken in the Biodiversity Assessment for the Concept EA (**ngh**environmental September 2008) field work was undertaken, which is the subject of this report. **Figure 1-1** describes the assessment process to date.

[1] A lifecycle group is defined as a group of organisms with similar life cycle attributes and ecological requirements.

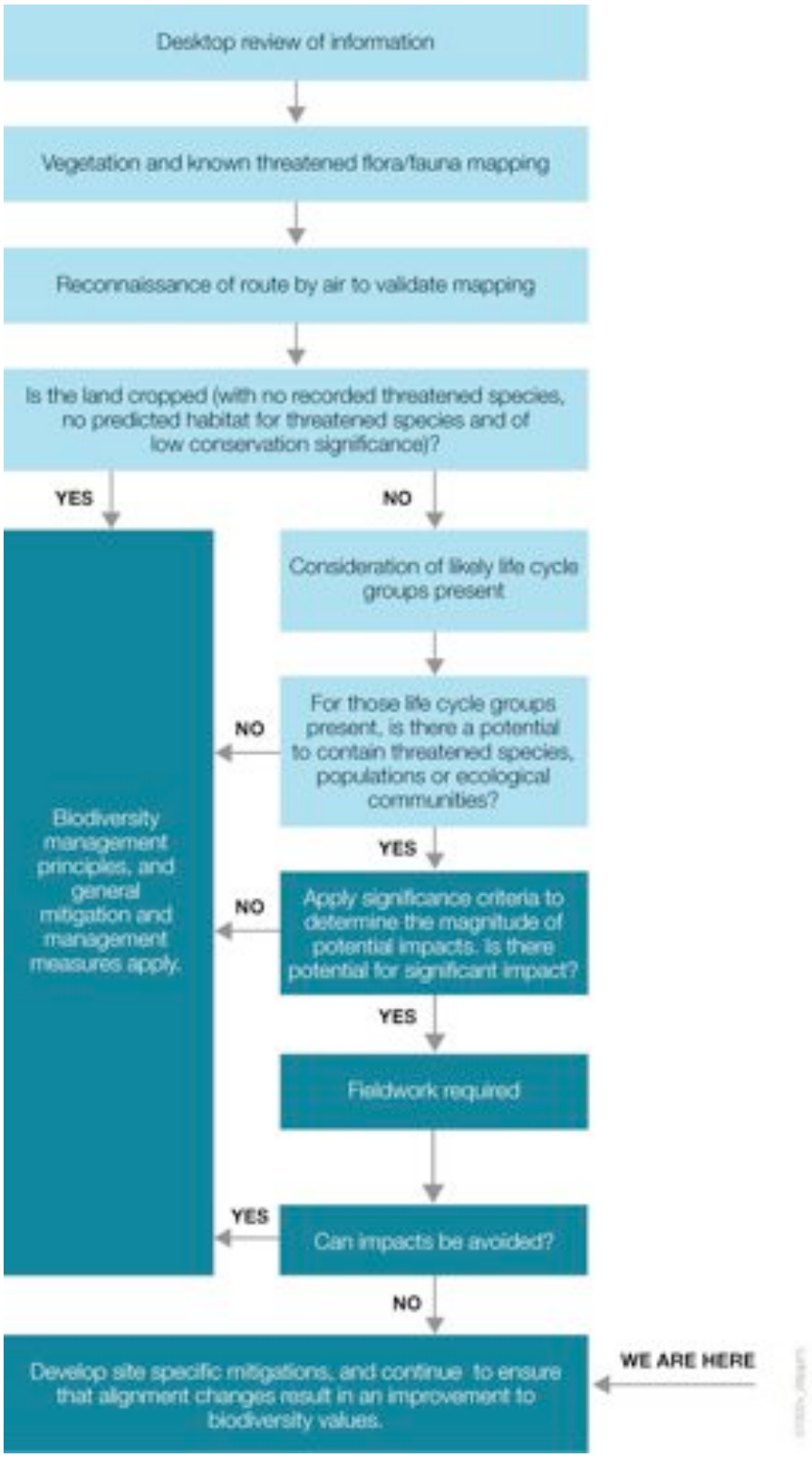

Figure 1-1 Biodiversity assessment process

1.2 FIELDWORK

Site fieldwork was carried out from 6 – 26 October 2008. Field work targeted the biodiversity constraint areas, threatened species, populations and Endangered Ecological Communities (EEC) determined as a result of the desktop and screening process described above. Fieldwork sought to describe and measure key biodiversity attributes, assess

the presence and condition of significant values and determine the nature and extent of impacts likely to result from the proposal. Field activities included general broad scale surveys and targeted surveys and habitat assessment for threatened species, populations and Endangered Ecological Communities known to be present, or with potential to be present at the site.

Field work focussed on the biodiversity constraint areas as shown on Figures 5-1 to 5-17 of **ngh**environmental (September 2008). In addition a number of additional areas were surveyed. Additional surveys were undertaken along the length of the proposal to accommodate for minor alignment changes since September 2008, where updated vegetation mapping and orthophotos showed existing intact vegetation and some in additional riparian areas where the route was easily accessible.

1.2.1 Analysis, assessment and report compilation

Data collected during fieldwork was analysed to determine threatened species habitat suitability, representation of vegetation types, with a focus on threatened species and populations and Endangered Ecological Communities (EEC) and the significance of biodiversity values present at each constraint area. The spreadsheet at **Appendix A** provides a breakdown of the survey outcomes in relation to the original biodiversity constraint areas identified in the Biodiversity Assessment for the Concept EA (**ngh**environmental September 2008). Each area fits into one of the following categories:

- Known constraint to be managed or avoided - constraint that was identified in the Biodiversity Assessment for the Concept EA (**ngh**environmental September 2008). For each of these constraints the Right of Way (ROW) has either been realigned to completely avoid this constraint or a management measure provided that would reduce the potential impact to an acceptable level.
- New Constraint to be managed or avoided – Due to a combination of alignment changes, higher resolution data and field work, some areas that were not identified in the Biodiversity Assessment for the Concept EA (**ngh**environmental September 2008) have since been identified as constraints. These areas have followed the same management hierarchy of avoidance where possible and where avoidance is not possible mitigation measures are provided that would reduce the potential impact to an acceptable level.
- Previously identified constraint no longer a constraint – field work, further data analysis or revision changes have confirmed that these areas are no longer constrained due to biodiversity issues.
- Survey Limitations – largely as a result of access constraints, some areas that were identified as constraints were not surveyed. There is a commitment to survey these areas prior to the construction phase.

This Biodiversity Assessment report presents the results of the field survey work. The field survey work, coupled with the previous desktop assessment has informed alignment changes in order to avoid biodiversity impacts as presented on F**igures 2-1 to 2-35.** Where impacts cannot be avoided entirely a series of management measures have been provided.

1.2.2 Survey limitations

Access was limited to some sections of the pipeline route through access not being granted by land owners. In other areas, difficult terrain and access conditions limited the number of times a site could be surveyed. Where access to a precise route location was impossible, every effort was made to assess threatened species habitat potential from nearby vantage points. Despite these efforts some areas that were identified as constraints were not surveyed. **Section 4** details a process to survey and manage these areas prior to construction.

In addition to the survey limitations as a result of access issues, biodiversity assessments of this nature are inherently restricted by the time of the year, seasonal characteristics, and natural environment fluctuations. The spring timing of the fauna surveys (October 2008), provided mild to warm temperatures conducive to maximising detection of reptiles, birds and mammals and flowering periods for many plant species. During the survey of the southern section of the route, rainfall provided conditions conducive to detecting frogs. Some heavy rain and thunderstorms during the second week impacted on the ability to conduct spotlighting and call playback.

Field surveys conducted over one season and for a relatively short period of time are inevitably expected to detect a sample of the total species present. For this reason the surveys targeted all habitat types that had been previously identified as supporting species, populations or communities with the potential to be significantly affected by the pipeline. In addition the surveys used recognised survey techniques and were guided by the requirements of the Draft Guidelines for Threatened Species Assessment (DECC 2005, DPI 2005).

Despite this it is recognised that the surveys conducted detected only a small sample of flora and fauna that could be expected to occur. The survey duration and intensity were however considered to have been sufficient for the evaluation of biodiversity constraints along the route.

In order to compensate for these limitations, avoidance, mitigation and management has relied heavily on the outcome of the habitat assessment and mitigation has taken a precautionary approach. It is worth noting that of the areas that were identified as constraints only 23km were not able to be surveyed primarily due to access constraints, this represents approximately 3.7% of the entire route.

2 FLORA AND FAUNA METHODOLOGIES

2.1 FLORA SURVEY APPROACH AND METHODOLOGY

2.1.1 Preliminary Assessments

The Biodiversity Assessment for the Concept EA (**ngh**environmental September2008) identified 23 Endangered Ecological Communities (EEC) with the potential to occur along the length of the proposal. As a result of the screening process twelve of these EEC were expected to occur and have the potential to be impacted by the pipeline corridor. Twenty-six threatened species and three endangered populations were identified as a result of the screening process with the potential to occur within the pipeline corridor and be impacted by the proposal. The field survey therefore targeted these constraint areas to validate the findings of the screening process.

2.1.2 Field survey and mapping

The methods and outputs of the assessment have been developed with reference to the requirements contained in the Draft Guidelines for Threatened Species Assessment (DECC 2005, DPI 2005) and with reference to the Director-General's Requirements for the Environmental Assessment.

Flora surveys were undertaken between 7-10th and 13-22nd October 2008 and were conducted by two botanists and accompanied by an assistant botanist. Survey locations focused on the potential constraint areas identified during the Biodiversity Assessment for the Concept EA (**ngh**environmental September2008). Additional surveys were undertaken along the length of the proposal where the orthophotos showed existing intact vegetation, riparian areas and/or wherever access was possible. These additional surveys were conducted to provide confidence in the screening methodology outlined previously, and also to ensure that there was a robust framework to evaluate all relevant aspects of the biodiversity landscape for the proposal.

A description of the different flora survey methods employed during the fieldwork is provided in **Table 2-1**. The survey method employed at each survey site varied according to the presence and condition of vegetation, the disturbance history and the potential presence of threatened species, population or EEC based upon the desktop assessment. The locations of each flora survey were mapped at an appropriate scale and are presented in **Figures 2-1 to 2-35. Table 2-2** outlines the initial constraint areas identified in the Biodiversity Assessment for the Concept EA (**ngh**environmental September 2008) and the survey effort within these areas. **Table 2-3** lists all the additional flora survey locations along the proposed pipeline corridor.

Botanical nomenclature follows Harden (1990-2001), except where recent taxonomic changes have occurred. Noxious weeds identified are those declared for the relevant control area under the *Noxious Weeds Act 1993*.

Map references locating significant vegetation features such as EECs and threatened species as well as noxious weeds were obtained using a hand-held GPS unit, and are based on the GDA datum to mirror topographic map sheets and existing vegetation community mapping.

Table 2-1: Flora survey methods undertaken along the proposal.

Flora Survey Methods	Description
Visual Assessment	A rapid visual survey was undertaken in agricultural areas. This primarily involved locating any remnant stands of native vegetation and/or isolated paddock trees. In other areas the vegetation type was identified.
Random meander surveys	Surveys were undertaken using the 'random meander' method (Cropper 1993) along pre-determined sections of the proposed corridor, in order to assess potential occurrences of threatened species or EEC. This method was employed rather than quadrats in order to maximise opportunities for detecting threatened, regionally significant or sparsely distributed plant species. A list of the key species present within the community was recorded.

Flora Survey Methods	Description
Targeted searches	Targeted searches were undertaken along pre-determined sections of the proposed corridor, where vegetation mapping indicated the presence of an EEC, or where threatened species or populations had previously been recorded in adjacent areas.
Vegetation assessment proforma	In areas of potential EEC and better quality native vegetation, including riparian vegetation, a full qualitative vegetation assessment was conducted including aspect, slope, soils, tree diameter, vegetation structure, dominant species present, fire history, condition, habitat value and connectivity and potential impacts of the proposal.
Restricted access	At inaccessible sites binoculars were used to assess vegetation community structure and if possible the dominant overstorey species were recorded. Where required these areas were identified as limitations and would continue to be investigated in accordance with the process outlined in Chapter 4.

Table 2-2: Summary of flora survey effort at previously identified potential constraint areas.

Constraint Area KP (Rev K)	Potential Constraint Identified (nghenvironmental2008)	Survey Effort and location
223.3-226.3	Coolibah - Black Box Woodland	Vegetation assessment proforma (KP 222.5) Targeted searches, Visual assessment (KP 222.5-224; 225; 226; 227.7-228.2)
230.3-231.3 236.3 238.3	Bluegrass (*Dichanthium* spp.) dominant grasslands of the Brigalow Belt Bioregions (North and South) *Swainsona murrayana* *Sida rohlenae*	Vegetation assessment proforma (KP 231.6) Targeted searches, Visual assessment (KP 236, 238)
233.3-235.3	Coolibah - Black Box Woodland Bluegrass (*Dichanthium* spp.) dominant grasslands of the Brigalow Belt Bioregions (North and South)	Targeted searches, Visual assessment (KP 233-235)
239.3 240.3-243.3 244.4-245.3	Coolibah - Black Box Woodland	Targeted searches, Visual Assessment (KP 239-240) No access (KP 244-248)
246.3-247.3 249.3	*Sida rohlenae* *Swainsona murrayana*	No access (KP 244-248) Targeted searches (KP 249)
251.3 - 252	Coolibah - Black Box Woodland Carbeen Open Forest EEC	Targeted searches, Visual assessment (KP 251-252)
253.8 254.8-256.8	*Sida rohlenae* *Swainsona murrayana* Coolibah - Black Box Woodland	Targeted searches, Visual assessment (KP 254-256)
260.8 264.8	*Sida rohlenae* *Swainsona murrayana*	Targeted searches

Constraint Area KP (Rev K)	Potential Constraint Identified (nghenvironmental2008)	Survey Effort and location
266.8 268.8		
272.8	Coolibah - Black Box Woodland	Visual assessment
275.8	Myall Woodland EEC	Random meander survey (KP 275.8-276.5)
283.8-286.8	*Sida rohlenae* *Swainsona murrayana*	No access
287.8-288.8	*Sida rohlenae* *Swainsona murrayana*	Visual Assessment, restricted access
289.8	Coolibah - Black Box Woodland	Visual Assessment
296.8- 298.8	*Sida rohlenae* *Swainsona murrayana* Myall Woodland EEC	Targeted searches
305.8 307.8 312.8-314.8 318.8-324.8	*Sida rohlenae* *Swainsona murrayana*	Random meander survey, Visual assessment
332.8	*Sida rohlenae* *Swainsona murrayana*	Visual assessment (KP 333)
333.8-334.8	*Sida rohlenae* *Swainsona murrayana*	No Access
337.8	*Sida rohlenae* *Swainsona murrayana*	No Access
338.8	Coolibah - Black Box Woodland	No Access
339.8	*Sida rohlenae* *Swainsona murrayana*	Restricted Access
341.8 348.8	*Sida rohlenae* *Swainsona murrayana*	No Access
379.8-380.8	Bluegrass (*Dichanthium* spp.) dominant grasslands of the Brigalow Belt Bioregions (North and South)	Visual assessment (KP 380-381)
399.8 401.8 404.8	Bluegrass (*Dichanthium* spp.) dominant grasslands of the Brigalow Belt Bioregions (North and South)	Vegetation assessment proforma (KP404.7)
476.8-477.8	*Cadellia pentastylis*	Random meander survey (477)
645	Box-gum woodland EEC	Random meander survey, Visual assessment (KP 642.8-644)
666-667	*Cymbidium canaliculatum* Box-gum woodland EEC	Targeted searches, Visual assessment (KP 664-666)

Constraint Area KP (Rev K)	Potential Constraint Identified (nghenvironmental2008)	Survey Effort and location
674	*Cymbidium canaliculatum* Box-gum woodland EEC	Targeted searches, Visual assessment (KP 673.8-674.8)
692-693	Box-gum woodland EEC	Restricted access
806-833	Swamp Oak Forest/Freshwater wetlands *Zannichellia palustris* *Eucalyptus parramattensis subsp. decadens*	Targeted searches, Visual assessment (KP 819-821)

Table 2-3: Additional flora survey locations along the proposed pipeline corridor

Survey Location KP (Rev K)	Reason for survey	Survey Effort
302.7-303.1	Patch of vegetation	Visual assessment
356-357 358 365	Riparian area and roadside woodland	Visual assessment (356-357) Vegetation assessment proforma (KP 358 and 365)
367	Riparian area	Vegetation assessment proforma
390.8-392	Riparian area	Vegetation assessment proforma (KP 392) Random meander survey (390.8-392)
405.6	Patch of native vegetation	Visual assessment
411.7	TSR	Vegetation assessment proforma
416.8	Patch of native vegetation along road edge	Vegetation assessment proforma
420 423.8	Riparian areas	Visual assessment
430.8	Road edge	Visual assessment
433.5-435, 451.5	Easy access, agricultural area, riparian area	Visual assessment
454	TSR	Vegetation assessment proforma, visual assessment of adjacent areas
462.2	Riparian area	Visual assessment
481	Easy access, and provides survey for context for other local areas.	Visual assessment
491-492	Easy access, and provides survey for context for other local areas.	Vegetation assessment proforma

Survey Location KP (Rev K)	Reason for survey	Survey Effort
502 505.4	Riparian area	Vegetation assessment proforma
513	Patch of vegetation	Vegetation assessment proforma
528.4	Riparian area	Vegetation assessment proforma
533	Riparian area	Vegetation assessment proforma
544-556	Easy access, and provides survey for context for other local areas.	Visual assessment
559.8	Riparian area	Visual assessment
581.5 585	Scattered paddock trees	Vegetation assessment proforma
593	Riparian area	Vegetation assessment proforma
604.3 606.5	TSR Road reserve	Vegetation assessment proforma
612-618	Patches of vegetation, inaccessible	Restricted access
620-621	Riparian area	Vegetation assessment proforma
626	Scattered vegetation, easy access	Vegetation assessment proforma
639-641	Vegetation along old highway, steep area	Vegetation assessment proforma
698-699	Potential for *Eucalyptus camaldulensis*	Targeted searches, visual assessment
708-709	Scattered vegetation, rocky area	Targeted searches, Visual assessment
719-721 724	Scattered vegetation, rocky area	Targeted searches, Visual assessment
768-769	Footslopes of Tangory	Targeted searches, Visual assessment
790-791	Escarpment slopes north of Rutherford	Visual assessment

2.2 FAUNA SURVEY APPROACH AND METHODOLOGY

2.2.1 Preliminary assessments

A preliminary assessment of fauna habitat values and the likelihood of threatened fauna species being present was undertaken based on species distribution records and known habitat requirements. The results of previous fauna survey work in the region were also reviewed for threatened fauna records. Habitat requirements were drawn from a range of sources, including reference books, scientific papers, local research and author experience. This review of information was provided in the Biodiversity Assessment for the Concept EA (**ngh**environmental September2008) and was used to inform the design of targeted fauna surveys that are the subject of this report. The process used to inform the field survey work is described above in Section 1.1 of this report.

2.2.2 Field surveys and mapping

Fauna surveys were carried out along the pipeline route over the period 13th to 25th October. Fauna field surveys were conducted by four teams working on separate sections of the pipeline route simultaneously. The entire route was surveyed for reptiles and amphibians by a team of two experienced herpetologists over a period of seven days. Surveys for birds and mammals and fauna habitat assessments were conducted by three teams during the same period. Each survey team comprised two to three experienced ecologists. Qualifications and experience of Senior ecologists are provided in **Appendix B**.

All data were recorded onto predesigned data sheets. Photographs and GPS Waypoints were taken for all survey locations. Survey locations are shown on **Figures 2-1 to 2-35** and survey effort is summarised in **Table 2-4**.

General site selection

Sites were selected on the basis of meeting one or more of the following criteria:

- Areas previously identified with potential to support threatened species (constraint areas)
- Areas identified from aerial photography that appeared to support intact vegetation and provide landscape connectivity, or may represent other suitable habitat as relevant, that may not have been captured in the Biodiversity Assessment for the Concept EA (**ngh**environmental September2008) due to alignment changes
- Riparian areas where a pipeline crossing point was proposed
- Feasibility and logistics of accessibility for survey

2.2.3 Targeted Fauna Survey Techniques

Birds

Standardised bird surveys were undertaken by experienced personnel. Birds were identified both by call and sight. A total of 32 bird surveys were undertaken over 29 sites using either a 20 min search over an area of 2 ha, or a fixed length transect, depending on the configuration of vegetation at the site. Opportunistic sightings of all bird species were made continuously while travelling between survey sites or conducting other surveys. A Kilometre Point (KP) on the pipeline was recorded for every opportunistic sighting.

Spotlighting and call playback was conducted for threatened owls (Masked Owl, Barking Owl and Powerful Owl) using a sequence of 5 minutes call broadcast/5 minutes listen for each species, followed by a 10 minute listening period and an extended period of spotlighting.

Mammals

Elliot trapping

Elliot trapping was used to target small mammals at sites expected to have a high potential for threatened small mammal occurrence and where accessibility allowed repeated access on a daily basis. Traps were spaced 10 m apart along a 100 m transect, baited with a mixture of rolled oats, peanut butter and honey, set for a minimum of three nights at each location and cleared daily within 2 hours of sunrise. Elliot trap lines were set at five sites along the route. This equated to a total of 234 trap nights.

Hair tubes

Hair tubes were set at 14 sites along the route. The number of hair tubes set at each site varied depending on the size of the site. Large (8.5 cm diameter x 50cm long) and small (4 cm diameter x 30cm) long hair tubes were set with adhesive tape on both ends. At a number of sites in the northern section 20 Faunatech hair funnels were also used. Traps were spaced 10 m apart, set alternately on the ground or in a tree. The area immediately surrounding the tree traps was sprayed with honeyed water. Tubes were baited with a mixture of rolled oats, peanut butter and honey and left in place for a minimum of three nights. A total of 541 trap nights were conducted. Adhesive tapes were then removed and all samples sent to hair expert Barbara Triggs for identification.

Anabat Surveys

Bat surveys were undertaken using 'Anabat' ultrasonic call detection recording equipment. Detectors were set at likely flyway and foraging points such as forest tracks and over creeks. Five Anabat detectors were used over the survey period resulting in a total of 22 Anabat nights. All files were sent to Glenn Hoye of Fly By Night Bat Surveys for analysis and species identification. Identified calls were given a certainty rating of confident, probable or possible.

Spotlighting

Spotlighting was conducted either on foot or by vehicle using hand held 55W spotlights to target nocturnal fauna such as arboreal mammals and owls. A total of 17 spotlighting surveys were undertaken during the survey period.

Spotlighting was carried out after undertaking owl call playback.

Reptiles

Active searches were conducted for reptiles by searching appropriate microhabitats such as leaf litter, loose bark, fallen timber, grass tussocks, surface rock, rubbish (corrugated iron etc) for a minimum of 1 person hour per site. Potential reptile habitat to be searched was identified from surveyor experience. All surveys were conducted by experienced herpetologists. Survey effort was stratified according to habitat complexity i.e. the lower the habitat diversity, the larger the area searched. All threatened reptiles identified in the Biodiversity Assessment for the Concept EA (**ngh**environmental September2008) were targeted during surveys. Reptile surveys were undertaken at 23 sites.

Amphibians

Nocturnal surveys were undertaken for frogs for a minimum of 30 person minutes per site and involved active spotlighting, call playback and passive listening for frog calls in appropriate habitats such as wetlands creeks etc. Call playback was conducted for *Litoria aurea, Litoria brevipalmata, Pseudophryne australis* and *Crinia tinnula*. Frog surveys targeting threatened amphibians were conducted at 29 sites. All species heard or seen were recorded. Diurnal searches of 15 person minutes were conducted at each frog site.

Fauna Habitat Assessment

Habitat assessments were carried out at 51 locations along the route in areas identified in the Biodiversity Assessment for the Concept EA (**ngh**environmental September2008) as fauna constraint areas. In addition, habitat assessments were also undertaken in other areas where alignment changes have occurred since September 2008. Habitat assessments provided a snap shot of the habitat types available in identified fauna habitat, for a range of species, threatened or otherwise. For each habitat assessment the following information was recorded:

- General description of site
- Height and density of dominant vegetation
- Dominant vegetation species
- Landscape connectivity
- Microhabitat features (e.g. stags, hollow bearing trees, fallen timber, proximity to water bodies)
- Presence of koala feed tree species
- Disturbance (grazing, trampling, weeds, etc)
- Evidence of feral animals
- Tracks and traces (scats, pellets, diggings, scratches)
- Presence of potential threatened species habitat

Herpetofauna Habitat Assessment

Reptile and amphibian habitat assessment involved a qualitative analysis of the presence of threatened herpetofauna habitat, and evaluation of likelihood of occurrence based on habitat qualities present, surrounding matrix, and degree of disturbance. Thirty-three herpetofauna habitat assessments were undertaken.

Opportunistic Records

At all times during field work, field team members made opportunistic observations of fauna and signs of fauna, where the location was relevant to the pipeline route. Such observations included:

- Bird, mammal, reptile and amphibian sightings
- Bird and amphibian calls
- Scats collection
- Diggings
- Scratches

Aquatic Habitat Assessments

A preliminary assessment of aquatic habitat and fauna was undertaken in the Biodiversity Assessment for the Concept EA (**ngh**environmental September2008) and identified the potential aquatic constraints along the proposed route. Features identified included:

- 14 waterways/wetlands within the Border Rivers/Gwydir Catchment (KP 222 – 366)
- 20 waterways/wetlands within the Namoi River Catchment (KP 401 – 613)
- 16 waterways/wetlands within the Hunter River Catchment (KP 627 – 808)
- One endangered ecological community under the *Fisheries Management Act 1994* (Lowland Darling River aquatic ecological community) located within the Border Rivers/Gwydir Catchment and Namoi River Catchment (KP 222 – 613)

Following the above assessment and identification of constraints, field investigations were undertaken at major waterways using a pro forma data sheet where aquatic habitat was assessed (Figures 2-1 to 2-35). Features recorded included:

- Extent and condition of the riparian zone
- Presence and condition of instream habitat (ie. Large woody debris, riffles, instream vegetation)
- Surrounding land use
- Presence of water
- Water quality

Table 2-4: Summary of fauna survey effort during this study

Technique	Target group	No. of sites	Timing	Total survey effort	Other comments
Bird censuses	Diurnal birds	32	20 minutes at each site	10.6 hrs	Opportunistic records also collected while driving between sites and within the general study area
Elliot trapping	Small ground dwelling mammals	5	Min 10 elliot traps at each site for 3 nights.	234 trap nights	
Hairtubes	Small ground dwelling mammals (Piliga mouse and Stripe faced dunnart)	16	10 hairtubes at each site for minimum 3 nights	541	Small and large hair tubes
Anabat call detection	Microchiropteran Bats	14	1 anabat detector for one night at each site	22 detector nights	Some detectors left out for 3 nights
Nocturnal call playback & spotlighting	Nocturnal birds & mammals	17	30-60 minutes per site	Minimum 17 person hours	
Nocturnal Frog Surveys	Frogs	29	30 minutes each	14.5 person hrs	
Diurnal Frog Surveys	Frogs	29	15 minutes per site	7.25 person hrs	
Hand searches	Reptiles	23	1 person hour per site	23 person hours	
Herpetofauna Habitat Assessment	Reptiles & Amphibians	33	15 minutes per site	16.5 person hours	Targeted towards frogs or reptiles depending on identified constraint
Habitat assessment	All fauna	51	30 minutes per site	25.5 person hours	Opportunistic records of all taxa were collected

Figures 2-1 to 2-35 show the survey effort along the proposal route. Where a map number is missing this is due to there being no biodiversity constraints identified and consequently no field surveys undertaken.

QUEENSLAND TO HUNTER GAS PIPELINE PRELIMINARY ENVIRONMENTAL ASSESSMENT

SURVEY EFFORT MAP 2.01 - LOWER HUNTER VALLEY

Map Scale 1:50,000
GDA1994 Datum
Geographic Coordinates

ngh environmental

151°40' 151°41' 151°42' 151°43' 151°44' 151°45' 151°46' 151°47' 151°48'

32°48' 32°49' 32°50' 32°51' 32°52' 32°53' 32°54'

816 817 818 819 820 821 822 823 824 825 826 827 828 829 830 831 832 833

NEW ENGLAND HIGHWAY
Hexham
Kooragang Nature Reserve
HUNTER RIVER
Hexham Swamp Nature Reserve
Worimi Regional Park
PACIFIC HIGHWAY
SANDGATE ROAD
COWPER STREET
NEWCASTLE ROAD

Fauna Survey Effort

- Fauna survey area
- Anabat
- Bird Survey
- Reptile survey
- Frog survey
- Fauna habitat assessment
- Spotlighting
- Herpetofauna habitat assessment

Flora Survey Effort

- Flora survey area
- Targeted Search
- Visual Assessment

- QHGP Mainline KPs Rev K
- QHGP Mainline Rev K
- NSW State Forests
- National Parks Estate (DECC)

Roads (250,000)

- Dual Carriageway
- Principal Road
- Secondary Road
- Minor Road
- Track

0 0.5 1 2 3 4
Kilometers