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Goulburn Mulwaree Council

Highlands Source Project

AS 2885 Pipeline Risk Assessment Report

2313312RPT0001.DOC

January 2010

INFRASTRUCTURE | MINING & INDUSTRY | DEFENCE | PROPERTY & BUILDINGS | ENVIRONMENT

Document Status

Rev	Date	Author	Checked	Approved	Comments
A	14/12/09	C. Smith	B. Phillips	D. Allen	
B	18/12/09	C. Smith	D. Allen	D. Allen	Issued for Client Comment
0	20/01/10				Issued Final

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Contents

Appendices

1. Executive summary

GHD Pty Ltd was commissioned to facilitate an AS 2885 Hazard Identification (HAZID) and Risk Assessment study on the impact of the Highlands Source Project pipeline on two hydrocarbon pipelines that run in adjacent easements.

The Risk Assessment was qualitative in nature and therefore dependent on the knowledge and experience of personnel present and the quality of the documentation available. Guidewords and the risk matrix from AS 2885-1-2007: *Pipelines - Gas and liquid petroleum - Design and construction* were used. Twelve hazards were identified by the workshop team. The inherent risk ranking of each hazard was initially determined and then the residual risk assessed after any recommended actions were implemented.

The appendices show the actions / recommendations identified, all of which require close out in an auditable fashion. The hazard with the highest assessed risk, even after implementation of recommendations, is rupture of one of the gas pipelines as a result of misdirected horizontal directional drilling at creek crossings and highways. This was assessed as an intermediate risk as defined by AS 2885.1, requiring additional actions to the extent practicable to reduce likelihood or mitigate consequences, plus demonstration that the risk posed is as low as reasonably practicable (ALARP). All other risks were assessed as low or negligible.

Although no formal ALARP study has been conducted at this stage of the project, with the implementation of these recommendations together with an ongoing active safety management system, the impact of the proposed design on the existing pipelines can be considered approaching or achieving ALARP. On this basis, the proximity of the proposed water pipeline to the existing hydrocarbon pipelines as described in the design documents can be considered acceptable from a risk perspective.

2. Abbreviations

Table 1

Abreviation	**Meaning**
ALARP	As low as reasonably practicable
AS	Australian Standards
CP	Cathodic Protection
DICL	Ductile Iron Cement Lined
HAZID	Hazard Identification Study
HDD	Horizontal Directional Drilling
HSP	Highlands Source Project
MAOP	Maximum Allowable Operating Pressure
MLV	Main Line Valve
MSDS	Material Safety Data Sheet
P&ID	Piping & Instrumentation Diagram
PPE	Personal Protective Equipment
SCADA	Supervisory Control and Data Acquisition
SCC	Stress Corrosion Cracking
WTP	Water Treatment Plant

3. Introduction

GHD is currently designing a pipeline to transfer water from the Wingecarribee Water Supply Reservoir to the Goulburn Water Treatment Plant (WTP). For about 60 km of its length, the proposed water pipeline's easement will be immediately to the south of existing easements for an ethane pipeline and a natural gas pipeline. These are operated by Qenos and APA respectively.

Due to the potential for the natural gas / ethane pipelines to be impacted by either the construction, operation or maintenance of the proposed new water pipeline, an AS 2885 risk assessment was commissioned by GHD to ensure that all risks to these pipelines had been reduced to as low as reasonably practicable (ALARP).

This document provides a record of discussions and agreed actions.

4. Project description

The Project is to construct and operate the water supply scheme that would transfer water from the Wingecarribee Water Supply Reservoir to the Goulburn Water Treatment Plant (WTP). The scheme comprises approximately 83 km of DN 300 mm and DN 375 mm diameter pipeline, a pump station at the Wingecarribee Reservoir, a booster pump station near Marulan, power and controls and a telemetry system.

If the Project is approved, it is proposed to have the transfer scheme operational by June 2011. The Project's timeframe is set by the conditions governing the provision of government funding under the Australian Government Water Smart Australia Program.

Two options are still being considered for the point at which the pipeline would enter the Goulburn water supply system. The options considered are:

» Pumping raw water from the Wingecarribee Reservoir to a reservoir located at the Goulburn WTP; and

» Pumping treated water from the Wingecarribee WTP to connect to the Goulburn Mulwarree mains supply.

4.1 Key activities

Key construction activities include:

» Trench excavations and placement of the pipeline;

» Constructing railway, road, services and river crossings;

» Constructing a pump station and controls at the Wingecarribee Reservoir site;

» Constructing a balance tank at an appropriate location along the pipeline (subject to design requirement);

» Reinstatement / revegetation; and

» Commissioning.

Key operational activities would include:

» Pumping of water from the Wingecarribee Reservoir to Goulburn;

» Regular maintenance of the pumping station;

» Regular maintenance of the air valves and scour valves; and

» Less frequent maintenance of the pipeline (*e.g.* pigging to remove blockages, or repairing bursts as required).

4.2 Pipeline

A summary of the key pipeline components is presented in Table 2.

Table 2 - Key pipeline components

Component	Key data
Transfer pipeline	Nominal diameter – 300 mm and 375 mm Total length – approximately 83 km Location – underground Trench depth – 1.5 m to 2 m Material – ductile iron cement lined (to be confirmed) Coating – corrosion protection and polyethylene sleeving
Soil production	Approximately 150,000 m^3 of spoil, of which approximately half would be used as backfill material and the remainder to remediate the 20 m wide construction impact zone.
Trucks for supply of pipe	Pipes are expected to be delivered at a rate of approximately 24 pipes lengths per truck, with each pipe length 6 m long. This equates to approximately 510 deliveries.
Construction – work crews	4 crews (3 pipeline crews, 1 pump station & connections crew) 20 to 30 personnel per crew
Construction corridor	20 m wide construction corridor area typically (except in specific areas where additional constraints exist or more or less width is required).
Booster pump station	Chainage – approximately near Marulan Area occupied – approximately 800 m^2 Number of pumps expected – 3 comprising 2 duty pumps and 1 standby pump Pump delivery flow – up to 7.5 ML/day Pump power – with pump station up to 260 kW Building dimensions – 12 m x 8 m x 5 m Power supply – 11 kV power lines
Pipeline easement	Likely to be 10 m wide
EA assessment corridor	100 m wide

4.2.1 Description of the water pipeline route

The preferred pipeline route corridor would be located mostly adjacent to existing infrastructure (gas, electricity and optical fibre) easements that have previously been cleared and either remain cleared or have regenerating vegetation present. From Wingecarribee Reservoir, the pipeline route largely runs adjacent to existing power line easements until it crosses the Hume Highway. After crossing the Hume Highway, the pipeline route would be located adjacent to and outside of an existing gas pipeline easement, which it follows almost the entire way to Goulburn.

The raw water pipeline route corridor is approximately 83 km long while the treated water pipeline route is approximately 75 km long.

A 20 m wide (maximum) corridor has been considered for construction. A 10 m wide easement along the length of the pipeline would be acquired for operation and maintenance purposes. GHD is currently undertaking landholder negotiations regarding access during construction, rehabilitation activities, and operation of the project.

The pipeline would also include auxiliary items at various positions along the pipeline route, such as isolation valves, concrete pits, air valves and scour valves. Pipeline marker posts would be installed at regular intervals (approximately every 200 m) to warn of the location of the underground water pipeline. The pipeline route has been changed slightly since the completion of the study, however the drawings in Appendix B show the route that was considered by the study team.

4.2.2 Air valves

At high points along the pipeline, air valves would be installed to enable air that becomes entrained to be released. These are common pipeline structures in both urban and rural settings designed to assist the water flow and pressure within the pipeline. Air valves would be contained within a concrete circular pit approximately 1200 mm to 1500 mm in diameter, approximately 600 mm above the ground surface and covered by a metal grating. It is anticipated that 45 primary air valves and approximately 20 to 30 secondary air release points would be located along the pipeline.

4.2.3 Scour valves

At low points along the pipeline, scour valves would be installed to enable cleaning of the pipeline and discharge of the scour liquid. Water from the scour valves would periodically be collected by a tanker, which would traverse the alignment from the nearest access point. Where the volume of water released from the scour valves exceeds that which can be successfully collected by a tanker, a nearby farm dam or waterway may be used to collect the scour water for treatment on site and eventually use by the landholder. It is anticipated that approximately 40 primary scour valves and approximately 30 secondary scour points would be located along the pipeline.

4.2.4 Divide valves (stop valves)

Divide valves (also known as stop valves) would be constructed along the pipeline to allow sections of the pipeline to be isolated and water flow in sections of the pipeline to be shut down, particularly while maintenance or repairs are undertaken. Up to 17 divide valves would be constructed along the alignment at regular 5 km intervals.

A stand pipe consisting of a tank constructed of concrete or steel approximately 4 m high and 10 m in diameter may need to be constructed on a high point located near Moss Vale. Stand pipes are required where there are sections of pipeline that may be higher than the discharge point. If this occurs, when pumping is stopped, water will drain out of the pipe. The installation of a stand pipe would modify the hydraulic gradient so that water would remain in the pipe when pumping is stopped.

4.2.5 Ancillary infrastructure

Access to the pipeline easement from existing roads would be required approximately every 3 to 4 km along the route. Where possible, existing access roads and farm tracks would be used to access the easement and the proposed easement alignment would be the main thoroughfare through the properties.

It is envisaged that access to some terrain would be a problem in some areas along the proposed alignment.

At completion of construction and restoration of the pipeline construction impact area, property fences would be reinstated and gates installed along the pipeline easement between properties. This would allow for ease of access to the pipeline easement for ongoing maintenance and inspections.

Water pipeline marker signs would also be installed along the pipeline route at regular intervals, horizontal bends, service crossings, either side of road crossings and at fence and gate crossings.

4.3 Construction of the pipeline

4.3.1 Pipeline trenching and placement

The pipeline construction corridor would be in the order of 20 m wide while the pipeline is being constructed. Preparation of the construction easement would include clearing of trees and vegetation where present and removal of topsoil and other obstacles such as rocks with a bulldozer. The proposed construction easement width would provide sufficient space to construct the trench while providing enough space for excavated material to be placed beside the trench, a trench safety area, pipes to be strung out beside the trench prior to installation and the movement of vehicles such as trucks, cranes and excavators beside the trench. Where specific obstacles such as large trees, endangered ecological communities and large boulders or significant landscapes are identified along the route, the construction corridor would be narrowed to 6 m to 8 m wide.

Pipes would be stockpiled at 5 km to 10 km centres adjacent to an existing road or access that is suitable for a semi-trailer truck. The pipes would then be transported to the cleared construction corridor and would be strung out along the edge of the existing gas pipeline easement, thus acting as a barrier to construction activities entering the gas easement.

The pipeline trench would be approximately 1 m wide and excavated to a nominal depth of 1.5 to 2.0 m below ground surface using either a tracked excavator or a tracked chain trencher. Stockpile areas of approximately 10 m by 10 m wide would be located intermittently along the pipeline easement. These stockpile areas would contain sand and other material that would be used for backfill where the natural material is too coarse for use.

Following construction, an easement (of approximately 10 m in width) would be maintained as a cleared landscape to allow access for ongoing maintenance activities.

Site compounds, storage, stockpile and lay down areas would be required at various locations along the pipeline. The proposed locations of the facilities have generally been selected to occupy existing cleared areas or areas that would be cleared for the excavation of the pipeline trench.

Access to land for the purposes of construction, rehabilitation and operation of the pipeline is the subject of discussions and negotiations between the proponent and the landowners.

4.4 Construction of pipeline crossings

The pipeline would cross railways (including the Moss Vale Unanderra Railway) and major roads (*e.g.* the Hume and Illawarra Highways), local roads, various water bodies (including the Wollondilly River) and a number of services. Alternative methods to trenching are likely to be used to traverse these features due to a number of factors, such as the need to limit disturbance to normal operation of roads and railways, limiting environmental disturbance to waterway crossings and avoiding important services (i.e. gas and optical fibre). The methods that may be employed include:

- Thrust boring;
- Horizontal directional drilling (HDD); and
- Pipe bridges.

The crossing techniques have been determined following consideration of technical, environmental and geological constraints; however they may be further refined during the detailed design phase.

4.5 Previous Risk Studies

A number of hazard studies have been conducted on the Highlands Source Project, however these related to risks associated with the water pipeline itself, rather than its impact on the existing ethane and natural gas pipelines. It is understood that AS 2885 risk assessments have previously been conducted for both of these pipelines, although they were not available for review prior to this study. An extract of the Public Environment Report for the Moomba to Sydney Ethane pipeline was reviewed prior to the study. This contained a synopsis of the hazard studies conducted on this pipeline. APA, as operators of the natural gas pipeline, participated in the study. These participants were familiar with the contents of the risk assessment on this pipeline.

5. Workshop details

5.1 Meeting Details

The risk workshops were held in GHD's Canberra office on 30 November 2009. Representatives from Goulburn Mulwaree Council (the Proponent), APA and GHD were present.

5.2 Scope

The focus of the workshop was to conduct a risk assessment based on the requirements of AS 2885 "Pipelines – gas and liquid petroleum" to examine the impact of the Highlands Source Project on the existing Moomba to Sydney Gorodok ethane pipeline and the APA natural gas pipeline in the adjacent easement. This included the potential impact of the construction, operation and maintenance of the water pipeline.

The objectives for the workshop were;

» Identify threats to the existing hydrocarbon pipelines;

» Investigate the adequacy of the controls in reducing risks to ALARP;

» Assess the currently designed safeguards and make recommendations on any additional control measure required.

5.3 Workshop Study Team

The workshop team comprised multi-disciplinary design, operations and project management representatives from Goulburn Mulwaree Council, APA and GHD. The meeting was led by Clinton Smith, an independent facilitator from GHD's Oil and Gas Service Group. A list of the study team members is provided in Appendix A.

A representative from Qenos was unable to attend but was invited to comment on the draft report prior to its finalisation.

5.4 Reference Drawings

A copy of the pipeline route that was reviewed during the study is included in Appendix B of this report.

5.5 HAZID Methodology

Hazard Identification aims to generate a list of hazards or 'threats' associated with the physical or chemical characteristics of a material, system, process or plant that have potential for causing harm. Subsequent qualitative risk assessment linked to the hazard scenarios provides a mechanism for ranking (prioritising) hazards for immediate design alteration and/or future detailed evaluations. Therefore, the HAZID methodology incorporates the following tasks:

» Identification of specific undesirable outcomes (consequences);

» Identification of material, system, process and plant characteristics (i.e. hazards) that could produce the undesirable outcomes; and

» Use of a risk matrix to qualitatively rank the identified hazard scenarios.

The second task of identifying the hazards is assisted by describing the undesired outcome of interest in enough detail to allow participants to converge on the source hazard. The purpose was to identify *inherent hazards* rather than deficiencies or concerns of the moment, as these would be the focus of operational health and safety surveys, pre-start up safety review and other such studies.

The hazard identification technique used for this study involved the team considering each of the guidewords from AS 2885 and postulating related potential hazards for the two existing pipelines. The hazards were ranked on their inherent risks based on a risk matrix, and then actions identified to reduce the risk towards ALARP where necessary. Where further actions were recommended, the hazard was ranked a second time to determine the residual risk after the action had been completed.

After this process had been completed, the proposed pipeline route was reviewed in detail to check for any previously unidentified hazards. While a number of issues were noted by the design team during this process, these were design issues for the water pipeline rather than hazards for the hydrocarbon pipelines and hence are not recorded here.

It should be stressed that the HAZID team only reviewed potential implications on the Gorodok/ Qenos and APA pipelines as a result of construction and operation of the proposed water pipeline. The results of the study are not an endorsement of any risk assessments previously conducted for the Gorodok/ Qenos and APA pipelines, nor a substitute should no such assessments have been conducted.

5.6 Perceived Study Quality

A thorough risk assessment was completed with the information available. There was sufficient expertise with the team members in both design and operations to allow a critical review of the design to occur. Sufficient time was allowed for the system to be covered comprehensively. Minutes were projected on to a wall as they were written to ensure that all team members could confirm that the intent of the discussions had been accurately recorded. A representative from Qenos was not able to attend the study however it is understood that APA is responsible for surveying their pipeline on a regular basis and their representatives were familiar with the details of both hydrocarbon pipelines.

Overall, the reliability and quality of this study are based on the assumptions made by the workshop team. These assumptions have been included as part of the process description and in the risk assessment minutes (Appendix C). If the assumptions are found to be incorrect, the workshop findings should be revisited to ensure that the changes to assumptions have minimal impact on the safety and operability of the process.

It was accepted that the methodology employed would identify the majority of hazards but was unlikely to catch every possible hazard. This underpins the requirement for an active safety management system throughout the operating life of the facility.

6. Workshop results

The primary objective of this study was to determine the safety, environmental and business hazards and risks to the existing ethane and natural gas pipelines associated with the installation of the adjacent water pipeline. In the workshop, inherent risks were assessed for 12 possible hazards.

In accordance with the AS 2885 Risk Matrix (Appendix D), hazards are categorised into five levels (negligible / low / intermediate / high / extreme).

Table F5 of AS 2885.1 requires that risks assessed as extreme or high are managed by modifying the threat, its frequency or consequences so that the risk is reduced to intermediate or below. Low and negligible risks require monitoring and regular review together with a management plan for low risks.

Intermediate risks require additional actions to the extent practicable to reduce likelihood or mitigate consequences, plus demonstration that the risk posed is as low as reasonably practicable (ALARP).

With the currently designed safeguards and measures in place, the following ranking inherent hazards were assessed;

- 4 negligible;
- 4 low;
- 2 intermediate;
- 1 high;
- 0 extreme.

One hazard (ID 15) was not risk ranked as its consequence were unknown.

Recommendations were not considered necessary for most of the hazards ranked as low or negligible as they were already regarded as ALARP. On the assumption that recommended actions are implemented for the remaining hazards, the following residual risks were assessed:

- 3 negligible;
- 2 low;
- 1 intermediate;
- 0 high;
- 0 extreme.

The workshop findings are summarised in Table 3.

Table 3 - Summary of Workshop Findings

ID	Hazard/Threat	Recommendation	Risk after implementation of recommendations
1	Blasting (not currently planned but may be necessary).	In the event that blasting is required, approval of the blasting criteria must be obtained by APA and Gorodok	Negligible
3	Use of temporary coffer dam in the vicinity of gas pipelines	Locate any coffer dams required clear of gas easement	Low
4	HDD going off track at creek crossing and highways and rupturing gas pipeline	Use tracking of the drilling head when drilling under the Hume highway to reduce the risk off going off track and impacting the gas line. Increase the offset from the gas pipelines at locations where HDD is used	Intermediate
6	Access to the water pipeline traversing the gas pipeline	Use administrative controls to ensure personnel stay to the water pipeline easement	Low
7	Installation of star pickets for fencing of construction areas	APA / Gorodok personnel to attend sites to approve any encroachment on to their easement	Negligible
10	Bogged vehicles during water pipeline maintenance (area above gas pipelines is prone to this)	None recorded	Negligible
14	CP/Anode beds running laterally off the gas pipelines for up to 400m	Ensure information on CP/Anode bed offtakes is transferred to detailed design. Cross check with above ground markings during excavation to avoid digging up earth lines.	Low
15	Operation of parallel CP system if a steel pipeline is used	Conduct investigation into potential interaction between existing CP system and new DICL pipeline	No ranking of consequence due to unknown impact. Pending investigation
18	Stress corrosion cracking - known problem in one of the existing gas pipelines	Project team to supply a gas detector for daily use prior to construction of each section in case of fugitive emissions.	Negligible

ID	Hazard/Threat	Recommendation	Risk after implementation of recommendations
		Include confirmation of gas free environment (including trench) as part of the daily pre-start meeting. Leak detection survey to be carried out by APA/ Qenos. Gas sniffers used to be suitable for both Methane and Ethane detection.	
27	Operation of scour valves	None recorded	Negligible
28	Construction of scour lines across gas easement	None recorded	Negligible
29	Failure of the water pipeline	None recorded	Low

The hazard with the highest assessed risk (ID 4), even after implementation of recommendations, is rupture of one of the gas pipelines as a result of misdirected horizontal directional drilling at creek crossings and highways. ID 15 (adverse interaction between adjacent cathodic protection systems) was not risk ranked due to the team's inability to determine the consequence, hence a recommendation for further investigation into the issue.

The full details of the findings and recommended actions can be found in Appendix C.

7. Closeout

Every recommended action recorded in Appendix C, whether or not it forms part of the project scope, requires auditable closeout to indicate how the identified hazard was addressed.

Close out of the report involves completing all required activities including such items as design verification and procedures to ensure that controls are in place. In addition, ongoing activities are required during the project implementation. These include the competency of personnel and management of change. All the hazards covered in this workshop should be reviewed by the responsible parties on a regular basis to ensure constant improvement. It is recognised that responsibility for some of the action items is outside of GHD's current scope of work and that ultimately it is the Proponent's responsibility to ensure that all actions are responded to.

The party with responsibility for the close out of each action and recommendation is identified in the study minutes. It is recommended that a final Risk Assessment Close Out report will be produced to document the response taken to each action. Independent audit of action closeout is recommended by GHD, but it is at the Proponent's sole discretion.

8. Conclusions and Recommendations

Risks to existing hydrocarbon pipelines associated with locating the proposed Highlands Source Project water pipeline adjacent to them have been reviewed by a team of appropriately knowledgeable and experienced people. Of the twelve hazards identified, associated risks have been reduced to negligible or low as defined by AS 2885.1 by the use of targeted control measures, except for one which has been classed as intermediate.

AS 2885.1 accepts risks of intermediate or lower risks, provided it can be demonstrated that all such risks are ALARP. While formal ALARP demonstration is outside the scope of the HAZID workshop, the team members were unable identify additional controls which would reduce risks lower than currently contemplated which is in itself, a prime indicator that ALARP has been achieved.

In the event that detailed engineering proceeds, a formal ALARP assessment will be required. At this stage however, it can be concluded that the risks to the hydrocarbon pipelines from the proposed water pipeline assuming that it is constructed as currently designed are acceptable.

It is recommended that:

- All recommendations identified in the workshop are implemented (see Appendix C)
- Formal close-out occur to provide assurance that recommendations have been properly implemented (Section 7 - Closeout)
- Highest management priority is given to the recommendations associated with IDs 4 and 15, as these represent the areas of highest or as yet unquantified risk.

Appendix A

Attendance List

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Project Form

SAFETY STUDY ATTENDANCE RECORD

☑ Risk Assessment	☐ HAZOP	☐ SIL	☐ CHAZOP	☐ Other
Title:				

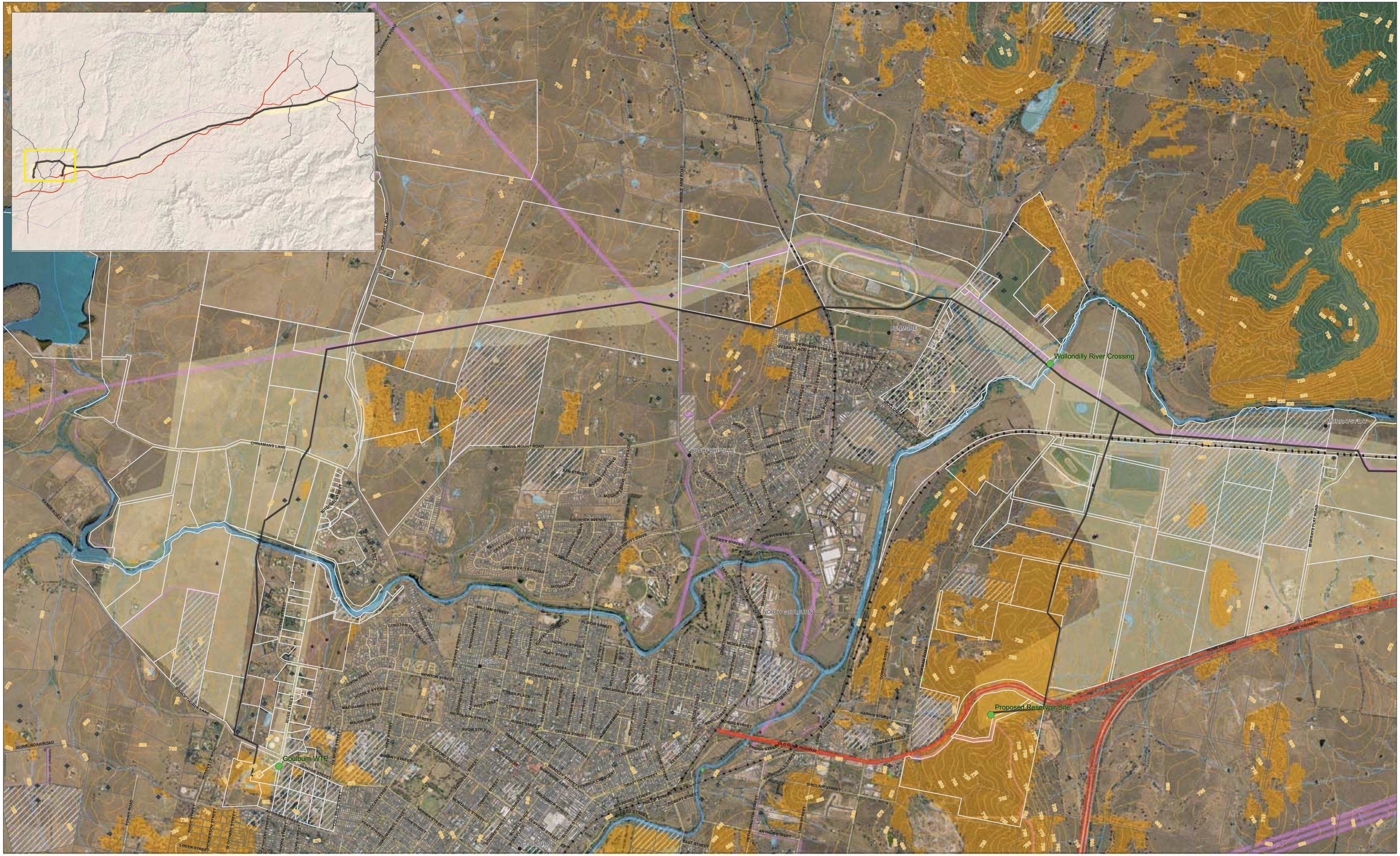
Date: 30/11/09	**GHD Job No:**	**Session Nos.**

Name	Company	Title	Signature	1	2
Clinton Smith	GHD	Facilitator			
Kyle O'Brien	GHD	Scribe			
James Earle	GHD	EA Coordinator			
Ryan Signor	GHD	EA Coord.			
Richard Davidson	APA	Mgr Asset & Engg NSW			
Mike Rodd	GHD	Design Leader			
Paul Wyatt	APA	Pipeline Operator			
Wayne Collier	APA	Pipeline Operator			
Rowan Lund	APA	Operations Manager			
Neil Hughes	GHD.	PM/CA GMD.			
Marina Hollands	GMC	A/Mgr Water Services			
Christian Leach	MWA.	Council PM/CA			

Note: In Session Nos. columns ✓ indicates full time attendance, * indicates part time attendance.

Appendix B

Reference Drawings



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Metres

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Horizontal Datum: Geocentric Datum of Australia (GDA)
Grid: Map Grid of Australia 1994, Zone 55

N

LEGEND

- PFN Site
- Locality
- Proposed Pipeline
- Proposed Pipeline Corridor
- Cadastre
- Cadastre Intersecting Corridor
- Bores
- Flora Record
- Fauna Record

Heritage Type

- PAD
- artefact scatter
- artefact scatter and P
- burial
- carved tree
- grinding grooves
- isolated find
- scarred tree
- stone quarry

- Contours (10m interval)
- River/Creek
- Natural Drainage
- Railways
- PrimaryRoad
- ArterialRoad
- SubArterialRoad
- LocalRoad
- Waterbody
- Existing easements

Heritage Item

- Archaeological
- General
- Landscape

Vegetation Classification

- EEC Vegetation
- Non EEC Vegetation

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Goulburn Mulwaree Council
Highlands Source Project

Job Number	23-13312
Revision	C
Date	01 DEC 2009

Western End (Goulburn) Route Investigation

Figure 1

Level 7, 16 Marcus Clarke Street Canberra ACT 2601 T 61 2 6113 3200 F 61 2 6113 3299 E cbrmail@ghd.com.au W www.ghd.com.au

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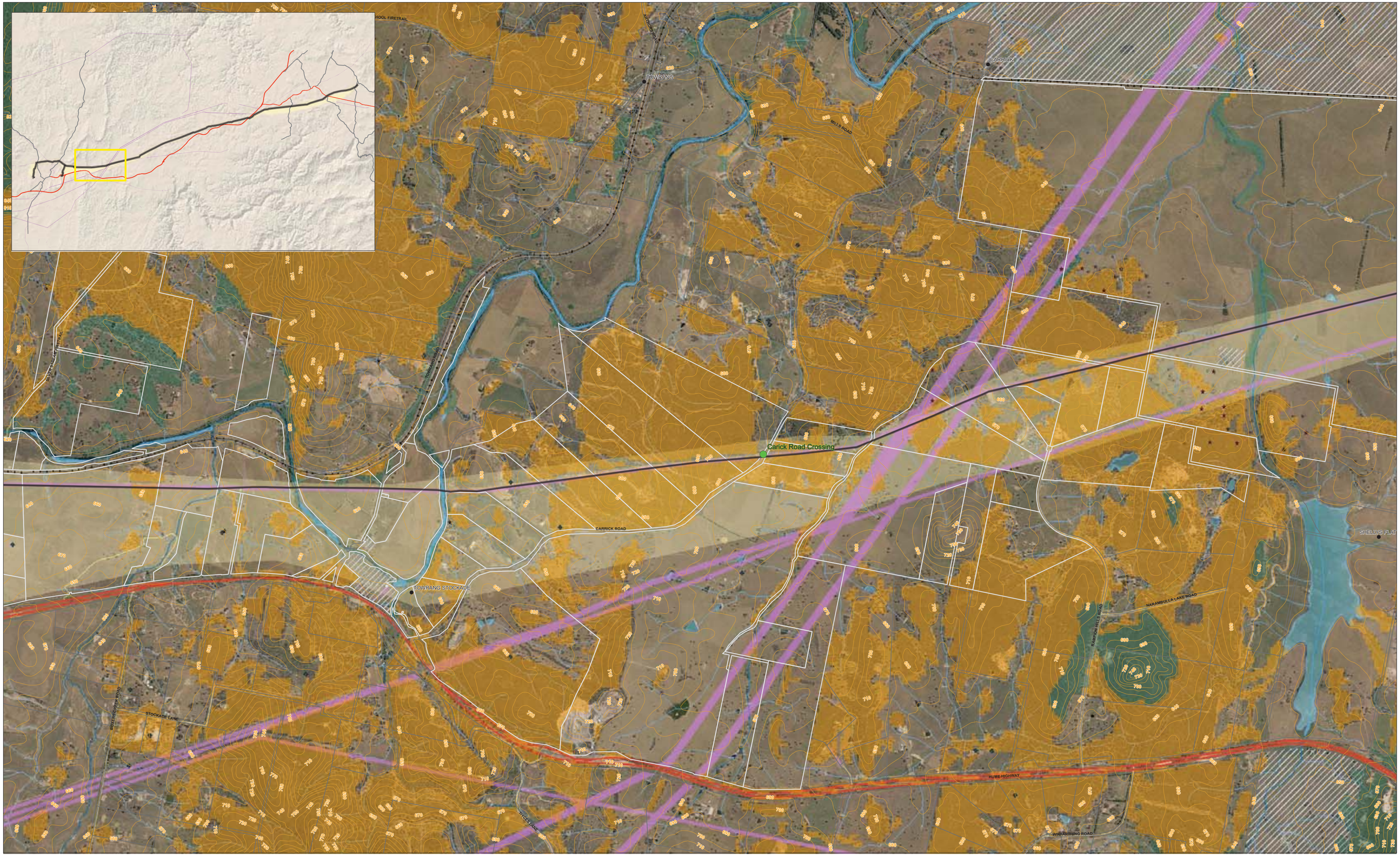

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Figure 2

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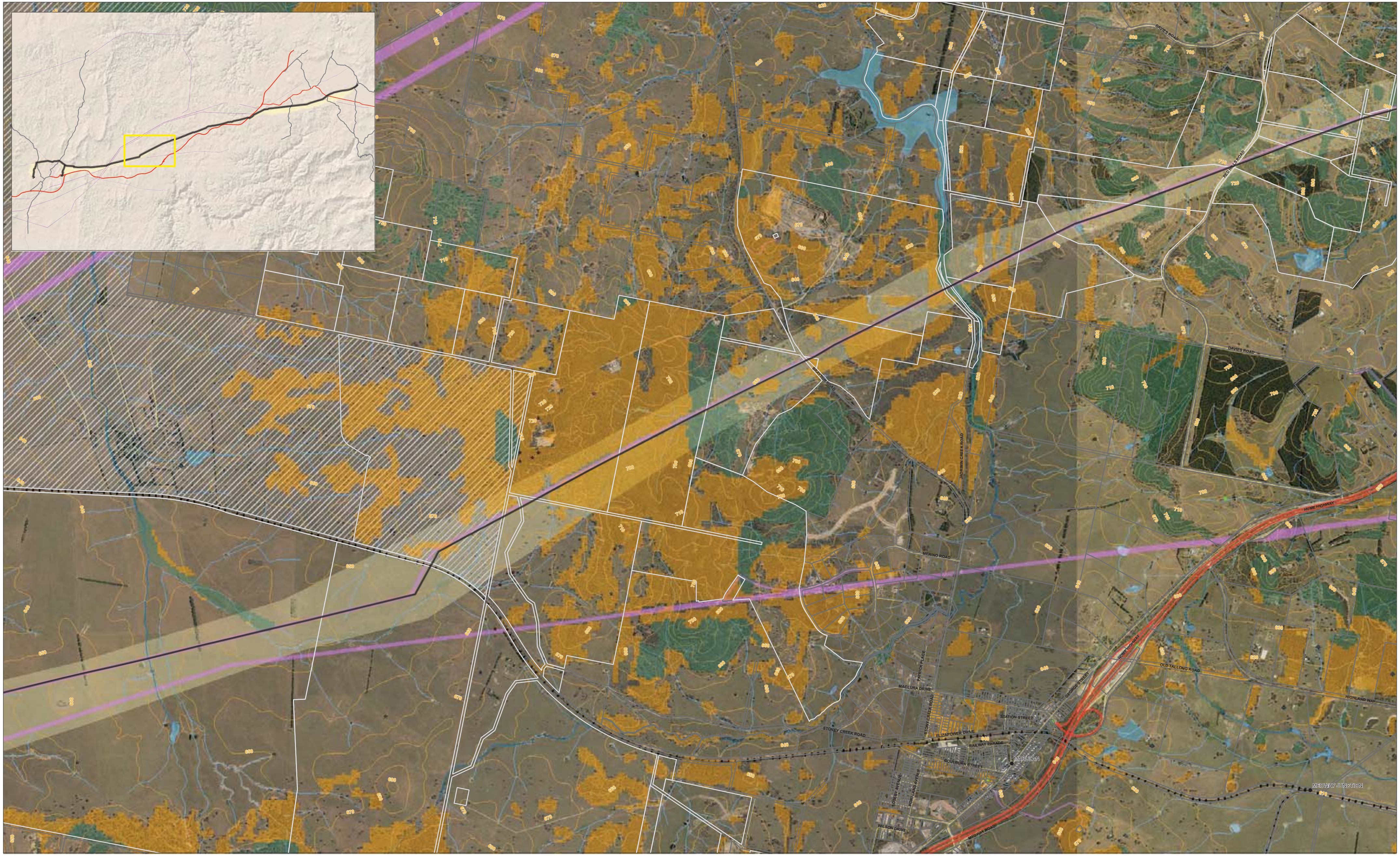

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- Existing easements

GMC Heritage (LEP)
Heritage Item

- Archaeological
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- Landscape

Vegetation Classification

- EEC Vegetation
- Non EEC Vegetation

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Goulburn Mulwaree Council
Highlands Source Project

Job Number	23-13312
Revision	C
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Western End (Goulburn) Route Investigation

Figure 3

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- Contours (10m interval)
- River/Creek
- Natural Drainage
- Railways
- PrimaryRoad
- ArterialRoad
- SubArterialRoad
- LocalRoad
- Waterbody
- Existing easements

Heritage Item

- Archaeological
- General
- Landscape

Vegetation Classification

- EEC Vegetation
- Non EEC Vegetation

CLIENTS|PEOPLE|PERFORMANCE

Goulburn Mulwaree Council
Highlands Source Project

Western End (Goulburn) Route Investigation

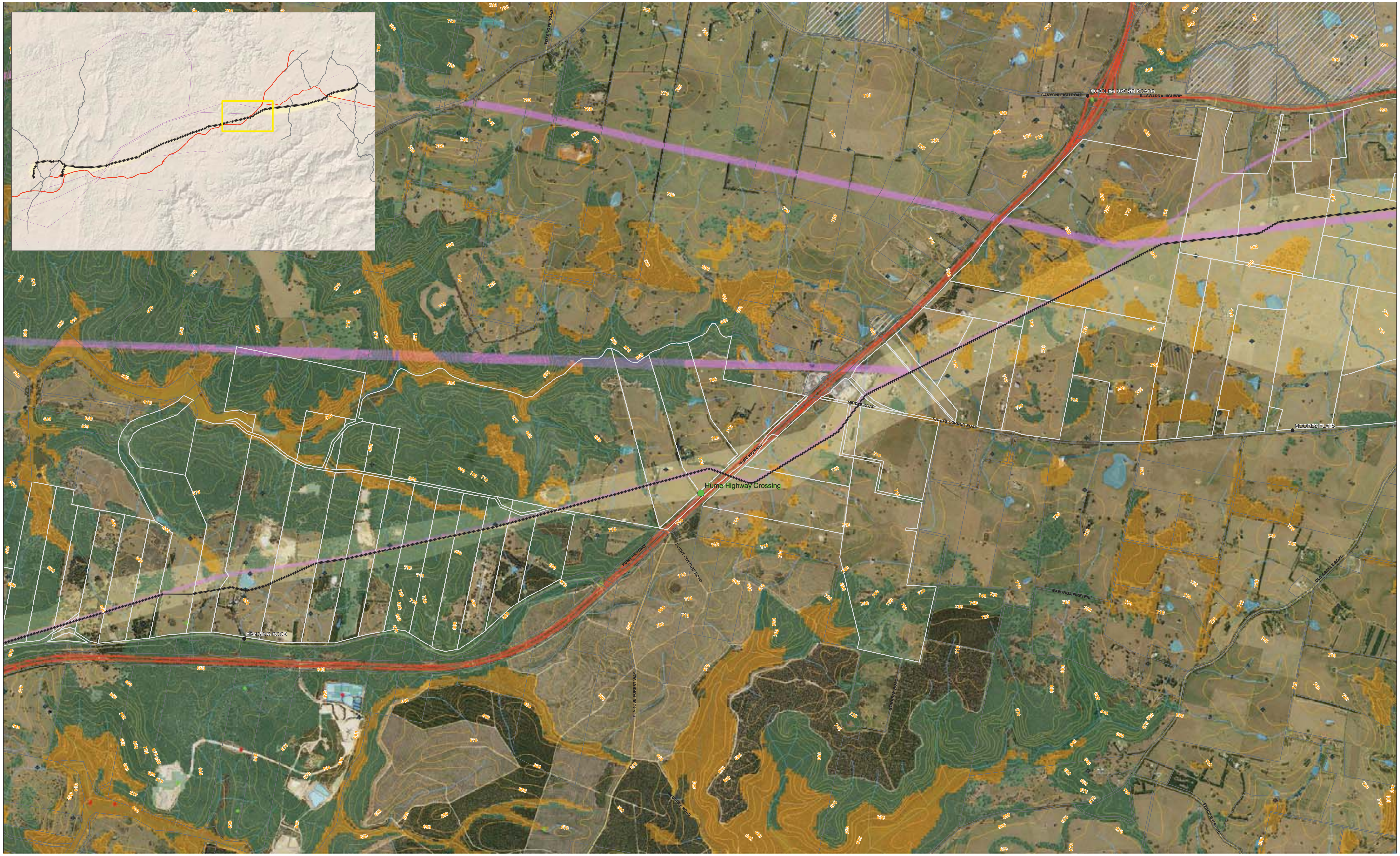
Job Number 23-13312
Revision C
Date 01 DEC 2009

Figure 4

G:\23\13312\GIS\ArcView\Wkspace\Working\23_13312_Z004_Western_End_Investigation_20091201_RevC.mxd

Data source: Data Custodian, Data Set Name/Title, Version/Date. Created by: ccharalambou

Level 7, 16 Marcus Clarke Street Canberra ACT 2601 **T** 61 2 6113 3200 **F** 61 2 6113 3299 **E** cbrmail@ghd.com.au **W** www.ghd.com.au



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0 250 500 750 1,000 1,250

Metres

Map Projection: Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia (GDA)
Grid: Map Grid of Australia 1994, Zone 55

N

LEGEND

- PFN Site
- Locality
- Proposed Pipeline
- Proposed Pipeline Corridor
- Cadastre
- Cadastre Intersecting Pipeline
- Bores
- Flora Record
- Fauna Record

Heritage Type

- PAD
- artefact scatter
- artefact scatter and P
- burial
- carved tree
- grinding grooves
- isolated find
- scarred tree
- stone quarry

- Contours (10m interval)
- River/Creek
- Natural Drainage
- Railways
- PrimaryRoad
- ArterialRoad
- SubArterialRoad
- LocalRoad
- Waterbody
- Existing easements

Heritage Item

- Archaeological
- General
- Landscape

Vegetation Classification

- EEC Vegetation
- Non EEC Vegetation

CLIENTS|PEOPLE|PERFORMANCE

Goulburn Mulwaree Council
Southern Source Pipeline

Western End (Goulburn) Route Investigation

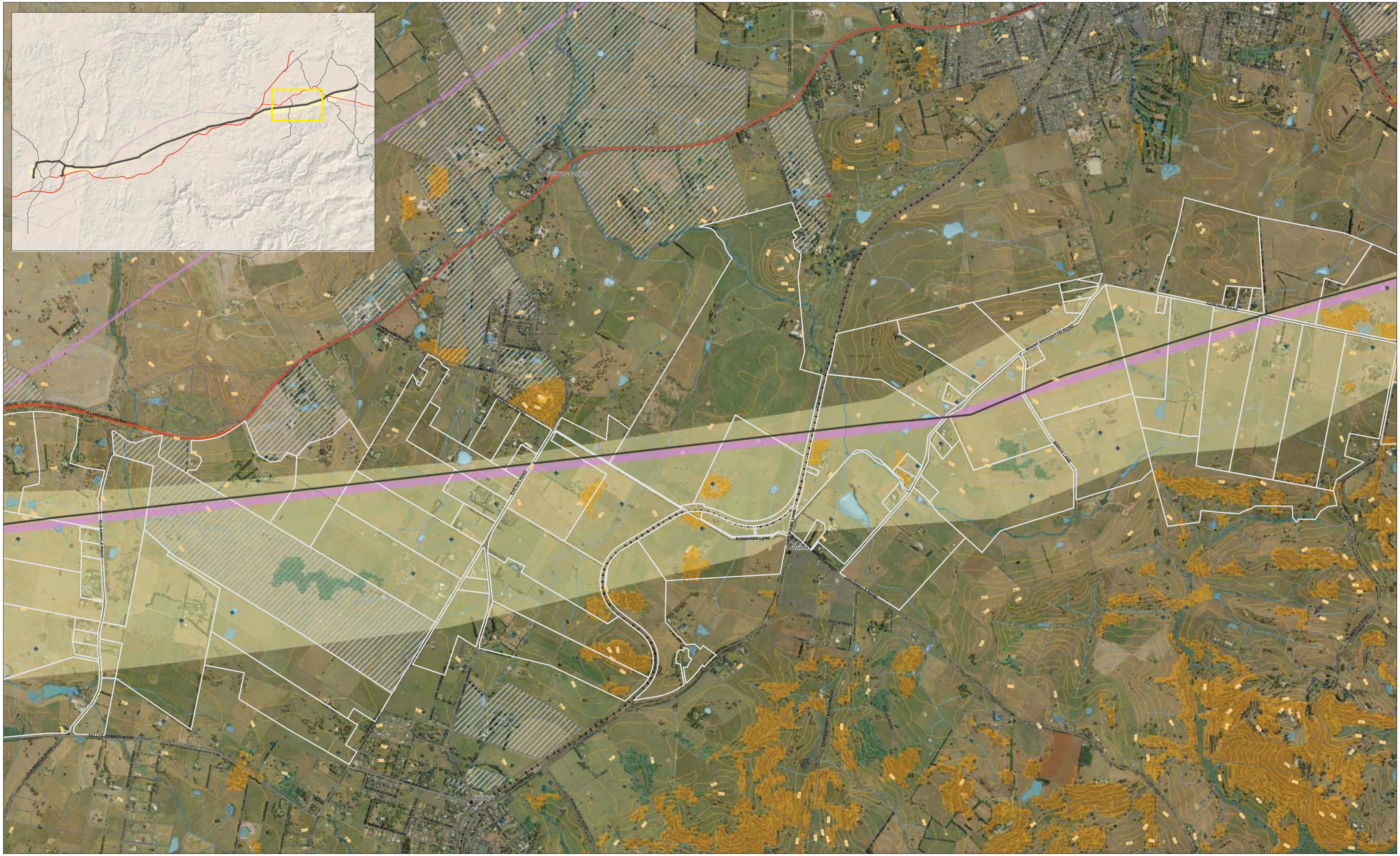
Job Number	23-13312
Revision	C
Date	01 DEC 2009

Figure 5

G:\23\13312\GIS\ArcView\Wkspace\Working\23_13312_Z005_Western_End_Investigation_20091201_RevC.mxd

Data source: Data Custodian, Data Set Name/Title, Version/Date. Created by: ccharalambou

Level 7, 16 Marcus Clarke Street Canberra ACT 2601 T 61 2 6113 3200 F 61 2 6113 3299 E cbrmail@ghd.com.au W www.ghd.com.au



1:10,000 (at A0)

0 250 500 750 1,000 1,250

Metres

Map Projection: Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia (GDA)
Grid: Map Grid of Australia 1994, Zone 55

N

LEGEND

- PFN Site
- Locality
- Proposed Pipeline
- Cadastre Intersecting Corridor
- Cadastre
- Proposed Pipeline Corridor
- Bores
- Flora Record
- Fauna Record

Heritage Type

- PAD
- artefact scatter
- artefact scatter and P
- burial
- carved tree
- grinding grooves
- isolated find
- scarred tree
- stone quarry

- Contours (10m interval)
- River/Creek
- Natural Drainage
- Railways
- PrimaryRoad
- ArterialRoad
- SubArterialRoad
- LocalRoad
- Waterbody
- Existing easements

Heritage Item

- Archaeological
- General
- Landscape

Vegetation Classification

- EEC Vegetation
- Non EEC Vegetation

GHD
CLIENTS|PEOPLE|PERFORMANCE

Goulburn Mulwaree Council

Goulburn Mulwaree Council
Highlands Source Project

Eastern End (Wingecarribbee) Route Investigation

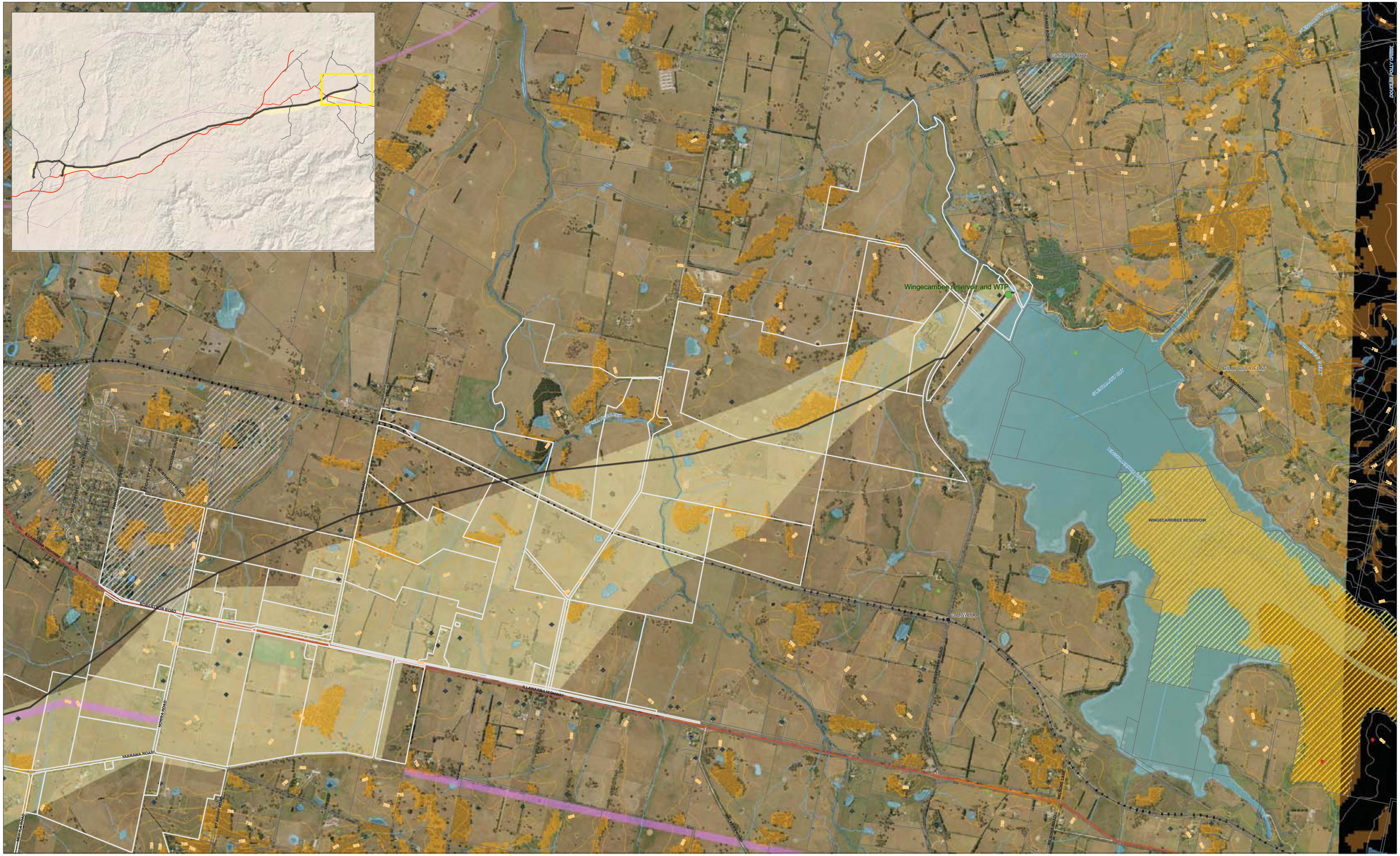
Job Number	23-13312
Revision	C
Date	01 DEC 2009

Figure 6

Level 7, 16 Marcus Clarke Street Canberra ACT 2601 **T** 61 2 6113 3200 **F** 61 2 6113 3299 **E** cbrmail@ghd.com.au **W** www.ghd.com.au

G:\23\13312\GIS\ArcView\Wkspace\Working\23_13312_Z006_Western_End_Investigation_20091201_RevC.mxd

Data source: Data Custodian, Data Set Name/Title, Version/Date. Created by: ccharalambou



1:10,000 (at A0)

0 250 500 750 1,000 1,250

Metres

Map Projection: Transverse Mercator
Horizontal Datum: Geocentric Datum of Australia (GDA)
Grid: Map Grid of Australia 1994, Zone 55

N

LEGEND

- PFN Site
- Locality
- Proposed Pipeline
- Cadastre
- Cadastre Intersecting Corridor
- Proposed Pipeline Corridor
- Bores
- Flora Record
- Fauna Record

Heritage Type

- PAD
- artefact scatter
- artefact scatter and P
- burial
- carved tree
- grinding grooves
- isolated find
- scarred tree
- stone quarry

- Contours (10m interval)
- River/Creek
- Natural Drainage
- Railways
- PrimaryRoad
- ArterialRoad
- SubArterialRoad
- LocalRoad
- Waterbody
- Existing easements

Heritage Item

- Archaeological
- General
- Landscape

Vegetation Classification

- EEC Vegetation
- Non EEC Vegetation

CLIENTS|PEOPLE|PERFORMANCE

Goulburn Mulwaree Council
Highlands Source Project

Job Number	23-13312
Revision	C
Date	01 DEC 2009

Eastern End (Wingecarribee) Route Investigation

Figure 7

G:\23\13312\GIS\ArcView\Wkspace\Working\23_13312_Z007_Western_End_Investigation_20091201_RevC.mxd

Level 7, 16 Marcus Clarke Street Canberra ACT 2601 **T** 61 2 6113 3200 **F** 61 2 6113 3299 **E** cbrmail@ghd.com.au **W** www.ghd.com.au

Data source: Data Custodian, Data Set Name/Title, Version/Date. Created by: ccharalambou

Appendix C

Risk Assessment Study Minutes

	TITLE																			
ID	Hazard Group	Potential Hazard	Location	Causes (Threats)	Impact Classification (Safety & Health / Financial / Reputation / Environmental / Legal / Customer)	Impact or Consequence Description	Existing Controls	Consequence(1)	Likelihood(1)	Level(1)	Rank(1)	Recommended Action (Improve existing controls / implement new controls)	Consequence(2)	Likelihood(2)	Level(2)	Rank(2)	Percent Complete	General Comments	Completion Date	Responsibility
1	External Interference	Excavation	Portion of alignment adjacent to gas easement (unless noted otherwise below)	Blasting (not currently planned but may be necessary).		Damage to gas pipeline caused by blasting, not necessarily immediately obvious.	HSP easement completely outside the gas easement. Blasting is currently not intended.	2-Minor	3-Unlikely	Low	12	In the event that blasting is required, approval of the blasting criteria must be obtained by APA and Gorodok.	2-Minor	2-Remote	Negligible	7				GHD
2				Hydraulic Hammering beyond 15m of gas pipelines		No impact on gas pipelines														
3				Use of temporary coffer dam in the vicinity of gas pipelines		Damage to gas pipeline caused by pile driving and other works	Alignment control, locating of existing pipelines prior to such work will be standard operating practise	3-Severe	3-Unlikely	Intermediate	13	Locate any coffer dams required clear of gas easement	3-Severe	2-Remote	Low	8				GHD
4		Drilling	Creek crossings and highways	HDD going off track at creek crossing and highways and rupturing gas pipeline		Rupture the gas pipeline	Precise location of gas pipelines. Control of alignment of HDD.	4-Major	3-Unlikely	High	14	Use tracking of the drilling head when drilling under the Hume highway to reduce the risk off going off track and impacting the gas line. Increase the offset from the gas pipelines at locations where HDD is used. **Additional Gorodok comment:** *large offsets will be required*	4-Major	2-Remote	Intermediate	9				GHD
5		Ploughing																		
6		Maintenance activities		Access to the water pipeline traversing the gas pipeline.		Possibility of pinhole leaks in pipeline coating leading to longer term corrosion. Erosion to the ground and potential bogging.	Pipelines are OK with external pressures below 100kPa, which is equivalent to an 8 tonne single axle load. This is larger than any truck that will be accessing the water pipeline.	2-Minor	3-Unlikely	Low	12	Use administrative controls to ensure personnel stay to the water pipeline easement. **Additional Gorodok Comment:** *any vehicle movement across the ethane pipeline will still require a full engineering review*								GMC
7		Installation of posts or poles		Installation of star pickets for fencing of construction areas		Potential damage to pipeline lining	Plan to minimise star picket use during construction to reduce this risk.	1-Trivial	2-Remote	Negligible	6	APA / Gorodok personnel to attend sites to approve any encroachment on to their easement. **Additional Gorodok Comment:** *this is only part of the process to be followed for any potential encroachment on the gas pipeline easement*	1-Trivial	2-Remote	Negligible	6				GHD/APA/Gorodok
8		Land use development (eg grading)				Covered in other line items														
9		Vehicle impact				Covered in other line items														
10		Bogged vehicles		Bogged vehicles during water pipeline maintenance (area above gas pipelines is prone to this)		Bogged vehicles in soft spot above pipeline	Water pipeline team will stay away from gas pipelines unless permission is specifically sought.	2-Minor	2-Remote	Negligible	7									
11		Excessive external loads from backfill or traffic										Pipe locators to be used to check the location of existing pipelines has been correctly marked. Consider means of showing demarcation of offset from pipeline. If the gas pipelines are to be crossed regularly, use steel plates to distribute the load. **Additional Gorodok comment:** *if gas pipeline is to be crossed, a designated crossing needs to be established, and design details need to be approved by gas pipeline owners*								GHD
12		Blasting				Covered in other line items														
13		Anchor dropping or dragging				Not relevant to this scope														
14	Corrosion	External corrosion / erosion		CP/Anode beds running laterally off the gas pipelines for up to 400m		Earth lines could be dug up during excavation.	Beds and CP lines are marked on drawings. Offtakes are shown on the APA alignment drawings.	3-Severe	3-Unlikely	Intermediate	13	Ensure information on CP/Anode bed offtakes is transferred to detailed design. Cross check with above ground markings during excavation to avoid digging up earth lines.	3-Severe	2-Remote	Low	8				APA/GHD
15				Operation of parallel CP system if a steel pipeline is used.		Potential for corrosion in any of the pipelines due to interaction.						Conduct investigation into potential interaction between existing CP system and new DICL pipeline.						No ranking of consequence due to unknown impact. Pending investiagtion		APA
16		Internal corrosion				Unaffected by scope of work														
17		Internal erosion				Unaffected by scope of work														
18		Environmentally assisted cracking	Portion of alignment adjacent to gas easement	Stress corrosion cracking - known problem in one of the existing gas pipelines		Possibility of fugitive emissions from leaks, ignited by hotwork in the area leading to bushfire. Pipeline rupture considered not credible.		2-Minor	3-Unlikely	Low	12	Project team to supply a gas detector for daily use prior to construction of each section in case of fugitive emissions. Include confirmation of gas free environment (including trench) as part of the daily pre-start meeting. Leak detection survey to be carried out by APA/Qenos. Gas sniffers used to be suitable for both Methane and Ethane detection.	2-Minor	2-Remote	Negligible	7				GHD/APA
19		Bacterial corrosion																		
20	Natural Events	Earthquake																		
21		Ground movement																		
22		Wind & cyclone																		
23		Bushfires																		
24		Lightning																		
25		Floods																		
26		Innundation leading to floatation																		
27		Erosion of cover or support	Vicinity of scour valves	Operation of scour valves		Leads to erosion and exposure of gas pipelines	If scour valve upstream of gas easement, plan to extend scour line downstream of gas pipelines	1-Trivial	3-Unlikely	Negligible	11									
28				Construction of scour lines across gas easement		Damage to gas pipelines during construction of scour lines	Monitoring by APA personnel. Hand digging or equivalent.	2-Minor	2-Remote	Negligible	7									
29	Operations and Maintenance	Operations (exceding MAOP, pigging, valve sequencing, incorrect operation of controls and protections, manual operation, fatigue from pressure cycling)		Failure of the water pipeline		Erosion of groundcover in the area. Possibility of exposing the gas pipelines.	Noticible loss of water. Area survaliance of gas pipelines.	2-Minor	4-Occasional	Low	17									
30		Maintenance (Inadequate procedures, actions contrary to procedures, Innaccurate test equipment, inadequate servicing)				Covered in other line items														
31	Design Defects	Failure to specify correct materials etc				Unaffected by scope of work														
32		Incorrect design, eg stress analysis				Unaffected by scope of work														
33		Failure to define correct range of operating conditions				Unaffected by scope of work														
34		Failure to allow for safe operations and maintenance				Unaffected by scope of work														
35	Material Defects	Incorrectly identified components				Unaffected by scope of work														
36		Undetected faults				Unaffected by scope of work														
37		Under-strength pipe				Unaffected by scope of work														
38		Manufacturing defect				Unaffected by scope of work														
39		Lack of inspection and test procedures to confirm material and equipment acceptability				Unaffected by scope of work														
40	Construction defects	Undetected or unreported damage				Unaffected by scope of work														
41		Undetected or unreported critical weld defects				Unaffected by scope of work														
42		Failure to install specified materials or equipment				Unaffected by scope of work														
43		Failure to install equipment using correct procedures or materials				Unaffected by scope of work														
44		Failure to install equipment in accordance with design				Unaffected by scope of work														
45		Failure to install the pipeline in specified location or manner				Unaffected by scope of work														
46		Inadequate testing of materials for defects prior to handover				Unaffected by scope of work														
47	Intentional Damage	Sabotage				Unaffected by scope of work														
48		Terrorism				Unaffected by scope of work														
49		Malicious Damage				Unaffected by scope of work														
50	Other Threats	Seismic Survey				Unaffected by scope of work														
51		Induced voltages from parallel electricity transmission lines				Unaffected by scope of work														
52		Fault voltages from nearby electricity transmission towers				Unaffected by scope of work														
53		Mine Subsidence				Unaffected by scope of work														
54	Inductions	Exposure to explosive atmospheres		Natural gas and ethane leaks		Exposure to flammable atmospheres including ethane which is heavier than air and not odourised.						Construction, operations and maintenance staff to attend free APA natural gas and ethane awareness courses.								APA/GHD/GMC

Appendix D

AS 2885 Risk Matrix

TABLE F2
SEVERITY CLASSES

Dimension	Severity class: Catastrophic	Major	Severe	Minor	Trivial
	Measures of severity				
People	Multiple fatalities result	Few fatalities; several people with life-threatening injuries	Injury or illness requiring hospital treatment	Injuries requiring first aid treatment	Minimal impact on health and safety
Supply	Long-term interruption of supply	Prolonged interruption; long-term restriction of supply	Short-term interruption; prolonged restriction of supply	Short-term interruption; restriction of supply but shortfall met from other sources	No impact; no restriction of pipeline supply
Environment (see Note)	Effects widespread; viability of ecosystems or species affected; permanent major changes	Major off-site impact; long-term severe effects; rectification difficult	Localized (<1 ha) and short-term (<2 y) effects, easily rectified	Effect very localized (<0.1 ha) and very short-term (weeks), minimal rectification	No effect; minor on-site effects rectified rapidly with negligible residual effect

NOTE: Significant environmental consequences may occur in locations that are relatively small and isolated.

F3 FREQUENCY ANALYSIS

A frequency of occurrence of each failure event shall be assigned for each location where risk estimation is required. The frequency of occurrence shall be selected from Table F3.

The contribution of operations and maintenance practices and procedures to the occurrence or prevention of failure events shall be considered in assigning the frequency of occurrence.

The frequency class for a threat that exists for a limited period should be assessed against the exposure period rather than the life of the pipeline.

TABLE F3
FREQUENCY CLASSES

Frequency class	Frequency description
Frequent	Expected to occur once per year or more
Occasional	May occur occasionally in the life of the pipeline
Unlikely	Unlikely to occur within the life of the pipeline, but possible
Remote	Not anticipated for this pipeline at this location
Hypothetical	Theoretically possible but has never occurred on a similar pipeline

F4 RISK RANKING

Table F4 shall be used to combine the results of frequency analysis and consequence analysis and determine the risk rank.

Risks determined to be low or negligible or demonstrated to be ALARP are accepted risks.

TABLE F4

RISK MATRIX

	Catastrophic	Major	Severe	Minor	Trivial
Frequent	Extreme	Extreme	High	Intermediate	Low
Occasional	Extreme	High	Intermediate	Low	Low
Unlikely	High	High	Intermediate	Low	Negligible
Remote	High	Intermediate	Low	Negligible	Negligible
Hypothetical	Intermediate	Low	Negligible	Negligible	Negligible

F5 RISK TREATMENT

F5.1 General

Action to reduce risk shall be taken in accordance with Table F5 based on the risk rank determined from Table F4.

The action(s) taken and its effect on safety management shall be documented and approved.

TABLE F5

RISK TREATMENT ACTIONS

Risk rank	Required Action
Extreme	Modify the threat, the frequency or the consequences so that the risk rank is reduced to 'intermediate' or lower For an in-service pipeline the risk shall be reduced immediately
High	Modify the threat, the frequency or the consequences so that the risk rank is reduced to Intermediate or lower For an in-service pipeline the risk shall be reduced as soon as possible, typically within a timescale of not more than a few weeks
Intermediate	Repeat threat identification and risk evaluation processes to verify and, where possible, quantify the risk estimation; determine the accuracy and uncertainty of the estimation. Where the risk rank is confirmed to be 'intermediate', if possible modify the threat, the frequency or the consequence to reduce the risk rank to 'low' or 'negligible' Where the risk rank can not be reduced to 'low' or 'negligible', action shall be taken to— (a) remove threats, reduce frequencies and/or reduce severity of consequences to the extent practicable; and (b) demonstrate ALARP For an in-service pipeline, the reduction to 'low' or 'negligible' or demonstration of ALARP shall be completed as soon as possible; typically within a timescale of not more than a few months
Low	Determine the management plan for the threat to prevent occurrence and to monitor changes that could affect the classification
Negligible	Review at the next review interval

F5.2 ALARP

A risk cannot be demonstrated as ALARP until consideration has been given to—

(a) means of further reducing the risk; and

(b) the reasons why these further means have not been adopted.

ALARP is achieved when the cost of further risk reduction measures is grossly disproportionate to the benefit gained from the reduced risk that would result.