

FOUR ARROWS ETHANOL PTY LTD

ABN: 26 116 072 434

**ENVIRONMENTAL ASSESSMENT
FOR AN
INTEGRATED ETHANOL AND DAIRY
DEVELOPMENT
AT
COLEAMBALLY**

Prepared by:



BOOTH ASSOCIATES
AGRIBUSINESS & ENVIRONMENTAL CONSULTANTS

FOUR ARROWS ETHANOL PTY LTD

ENVIRONMENTAL ASSESSMENT

FOR A PROPOSED

INTEGRATED ETHANOL AND DAIRY DEVELOPMENT

AT

COLEAMBALLY, NSW

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CERTIFICATION

Submission of Environmental Assessment (EA)

Prepared under the Environmental Planning and Assessment Act 1979
Part 3A and Environmental Planning and Assessment Regulation 2000.

EA Prepared by:

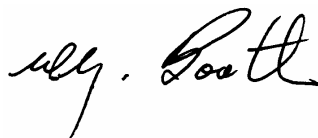
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In respect of:	The construction and operation of an Ethanol Plant and Intensive Dairy at Coleambally, NSW.
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Land to be Developed	The proposed project is to be carried out on land shown on the figures included in the EA. The land is owned by Four Arrows Ethanol Pty Ltd.
Lots No. 79, 80, 112 Parish Boona County Boyd	☐ Figure(s) attached

Environmental Assessment	☐ An Environmental Assessment (EA) is attached.
--------------------------	--

Certification	I certify that I have prepared the contents of this Environmental Assessment and to the best of my knowledge the information contained within this report is true in all material particulars and is neither false nor misleading.
---------------	--



Signature

Name: William G Booth

Date: 03/10/06



Signature

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Date: 03/10/06

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LIST OF ABBREVIATIONS

AADT	average annual daily traffic
AGM	Annual General Meeting
AHD	Australian Height Datum
AHIMS	Aboriginal Heritage Information Management System
ALARP	as low as reasonably practicable
ARTC	Australian Rail Track Corporation
AWT	Australian Water Technologies
BAP	bio-fuels action plan
BOD	Biological Oxygen Demand
BPIP	US Building Profile Input Program
CEC	Cation Exchange Capacity
CEMP	Construction Environmental Management Plan
CIA	Coleambally Irrigation Area
CIC	continual improvement cycle
CICL	Coleambally Irrigation Co-operative Limited
CIP	Clean-in-Place
CMA	Catchment Management Authority
CSIRO	Commonwealth Scientific and Industrial Research Organisation
DAP	Di-Ammonium Phosphate
DC	Drainage Channel
DEC	Department of Environmental and Conservation
DEH	Department of Environment and Heritage
DNR	Department of Natural Resources
DM	dry matter
DOP	Department of Planning
DPI&F	Department of Primary Industries and Fisheries
DSE	dry sheep equivalent
DUAP	Department of urban Affairs and Planning
EA	Environmental Assessment
EBL	Enzootic Bovine Leukosis
EBS	Environmental Balance Sheet
EMS	Environmental Management System
EMP	Environmental Management Plan

EMS	environment management systems
EP&A	Environmental Planning and Assessment
EPBC	Environment Protection and Biodiversity Conservation
ESD	Environmentally Sustainable Development
ESD	ecological sustainable development
ESP	Exchangeable Sodium Percentage
GHG	Greenhouse Gases
GHG	greenhouse gases
ha	hectares
HACCP	Hazards Analysis Critical Point
HAZCHEM	Hazardous Chemical
HAS	Holmes Air Sciences
HDPE	High Density Polyethylene
IAEA	International Atomic Energy Agency
IGAE	Inter-Government Agreement on the Environment
IGE	Inter-Generational Equity
IGE	Inter-generational equity
KV	Kilovolts
LALC	Local Aboriginal Land Council
LMGMA	Lower Murrumbidgee Groundwater Management Area
LWMP	Land and Water Management Plan
MCE	Moore Consulting & Engineering
ML	mega litres
MURROC	Murray, Regional Organisation of Councils
NEPM	National Environment Protection Measures
NPWS	National Parks and Wildlife Service
NHMRC	National Health and Medical Research Council of Australia
NRA	National Registration Authority
NRM	Natural Resource Management
NSL	natural surface levels
OH & S	Occupational Health and Safety
OEMP	Operational Environmental Management Plan
ou	odour unit
PFM	Planning Focus Meeting
PHA	Preliminary Hazard Assessment

POEO	Protection of Environmental Operations
QA	Quality Assessment
RIVROC	Riverina, Regional Organisation of Councils
RRS	Responsible Resource Stewardship
RTA	Roads and Traffic Authority
SAB	sub-angular blocky
SOC	Statement of Commitments
TBL	Triple Bottom Line
The Site	proposed development site
TSC	Threatened Species Conservation
TSSC	Threatened Species Scientific Committee
TSP	total suspended particulate matter
US EPA	United States Environmental Protection Agency
VCE	Vapour Cloud Explosion
VOC	Volatile Organic Compounds
WHO	World Health Organisation
WDG	wet distillers grain

GLOSSARY OF TERMS

aerobic	involving or requiring free oxygen
Aeolian	relating to or arising from the action of the wind
ameliorate	make (something bad or unsatisfactory) better
anaerobic	an absence of free oxygen
berms	an artificial flat area in or around an artificial water body which is subject to intermittent inundation with water
bund	an embankment or causeway to contain products and/or materials
crowns	the top or highest part of something
derivates	originating from, based on, or influenced by
detritus	waste or debris of any kind
duress	threats, violence, constraints, or other action, used to coerce someone into doing something against their will or better judgement.
effluent	outwards flowing products often but not always relating to liquid wastes. May also relate to a natural stream caused by discharge from another major stream or river
egress	the action of going out of or leaving a place
evinced	indicate
excreta	matter discharged from the body
gilgai	waterhole
ideology	the set of beliefs characteristic of a social group or individual.
impervious	not allowing fluid to pass through
impetus	something that makes a process or activity happen or happen more quickly
in situ	in the original place
ingress	the action or fact of going in or entering
inherent	existing in something as a permanent, essential, or characteristic attribute
iterative	relating to or involving iteration, especially of a mathematical or computational process
linear	arranged in or extending along a straight or nearly straight line
littoral	region lying along a shore
luminaries	a complete electric light unit
per se	by or in itself or themselves; intrinsically
permeability	allowing liquid of gases to pass through it
pers comm	personal communication
piezometer	an instrument for measuring the pressure of a liquid or gas, or something related to pressure
quasi	apparently but not, seemingly
RAW	readily available water
residual	remaining after the greater part or quality is gone

riparian	relating to or situated on the banks of a river
vertisol	a clayey soil with little organic matter which occurs in regions having distinct wet and dry seasons

PROJECT CONTINUUM

The reality of any proposal is a recognition that all projects are but a “work in progress”.

In preparing this Environmental Assessment (EA) the original broad project criteria have been modified and amended in response to the progressive findings of the EA investigations. Furthermore as new information may potentially become available during the detailed design and construction phases there could be some limited modification to the project specification prior to commissioning.

Such an evolving process enables an optimisation of the beneficial impacts and a minimisation or even removal of the potentially negative impacts of the proposed project.

This EA is therefore presented for the approval process in the knowledge that some future modifications to the project may be required in the subsequent detailed design and construction phases and before the project is commissioned.

In accordance with best project practice any relevant variations to the project:

- As approved;
- As designed;
- As constructed; and
- As commissioned.

will be driven by the need for best environmental and social outcomes and will be discussed with relevant agency representatives and formally documented as appropriate.

Finally there will be the need to performance monitor and review the project within a continuous improvement cycle. This EA is therefore a component of the continuum of evolution of the sustainable development and operation of the proposed project.

WOULD/WILL

As a determination on the project will only be made after the Environmental Assessment (EA) has been on public display and submissions considered, the future conditional tense is used throughout this EA and Statement of Commitments when describing the project, alternatives and assessing impacts. “Would” is therefore, used throughout the text in preference to “Will”.

If approval is given for the project to proceed under the NSW environmental planning legislation, all “would” preferences should be interpreted as “will”.

GUIDELINES FOR MAKING A SUBMISSION

How Does Your Submission Fit into the EA Process?

Submissions from members of the public, government agencies and interest groups are invited and sought in response to this Environmental Assessment.

The Department of Planning (DOP) will prepare an Assessment Report of the Environmental Assessment and all public submissions received, and will provide that report to its Minister along with a recommendation on whether or not the project should be granted planning approval.

Why Write a Submission?

A submission is a way to provide input into the environmental assessment process for the proposal.

Submissions can provide information, comment on the proposal and findings, or suggest improvements.

What Should You Include in a Submission?

It is particularly useful if you can indicate:

- Your interest in the proposal;
- Your opinion of the proposal (or particular aspects of it);
- What measures you consider would be appropriate to improve the proposal;
- Any errors or omissions in the information presented in the Environmental Assessment; and
- Any further factual information you have (and its source).

Your comments may also cover related facts or topics that you believe should be considered.

All submissions will be treated as public documents unless otherwise stated.

What Should you Keep in Mind?

You will make it easier for your submission to be analysed if you:

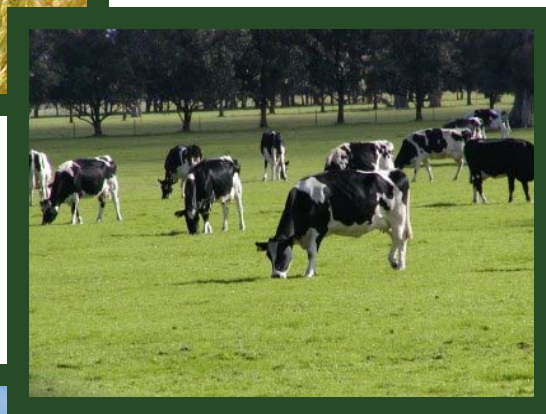
- Attempt to list points, so that the issues raised are clear;
- Refer to each point to the appropriate sections in the Environmental Assessment;
- Include your name, address and the date;
- Ensure that your submission is as legible as possible; and
- Provide sketches and/or diagrams if they assist in clarifying your submission.

Where to Send Submissions

Submissions should be addressed to:

Four Arrows Ethanol Pty Ltd Environmental Assessment
Department of Planning
23 – 33 Bridge Street
SYDNEY NSW 2000

Executive Summary



DESCRIPTION OF OPERATIONS

General

The proposed development is expected to require capital investment costs in excess of A\$100M, and provide direct employment across both the ethanol and dairy enterprises of approximately one hundred (100) full time personnel (see comment on staffing below). These personnel would be employed in split shifts, with hours of operation for the production of ethanol anticipated to be undertaken 24 hours a day, and other supporting operations (transportation, dairy) hours of operation to be limited to recognised daylight hours (7.00am to 10.00pm).

Construction of the proposed development would be expected to commence immediately upon submission and approval of a construction environment management plan (CEMP) to the Department of Planning. Construction would be expected to take between 9 and 12 months (best case scenario) and would be expected to directly employ 150⁺ personnel during this phase of the proposed development.

Ethanol

At full production the proposed ethanol enterprise will produce 300ML of ethanol per year, contributing 85% of to the Federal Government's Biofuels Action Plan target of 350ML of total biofuels by the year 2010.

To achieve this output Four Arrows Ethanol Pty Ltd will have to source substantial volumes of raw materials. It is projected that 725,000 tonnes of high starch grains, consisting of wheat, barley and corn, will be required each year to achieve the 300ML target. Most of this grain will be sourced from throughout the region with additional supplies contracted from other areas within the state and into the production areas of Victoria.

The ethanol process will produce substantial volumes of by-products including CO₂ and wet distillers grain. The CO₂ will be sold off to an existing market that reuses the product primarily for the purpose of carbonated beverages and for industrial purposes. Wet distillers grain beyond that needed for the integrated dairy enterprise will be sold to the local intensive feedlot industry where strong demand for the product already exists.

Dairy

It is proposed that the dairy enterprise can produce volumes of milk in the vicinity of 76.5ML/year. To achieve this, a herd of 18,000 cattle will be maintained on the site, being comprised of 6,000 milkers, 1,200 dry cows and first calf heifers, and 10,800 heifers from 1 week to 2 years of age. The entire herd will be accommodated within purpose built freestall sheds and enclosures designed to achieve the highest standard in animal welfare.

A secondary component of the dairy enterprise will be the sale of all culled heifer calves. The bull calf births will be kept to a minimum due to the use of sexed semen. These will be sold off to the dairy beef market at an early age. Heifer calves will continue to be raised and progressively culled if displaying any undesirable genetic traits. Best quality heifers will enter the dairy herd replacing aging, low productivity or deceased cattle.

The dairy will produce in the vicinity of 30,000 tonnes of manure each year. This manure will be used as fertiliser, being transported off site to the Four Arrows “Tubbo” aggregation properties adjacent to the development site. The manure will be incorporated into the soil profile at an appropriate rate (<15t/ha) supplementing the normal application of inorganic fertilisers.

Staffing

It is anticipated that the combined dairy and ethanol enterprise will employ one hundred (100) full time personnel. This development and its staffing numbers will, through its very nature, lead to increased employment across the region through the requirement for construction teams and support resources once operations commence.

The development is assured to be a boon to the region’s producers, businesses and local companies as well as providing benefits to the greater community, as the letters of support referenced in this EA attest to.

CONSULTATION

A Planning Focus Meeting was held between Booth Associates and representatives of relevant agencies at Darlington Point on 2 December, 2005 to discuss the issues that were perceived to be associated with the proposed development.

Representatives included:

- NSW Department of Planning;
- NSW Department of Environment and Conservation;
- NSW Department of Primary Industries;
- NSW Department of State and Regional Development;
- Murrumbidgee Shire Council; and
- Representatives of Four Arrows Group.

The Road and Traffic Authority (RTA) were not present at this meeting. However, later contact resulted in a formal RTA contribution to the Director General’s specifications.

The Director General’s specifications are the culmination of the contributions made by the various representatives which resulted in a comprehensive list of environmental issues of potential concern. the investigation of these issues were considered to be critical to ensure the development results in minimal negative impacts upon the triple bottom line (TBL) of social, economic and environmental factors.

The investigations within this Environmental Assessment were not limited to the Director General’s specifications. Other issues for consideration were derived from community and stakeholder consultation processes and the on-going project investigative outcomes.

THE MAJOR IMPACT ASSESSMENTS

Air Quality Assessment

The project site is located in a rural agricultural area, where background levels of air pollution are typically low. The present principle source of emissions is motor vehicles utilising the adjacent Kidman Way. Bushfire and wind blown dust can also potentially contribute to particulate loading. Present conditions indicate that no negative air quality issues currently exist.

Emissions from the proposed ethanol and intensive dairy will comprise gases and particulate emissions from the ethanol plant and odour and dust from the intensive dairy.

The potential pollutants have been identified as follows:

- Carbon monoxide – this is typically associated with the movement of motor vehicles and is not anticipated that increased levels from the development will present as an issue;
- Nitrogen oxide – this is typically associated with the movement of motor vehicles and increased concentrations are not anticipated to present as an issue; and
- Sulphur dioxide – this is typically associated with processing and industry and vividly increased concentration from the development are not anticipated to present as an issue.

Odour emissions from the ethanol plant are as follows:

- The fermentation of grain;
- The distillation of ethanol;
- The extraction, storage and movement of wet distillers grain to the dairy enterprise and off site;
- The storage and loading of ethanol; and
- Aqueous ammonia which is unlikely to be released into the atmosphere.

Odour emission rates from the dairy are those typically associated with dairy enterprise. These will be mainly excreta produced by dairy cattle. The dairy will be the dominant source of odour from this project. The other main sources being the anaerobic and aerobic ponds used to process waste water.

It is recommended that odour emission should be controlled from the ethanol plant through the following methods:

- Using well maintained high efficiency wet CO₂ scrubber;
- Using thermal oxidizer/heat recovery boiler to control emissions from the distillation system; and
- Minimising Volatile Organic Compound (VOC) emissions from storage tanks using internal floating roofs, utilising some wet distillers grain on-site, and trucking excess wet distillers grain from the site each day.

From dispersion modelling of emissions using predicted metrological data, odours and gaseous concentrations from the proposed development would comply with current air quality standards.

Noise Impact Assessment

Day time and night time noise levels at the site are presently low. The greatest contribution at this time is from motor vehicles travelling along the Kidman Way that runs parallel to the properties eastern boundary.

Noise sources emanating from the proposed activities will occur in the construction and operational phases. The construction phase will involve the constant use of heavy machinery for landforming and the building of structures. During operations, increases in ambient noise will be generated by the 18,000 head dairy herd and the ethanol production. Other on-site noise will be created by the waste water facility and support activities such as the movement of forklifts and light trucks.

The proposed increase in heavy vehicle movements will affect noise levels at the site and residences adjacent to the Kidman Way. It is anticipated that the main truck movements will be from the site to the Willbriggie railhead to collect resources and possibly deliver product. The community of Darlington Point will be most affected by these movements as all north bound trucks (not using the Sturt Highway) will be required to travel through the township. Other vehicular noise contribution will be made from staff vehicles entering and leaving the site.

It is anticipated that construction noise will affect the residence on neighbouring Farm 641. It is proposed that an earth mound or other suitable barrier be constructed to mitigate the noise impact from construction. Noise goals can be achieved at the ethanol facility with the acoustic enclosure of equipment where required. Assessment of predicted noise levels emitted by the dairy herd concluded that EPA noise goals will be met. This will be maintained through the use of animal management techniques such as feeding to appetite and controlled and calm movement of cattle throughout the dairy facility.

Traffic Assessment

The Kidman Way running from Jerilderie through to the Queensland border services the proposed site. There are currently very few vehicle movements onto and off of the site beyond those conducting normal from maintenance and operations. Current vehicle movements are restricted to periods during planting and harvest of crops and those associated with any livestock enterprises on-site.

The proposed development requires substantial vehicle movement increases of both light and heavy vehicle classes compared to those that currently exist. Staff vehicles will move onto and from the site at the beginning and end of shifts. These volumes will have an impact on traffic along the Kidman Way during these limited, concentrated periods.

There will be large numbers of heavy vehicles moving to and from the site along the Kidman Way. These will be transporting resources and product. Other heavy vehicle movement will be via Eulo Road to the adjacent "Tubbo Station" property that will be accepting manures, damaged grain and dead stock.

Three specific locations have been identified that will be especially impacted by the increased vehicle movements:

- The access and egress at the site;
- The Willbriggie railway siding; and
- The township of Darlington Point.

Access and egress to the site is currently through a farm gate from the Kidman Way. The proposed project will require development of traffic separation laneways at the proposed entry to cater for increases of both light and heavy vehicle classes. The access and egress configuration will be required to comprise of:

- Turning lanes from the north into the development;
- Speed-up merging lanes for vehicles exiting the development traveling south;
- Passing lanes for vehicles traveling south;
- Slow-down entry lanes for vehicles entering the development from the south; and
- Speed-up merging lanes for vehicles heading north.

Further assessments may be required in regards to potential upgrades at the Willbriggie rail siding/Kidman Way intersection. It is intended that this site is to be utilised for the pick-up of the majority of the grain and raw material required for ethanol production, plus the possible transportation of product. The existing grain storage facilities at the Willbriggie site are currently in use and frequented by heavy vehicles, the numbers of which increase at times of local crop harvest. The addition of the ethanol project vehicles accessing the Willbriggie siding may challenge the safety and functionality of the existing access and egress provisions. It is suggested that speed limits at the rail crossing be reviewed once the development proceeds.

The township of Darlington Point normally enjoys a smooth traffic flow. There may be some delays for vehicles entering the Kidman Way from local streets within the township if vehicle numbers are to increase, however this is not seen to have a major impact on the level of convenience. Currently, a 50km speed limit exists within the township, and would remain in force, ensuring the on-going safety of motor vehicle users and pedestrians.

Visual Amenity

The current site is predominantly flat with a general slope from north east to south west and a sandhill rise located at its centre. The property has been predominantly cleared for irrigated cropping and grazing enterprises. There are some areas of remnant vegetation with scattered stands of White Cypress (*Callitris glaucophylla*) on the sandhill, scattered and isolated areas of Myall (*Acacia pendula*), and belts of Black Box (*Eucalyptus largiflorens*) along the southern boundaries.

It is proposed that remnant vegetation communities be maintained. Visual amenity at the site will be enhanced through the establishment of 50 metre wide, full perimeter plantings, established with a mosaic of groundcover, understorey and over-storey species, and additional areas of habitat restoration and wetland creation. In addition to these areas, all non-developed sections of the site surrounding supportive infrastructure will be landscaped with grasses and other species as appropriate. All plantings will be of locally sourced, locally indigenous native species.

At present there is no source of illumination on the project site. The proposed development does require illumination at night, and there is potential for outdoor lighting to create obtrusive effects through potential light spill off-site. A detailed lighting design will be prepared when final building and infrastructure layout has been approved in accordance with the relevant standards.

Flora and Fauna

The property has been predominantly cleared for irrigated cropping and grazing enterprises. There are some areas of remnant vegetation with scattered stands of White Cypress (*Callitris glaucophylla*) on the site's central sandhill, scattered and isolated areas of Myall (*Acacia pendula*), and belts of Black Box (*Eucalyptus largiflorens*) along the southern boundaries.

Desktop studies have revealed that White Cypress woodlands are receiving more focus and gaining appreciation for providing remnant habitat for native flora and fauna both specifically associated with these communities and when occupying intermittently. Myall woodlands are listed as Endangered Ecological Communities whilst Coolibah-Black Box communities are afforded protection in the northern Riverina, however this does not extend to the proposed development site.

Call playback surveys, habitat searches and opportunistic sightings only resulted in the identification of one (1) threatened avifaunal species, being the Grey Crowned Babbler (*Pomatostomus temporalis temporalis*) within an adjacent roadway corridor; however it is highly possible that their range would extend onto the proposed development site.

Remnant vegetation communities on the site are of poor representation due to prior agricultural clearing and pre-existing management regimes. Understorey and mid-storey vegetation is typically degraded throughout. Age structure is mostly uniform with little regeneration possibly due to grazing pressure from rabbits. Over-storey vegetation does provide some habitat for avifaunal species which migrate between the near-by Boona and Brett's State Forests via the proposed development site.

It is proposed that all identified vegetative communities be excluded from development and protected by a conservation caveat. Habitat enhancement would be achievable through the implementation of a management strategy that includes removing grazing pressure, limiting weed competition, increasing connectivity and groundcover, and potentially reintroducing a flooding regime to the Black Box depression area.

Four Arrows are committed to flora and fauna management strategies that reflect those targets detailed within the Coleambally Land and Water Management Plan and include a rabbit management plan, extensive vegetative plantings and the establishment of a wetland area. The commitment of the Four Arrows Group is already evident in the on-going plantings of native species on all its Riverina holdings.

Indigenous Heritage

There are no official recorded sites of indigenous heritage listed for the proposed development site. However, there was a high potential for particular landforms within the project area to contain sites of indigenous heritage significance. A field survey was conducted by appropriately experienced experts to ensure a comprehensive investigation was undertaken.

The specific survey targeted the following:

- A sandy ridge running east west through the centre of the property; and
- The remnant black Box woodland depression on the southern boundary of the site.

A number of scar trees were identified within the Black Box depression in the southern part of the site. A total of four (4) examples were identified with one being upon a live tree and other evidence on fallen timber.

All sites of indigenous site significance are within the proposed vegetative conservation areas and will not be impacted upon by the development.

EXECUTIVE SUMMARY

BACKGROUND

The rapidly increasing cost of fossil fuels in response to declining supplies has accelerated the demand for biofuels

On 22 December 2005, the Federal Government released the Biofuels Action Plan, drawing together major oil companies, the Independent Petroleum Group, retailers and other market stakeholders, to develop a competitive biofuels market in Australia. Government biofuel targets of 350ML of production by the year 2010 were tabled and there have been many and varied inroads made towards achieving these targets.

In response to the improving outlook for biofuels, the Four Arrows Group has decided to invest in a 300ML ethanol plant on its Coleambally property in south-west New South Wales. Integrated with the proposed ethanol plant is a 6,000 cow constantly in milk dairy to optimise the usage of distillers grain generated by the ethanol plant. The scale of the proposed project has been driven by the need to achieve cost efficiencies and economies of scale.

SITE LOCATION AND DESCRIPTION

The proposed development site is situated within the Murrumbidgee Shire on the western side of the Kidman Way approximately seven (7) kilometres north of the township of Coleambally and seventeen (17) kilometres south of Darlington Point.

The Murrumbidgee Shire is part of the Riverina region which is one of Australia's most diverse food production locales. The area's prosperity results from an extensive irrigation supply network that provides water to a variety of enterprises.

Prior land use at the proposed site has typically been irrigated agricultural production dominated by rice growing. It is intended the proposed development will continue water supply agreements with Coleambally Irrigation Co-operative Limited to maintain an infrastructure adjacent to its property to provide water to the dairy and ethanol enterprises as required.

Although the property has been extensively developed for irrigation purposes, some relatively undisturbed areas remain. There is a sandhill situated at the centre of the site with stands of White Cypress (*Callitris glaucophylla*), isolated communities of Myall woodland (*Acacia pendula*) scattered around parts of the site, and areas of Black Box (*Eucalyptus largiflorens*) depressions are present along the southern boundaries.

The surrounding land use is typically irrigated agriculture interspersed with broadacre cropping, livestock systems, agricultural production infrastructure and rice industry infrastructure. The area surrounding the proposed site is zoned (Rural 1(a)) as is the proposed site itself. Surrounding irrigation properties include scattered residences and the townships of Coleambally and Darlington Point, though for the main, are far enough removed from this site so as to not be affected by the majority of environmental impacts. There is only one close neighbour (Farm 641) which is owned and managed by the Four Arrows Group.

The design and construction stages present the highest potential to impact upon undiscovered sites. The following protocol shall be implemented if there is any doubt to whether a site has been unearthed:

- Immediate cessation of works in that area;
- Notification to the National Parks and Wildlife Service (NPWS) and the Griffith Local Aboriginal Land Council (GLALC); and
- Await advice from relevant authorities before proceeding.

A number of recommendations have been made to ensure the further protection of these areas, including:

- Total archaeological site avoidance;
- Employment of local experts from the GLALC, or other recognized expert aboriginals to act as monitors during site disturbance works;
- No new establishment of firebreaks and vehicle tracks in remnant vegetation areas beyond those existing without approval; and
- Additional discoveries to be recorded and forwarded for entry into the Aboriginal Heritage Information Management Systems database (AHIMS).

Non-Indigenous Heritage

No sites of non-indigenous heritage were found to exist on the proposed development site. A search of the Register of the National Estate did identify three (3) sites on the adjacent “Tubbo Station”. sections of Tubbo” are proposed to be utilised to support the development, for the incorporation of manures and damaged grain into the soil profile and the disposal of carcasses. Management of “Tubbo” have been previously advised of their obligations and responsibilities under the Register of the National Estate Guidelines and it is not envisaged that activities conducted to support the proposed development will pose any threat due to present arrangements and on-going management practices.

Hazards and Risks

The proposed development is considered a potentially hazardous environment as highly volatile goods are imported, stored, processed and exported from the site. The major activities that present high risk situations in the production of ethanol have been identified as:

- Grain receipt and storages – explosive dusts;
- Ethanol manufacture – spillage, fire and explosion;
- Ethanol storage/transfers – spillage, fire, explosion; and
- Petrol receipts – spillage, fire, explosion.

The dairy enterprise presents a less hazardous situation than ethanol production; however associated risks prevail through the storage and handling of mixed agricultural and veterinary chemicals. These would include but not be limited to:

- Mastitis treatments;
- Antibiotics;
- Fertility treatments;

- Vaccines;
- Antiseptics;
- Alkali washes; and
- Lodophores.

The combined chemical store for at the ethanol and dairy enterprise will be appropriately designed, and constructed to promote the highest safety standards and adhere to Australian standards and OH&S requirements. Staff will be trained in the handling and application of chemicals and their storage. Audits will be conducted regularly to ensure that all accidents have been reported, misuse has been noted and no theft has occurred. These measures will ensure the safety of staff, the greater community and the environment.

It has been assessed that any hazardous or life-threatening explosive event that has the potential to occur at the site would be contained within the bounds of the enterprises. There is minimal chance of injury or distress to off-site inhabitants. Utilisation of separation distances confining all consequences within the site, the surrounding land use remaining rural with a low population density, the implementation of a traffic management policy and design and operation of the facility to the appropriate Australian standards will all contribute to the alleviation of hazards within and beyond the site boundary.

Animal Welfare

For its commercial success the proposed dairy enterprise will demand no less than best practice attention cattle comfort and the management of disease. The main animal husbandry considerations are seen to include the management of dust, carcasses, respiratory and ocular disease and limiting conditions that can create mud/manure interfaces causing odour, creation of an unsanitary environment that can harbour and promote disease, and hindrance to cattle movement that can cause slips and falls resulting in lameness and fractures.

Intensive enterprises such as the proposed dairy are constantly confronted with the risk of disease outbreaks. The major diseases that have the potential to present themselves include metabolic disease, acidosis, lameness, mastitis and respiratory disease.

The engagement of an on-site veterinarian to continually monitor the herd and isolate and treat sick or diseased animals will ensure the on-going health and vitality of the enterprise.

Mitigation of cattle ailments will be addressed during all phases of the establishment and operation of the dairy. The features and layout of sheds and infrastructure will be a major consideration during the design of the facility. The training of staff and identification of skill sets required for achieving the highest standard in animal care and handling will be constantly monitored and implemented during the dairy operations.

Waste Management

Ethanol Waste Management

A number of waste streams have been identified from the proposed ethanol facility. Applying the classification of “waste” to these derivatives and by-products is not entirely accurate as many can be resold as a stand-alone product or re-cycled for other beneficial uses. Therefore, many so-called “wastes” are in reality a “resource”. For this reason, issues surrounding the management and disposal of wastes do not present as a significant problem. Other wastes managed and processed on-site have been adequately catered for within the initial development design.

Specific “waste” streams are:

- Carbon Dioxide – Carbon dioxide is produced during ethanol production. Calculations affirm that the CO₂ volumes are being generated in commercial quantities. The CO₂ will be captured during the fermentation process and sold direct to a number of markets including use for carbonated beverage production;
- Wet Distillers Grain – The wet distillers grain will be firstly utilised as a basis for feed rations to be fed to the project dairy herd. The remainder is to be sold under contract and exported off-site to regional beef feedlots. The local feedlot cattle enterprises are continually sourcing the most economical and high value feed available and have already formally requested contracts to ensure access to the product;
- Recycling – Water recycled from within the distillation process (known as “thin stillage”) will be continuously cycled within the ethanol production process and topped up with fresh water purchases. Water extracted from the wet distillers grain system will be processed and re-cycled back into ethanol production via a closed system extraction and filtering system; and
- Damaged Grain – Damaged grain due to spoiling from the affects of weather is anticipated to be minimal due to the effective design of storages. This grain will be unsuitable for ethanol production or for mixing with cattle feed and will be disposed of off-site. The grain will be broadcast onto and incorporated into the agricultural soils of the nearby, Four Arrows Group owned and operated “Tubbo Station”. Any excesses can be also utilised at the Four Arrows owned and operated “Belvedere” farm and/or other Four Arrows Pty Ltd Riverina properties.

Dairy Enterprise Waste Management

The dairy enterprise to a lesser extent produces saleable by-products and derivatives, which, in this particular project will be transferred to “Tubbo Station”. The key issues are:

- *Manure* – Substantial amounts of manure will be produced by the dairy enterprise each year. This will be from yard scrapings and flush lanes. It is agreed that “Tubbo Station” will accept these manures and incorporate them directly into the agricultural soils of the property at pre-determined and suitable rates. This will replace a large portion of the inorganic fertilisers normally required for the production of crops on these properties;
- *High Nutrient Water* – High nutrient water being flushed from the dairy enterprise will be transported to sedimentation ponds where manures will be allowed to settle out of suspension and then collected. The water will flow into a surge pond and then be pumped into anaerobic ponds for de-nitrification. Once this water has been processed, it will pass into aerobic ponds and be re-used for the purpose of flushing dairy sheds; and
- *Carcasses and Dead Cattle* – Carcasses will be transported to “Tubbo Station” where they will be buried in accordance with the documented procedures.

Administrative and Support Facility Wastes

Grey water from administrative and other support facilities will be recycled through appropriate packaged effluent treatment systems and re-used for best practice irrigation of landscaping and gardens.

Containers

Chemicals and other containers shall be either recyclable or returned to the manufacturer.

Truck Wash Down

The truck wash down bay provides a significant function for the proposed development. Trucks will be washed and backloaded thus reducing the amount of vehicle movements required for normal operations. Waste water and wash down materials will be segregated and disposed of accordingly being consistent with best management practice.

Soils

A total of twenty one (21) deep slot trenches were excavated for the purposes of appraising the site soils and geomorphology. The findings were and cross-referenced to prior soils documentation made available through the Coleambally Irrigation Corporation Limited.

At each soil trench the following soil physical characteristics were appraised:

- Depth of each soil horizon;
- Soils texture;
- Soils colour;
- Soils structure;
- Mechanical resistance to root penetration;
- Porosity;
- Infiltration status;
- Drainage status;
- Soil compaction;
- Depths to amount of soil lime and/or gypsum; and
- Presence of any layers, which may restrict water penetration.

Four (4) main soil types were identified as being present on the proposed development site with the following approximately distribution:

- Sands covering approximately 12% of the project area;
- Red/brown earths covering approximately 57% of the project area;
- Grey transitional soils covering approximately 25% of the project area; and
- Black self-mulching clays covering approximately 6% of the project area.

The soils at the site displayed considerable variations from sands to duplex soils to vertisols and typically containing natural lime and gypsum at variable levels. The above classifications provide a sound representation of the soil types that are present.

It has been identified that the proposed buildings and infrastructure are compatible with soil types however, further testing will be required during the design and construction phases to reaffirm that present conclusions are credible.

Water

Surface Water

The proposed development site predominantly slopes from the north-east to the south-west. CICL drainage channel DC400 runs across the southern edge of the site. It is intended that all surface flows will be contained on the site except for those designed to move from the site in a controlled manner and of acceptable quality to be received by DC400, in extreme weather events.

There is no natural drainage line through the project site. Any surface water, which may be generated regionally through either other operations not related to this development, or from rainfall events are already prevented from running onto the site by the pre-existing Kidman Way that runs the entirety of the eastern boundary, DC400 to the south, and a CICL supply channel at the northern site boundary.

There will be three (3) water categories generated by the development being:

- Category 1 – Water which is run-off from roofed areas and which is clean rainwater for potable usage;
- Category 2 – Water which runs off any landscape that may be irrigated and water which may run off from dedicated paved or other nominated landscaped areas; and
- Category 3 – Water which has a high loading of waste material and which is generated by the dairy enterprise.

Category 1 water can be captured and stored in localised tanks or diverted to the ethanol reserve storage. Category 2 water would be directed into the constructed wetlands area and drawn upon if required for irrigation purposes. Category 3 water will be processed through the sediment basins and anaerobic and aerobic ponds for denitrification and then re-used once again to flush freestall sheds and for irrigation.

All collection infrastructure and storages including ponds have been designed to cater for extreme rainfall event and/or periods with the facility to pump water into the drainage channel if required.

The entire site will be engineered in such a way that a variety of containment techniques will isolate run-off and direct it to the appropriate water storages. Category 3 water is of the greatest concern and will be contained appropriately. This will involve the construction of bunding encompassing commodity sheds, freestall dairy sheds, maternity sheds, sick cow sheds, cattle yards, truck wash down areas, sedimentation basins, manure heaps, surge storage and abutting up to the engineered aerobic and anaerobic ponds. The bunding can be in a number of forms including roadways and earthen embankments.

Groundwater

Groundwater is captured within a range of geological formations that results primarily from percolating surface water. The Shepparton Formation is of particular interest in relation to the proposed development being from natural surface level (NSL) through to 75 metres below NSL. Groundwater in this formation rose to less than 10 metres below NSL in the 1990's, however the recent trend has been for lowering water tables due in part to current drought conditions and a response to the implementation of the Coleambally Irrigation Area Land and Water Management Plan (CIA LWMP). Groundwater measurements in the 1970 have revealed levels to be between 2 metres and 20 metres below NSL. This elevated water table was predominantly due to less than best management practices associated with irrigated cropping in the CIA. The subsequent decline in groundwater levels and recent improvement in response to the CICAL LWMP reveals the sensitivity of the area to react to both best and less than best water management practices.

Data collected on 6 July 2006 from six (6) CICAL piezometers around the project property revealed water levels to be between 9.78 below NSL and 15.93 below NSL. In addition to these readings, data was gained from the drilling of six (6) test bores located approximately central to each of the water storage and ponds.

Information on soil horizons, textures and the presence or absence of moisture was recorded in the six (6) test bores. Free groundwater was not recorded; however some sites were seen to have the potential for groundwater accession.

Groundwater movement, and the prevention of possible accessions, will be a major consideration at all phases of development.

Maintenance and even improvement in groundwater condition is directly affected by those proposed mitigation measures that are involved with surface water management. Aside from this, the greatest consideration that must be applied to ensure the maintenance of desirable groundwater levels and quality is the development of "secure" anaerobic and aerobic ponds for the management of effluent from the dairy enterprise. That is, the floors and walls of the storages are sealed to an extent that groundwater accession is simply not possible. To abate the possibility of groundwater accession from these sources the following would be implemented:

- The establishment of compacted clay liners of at least 600mm depth with a replicated and demonstrated permeability of not exceeding 1×10^{-9} m/sec for all water storages, settlement ponds and storage areas;
- The installation of suitable leakage monitoring and leakage capture systems over the compacted clay liner, for both the anaerobic and aerobic storages;
- High quality geosynthetic liners be installed over the leakage monitoring and capture systems for the anaerobic and aerobic storages;
- The geosynthetic liner to be most likely 1.5mm thick and installed by qualified technicians, and verified by the project engineer prior to commissioning; and
- Upon approval and during design level investigations, that more detailed soil suitability investigation is undertaken for all areas proposed for water storage and effluent management.

The decision on whether to rely on a >600mm compacted clay liner or geosynthetic membrane liner will be made by the project geotechnical engineer, in full consultation with Department of Natural Resource staff, with the benefit of the future detailed design level investigation prior to construction/installation

STATEMENT OF COMMITMENTS

A Statement of Commitments has been prepared detailing 250 assurances that Four Arrows Ethanol Pty Ltd will implement upon approval of the development application, the components of which make up this Environmental Assessment. These assurances will be compiled and integrated into an Environmental Management Plan (EMP) that will include a Construction Environmental Management Plan (CEMP) and an Operational Environmental Management Plan (CEMP). These plans will drive all facets of design, construction and operations of the combined ethanol and dairy enterprises. The Plans will not only include the strategies and actions that will be undertaken, but also detail the monitoring techniques, auditing procedures and any relevant mitigation measures that are to be implemented.

DEVELOPMENT JUSTIFICATION

The proposed development is justified based on its ability to achieve the maintenance and enhancement of biophysical, economic and social aspects. The following comments provide credibility and validate the project from an anthropocentric and ecologically sustainable perspective.

Biophysical Justification

At the national and international level:

- It is recognised that a continuation of the use of fossil fuels is both detrimental to the environment and society and supplies are in decline;
- Four Arrows Ethanol Pty Ltd intend to produce a product (ethanol) that is considerably less hazardous to the environment than that posed by the unfettered and continued use of fossil fuels; and
- The development is congruent with the objectives of the Australian Government's National Bio-fuels Action Plan (BAP) that targets the total production of 350ML of all biofuels by the year 2010. The BAP aims to accelerate the move away from the current dependency on fossil fuels and non-renewable energy sources to renewable energy sources which are environmentally sound.

At the local level the development justification includes:

- Native flora and fauna will be enhanced through the establishment of conservation zones and caveats;
- Habitat will be enhanced through the addition of locally indigenous native plantings and the conservation of remnant vegetation;
- Archeological features and heritage sites will be isolated from the development with additional unearthings being recorded and protected;
- The soil types within the project site have been deemed to be suitable for the establishment of the proposal building and infrastructure. Additional design level investigations will ensure site and situation specific issues are attended to in the construction and operational phases;
- Substantial consideration and investigation has been given to groundwater issues within the initial design and project layout. This has resulted in recommended strategies to be pursued so as not to adversely contribute to increased groundwater levels and reduced groundwater quality; and
- Hydraulic loading will be decreased due to run-off manipulation, collection and isolation. All wastes and by-products from the site will be either sold to existing markets as in the case of CO₂ and wet distillers grain or utilised on adjoining properties to substitute the use of organic fertilizers.

Economic Justification

The development will contribute significantly to the future economic growth and welfare of the local community and surrounding district as:

- The proponent has expressed keen interest in utilising local people, businesses and products during all phases, particularly during construction;
- Other benefits will present themselves through the considerably large purchases of grain necessary for ethanol production and to support the dairy herd;
- The ethanol by-product (brewer's grain) will be sold to other intensive livestock industries as a preferred input to feedlot rations;
- Economic mechanisms such as taxes, royalties and levies will be required to be paid, thus creating revenue; and
- The size of the development will result in cost and operational efficiencies, thus minimising the cost of ethanol, making it a commercially attractive product. The increased use of which will benefit the environment with reduced reliance on fossil fuels.

Social Justification

It is recognised that most rural regional communities are in economic and social decline. The proposed development, as well as promoting employment, will promote the requirement for an increased range and level of skills. This will involve the introduction of new expertise and the training of local labour, resulting in a widening of social structure.

The development assures minimal negative impact on the local communities and/or surrounding neighbours as all aspects of social welfare have been considered including:

- Noise;
- Odour;
- Traffic;
- Transport;
- Visual amenity; and
- Heritage.

ENVIRONMENTALLY SUSTAINABLE DEVELOPMENT (ESD)

The proposed development satisfies the requirements of ESD at a number of levels as follows:

- Precautionary Principle – The concept design and layout of the site has been carried out using:
 - o The findings and conclusions drawn from an experienced and peer respected team of sub-consultants with relevant expertise in their field;
 - o The expertise, knowledge and experience of the project team in natural resource management and environment protection; and
 - o The desire of the project team, and that of the proponent, to utilise the proposed development site's natural attributes and infrastructural enhancements in such a way as to benefit the economy, society and the environment.
- Inter-generational Equity – On a national and global level, the use of biofuels is removing society's reliance on non-renewable and polluting sources of energy, thus benefiting the environment and the welfare of future generations.

On a local level, the project design layout and integrated proposal has been the result of comprehensive and iterative investigations into the long term impacts that may present themselves when the project proceeds. To optimise the beneficial outcomes appropriate mitigation measures have been recommended. These mitigation strategies and actions will be detailed within an approved Environmental Management Plan that will be developed.

- Biological Integrity and Ecological Diversity – Management of the proposed development is committed to the conservation and maintenance of existing remnant vegetation. The planting of extended tracts of locally indigenous native trees, shrubs and under-storey will ensure the property becomes of greater ecological value to the movement and habitation of avian and other terrestrial species. All proposed designs and management strategies are congruent with the Coleambally Land and Water Management Plan;
- NRM Valuation and Pricing – The project provides an opportunity to gain new information on environmental values, in that this commitment will establish a non-traditional market and price for a product accordingly. The level of acceptance will provide an indication of society's willingness to embrace alternative fuel sources; and
- Performance Monitoring – Approval of the proposal will trigger the development of a Construction Environmental Management Plan and an Operational Environmental Management Plan that will be used as the blueprints for all actions and procedures during the construction and operation of the intended development. The proponent has committed to a range of factors to be incorporated within both plans including performance monitoring of each aspect considered a risk to environmental health and social welfare.

CLIMATE CHANGE

The development produces considerable amounts of greenhouse gases that have the potential to contribute towards climate change. These include:

- Methane;
- Carbon dioxide; and
- Nitrous Oxide.

The CSIRO Greenhouse Gas Abatement Calculator was used to assess the greenhouse gas impact. It has been calculated that the proposed management strategies for CO₂ harvesting, and the benefit of ethanol use to the environment, will result in a "net reduction" in the level of greenhouse gas emissions with an ultimate "net reduction" in contributions to global warming.

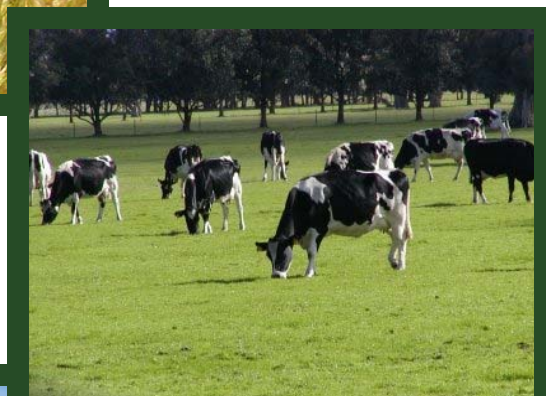
NO PROJECT SCENARIO

The expected demand for biofuels is such that it should be assumed that if this particular project is not approved then a replacement project will take its place at a location or locations yet to be determined. Thus it is a case of where a project is commissioned, not if a project will be commissioned.

SUMMARY

Given the merging of the project conceptual design and operational plan in response to the EA investigations, the outcomes are the principles of the ESD are not only sustained but are enhanced. It is therefore a justifiable decision to approve the project provided it maintains the intended outcomes.

Environmental Assessment





1.0 INTRODUCTION

1.1 Proponent

The proponent is “*Four Arrows Ethanol Pty Ltd (ABN 26 116 072 434)*” and is a part of the Four Arrows Group.

The Four Arrows Group of companies has substantial investments in a range of commercial sectors including primary production. Within the primary production portfolio are three (3) separate aggregations of land holdings in the Murrumbidgee Valley as follows:

- Wagga Wagga – “Tahara” aggregation of some 7,000ha in the eastern section of the valley producing wool, sheep meats, beef, dairy products, cereal grains, oilseeds and forage products;
- Darlington Point – “Tubbo” aggregation of some 35,000ha in the central sections of the valley. The “Tubbo” aggregation includes a number of Coleambally Irrigation Area farms which, along with the “Tubbo” property itself, has an amalgamation of water entitlements to some 40,000ML of which approximately 50% is surface water and 50% is groundwater. Production includes wool, sheep meats, beef, cereal grains, oilseeds, forage products and a substantial horticultural enterprise; and
- Hay – “Toronga” aggregation of some 39,900ha is located in the western sections of the valley. The “Toronga” aggregation consists of substantial irrigation development and pastoral enterprises with water diverted from private pumps on the Murrumbidgee River.

The Four Arrows Group of companies investments in primary production are strategically well placed across climatic zones and landscapes within the Murrumbidgee Valley. The properties are close enough to enable operational integration with complementary production characteristics, economies of scale whilst spreading commercial and operational works.

1.2 Background

1.2.1 General

Investment in water for irrigation and water related projects form a major component of the Four Arrows Group’s primary production portfolio. With the incorporation of a number of Coleambally farms in the “Tubbo” aggregation, the Four Arrows Group has a significant investment and interest in the social, commercial and environmental well being of the Coleambally Irrigation Area (CIA). To this end, the Four Arrows Group has developed a strong and mutually beneficial relationship with the now privatised Coleambally Irrigation Co-operative Limited (CICL).

At the 2005 Annual General Meeting (AGM) of the Ricegrowers’ Association, the potential for ethanol production in the Riverina was raised. The AGM outcomes were timely and coincided with:

- Positive results of other on-going investigations being already undertaken by the Four Arrows’ senior management;
- Rapidly escalating prices for fossil fuels;



- Increasing interest by the Australian Government in promotion a change to biofuels and biofuel blends; and
- Broadening community interest in biofuels.

The convergence of events and circumstances accelerated the decision to bring the project to fruition.

1.2.2 Site Selection

1.2.2.1 Environmental Balance Sheet

Prior to determination of the most suitable site for the proposed development, alternative sites for the development were reviewed based on subjective assessments of alternative Four Arrows' properties, and said assessments were compiled into what is referred to as an "Environmental Balance Sheet" (EBS). The EBS provides a basic system for comparing the potential positive and negative impacts from a "with" development or "without" development scenario, or alternatively can review the positive and negative aspects of a proposed development between a number of alternative sites.

Attached as Annexure 1.2.1 is a copy of the EBS for the proposed development and the outcomes of subjective assessment for three (3) project site options.

Each of the three (3) options is reviewed in regards to a collection of "Heads of Consideration". Heads of Consideration, in their broadest sense are a listing of all potential issues whether they are environmental, social or economic and review of possible improvements or declines in these Heads of Consideration based on the proposed development scenario.

In this particular EBS, Option A provides the benchmark for which Options B and C are compared for suitability as an alternative development site. Each of these Heads of Consideration is given a rating from 1 to 10, with an increase in rating number identifying a positive outcome and a decrease in rating number indicating a decline in environmental outcome. In Options B and C, alternative scenarios and changes which would result in a net positive outcome are identified by a green colouration and those options which would result in a negative or a decline in the quality of a Head of Consideration are identified in red.

Option A considers these changes in the Heads of Consideration for the dairy and ethanol plant as currently proposed. Option B reviews the potential for the ethanol plant to remain where it is currently proposed and the dairy to be relocated to "Tubbo" station. Option C proposes that both the dairy and ethanol plant are located on "Tubbo" station.

Option A indicates that when all ratings as they are currently subjectively assessed are tallied, a benchmark score of 393 is set. Option B indicates an overall rating score of 373, and Option C a rating score of 347. These ratings in effect represent a decline in score of 20 and 46 respectively.

Based on this preliminary system, it was determined that the current site would pose the most suitable development site prior to any specific investigations that may potentially contradict this determination.

As can be seen in Annexure 1.2.1 some of the key areas for which these declines in score and ultimately a reduction in overall site suitability of Options B and C, focus on issues specific to pre-existing infrastructure i.e. electricity and water supply, and suitable road network, and identify greater negative traffic impacts for Options B and C with some declines in regards to the commercial feasibility of the project itself, and other supporting and surrounding commercial ventures.

Ultimately there is no perfect site for a development of this nature. Site selection is a product of assessing the net positives of the development versus the net negative impacts from the development. The relative importance of the negatives of a site can be argued infinitum, however the EBS as provided, does allow for basic, initial analysis of suitability of one option over another. The EBS is not



an absolute science, however can provide reasonable assessment in lieu of specific in-field survey and analysis, and thus provides the basis for having selected the current proposed development site for subjection to further detailed investigations in the preparation of this EA.

1.2.2.2 Site Selection Summary

The following broad criteria influenced the decision to locate the project on this particular site at “Tubbo”:

- The outcomes of the EBS;
- “Tubbo” is the central aggregation within the Four Arrows group;
- “Tubbo” is essentially part of the CIA, is adjacent to the Murrumbidgee Irrigation Area and is operationally close to the Murray Irrigation Districts and the Victorian Irrigation Districts. Irrigation provides relatively stable grain production streams for the ethanol plant and forages for the proposed integrated dairy enterprise;
- Surrounding the irrigation districts are substantial areas of dryland farming capable of the supply of the necessary grain for ethanol production;
- Within close operational distances are:
 - o A number of intensive animal industries to use the surplus distillers grain output from the ethanol plant;
 - o Major commercial centres for support services;
 - o Access to electricity, gas and water;
 - o Access to transport and freight services and to major highways; and
 - o The ability to integrate the project with “Tubbo” operations and especially for the sustainable management of manure.

A particular driver of the decision to locate the project within the “Tubbo” aggregation is to support the already large investment of \$10M’s with an integrated ethanol plant and dairy enterprise further supporting and promoting community well-being.

The mix of skills and qualifications in the people needed in the project will provide an impetus for diverse growth rather than decline in the Coleambally and Darlington Point townships. The outcomes will include increases in the quantum and diversity of skills available to commercial businesses including the Four Arrows businesses.

1.3 Objective of the Proposal

1.3.1 General Overview

In simple terms the objective of the proposal is to construct:

- An ethanol plant with the capacity to produce 300ML of ethanol per annum; and
- An integrated intensive freestall dairy with the capacity to constantly milk 6,000 head of cattle per day for 365 days per year.



The drive behind the construction of the ethanol facility is in response to a number of factors, namely:

- Increases in global oil prices, and associated fossil fuel costs;
- Society dictating that hydrocarbon refinery industries undertake a drive towards environmental sustainability and reduce carbon dioxide emissions through the use of non-oil based derivatives; and
- A desire for the reduction of greenhouse emission from vehicular based modes of transport.

The driving factors behind the production of the dairy enterprise are:

- To utilise the by-products from ethanol production; and
- A removal of the need for a large percentage of the off-site transport of by-products from the ethanol facility.

This facility, upon approval has the opportunity to meet or address all of the points listed above. Additional to the above objectives is the proposed development also provides economic and social positive outcomes for surrounding rural producers and rural communities. The project also presents opportunities for increases in natural resource habitat connectivity throughout a region which has a reputation of being poorly conserved and highly fragmented.

1.3.2 Specific Project Approvals

The proponent, four Arrows Ethanol Pty. Ltd. (ABN26 116 072 434), specifically seeks approval from the Minister of the Department of Planning for undertaking the specific design, construction and commissioning of the following project components and activities;

- An Ethanol production facility and all necessary associated infrastructures capable of 300ML ethanol production per annum. (Ethanol Plant, Workshop, Truck Washdown, Grain Storage, Water Storage, Roadways, Administration and Visitors Centre);
- An intensive freestall dairy and all necessary associated infrastructure with a milking capacity of 6000 head. (Freestall Sheds, Dry Pens, Dairy, Milk Storage, Maternity Shed, Cattle Yards, Feed/Commodity Shed);
- Cattle housing and all necessary supporting infrastructure to maintain a supporting herd of 12,000 cattle;
- A total of 18,000 head of cattle to be housed onsite (6,000 milkers, 1,200 dry cows, 10,800 support herd);
- Waste management and effluent systems onsite with capacity to manage all wastes from the Ethanol Plant, Freestall Dairy and supporting cattle onsite. (Sedimentation Basins, Storm Surge Pondages, Anaerobic Ponds, Aerobic Ponds, Manure Storage, Runoff Storage, Channels); and
- The disposal of effluent wastes and various organic wastes borne of herd mortalities and culls offsite to surrounding suitable agricultural lands.

The components identified above are discussed in greater detail throughout this EA, and graphical representation of the locations of the various components is provided in Section 3.3 of this EA.



1.4 Commercial and Community Relationships

The proposed ethanol plant and dairy facility will integrate with the local and broader community in many diverse ways. The following list will provide a guide as to the range and diversity of relationships:

- Regional grain growers of a range of cereal and specialty crops;
- Fuel companies for blending of ethanol;
- Coleambally Irrigation Co-operative Limited and its shareholders;
- Milk processors;
- Intensive animal industries and in particular beef feedlots;
- The regional and national trucking industry;
- Government at the Local, State and Federal levels; and
- Other specialist input suppliers over south eastern Australia.

The location of the proposed ethanol plant and dairy facility is within the CIA and close to the nearby Murrumbidgee Irrigation Area and the Murray Valley Irrigation Areas and districts. These intensive irrigation regions are major producers of a diverse range of grain crops as well as other forms of potentially suitable produce for an ethanol plant and other bio-fuel plants. Surrounding these areas are major dryland grain producing areas. The demand for grain in and around the proposed development is already significant and growers tend to be relatively buffered against market fluctuations because of the local demand. The production of ethanol is projected to require approximately 675,000 tonnes of high starch grains per year. This grain requirement is expected to create further local demand and place a relative floor in the price for regional grains.

Of particular interest is that grain may not only be accumulated throughout the immediate region, but also throughout the remainder of southern New South Wales and northern Victoria by existing grain buyers. These buyers may then contract to supply product which they have accumulated and have stored on a time delivery basis for the project usage. This supply strategy will minimise the quantum of product needed to be accumulated on the project site near harvest time.

The intensive animal industries in the Riverina region are well established and are also major purchasers of grain for the feeding of livestock. The production of wet and/or dry distillers grain as a by-product from the ethanol plant will be a ready and constant source of highly suitable product for input to particularly the beef feedlot and pig industries. To this extent one major feedlot has already made preliminary contact with the view to developing a longer term relationship for the purchase of distillers grain.

Fuel companies are obvious businesses which will be interested in a constant supply of large volumes of product where Quality Assurance (QA) standards are expected to be maintained, and the scale of operations will minimise the issues inherent in dealing with smaller and numerous other ethanol producers.

Ethanol plants require substantial volumes of water over the full twelve (12) month period of a year and the associated dairy will require substantial volumes of water for the cattle and their management. The project site consists of the amalgamation of three (3) additional areas to existing farms within the CIA. Coleambally Irrigation Co-operative Limited (CICL) is the privatised entity which has assumed responsibility for the supply and delivery of up to 600,000ML of water to over 600 Coleambally farms owned by the shareholders of CICL. CICL will be responsible for delivering water. Attached as Annexure 1.4.1 is recent correspondence from CICL affirming its keen interest to be involved with Four Arrows Ethanol Pty Ltd.



The trucking industry will be a major beneficiary in the accumulation and delivery to the site of a range of input products. This will include the grain and additives required for ethanol production, the delivery of ethanol from the plant, the wet brewer's grain and milk and the movement of a mix of products locally to and from the site.

The Coleambally and Darlington Point communities will be major beneficiaries, as will the larger regional communities including the city of Griffith and the towns Leeton and Narrandera etc. Each of these communities will provide housing and other support facilities for the employees of the ethanol plant and the dairy, as well as to all the service industries.

The proposed project will provide a major drawcard for labour workers and will also attract professional people such as veterinarians, engineers, technicians, animal nutrition specialists and quasi-technical type people. Such diversity in the professional and non-professional disciplines will add to the natural well-being of the communities and provide an attraction for subsequent generations to remain within these communities.

The involvement of government at the local, State and Federal level is obvious. The Federal Government Bio-fuels Action Plan has indicated a desire for the nation to produce 350ML per annum of bio-fuels by the year 2010. At 300ML of ethanol per annum, the Four Arrows Ethanol Pty Ltd project, subject to this EA is expected to produce 85% of the desired bio-fuels production, making it a highly significant project. Government at all levels may be expected to maintain a close liaison with the proposed facility. At a local level, the Shire of Murrumbidgee will be the immediate beneficiary, with benefits being felt within the City of Griffith and the Shires of Leeton, Narrandera, Jerilderie, Urana and Hay.

At a local level, the Four Arrows Ethanol Pty Ltd Management Group has "Tubbo" located in close proximity to the ethanol plant. "Tubbo" will be a major source of product to the ethanol plant as well as forages and other products for the dairy cattle to mix with the wet distillers grain. Furthermore, "Tubbo" at over 30,000ha, with 3,000ha of irrigation development, will be an excellent site to distribute the manure and manage other appropriate waste products from the dairy and ethanol plant.

Other businesses and industries to benefit will include, but not be limited to the following:

- The export of dairy heifers to the growing Asian market, which is demanding quality joined heifers;
- The potential to produce value added milk products on site and, subject to future investigations, to minimise the cartage of low value water found in milk products away from the site through the processing of milk powder;
- The provision of a visitor centre within the proposed development area will enhance the regional tourist industry; and
- The capture and compression of substantial volumes of carbon dioxide as a natural emission from the ethanol plant and for use in the carbonated beverage and other appropriate industries.

The proposed ethanol plant and integrated dairy will be a major boost to the overall regional development and will add to the level of commercial activity and depth and diversity of the structure of communities therein.



1.5 Approvals Process

In the preparation of this EA, as a major project for which Part 3A of the EP & A Act applies, various other acts and regulations have been reviewed to ensure compliance with relevant legislation. Section 75U of Division 4 of Part 3A of the Environmental Planning and Assessment Amendment (Infrastructure and Other Planning Reform) Act 2005 No. 43, identifies various approvals and legislation that do not apply for an approved project under Part 3A of the EP & A Act. Section 75V of Division 4, Application of other provisions of this and other Acts No. 43, identifies approvals and legislation that must be applied (ie cannot be refused) if necessary for carrying out an approved project under Part 3A of the EP & A Act.

Both of these sections are included below:

“75U Approvals etc legislation that does not apply

- (1) *The following authorisations are not required for an approved project (and accordingly the provisions of any Act that prohibit an activity without such an authority do not apply):*
 - (a) *the concurrence under Part 3 of the of the Minister administering that Part of the Act,*
 - (b) *a permit under section 201, 205 or 219 of the [Fisheries Management Act 1994](#),*
 - (c) *an approval under Part 4, or an excavation permit under section 139, of the [Heritage Act 1977](#),*
 - (d) *a permit under section 87 or a consent under section 90 of the [National Parks and Wildlife Act 1974](#),*
 - (e) *an authorisation referred to in section 12 of the [Native Vegetation Act 2003](#) (or under any Act to be repealed by that Act) to clear native vegetation,*
 - (f) *a permit under Part 3A of the [Rivers and Foreshores Improvement Act 1948](#),*
 - (g) *a bush fire safety authority under section 100B of the [Rural Fires Act 1997](#),*
 - (h) *a water use approval under section 89, a water management work approval under section 90 or an activity approval under section 91 of the [Water Management Act 2000](#).*
- (2) *Division 8 of Part 6 of the [Heritage Act 1977](#) does not apply to prevent or interfere with the carrying out of an approved project.*
- (3) *The following orders or notices cannot be made or given so as to prevent or interfere with the carrying out of an approved critical infrastructure project:*
 - (a) *an interim protection order (within the meaning of the [National Parks and Wildlife Act 1974](#) or the [Threatened Species Conservation Act 1995](#)),*
 - (b) *an order under Division 1 (Stop work orders) of Part 6A of the [National Parks and Wildlife Act 1974](#), Division 1 (Stop work orders) of Part 7 of the [Threatened Species Conservation Act 1995](#) or Division 7 (Stop work orders) of Part 7A of the [Fisheries Management Act 1994](#),*



- (c) an environment protection notice under Chapter 4 of the [Protection of the Environment Operations Act 1997](#),
- (d) an order under section 124 of the [Local Government Act 1993](#).

Note. Under the [National Parks and Wildlife Act 1974](#), actions that are essential for carrying out an approved project provide the same defence to actions relating to harm to native fauna (and threatened species) as a development consent under Part 4, or environmental assessment under Part 5, of this Act provide.

75V Approvals etc legislation that must be applied consistently

- (1) An authorisation of the following kind cannot be refused if it is necessary for carrying out an approved project and is to be substantially consistent with the approval under this Part:
 - (a) an aquaculture permit under section 144 of the [Fisheries Management Act 1994](#),
 - (b) an approval under section 15 of the [Mine Subsidence Compensation Act 1961](#),
 - (c) a mining lease under the [Mining Act 1992](#),
 - (d) a production lease under the [Petroleum \(Onshore\) Act 1991](#),
 - (e) an environment protection licence under Chapter 3 of the [Protection of the Environment Operations Act 1997](#) (for any of the purposes referred to in section 43 of that Act),
 - (f) a consent under section 138 of the [Roads Act 1993](#).
- (2) If:
 - (a) the Minister determines when giving approval for a concept plan under section 75P that approval to carry out the project or any particular stage of the project is to be subject to the other provisions of this Act, and
 - (b) development consent to carry out the project or that stage of the project is given under Part 4, an authorisation of the kind referred to in subsection (1) or section 75U (1) cannot be refused if it is necessary for carrying out the project or that stage of the project and is to be substantially consistent with the development consent.
- (3) This section does not apply to or in respect of:
 - (a) an application for the renewal of an authorisation or a renewed authorisation, or
 - (b) an application for a further authorisation or a further authorisation following the expiry or lapsing of an authorisation, or
 - (c) in the case of an environment protection licence under Chapter 3 of the [Protection of the Environment Operations Act 1997](#)—any period after the first review of the licence under section 78 of that Act.



- (4) *A reference in this section to an authorisation or approval includes a reference to any conditions of the authorisation or approval.*
- (5) *This section applies to a person, court or tribunal that deals with an objection, appeal or review conferred on a person in relation to an authorisation in the same way as it applies to the person giving the authorisation."*

Not all legislation identified in this section is directly relevant to the proposed development based on the above sections. Notwithstanding, all previously and currently relevant legislation has been reviewed to ensure satisfactory compliance where required, and that the overriding principles of legislation tabled for the protection of the environment is considered in the design and commissioning of the proposed development.

1.5.1 Local Planning Matters

1.5.1.1 Murrumbidgee Shire Local Environmental Plan 1994

General Aims and Objectives

The general aims of this plan are:

To encourage the proper management, development and conservation of natural and man-made resources within the Murrumbidgee area by protecting, enhancing and conserving –

- (i) *natural drainage lines;*
- (ii) *prior streams;*
- (iii) *prime crop and pasture land;*
- (iv) *timber, minerals, soil, water and other natural resources;*
- (v) *areas of significance for nature conservation;*
- (vi) *areas of high scenic or recreational value;*
- (vii) *places and buildings of archaeological or heritage significance, including aboriginal relics and places;*
- (viii) *the bed and banks of the Murrumbidgee River; and*
- (ix) *waterways and associated wetlands for their fish and fish habitat values; and*

To replace the existing planning controls with a single local environmental plan to help facilitate the growth and development of the Murrumbidgee Area in a manner which is consistent with the aims specific in paragraph (a) and which –

- (i) *minimises the cost to the community of fragmented and isolated development of rural land;*
- (ii) *facilitates the efficient and effective provision of amenities and services;*
- (iii) *facilitates a range of residential and employment opportunities in accordance with demand;*



- (iv) *facilitates farm adjustments;*
- (v) *ensures that the efficiency of arterial roads is not adversely affected by development on adjacent land; and*
- (vi) *provides for orderly development of tourist activities.*

Zoning

The proposed site located within Zoned 1(a) General Rural Zone as per the Murrumbidgee Local Environmental Plan (1994)

1. The objectives of Zone 1(a) are:

The objectives of this zone are to promote the proper management and utilisation of resources by:

- (a) *protecting, enhancing and conserving -*
 - (i) *natural drainage lines;*
 - (ii) *prior streams;*
 - (iii) *agricultural land in a manner which sustains its efficient and effective agricultural production potential;*
 - (iv) *soil stability by controlling and locating development in accordance with soil capability;*
 - (v) *forests of existing and potential commercial value for timber production;*
 - (vi) *valuable deposits of minerals, coal, petroleum and extractive materials by controlling the location of development for other purposes in order to ensure the efficient extraction of those deposits;*
 - (vii) *water resources for use in the public interest;*
 - (viii) *areas of significance for nature conservation, including areas with rare plants, wetlands and significant wildlife habitat; and*
 - (ix) *places and buildings of archaeological or heritage significance, including Aboriginal relics and places;*
- (b) *preventing the unjustified development of prime crop and pasture land for purposes other than agriculture;*
- (c) *facilitating farm adjustments;*
- (d) *minimising the cost of the community of –*
 - (i) *fragmented and isolated development of rural land; and*
 - (ii) *providing, extending and maintaining public amenities and services;*
- (e) *providing land for future urban development for, future rural residential development and for future development for other non-agricultural purposes, in accordance with the need for that development.*



2. *Without development consent Agriculture (other than animal boarding or training establishments, intensive livestock keeping establishments, land forming and sand hill vegetation clearing); forestry in accordance with a vegetation management plan.*
3. *Only with the development consent any purpose other than a purpose included in item 2 or 4.*
4. *Prohibited integrated housing development; motor showrooms; residential flat buildings; shops (other than general stores not exceeding 100 square metres in gross floor area); villa homes.*

General considerations for development within rural zones

1. *The Council shall not consent to an application to carry out developments on land within Zone No. 1(a), 1(c) or 1(d) unless it has taken into consideration, if relevant, the effect of the carrying out of that development on –*
 - (a) *the present use of the land, the potential use of the land for the purposes of agriculture and the potential for sustained agricultural production of any of that land which is prime crop and pasture land;*
 - (b) *vegetation, timber production, land capability (including soil resources and soil stability) and water resources (including the quality and stability of watercourses and groundwater storage and riparian rights);*
 - (c) *the future extraction of known valuable deposits of minerals, coal, petroleum, sand, gravel or other extractive materials and areas considered to be prospective of these materials;*
 - (d) *the protection of areas of significance for nature conservation or of high scenic or recreational value, and places and buildings of archaeological or heritage significance, including Aboriginal relics and places;*
 - (e) *the cost of providing, extending and maintaining public amenities and services to the development.*
 - (f) *future expansion of settlements in the locality; and*
 - (g) *where the land is within Zone No. 1(a) and within 400 metres of the bank of the Murrumbidgee River, the effect of the development on the riparian lands of that river.*

Development along arterial roads

1. *The Council shall not consent to an application to carry out development on land which has frontage to an arterial road unless –*
 - (a) *Access to that land is provided by a road other than the arterial road, wherever practicable; and*
 - (b) *in the opinion of the Council, the safety and efficiency of the arterial road will not be adversely affected by –*
 - (i) *The design of the access to the proposed development;*
 - (ii) *the emission of smoke or dust from the proposed development; or*
 - (iii) *the nature, volume or frequency of vehicles using the arterial road to gain access to the proposed development.*



2. The Council shall not consent to an application to carry out development on land within Zone No. 1(a) or (c) for any purpose listed in Schedule 3 if the development on the land for the purpose will have direct access to –

(a) an arterial road; or

(b) a road connecting an arterial road where the access to that road is within 90 metres (measured along the road alignment of the connecting road) of the alignment of the arterial road.

The Murrumbidgee Shire Council are relieved of their requirement to approve proposed developments based on this plan as the project is a Major Project as per the EP & A Act (1979). As such the Minister for the Department of Planning is the sole consent authority for this project.

1.5.1.2 Coleambally Land and Water Management Plan (LWMP)

The objective of the Coleambally Land and Water Management Plan was phrased as follows:

“To ensure the CIA remains a sustainable irrigation area and will address specifically the control of watertables and salinity, downstream effects of the CIA and future research needs for the area, and to ensure that the final plan is acceptable to the CIA landholders, townspeople of Coleambally, residents of those areas serviced by water from the CIA and any government instrumentalities associated with the CIA”.

This general objective was later complemented by six (6) more specific objectives:

Objective 1:

“Levels of productivity and profitability, together with the social well being of the community to be at least maintained to present levels”.

Objective 2:

“To control net recharge to the groundwater so that the area of land affected by salinity (defined as rootzone soil salinity not greater than 2dS/m ECe) does not exceed more than 15% of the total land area”.

Objective 3:

“To control the downstream effects of water quality by managing drainage discharges from farms and in the drainage system to be within conditions set by the EPA Pollution Control Licence”

Objective 4:

“To manage salt loads from the Coleambally Irrigation Area in accordance with agreed targets under the MDBC Salinity and Drainage Strategy”.



Objective 5:

"To control the external effects of groundwater flow from the Coleambally irrigation Area so that long term environmental impacts are minimised".

Objective 6:

"To address the decline in natural resource habitat within Coleambally and to maintain and, where possible to enhance existing ecological systems through appropriate drainage quantity and quality management".

The intended construction and operation of the proposed development does meet the objectives as outlined in the Coleambally LWMP.

1.5.2 State Planning Matters /Legislation

1.5.2.1 State Environmental Planning Policies

State Environmental Planning Policy No. 11 – Traffic Generating Developments

Rationalises consultation required in relation to traffic-generating developments. The policy establishes the Roads and Traffic Authority as the sole traffic management authority to be consulted, and ensures it is given the opportunity to make a representation on a development application before the local council decides whether to approve a proposal. The policy is being reviewed to remove requirements for unnecessary consultations.

The aims, objectives, policies and strategies of this Policy are to ensure that the Traffic Authority:

- (a) Is made aware of, and*
- (b) Is given an opportunity to make representations in respect of, development referred to in Schedule 1 or 2.*

The aims and objectives of SEPP11 have been met in the preparation of this EA.

**State Environmental Planning Policy No. 30 – Intensive Agriculture**

Requires development consent for cattle feedlots having a capacity of 50 or more cattle or piggeries having a capacity of 200 or more pigs. The policy sets out information and public notification requirements to ensure there are effective planning control over this export-driven rural industry. The policy does not alter if, and where, such development is permitted, or the functions of the consent authority.

The aims of this Policy are:

- (a) to require development consent for cattle feedlots having a capacity to accommodate 50 or more head of cattle, and piggeries having a capacity to accommodate 200 or more pigs or 20 or more breeding sows, and*
- (b) to provide for public participation in the consideration of development applications for cattle feedlots or piggeries of this size, and*
- (c) to require that, in determining a development application for cattle feedlots or piggeries of this size, the consent authority is to take into consideration:*
 - (i) the adequacy of information provided, and*
 - (ii) the potential for odour, water pollution and soil degradation, and*
 - (iii) measures to mitigate potential adverse impacts, and*
 - (iv) measures for the health and welfare of animals, and*
 - (v) relevant guidelines, so as to achieve greater consistency in environmental planning and assessment for cattle feedlots and piggeries.*

The aims of SEPP 30 outlined above have been met in the preparation of this EA. This EA seeks the appropriate approvals from the Department of Planning.

State Environmental Planning Policy No. 33 – Hazardous and Offensive Development

Provides new definitions for “hazardous industry”, “hazardous storage establishment”, “offensive industry” and “offensive storage establishment”. The definitions apply to all planning instruments, existing and future. The new definitions enable decisions to approve or refuse a development to be based on the merit of proposal. The consent authority must carefully consider the specifics of the case, the location and the way in which the proposed activity is to be carried out. The policy also requires specific matters to be considered for proposals that are “potentially hazardous” or “potentially offensive” as defined in the policy.

For example, any application to carry out a potentially hazardous or potentially offensive development is to be advertised for public comment, and applications to carry out potentially hazardous development must be supported by a preliminary hazard analysis (PHA).



The policy does not change the role of councils as consent authorities, land zoning, or the designated development provisions of the Environmental Planning and Assessment Act 1979.

The policy aims:

- (a) to amend the definitions of hazardous and offensive industries where used in environmental planning instruments, and*
- (b) to render ineffective a provision of any environmental planning instrument that prohibits development for the purpose of a storage facility on the ground that the facility is hazardous or offensive if it is not a hazardous or offensive storage establishment as defined in this Policy, and*
- (c) to require development consent for hazardous or offensive development proposed to be carried out in the Western Division, and*
- (d) to ensure that in determining whether a development is a hazardous or offensive industry, any measures proposed to be employed to reduce the impact of the development are taken into account, and*
- (e) to ensure that in considering any application to carry out potentially hazardous or offensive development, the consent authority has sufficient information to assess whether the development is hazardous or offensive and to impose conditions to reduce or minimise any adverse impact and*
- (f) to require the advertising of applications to carry out any such development*

The aims of SEPP 33 outlined above have been met in the preparation of this EA. A Preliminary Hazards Assessment has been undertaken in the preparation of this EA.

State Environmental Planning Policy No 52—Farm Dams and Other Works in Land and Water Management Plan Areas

Aims of Policy:

- (1) This Policy aims to require environmental assessment under Part 4 of the [Environmental Planning and Assessment Act 1979](#) of development for the purpose of artificial waterbodies (other than minor works in restricted locations) that will be carried out under farm plans that implement land and water management plans.*

Consequently, that development will be able to be lawfully carried out only with development consent granted by the council of the local government area in which it will be carried out and only after a statement of environmental effects or (in the case of large works or those on environmentally sensitive land) only after an environmental impact statement has been considered by the council.



- (2) *This Policy also aims to allow the carrying out of development without development consent for the purpose of the following:*
- (a) *small artificial waterbodies, such as those used for the purpose of storing water run-off for reuse, but only in locations restricted by this Policy,*
 - (b) *routine maintenance of irrigation channels, and the use of land for related access, whether or not a land and water management plan applies to the land concerned,*
 - (c) *emergency work on irrigation channels by irrigation corporations and their use of land for related access, whether or not a land and water management plan applies to the land concerned.*

The aims of SEPP 52 outlined above have been met in the preparation of this EA. The approvals required for the development to proceed are the sole responsibility of the Department of Planning as per a Part 3A project under the EP&A Act (1979).

State Environmental Planning Policy – (Major Projects) 2005

The aims of this Policy are as follows:

- (a) *to identify development to which the development assessment and approval process under Part 3A of the Act applies,*
- (b) *to identify any such development that is a critical infrastructure project for the purposes of Part 3A of the Act.*
- (c) *To facilitate the development, re-development or protection of important urban, coastal and regional sites of economic, environmental or social significance to the State so as to facilitate the orderly use, development or conservation of those State significant sites for the benefit of the State.*
- (d) *To facilitate service delivery outcomes for a range of public services and to provide for the development of major sites for a public purpose or re-development of major sites no longer appropriate or suitable for public purposes.*
- (e) *To rationalise and clarify the provisions making the Minister the approval authority for development and sites of State significance, and to keep those provisions under review so that the approval process is devolved to council when State planning objectives have been achieved.*

Section 75B, *Kinds of Projects*, of the EP&A Act makes provision for major projects “to be identified through various means, including of development that in the opinion of the Minister is of State or Regional Environmental Planning significance or by way of order by Minister published in a gazette or declaration in State Environmental Planning Policy specifically Major Projects 2005 (SEPP 2005)”.



Schedule 1 of SEPP 2005 identifies classes of development which are major projects. Specifically Group 1 Sub-group 3 of Schedule 1 refers to Agricultural Produce Industry and Food and Beverage Processing including Ethanol Plants. In conjunction, Group 1 Sub-section 1 of Schedule 1 also triggers the proposal as a Major Project given the Dairy is an intensive livestock industry development that employs twenty (20) or more people.

Consequently, having triggered these categories the development is therefore classified as a Major Project under SEPP 2005 and the Minister for Planning is the sole approval authority.

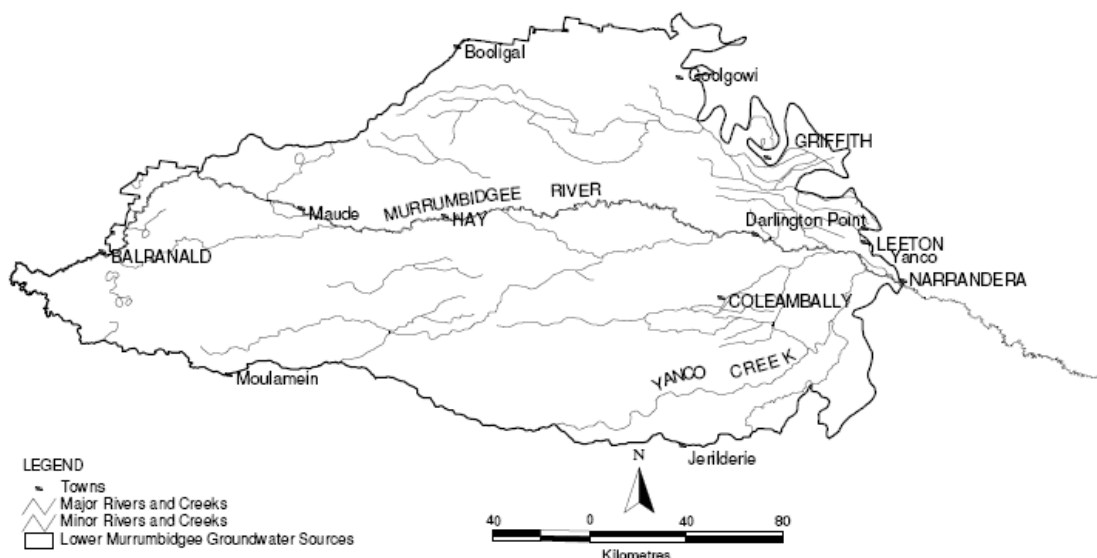
The aims of SEPP (Major Projects) 2005 constitute the basis for preparation of this EA.

1.5.2.2 Lower Murrumbidgee Groundwater Source – Water Sharing Plan

This plan covers land within the Murrumbidgee, Lachlan and Murray Water Management Areas known as the Lower Murrumbidgee Groundwater Sources as shown on the map below.

Note: The Murrumbidgee, Lachlan and Murray Water Management Areas are shown on the map

Map: Sharing Plan for the Lower Murrumbidgee Groundwater Sources 2003





The objectives of this Plan are:

- (a) share groundwater sustainably between users and the environment,*
- (b) share groundwater equitably amongst extractive users,*
- (c) provide for basic landholder rights and priorities of use,*
- (d) protect groundwater quality,*
- (e) maximise the social, economic and environmental benefits of groundwater management strategies, and*
- (f) minimise the negative social and economic impacts of groundwater management strategies.*

The objectives of this plan have been considered throughout the investigation of groundwater issues and preparation of appropriate mitigation strategies arising from the proposed development.

1.5.2.3 *Protection of the Environment Operations Act 1997*

The objectives of this Act are as follows:

- (a) to protect, restore and enhance the quality of the environment in New South Wales, having regard to the need to maintain ecologically sustainable development,*
- (b) to provide increased opportunities for public involvement and participation in environment protection.*
- (c) to ensure that the community has access to relevant and meaningful information about pollution,*
- (d) to reduce risks to human health and prevent the degradation of the environment by the use of mechanisms that promote the following:*
 - 1. pollution prevention and cleaner production,*
 - 2. the reduction to harmless levels of the discharge of substances likely to cause harm to the environment,*
 - 3. the elimination of harmful wastes,*
 - 4. the reduction in the use of materials and the re-use or re-cycling of materials,*
 - 5. the making of progressive environmental improvements, including the reduction of pollution at source*
 - 6. the monitoring the reporting of environmental quality on a regular basis*
- (e) to rationalise, simplify and strengthen the regulatory framework for environment protection.*



- (f) to improve the efficiency of administration of the environment protection legislation,
- (g) to assist in the achievement of the objectives of the Waste Avoidance and Resource Recovery Act 2001.

The objectives outlined above have been considered throughout the investigations and preparation of the EA for the proposed development, and appropriate licences required identified to ensure adherence to the POEO Act objectives

1.5.2.4 Native Vegetation Act 2003

Part 1 Preliminary

Objectives of Act

The objectives of this Act are:

- (a) to provide for, encourage and promote the management of native vegetation on a regional basis in the social, economic and environmental interests of the State, and
- (b) to prevent broadscale clearing unless it improves or maintains environmental outcomes, and
- (c) to protect native vegetation of high conservation value having regard to its contribution to such matters as water quality, biodiversity, or the prevention of salinity or land degradation, and
- (d) to improve the condition of existing native vegetation, particularly where it has high conservation value, and
- (e) to encourage the revegetation of land, and the rehabilitation of land, with appropriate native vegetation, in accordance with the principles of ecologically sustainable development.

Part 2 Key concepts

Meaning of Native Vegetation

- 1) For the purposes of this Act, **native vegetation** means any of the following types of indigenous vegetation:
 - (a) trees (including any sapling or shrub, or any scrub),
 - (b) understorey plants,
 - (c) ground cover (being any type of herbaceous vegetation),
 - (d) plants occurring in a wetland.
- 2) Vegetation is **Indigenous** if it is of a species of vegetation, or if it comprises species of vegetation, that existed in the State before European settlement.



- 3) For the purposes of this Act, **native vegetation** does not include any mangroves, seagrasses or any other type of marine vegetation to which section 205 of the Fisheries Management Act 1994 applies

The proposed development does not impact on the environment in any way that is contradictory to the aims and objectives of the Native Vegetation Act 2003.

1.5.2.5 Roads Act 1993

The objectives of this Act are:

- (a) To set out the rights of members of the public to pass along public roads, and*
- (b) To set out the rights of persons who own land adjoining a public road to have access to the public road, and*
- (c) To establish the procedures for the opening and closing of a public road, and*
- (d) To provide for the classification of roads, and*
- (e) To provide for the declaration of the RTA and other public authorities as roads authorities for both classified and unclassified roads, and*
- (f) To confer certain functions (in particular, the function of carrying out roadwork) on the RTA and on other roads authorities, and*
- (g) To regulate the carrying out of various activities on public roads.*

Consent under Section 138 of the Roads Act is no longer required for a Part 3A project as per the EP & A Act (1979). The Act has been considered in driving consultation with the RTA during EA preparation.

1.5.2.6 Water Management Act 2000

The objectives of this Act are to provide for the sustainable and integrated management of the water sources of the State for the benefit of both present and future generations and, in particular

- (a) To apply the principles of ecologically sustainable development, and*
- (b) To protect, enhance and restore water sources, their associated ecosystems, ecological processes and biological diversity and their water quality, and*



- (c) *To recognise and foster the significant social and economic benefits to the State that result from the sustainable and efficient use of water, including:*
 - (i) *Benefits to the environment, and*
 - (ii) *Benefits to urban communities, agriculture, fisheries, industry and recreation, and*
 - (iii) *Benefits to culture and heritage, and*
 - (iv) *Benefits to the Aboriginal people in relation to their spiritual, social, customary and economic use of land and water.*
- (d) *to recognise the role of the community, as a partner with government, in resolving issues relating to the management of water sources,*
- (e) *to provide for the orderly, efficient and equitable sharing of water from water sources,*
- (f) *to integrate the management of water sources with the management of other aspects of the environment, including the land, its soil, its native vegetation and its native fauna,*
- (g) *to encourage the sharing of responsibility for the sustainable and efficient use of water between the Government and water users,*
- (h) *to encourage best practice in the management and use of water.*

The Principles of Ecologically Sustainable Development outlined in this EA ensure the proposed development meets with the objectives of this Act.

1.5.2.7 *National Parks and Wildlife Act 1974*

The objectives of this Act are as follows:

- (a) *The conservation of nature, including, but no limited to, the conservation of:*
 - (i) *habitat, ecosystems and ecosystem processes, and*
 - (ii) *biological diversity at the community, species and genetic levels, and*
 - (iii) *landforms of significance, including geological features and processes, and*
 - (iv) *landscapes and natural features of significance including wilderness and wild rivers,*
- (b) *the conservation of objects, places or features (including biological diversity) of cultural value within the landscape, including, but not limited to:*
 - (i) *places, objects and features of significance to Aboriginal people, and*
 - (ii) *places of social value to the people of New South Wales, and*
 - (iii) *places of historic, architectural or scientific significance,*



- (c) *fostering public appreciation, understanding and enjoyment of nature and cultural heritage and their conservation,*
- (d) *providing for the management of land reserved under this Act in accordance with the management principles applicable for each type of reservation.*

The objectives of this Act are to be achieved by applying the principles of ecologically sustainable development.

In carrying out functions under this Act, the Minister, the Director-General and the Service are to give effect to the following:

- (a) *the objects of this Act,*
- (b) *the public interest in the protection of the values for which land is reserved under this Act and the appropriate management of those lands.*

No land protected by the NP&W Act (1974) or potentially managed by this Act will be affected by the issues identified in this EA.

1.5.2.8 *The Heritage 1977 Act*

136 Order restricting harm to buildings etc

- (1) *Where the Minister or the Chairperson of the Heritage Council is of the opinion that a building, work, relic or place (not being a building, work, relic or place the subject of an interim heritage order or listing on the State Heritage Register) is being or is about to be harmed, he or she may order that any work being carried out with respect to that building, work, relic or place shall cease and that no work, other than such work as may be specified in his or her order, shall be carried out with respect to that building, work, relic or place within a period of 40 days after the date of his or her order.*
- (2) *An order made by the Minister or the Chairperson of the Heritage Council under subsection (1) shall take effect on and from the date on which a copy of that order is affixed to the building, work, relic or place the subject of that order.*
- (3) *Where the Minister makes an order under subsection (1), the Minister shall immediately request the Heritage Council to furnish to him or her, within the period of 40 days after the date of that order, advice with respect to the making of an interim heritage order in respect of the building, work, relic or place the subject of his or her order.*
- (4) *The Heritage Council shall comply with the Minister's request.*
- (5) *Where the Chairperson of the Heritage Council makes an order under subsection (1), he or she shall take all such steps as are necessary to enable the Heritage Council to furnish to the Minister, within the period of 40 days after the date of that order, advice with respect to the making of an interim heritage order in respect of the building, work, relic or place the subject of his or her order.*



- (6) *The Minister may revoke an order made under subsection (1) at any time after the Minister has received the advice or recommendation of the Heritage Council under subsection (3) or (5) but only during the period of 40 days after the date of that order.*

Division 9 Protection of certain relics

139 Excavation permit required in certain cases

- (1) *A person must not disturb or excavate any land knowing or having reasonable cause to suspect that the disturbance or excavation will or is likely to result in a relic being discovered, exposed, moved, damaged or destroyed unless the disturbance or excavation is carried out in accordance with an excavation permit.*
- (2) *A person must not disturb or excavate any land on which the person has discovered or exposed a relic except in accordance with an excavation permit.*
- (3) *This section does not apply to a relic that is subject to an interim heritage order made by the Minister or a listing on the State Heritage Register.*
- (4) *The Heritage Council may by order published in the Gazette create exceptions to this section, either unconditionally or subject to conditions, in respect of any of the following:*
- (a) any relic of a specified kind or description,*
 - (b) any disturbance or excavation of a specified kind or description,*
 - (c) any disturbance or excavation of land in a specified location or having specified features or attributes,*
 - (d) any disturbance or excavation of land in respect of which an archaeological assessment approved by the Heritage Council indicates:*
 - (e) that there is little likelihood of there being any relics in the land, or*
 - (i) that any relics in the land are unlikely to have State or local heritage significance.*
- (5) *This section does not prevent a person from disturbing or excavating land in which a historic shipwreck is situated in accordance with a historic shipwrecks permit in force in respect of that shipwreck.*

Sections of the Heritage Act previously referred to for project approval no longer apply to a Part 3A project as per the EP&A Act (1979). Heritage matters onsite have been considered however based on the overall aims and objectives of the Heritage Act 1977.



1.5.2.9 Fisheries Management Act 1994 No. 38

The objectives of this Act are to conserve, develop and share the fishery resources of the State for the benefit of present and future generations.

In particular, the objects of this Act include:

- (a) to conserve fish stocks and key fish habitats, and*
- (b) to conserve threatened species, populations and ecological communities of fish and marine vegetation, and*
- (c) to promote ecologically sustainable development, including the conservation of biological diversity, and, consistently with those objects:*
- (d) to promote viable commercial fishing and aquaculture industries, and*
- (e) to promote quality recreational fishing opportunities, and*
- (f) to appropriately share fisheries resources between the users of those resources, and*
- (g) to provide social and economic benefits for the wider community of New South Wales.*

Note: *At common law, the public has a right to fish in the sea, the arms of the sea and in the tidal reaches of all rivers and estuaries. The public has no common law right to fish in non-tidal waters—the right to fish in those waters belongs to the owner of the soil under those waters. However, the public may fish in non-tidal waters if the soil under those waters is Crown land. In the case of non-tidal waters in rivers and creeks, section 38 declares that the public has a right to fish despite the private ownership of the bed of the river or creek. However, the right to fish in tidal or non-tidal waters is subject to any restriction imposed by this Act.*

The proposed development does not affect resources protected or impacted by this Act.

1.5.2.10 Rural Fires Act 1997

The objectives of this Act are to provide:

- (a) for the prevention, mitigation and suppression of bush and other fires in local government areas (or parts of areas) and other parts of the State constituted as rural fire districts, and*
- (b) for the co-ordination of bush fire fighting and bush fire prevention throughout the State, and*
- (c) for the protection of persons from injury or death, and property from damage, arising from fires, and*



- (d) *for the protection of the environment by requiring certain activities referred to in paragraphs (a)–(c) to be carried out having regard to the principles of ecologically sustainable development described in section 6 (2) of the Protection of the Environment Administration Act 1991.*

The proposed development has been assessed against the principles of ecologically sustainable development as identified in objective (d) above.

1.5.2.11 EP & A Act (1979)

The Environmental Planning and Assessment (EP&A Act 1979 & EP&A Regulation 2000) provides the framework for Environmental Planning in NSW. A detailed assessment of likely impacts of the project must be undertaken prior to any decision to proceed with the proposal that has potential for impact on the environment. Part 3A of the EP&A Act outlines the processes and points of consideration by approval authorities when determining a potential project impact and whether a project should be approved. In this instance the proposed project is defined as a major project under the provision of the EP & A Act and State Environmental Planning Policy (Major Projects) 2005.

This EA has been prepared as per the requirements of this Act.

1.5.2.12 Threatened Species Conservation Act 1995

The objects of this Act are as follows:

- (a) *to conserve biological diversity and promote ecologically sustainable development, and*
- (b) *to prevent the extinction and promote the recovery of threatened species, populations and ecological communities, and*
- (c) *to protect the critical habitat of those threatened species, populations and ecological communities that are endangered, and*
- (d) *to eliminate or manage certain processes that threaten the survival or evolutionary development of threatened species, populations and ecological communities, and*
- (e) *to ensure that the impact of any action affecting threatened species, populations and ecological communities is properly assessed, and*
- (f) *to encourage the conservation of threatened species, populations and ecological communities by the adoption of measures involving co-operative management.*



The proposed development as assessed does not negatively impact or contradict the objectives of this Act.

1.5.3 Federal Planning Matters /Legislation

1.5.3.1 Murray–Darling Basin Act 1992

The proposed project utilises water from the Murray –Darling river system in accordance with a licence issued under the Water Management Act 2000 and would have no significant effect on the flow, use and control of water in the River Murray. Therefore the referral provisions of the MDBA do not apply to the project.

1.5.3.2 Environment Protection and Biodiversity Conservation Act 1999

The objectives of this Act are:

- (e) to provide for the protection of the environment, especially those aspects of the environment that are matters of national environmental significance; and*
- (f) to promote ecologically sustainable development through the conservation and ecologically sustainable use of natural resources; and*
- (g) to promote the conservation of biodiversity; and*
 - (i) to provide for the protection and conservation of heritage; and*
- (h) to promote a co-operative approach to the protection and management of the environment involving governments, the community, land-holders and indigenous peoples; and*
- (i) to assist in the co-operative implementation of Australia's international environmental responsibilities; and*
- (j) to recognise the role of indigenous people in the conservation and ecologically sustainable use of Australia's biodiversity; and*
- (k) to promote the use of indigenous peoples' knowledge of biodiversity with the involvement of, and in co-operation with, the owners of the knowledge.*

In order to achieve its objects, the Act:

- (a) recognises an appropriate role for the Commonwealth in relation to the environment by focussing Commonwealth involvement on matters of national environmental significance and on Commonwealth actions and Commonwealth areas; and*



- (b) strengthens intergovernmental co-operation, and minimises duplication, through bilateral agreements; and*
- (c) provides for the intergovernmental accreditation of environmental assessment and approval processes; and*
- (d) adopts an efficient and timely Commonwealth environmental assessment and approval process that will ensure activities that are likely to have significant impacts on the environment are properly assessed; and*
- (e) enhances Australia's capacity to ensure the conservation of its biodiversity by including provisions to:*
 - (i) protect native species (and in particular prevent the extinction, and promote the recovery, of threatened species) and ensure the conservation of migratory species; and*
 - (ii) establish an Australian Whale Sanctuary to ensure the conservation of whales and other cetaceans; and*
 - (iii) protect ecosystems by means that include the establishment and management of reserves, the recognition and protection of ecological communities and the promotion of off-reserve conservation measures; and*
 - (iv) identify processes that threaten all levels of biodiversity and implement plans to address these processes; and*
- (f) includes provisions to enhance the protection, conservation and presentation of world heritage properties and the conservation and wise use of Ramsar wetlands of international importance; and*
 - (i) includes provisions to identify places for inclusion in the National Heritage List and Commonwealth Heritage List and to enhance the protection, conservation and presentation of those places; and*
- (g) promotes a partnership approach to environmental protection and biodiversity conservation through:*
 - (i) bilateral agreements with States and Territories; and*
 - (ii) conservation agreements with land-holders; and*
 - (iii) recognising and promoting indigenous peoples' role in, and knowledge of, the conservation and ecologically sustainable use of biodiversity; and*
 - (iv) the involvement of the community in management planning*

Whilst specific localities, habitats and species protected by this Act have been identified during the investigation phase, no impacts on identified localities, habitats or species will result to contradict the objectives of the EPBC Act (1999).



1.6 Environmental Assessment Structure

Pursuant to sections 75F of the EP&A Act, an environmental assessment must be prepared as per the requirements of the Director General of the Department of Planning. These requirements are prepared in consultation with relevant public authorities and incorporate requirements for assessment of any key issues raised by those public authorities.

Our request for these requirements was made by the submission of a Part 3A Application and was forwarded to the Department of Planning on 20 January 2006. The Director General's requirements which also include requirements from the Department of Environmental and Conservation (DEC), the Department of Natural Resources (DNR), the Roads and Traffic Authority (RTA) were issued on the 24 January 2006.

It is noted under Section 75F(3) of the EP&A Act 1979, the Director General may alter or supplement these requirements if necessary. A copy of the Director General requirements is enclosed as Annexure 1.6.1.



2.0 ISSUES IDENTIFICATION AND PRIORITISATION

2.1 Overview

The basis of this EA is primarily concerned with the prediction and scientific assessment of impacts that the proposed ethanol production plant and dairy enterprise may have on the environment and human welfare. Also included in this process is the formulation of mitigation practices that may be pursued to abate any undesirable outcomes. The EA process embraces the identification of issues and concerns from a multitude of sources.

It is crucial to the EA's success that a comprehensive and informative process be applied that will trigger an array of data sources providing information concerning potential issues and the possibility of negative outcomes. It is desirable that an EA examine a complement of issues, which may even result in a no impact conclusion, rather than fragmented issues which result in areas not being considered at all.

It is understood each situation is unique and the aspects which may be influenced by a development have inherent and endemic qualities which must be examined separately in each case. Each system reacts differently when the factors of development are applied.

Stakeholders involved in the on-going issue identification process came from two (2) distinct sectors of the community:

- Those agencies who will directly affect the planning, design, implementation and monitoring of the proposed activities; and
- Those individuals directly affected by environmental variations brought about by the development, primarily neighbouring properties within a 5km zone.

Consideration has also been given to those stakeholders who are indirectly affected by the development which include:

- Those influenced from upgraded infrastructure;
- Individuals whose financial status may be varied due to increased economic activity in the local area; and
- Organisations such as Councils that will be required to provide services etc.

Major areas of concern were generated from an initial Planning Focus Meeting (PFM) where all appropriate agencies were invited to identify and assess the issues they thought would eventuate from the construction and operation of the ethanol and dairy enterprises. All concerns were noted by Booth Associates for consideration and inclusion as points for investigation. The PFM has delivered to the agencies a comprehensive understanding of the development and the opportunity to assess the issues which may be involved. This identification and education process assisted in generating issues that were submitted by each individual department and which later became the Director General's specifications, providing topics to be addressed by this EA.

Similar meetings were conducted on an individual basis with other stakeholders who comprised of property owners within a 5km radius of the development. This community consultation process involved interested parties being visited and introduced to the proposed development and supplied with relevant data. Additional information was further supplied upon request. All concerns were recorded and cross-referenced with those identified by individual agencies. Any auxiliary issues which were identified were then investigated.



The Development Application process will also give stakeholders and the greater community opportunity for comment on the EA and the Development Proposal in its entirety, assuring that all relevant issues have been identified and explored in appropriate depth. This process ensures that abatement and mitigation measures can be developed to counteract all foreseeable vagaries which may result from the development.

2.1.1 Stakeholder Consultation

2.1.1.1 Planning Focus Meeting

A Planning Focus Meeting (PFM) was held at Darlington Point on 2 December 2005, and was attended by the following personnel.

Table 2.1.1: Attendees at Planning Focus Meeting

Name	Representing
Mr C Ritchie	NSW Department of Planning
Mr C Bretherton	NSW Department of Environment and Conservation
Ms J Barnes	NSW Department of Environment and Conservation
Mr D Davis	NSW Department of Primary Industries
Mr K O'Keeffe	NSW Department of Primary Industries
Mr W Cowley	NSW Department of State and Regional Development
Mr R Boyd	Murrumbidgee Shire Council
Mr W Booth	Booth Associates
Mr S Lee	Booth Associates
Mr P Wells	Murrumbidgee Shire Council
Mr P Goodsall	Murrumbidgee Shire Council
Mr J Byrnes	Four Arrows Rural Manager
Mr A Hayes	Farm Manager for Tubbo Station

The PFM provided opportunity for an informative presentation of the proposed development and discussion and identification of the issues to be included in the Director General's specifications issued by the Department of Planning. The issues noted by Booth Associates on the day are included within the following table:

Table 2.1.2: PFM Issues and Concerns

PFM OUTCOMES	DOP	DPI	DSRD	DEC	DNR	RTA	ARTC	MSC	SECTION
Community Consultation									
▪ Ensure comprehensive community consultation process	✓								2.1.1.3
General									
▪ The inclusion of sufficient detail within the EA document including scale of development, figures and pictures.	✓								3.0
Security									
▪ What are the provisions for the abatement of terrorism?	✓								4.10
Traffic									
▪ The inclusion and close liaison with RTA to design efficient and effective mitigation solutions for increased traffic volumes.	✓								4.4
▪ Address transportation relative to RTA requirements.		✓							4.4
Environmental									
▪ Conduct comprehensive threatened species assessments.	✓								4.12
▪ Address the disposal and possible uses for effluent.					✓				4.8.4



PFM OUTCOMES	DOP	DPI	DSRD	DEC	DNR	RTA	ARTC	MSC	SECTION
▪ Include on-site waste water management infrastructure and strategy.					✓				4.5
▪ Address issues that may affect the surrounding environment/enterprises and mitigation strategies					✓				4.0
▪ Include comment on visual amenity of development and structures.					✓				4.9
▪ Investigate links to renewable energy suppliers in the area.					✓				N/A
▪ Address water balances and water discharge from site.				✓					4.1
▪ Address waste water infrastructure and management strategies.				✓					4.5
▪ What is the impact on adjoining enterprises?		✓							4.0
▪ Include envisaged noise and odour levels and mitigation strategies.				✓					4.2, 4.3, 5.2, 5.3
▪ Address the protection of natural flora and fauna species including strategies to achieve this end.				✓					5.9
By-Products									
▪ Waste product/effluent disposal contracts are long term and secure.	✓								4.8
▪ Investigate methane production levels and the feasibility of methane capture.		✓							4.14
Resources		✓							CIC
▪ Questions feed source and security.		✓							CIC
▪ Comment on the reliance of grain only inputs.		✓							CIC
▪ Investigate supply chains.					✓				CIC
Economic									
▪ What is the benefit to local growers when sourcing inputs?			✓						5.11.3
▪ What is the benefit to local communities?		✓							5.11.3
▪ Concessions from government organisations, particularly local councils.		✓							CIC
▪ How secure are product markets for brewer's grain etc?			✓						CIC
Water Balance									
▪ Include water balance requirements for ethanol and dairy enterprises.					✓				4.1
Animal Welfare									
▪ Address feed quality and nutrient balances.		✓							4.1.3
▪ Include water balance calculations		✓							4.1
▪ Inclusion of quarantine strategy.		✓							4.11.2
▪ Address strategy for disease outbreaks and disposal of affected stock.		✓							4.11.2
▪ Address general animal welfare, particularly housing, movements and spelling facilities.		✓							4.11
Effluent									
▪ Address effluent production, management and disposal.		✓							4.8.4
Infrastructure									
▪ Include emergency provisions for power and water especially for dairy enterprise.		✓							3.3./1.4
▪ Investigate additions and upgrade necessary to provide gas supply								✓	3.3.3.1
NB: ARTC and RTA did not attend PFM									
DOP = Department of Planning			DPI = Department of Primary Industries						
DSRD = Department of State and Regional Development			DEC = Department of Environment and Conservation	CIC = commercial in confidence					
DNR = Department of Natural Resources			MSC = Murrumbidgee Shire Council						
RTA = Roads and Traffic Authority			ARTC = Australian Rail Track Corporation						



The table includes the Agencies which expressed concern about the identified issues. To ensure that each issue has been appropriately addressed the corresponding Section No. has also been included within the table.

2.1.1.2 Agencies' Submissions

The relevant agencies have formulated and submitted their specific requirements to the Department of Planning for consideration and evaluation which comprised the Director General's specifications for this Four Arrows' development being an ethanol production facility and complementary dairy enterprise.

An abbreviated version of the specific requirements of each Agency has been included within the table below along with the corresponding section number to ensure all issues and concerns have been addressed. The full documentation has been included as Annexures 2.1.1, 2.1.2 and 2.1.3.

Table 2.1.3: Agencies' Specific Issues

SPECIFIC ISSUES	DOP	DPI	DSRD	DEC	DNR	RTA	ARTC	MSC	SECTION
<u>Environmental Impacts</u>				✓					4.2
▪ Air				✓					4.3
▪ Noise/Vibration				✓					4.3
▪ Water - Water Quality				✓					4.5
Wastewater				✓					4.5
Stormwater				✓					4.5
Groundwater				✓					4.5
▪ Waste and Chemicals – management strategies for the treatment and disposal/utilisation of all liquid and solid wastes generated by the proposed activities.				✓					4.8
▪ Mitigation and Management Operations to reduce risks to human health and prevent degradation of the environment.				✓					5.0
<u>Impact on Threatened Species and Habitat</u>				✓					4.12
<u>Impact on Aboriginal Cultural Heritage Values</u>				✓					4.13
<u>Effluent and Waste Management</u>					✓				4.8
▪ Details of all solid and liquid wastes that will be stored on-site					✓				4.8
▪ Details of the proposed management system for the solid and liquid wastes from the operation of enterprises which should include all methods to reuse/recycle waste streams.					✓				4.8
▪ Details of the design and location of detention or evaporation basins or other structural works required to store wastes.					✓				3.3
▪ Details of stormwater management on all waste storage and disposal (reuse) areas.					✓				4.1 4.5
▪ Potential issues with surrounding landholders and water licence holders, and identify any impacts associated with the construction of water or effluent storages.					✓				4.5
<u>Groundwater Management Issues</u>					✓				5.5.2
▪ Details of the groundwater aquifers below the site, or those likely to be affected by the proposal.					✓				5.5.2
▪ Details to identify potential sources and pathways for pollution including contamination from seepage through stormwater, effluent or solid waste storage or reuse areas.					✓				4.5.3
▪ Details on proposed mitigation measures to ensure there is to be no contamination of groundwater resources as a result of the proposed development					✓				5.5.2
▪ Details of any proposed groundwater monitoring proposal. Groundwater monitoring information must provide the following details for any proposed					✓				



SPECIFIC ISSUES	DOP	DPI	DSRD	DEC	DNR	RTA	ARTC	MSC	SECTION
monitoring bore: - The location of any proposed monitoring bores/piezometers. - The depth of any proposed monitoring bores/piezometers. - The rationale for the proposed location and depths of monitoring bores.									5.5.2
Native Vegetation ▪ Detail the vegetation present on the site, and any proposed vegetation management activities. If native vegetation is to be cleared or damaged as a result of the development, then any impacts need to be identified.					✓				4.12.2 5.9.1
Soil and Water Management ▪ Details of sediment and erosion control measures to be put in place during construction.					✓				5.2.2
Visual Impact ▪ Visual impact from the Kidman Way may be softened by using native vegetation buffer zones adjoining the proposed development					✓				5.7
Traffic Impact ▪ Types and volumes of vehicles to be used.						✓			4.4.4
▪ The direction of travel of all vehicles entering and exiting the site.						✓			4.4.4
▪ AADT (annual average daily traffic) on key streets.						✓			4.4.3.2
▪ Peak period traffic volumes and congestion levels at key adjacent intersections.						✓			4.4.3.2
▪ Hours and days of operation.						✓			4.4.3.4
▪ Safety and efficiency of the internal road layout.						✓			4.4.4
▪ Impact of generated traffic on key adjacent intersections, the environment and other major traffic generating developments in close proximity.						✓			4.4.5
▪ Accident history of road network in the area.						✓			4.4.4
▪ Access location and width.						✓			4.4.3.7
▪ Sight distance at access location						✓			4.4.5
▪ Assessment of traffic noise and dust effects.						✓			4.3

2.1.1.3 Community Consultation

The community consultation process involved neighbours living within a 5km radius of the development who are most likely to be directly, physically and economically affected by the enterprise. Members of local organisations such as Council and Chamber of Commerce were also contacted and briefed.



A detailed list of contacts and responses has been included within the following tables:

Table 2.1.4: Surrounding Communities' Members Contacted for Consultation

Name	Farm No.	Date	Comment
BJ Kelly	7	03/04/06	No answer left message on answering machine.
TA Rawson	14	03/04/06	No answer left message on answering machine.
PJ Robb	6	03/04/06	No answer left message on answering machine.
NR Seargeant	34	03/04/06	No answer.
GR & DM Druitt	38	03/04/06	Recording - no connection.
GR & DM Briggs	40	03/04/06	Interested in meeting. Busy as rice harvest is on. Will call back if they can fit in meeting.
JB Hogan	143	03/04/06	Appointment Friday 07/04/06.
NG & F Schliebs	142	03/04/06	Appointment Friday 07/04/06.
KJ Guest	643	03/04/06	Recording – no connection.
PD & MM Toscan	69	03/04/06	Call back if interested.
IF & LF Evans	39	03/04/06	No answer left message on phone.
BA Oliver	88 Muntz Lane	03/04/06	Recording - no connection.
ME Sheppard	108	03/04/06	No answer.
VM Bellato	PO Box 88	03/04/06	Appointment Friday 07/04/06.
BR Cobden	78	03/04/06	Recording – no connection.
WJ Boag		03/04/06	Recording – no connection.
AJ & J Toscan	Sturt Highway	03/04/06	Not interested in seeing anyone.
RH & SJ Black	PO Box 69	03/04/06	No answer left message.
D Hopwood	31	03/04/06	No answer left message.
KM & KF Naseby	19	03/04/06	Call back if interested.
VH Whelan	34 Currawong Crescent	03/04/06	Recording – no connection
NJ Wiseman	23 Kingfisher Avenue	03/04/06	Appointment Friday 07/04/06.
RL & DM Gray	PO Box 107	03/04/06	Recording – no connection.
MP & PM Witham	Mundoora	03/04/06	No answer – left message.
BT Mannes	107	03/04/06	Appointment Friday 07/04/06.
DJ & CA Hardy	507	03/04/06	Appointment Friday 07/04/06.
A & J Jackson	Uralla road	03/04/06	Interested. Will call back.


Table 2.1.5: Surrounding Communities Responses

Name	Address	Outcome
Mr & Mrs B Hogan	Farm 143 Hogan Lane 07/04/06	- General briefing and chat. - Major concerns are odour, flies and traffic. - Understood the nature of project. - Required copy of EPA guidelines. - Faxed copy of EPA web address. - Will contact again if needs more information. - Keen to purchase manure and to supply grain/silage/etc. - Keen to see project proceed if concerns are addressed.
Mr & Mrs Bellato	Farm 146 Jimmy Cull Road 07/04/06	- General briefing and chat. - Keen to understand principles of project. - Keen to supply products to project at right price. - Keen to see project proceed.
Mr & Mr L Chirgwin	Coleambally Saltbush Native Nursery 643 Rosewood Road 07/04/06	- General briefing and chat. - Keen to understand project. - Concerns over odour, flies and traffic but thought these issues not insurmountable. - Keen to supply nursery material and provide project landscaping. - Keen to see project proceed.
Mr & Mrs K Mannes Mr S Mannes Mr J Mannes	Farm 106 Prickley Road 07/04/06	- General briefing and chat. - Keen to understand project - Concerns over flooding, odour, flies and traffic but could see how issues could be managed by project operations. - Keen to see project proceed and to supply grain/silage/etc.
Mr J Wiseman	Farm 95 Main Channel Road 07/04/06	- General briefing and chat. - No particular concerns other than issues of establishment rumour of plant. - Keen to see it go ahead. No negativity.
Mr N Schliebs	Farm 142 Hogan Lane 07/04/06	- Concerned about odour and noise. - Happy to see plant established on northern end of site. - Satisfied the location and management of manure/effluent was sufficient to alleviate most odour issues. - Wants maps provided.
Mr & Mrs D Hardy	Farm 507 Hardy Road 07/04/06	- Concerned about traffic safety implications from proposed plant. - Concerned about plant safety if there was a fire accident. - Asked whether there would be a weighbridge to enable local supply to be delivered direct to site. - Happy to see plant established. - Concerned over bore water. Would the development jeopardise their bore capacity? - Concern over odour.
Mr B Witham	"Mundoora" Ercildourne Road 13/04/06	- General briefing and discussion BA offices. - Major concerns traffic, odour, flies. - Queried the detail of the project to best understand project. - Keen to supply grain/silage/etc. - Would like to see project proceed. - Suggested contact be made with Mr M Toscan and gave mobile number.
Mr M Toscan	17/04/06	Left message on mobile – no response.



Name	Address	Outcome
Mr A Hayes	Farm 641 Kidman Way various dates	▪ "Tubbo" Irrigation Manger for Four Arrows Group. ▪ Lives immediately adjacent to the project. ▪ Advised that odour flies and traffic were issues which needed to be addressed in sufficient depth, breadth and detail to settle broad community concerns.
Coleambally Chamber of Commerce		▪ Addressed meeting. ▪ Answered many questions. ▪ Very supportive.
Griffith City Council		▪ Briefed Mayor, General Manager, CEO and other senior staff. ▪ City Council impacted by the grain haulage from Willbriggie and provision of services generally. ▪ Very supportive.
Murrumbidgee Shire Council		▪ Briefed council at meeting 20/04/06. ▪ Very supportive. ▪ Also briefed Manager, Environmental Services separately 07/04/06.
Murray, Regional organisation of Councils (MURROC)	2 August 2006	▪ Briefed general managers and representative councilors from nine (9) southern Shire and City Councils which could be impacted by the proposed project. ▪ Very supportive of the proposed project. ▪ Closer Councils noted the potential to adversely impact on roads and even on people transferring out. ▪ Councils with some perceived negative impacts were also quick to note that they considered the overall net impacts to be substantially beneficial.
Riverina, Regional Organisation of Councils (RIVROC)	9 August 2006	▪ Briefed general managers and representative councilors from seven (7) southern Shire and City Councils which could be impacted by the proposed project. ▪ Very supportive of the proposed project. ▪ Closer Councils noted the potential to adversely impact on roads and even on people transferring out. ▪ Councils with some perceived negative impacts were also quick to note that they considered the overall net impacts to be substantially beneficial.

2.1.1.4 Shire and Commercial Representatives

Coleambally Chamber of Commerce

At the invitation of the Coleambally Chamber of Commerce a PowerPoint presentation was undertaken at their March 2006 meeting. The Chamber was informed of the progress of the Environmental Assessment investigations and status of reporting. Approximately thirty (30) people attended the meeting held at the Coleambally Bowling Club. Following the presentation a number of questions were asked primarily on when the project would be likely to start and what provision will there be for housing either on-site or in promoting accommodation and housing within the township of Coleambally. The chamber members were enthusiastic and no negative comments were received. Letters of support received following the presentation are contained in Annexure 2.1.4.

The majority of chamber members were enthusiastic and no negative comments were received.



Subsequent to the formal presentation, a series of telephone conversations and face-to-face discussions with Chamber Committee personnel and Chamber members have allowed verbal updates on the project progress. The constant response has been very supportive of the project, and encouragement to see the project brought to commercial reality.

Griffith City Council

A PowerPoint presentation was made on two (2) separate occasions to senior management of the Griffith City Council and the Griffith City Mayor. At one of the meetings the Member for Riverina, Mr Tony Catanzariti was in attendance. The Griffith City Council is keen to see the development proceed based on the additional benefits the City will receive though the major part of the project is within the Murrumbidgee Shire. The Willbriggie rail siding is within the Griffith City Council area as will be many of the roads through which the transports, carting product to and from the Ethanol plant, will traverse. Because the Willbriggie rail line is suspended by the NSW State Government, any additional product which can be transported in or out by rail will minimise traffic on public roads. Griffith City and Murrumbidgee Shire Councils have been promoting the opening of the rail siding and have sought the support of the local member, Mr Catanzariti. The re-opening of the railway line and the Willbriggie rail siding will facilitate rail freight for a range of other products being produced within the Murrumbidgee Irrigation Area and the Coleambally Irrigation Area. Rice, wines, fruit and other grains will be high on the list of regional products benefiting from rail freight.

CICL Shareholders

A PowerPoint presentation was made to an April 2006 shareholder meeting following a direct invitation by the Board of Directors of Coleambally Irrigation Co-operative Limited. The presentation covered all the statistics and issues surrounding the proposed project and its expected impact on the local and regional communities. The majority of questions following the presentation centred on potential start-up dates for the project, expressions for support for the project and clarification of issues. No negative issues were raised.

A further presentation was made to a CICL shareholder's meeting in May 2006, and following extensive questioning again all comments made were positive and supportive of the project.

Subsequent to the formal presentation a series of telephone conversations and face-to-face discussions with CICL Senior Management and Directors have allowed verbal updates on the project progress. The constant response has been very supportive of the project and encouragement to see the project brought to commercial reality.

Murrumbidgee Shire Council

A PowerPoint presentation was made to the April meeting of Murrumbidgee Shire Council with all Councillors and senior staff members in attendance. All questions following the presentation were supportive of the project with main queries centred on a likely starting date for the project, points of clarification on particularly traffic impacts and the need for supplying natural gas into the area.

Murray and Riverina Regional Organisation of Councils

A request was made to Booth Associates, with its origin the office of the General Manager of the Jerilderie Shire Council for a presentation to be made to both the Murray and Riverina Regional Organisations of Councils.

The presentation to Murray ROC was made at the Berrigan Shire Council Chambers on 2 August 2006 with representatives of nine (9) Councils being in attendance. In total, twenty-three (23) General Managers, Councillors and senior staff were present, and all attendees were supportive of the project.



The presentation to Riverina, ROC was made at the Murrumbidgee Shire Council Chambers on 9 August 2006 with representatives of seven (7) Councils being in attendance. In total, fourteen (14) attendees were present representing seven (7) representation seven (7) separate councils in absentia. General Managers, Councillors and senior staff were present, and all attendees were supportive of the project.

2.1.1.5 Federal Agency Representatives

The investigations undertaken during the compilation of this EA have determined that there are no impacts on matters of National environmental significance as per the EPBC Act (1999), and as such comment from the Department of Environment and Heritage (DEH) has not been sought. It is also noted that as the proposed development is a project under Part 3A of the EP&A Act (1979), the Minister of the Department of Planning (DOP) is the sole consent authority.

It would be expected that if deemed appropriate, representatives of the DEH would provide comment to the DOP during the public display period for this EA and any relevant comments considered by the DOP in preparation of Conditions of Consent prior to approval of the proposed development.

2.1.2 Director General's Specifications

The final Director General's Specifications have been abbreviated and included as the table below. Full documentation can be viewed as Annexure 1.6.1.

Table 2.1.6: Director General's Specifications

DG SPECIFICATIONS	DOP	DPI	DSRD	DEC	DNR	RTA	MSC	SECTION
General Requirements								
▪ A description of the proposal, including construction, operation and staging.	✓							ES 3.0
▪ An assessment of the environmental impacts of the project, with particular focus on the key assessment requirements.	✓							4.0
▪ Justification for undertaking the project with consideration of the benefits and impacts of the proposal.	✓							5.10
▪ A draft Statement of Commitments Detailing measures for environmental mitigation, management and monitoring.	✓							7.0
▪ Certification by the author of the Environmental Assessment that the information contained in the Assessment is neither false nor misleading.	✓							i
Key Assessment Criteria								
▪ Air Quality – a comprehensive air quality impact assessment also to include a full assessment of the impact of greenhouse gases.				✓				4.2 4.14
▪ Water Management – a water balance for the site, including details on water sources, water consumption, recycling and the impact of any water release from the site on surface and groundwater impacts. Impacts on surrounding landholders and water licence holders.					✓			4.5 4.5.2.5
▪ Transport – a Traffic Impact Study (TIS) prepared in accordance with the RTA's publication Guide to Traffic Generating Developments.						✓		4.4
▪ Noise and Vibration – an assessment of the predicted noise impacts resulting from all noise sources, including rail and road traffic noise and the measures to manage any noise impacts.				✓				4.3
▪ Hazards and risk – assessment of the potential hazards and risks associated with the proposed project.	✓							4.6



DG SPECIFICATIONS	DOP	DPI	DSRD	DEC	DNR	RTA	MSC	SECTION
Waste Management – Environmental Assessment must identify the quantity and nature of all liquid and solid waste to be stored, disposed and/or treated at the site and describe how this waste would be handled, processed and if necessary disposed of				✓				4.8 5.5
General Environmental Risk Analysis – an environmental risk analysis to identify potential environmental impacts associated with the project (construction and operation), proposed mitigation measures and potentially significant residual environmental impacts after the application of proposed mitigation measures.	✓	✓	✓	✓	✓	✓		4.0 5.0 7.2
Where additional key environmental impacts are identified through this environmental risk analysis an appropriately detailed impact assessment of these additional key environmental impacts must be included.				✓	✓			4.0
Booth Associates You must undertake an appropriate and justified level of consultation with the following parties during the preparation of the Environmental Assessment. - Department of Environment and Conservation; - Department of Natural Resources; - Murrumbidgee Shire Council; - Department of Primary Industries; - Roads and Traffic Authority; - Australian Rail Track Corporation; and - Affected residents and relevant community groups.	✓	✓	✓	✓	✓	✓		2.1

NB: ARTC and MSC did not contribute to the formalisation of DG Specifications.

To ensure that the EA has been as comprehensive and rigorous as possible, identified issues and concerns have been prioritised and addressed to what is considered appropriate level.



3.0 THE LOCATION

3.1 Development Site

The proposed development is to be established in the Murrumbidgee Shire on the western side of the Kidman Way approximately 7km north of the township of Coleambally and approximately 17km south of the township of Darlington Point. The site is locally referred to as Farm Nos. 25 Additional, 26 Additional, 108 Additional and 641 Additional and covers an area of approximately 359ha. The land is registered as Lots 79, 80 and 112 of DP 750896 within Parish Boona, County Boyd.

The Murrumbidgee Shire is located within the central part of the Riverina region. The Riverina region extends from the Great Dividing Range in the east, and stretches across the south west plains to Hay and surrounds, covering an area of approximately 63,500km². The northern and southern boundaries are bordered by the Lachlan and Murray Rivers respectively, with the Murrumbidgee River bisecting the region from east to west.

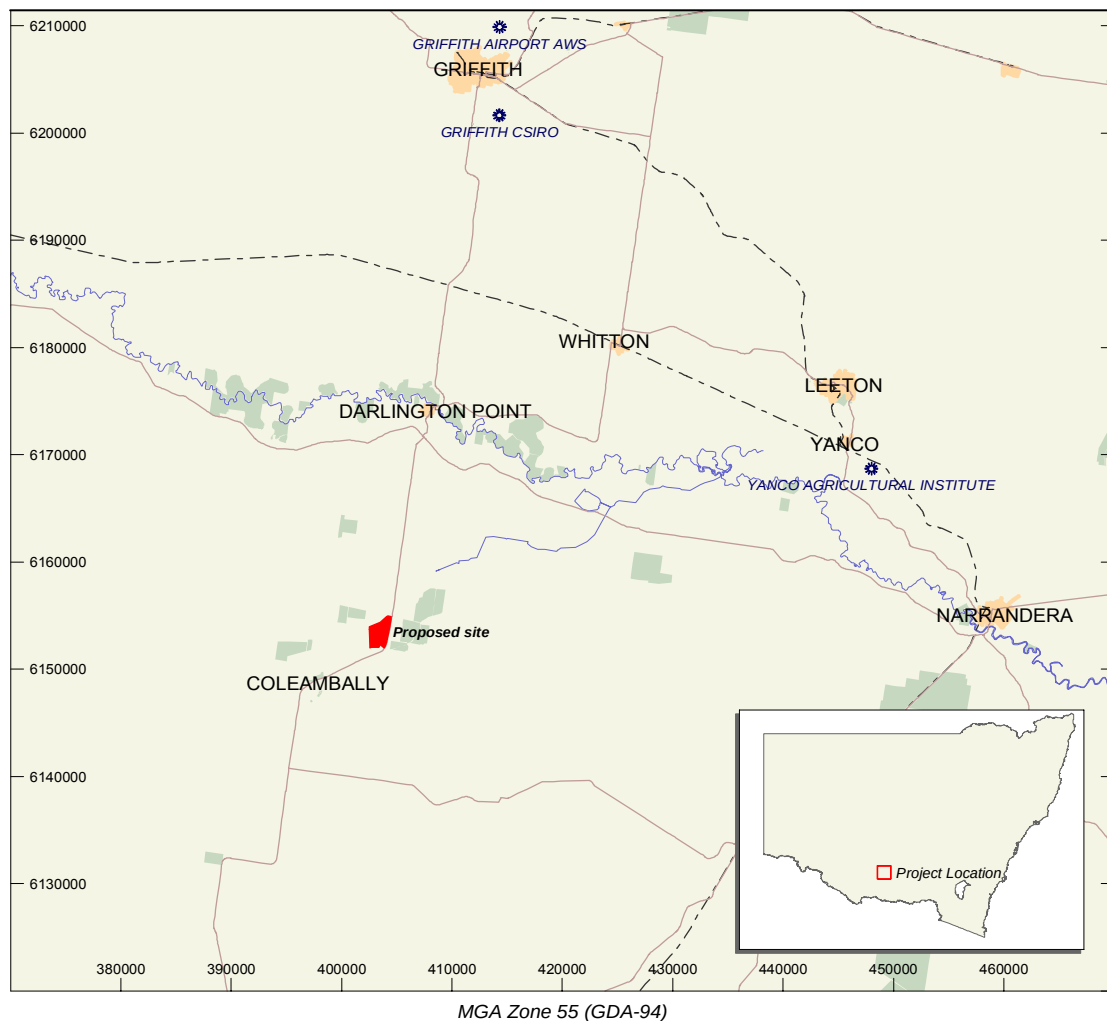


Plate 1:
Location of Proposed Ethanol Plant and Dairy Enterprise



3.2 Affected Environment

3.2.1 Land Use

The Murrumbidgee Shire and the Riverina as a whole comprise one of Australia's most diverse food producing regions. The area supports a large diversity of production systems, including cereals, oilseeds, pulses, fruits, wine and citrus, vegetables, fibres, beef, lamb, dairy, poultry and timber. There are also a large number of processing facilities servicing the region, value adding to raw agricultural and primary industry produce. The CIA itself encompasses the production of rice, wheat, barley, oats, canola, soybeans, maize, sunflowers, lucerne, grapes, prunes and pastures for sheep and cattle. Much of the produce from the region reaches the export markets; an example of which is that 80% of rice produced is destined for overseas countries.

The land use history of the proposed site is one of border check and lasered contour irrigation of the southern portions, with land formed irrigation bays on the northern portion. The central section of the site comprises an elevated sand hill with stands of White Cypress (*Callitris glaucophylla*), and has not been subject to flood irrigation. Irrigated crops in the form of rice and cereals have been produced on a rotational basis with grazing of domesticated stock. The proposed site falls within the northern intensive area of the CIA, and surrounding land use is consistent with the agricultural production systems on the proposed development site.

3.2.2 Buffers

Surrounding the proposed development site are areas of intensive irrigated agriculture, broad acre cropping, livestock systems, state forests and agricultural production infrastructure and industry. The area surrounding the proposed site is zoned Rural 1(a) as per the Murrumbidgee Local Environment Plan and the townships of Darlington Point and Coleambally are far removed as identified in Section 2.1. Residential occupancy surrounding the proposed site is limited, with the Four Arrows owned Farm 641 Additional property being the nearest residence to the site, and the Walsh rice sheds facility bordering the northern boundary of the proposed site. Presently there is limited vegetation as buffer systems along the eastern and southern boundaries of the proposed site.

3.2.3 Climate and Meteorology

3.2.3.1 Introduction

The proposed development site is relatively removed from the nearest existing meteorological stations, and as such, historical weather data has been developed from investigation of the nearest available stations, and Holmes Air Sciences (HAS), contracted to undertake detailed air quality investigations (see section 4.2) have utilised the information from those stations, coupled to the use of the prognostic model; The Air Pollution Model (TAPM), as described below.

The closest meteorological stations with hourly meteorological data are Yanco Agricultural Institute, approximately 45 km to the northeast of the study area; and Griffith Airport, approximately 60 km to the north of the project area. The data at these sites are not quality controlled by the Bureau of Meteorology.



The investigation of surrounding climatic conditions and the utilisation of data for local climatic conditions as calculated by TAPM is vital to gain an understanding of how local conditions may affect issues such as air quality, and noise and dust dispersion. The rate at which pollutants are dispersed is dependent on wind speed, wind direction, atmospheric stability class (categorises the rate at which a plume will disperse). In the Pasquill-Gifford stability class assignment scheme used by Holmes Air Sciences, there are six stability classes, A through to F. Class A relates to unstable conditions, such as might be found on a sunny day with light winds. In such conditions plumes will spread rapidly. Class F relates to stable conditions, such as occur when the sky is clear, the winds are light and an inversion is present. Plume spreading is slow in these circumstances. The intermediate classes B, C, D and E relate to intermediate dispersion conditions) and mixed-layer height. This section describes the dispersion meteorology and climate of the study area. It provides information on prevailing wind patterns and historical data on temperature, humidity and rainfall. The data base used and the way in which it has been used to derive the parameters required for dispersion modelling are discussed below.

A meteorological station was installed on the project site on 16 February 2006 with installation and is operation in accordance with AM-1 and AM-4 of the *Approved Methods for the Sampling and Analysis of Air Pollutants in New South Wales*. The station measures wind speed and direction, temperature, pressure, humidity, solar radiation and rainfall. The station will continue to measure atmospheric conditions while the proposed facility is operating. As less than a year of data has been collected to date, weather data from nearby Bureau of Meteorology stations have been presented below.

3.2.3.2 Meteorology

3.2.3.2.1 Wind

Yanco Agricultural Institute wind data

As the title suggests, *Figure 3.2.1: Annual and Seasonal Windroses for Yanco Agricultural Institute 2005* shows annual and seasonal windroses of wind data from Yanco Agricultural Institute for 2005. On an annual basis the most frequent winds are from the north, east and south western quadrant. The windroses for autumn and spring also show this pattern. In summer the wind is most commonly from the south western quadrant, whereas in winter the wind is predominantly from the north. The annual average wind speed is 4.1m/s.

Griffith Airport wind data

Figure 3.2.2: *Annual and Seasonal Windroses for Griffith Airport 2005* shows the annual and seasonal windroses compiled from the Griffith Airport data for 2005. The data show a high frequency of winds from the east, north and south western quadrant on an annual basis. In summer the wind is predominantly from the south western quadrant, while in winter the wind is most commonly from the north, the north western quadrant and the east. In autumn the wind is mainly from the east and the southern sector, while in spring the wind is fairly evenly distributed, with easterly winds the most frequent. The annual average wind speed is 4.4m/s.

TAPM meteorological data

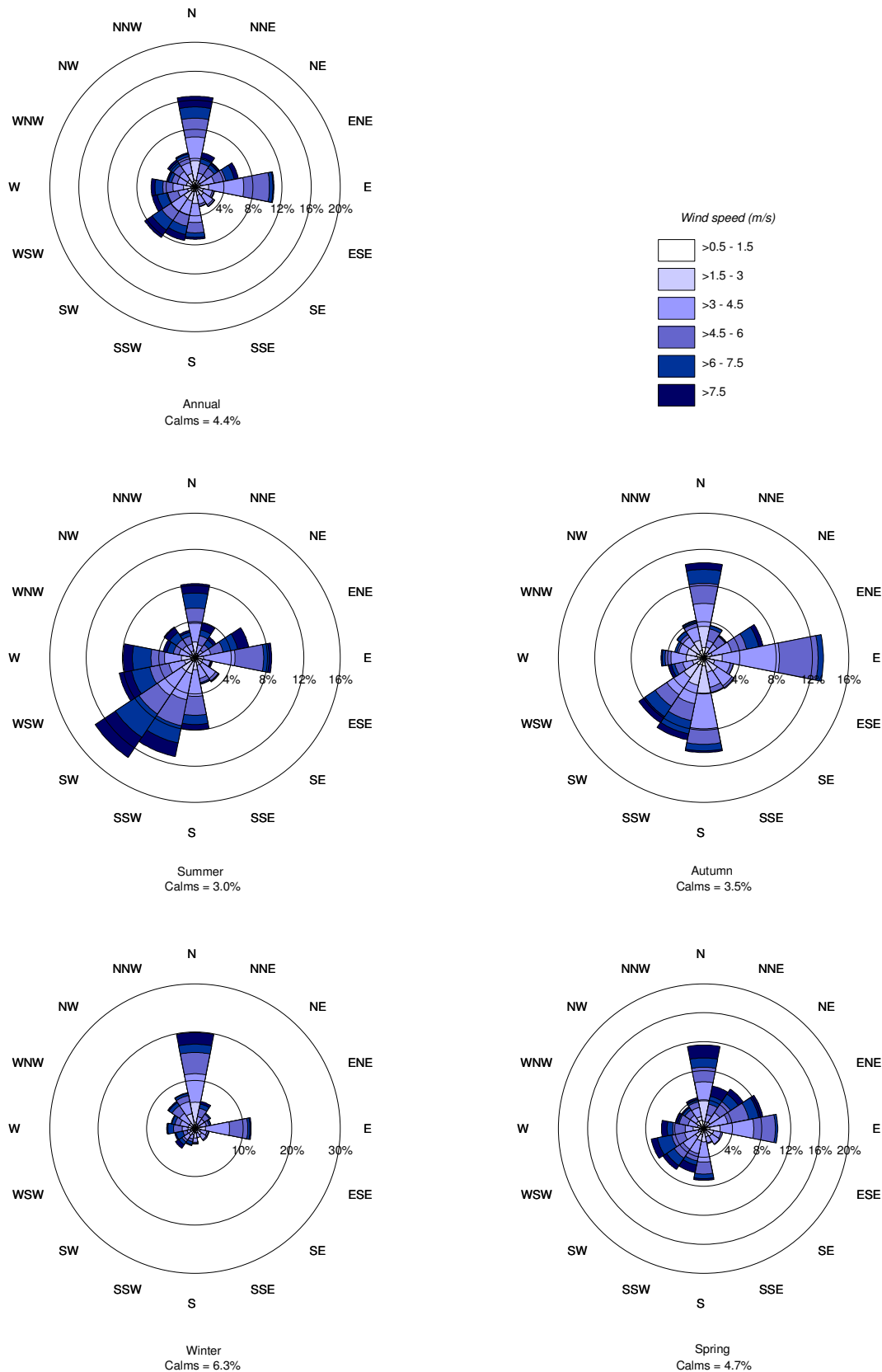
In dispersion modelling it is often the case that there are no on-site data available and as with this assessment the closest Bureau of Meteorology data are not site-specific. Due to limitations in the data collection (for example, the wind direction data are collected in 10° increments) they may not represent all the features of wind flow in the local area.

3.2.1

Annual and Seasonal Windroses for
Yanko Agricultural Institute 2005

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3.2.2

Annual and Seasonal Windroses for
Griffith Airport 2005

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To aid in the assessment of projects where meteorological data are lacking, the Commonwealth Scientific and Industrial Research Organisation (CSIRO) has developed a prognostic model – The Air Pollution Model (TAPM) – which predicts flows important to local scale meteorology, such as sea breezes and terrain induced flows. It uses data from the Bureau of Meteorology Global Analysis and Prediction (GASP) model. This feeds into the Limited Area Prediction System (LAPS) (Puri *et al.* (1997)) which is used to provide meteorological predictions over 37km grids. TAPM uses information such as terrain and sea breezes to fine tune these data to provide meteorological data on a smaller scale. The model is discussed further in the user manual (Hurley, 2002).

A synthetic, site-specific meteorological data set for the site was created using TAPM Version 2.0. The model used 2005 data centreing on the proposed project site at 34°45.5' S and 145°56.5' E.

Figure 3.2.3: *Annual and Seasonal Windroses for Coleambally 2005 (TAPM)* shows the annual and seasonal windroses compiled from the data generated using TAPM for the project site. The winds are predominantly from the north northeast and south southwest on an annual basis. Summer winds are predominantly from the south southwest, while in autumn there is also a high frequency of winds from the northeast. In winter the winds are predominantly from the north northeast and the north western sector. In spring the winds are most commonly from the northeast and north northeast with frequent winds from the south western quadrant. The annual average wind speed is 4.1 m/s. These patterns are similar to those observed in the airport data.

Figures 3.2.1, 3.2.2 and 3.2.3 show that there are a higher percentage of calm periods in the Yanco Agricultural Institute and Griffith Airport data than in the TAPM file. However, assessment of the Yanco Agricultural Institute and Griffith Airport show the higher percentage of calm periods in the airport data are more than likely due to the anemometer stalling rather than extended periods with no wind as the majority of the calm periods are seen to be due to consecutive hours with the same wind speed and direction.

3.2.3.2.2 Stability Class

Stability is usually assigned according to six classes, A to F. The frequency of occurrence of the different stability categories expected at Coleambally, based on the TAPM meteorological data, are listed and displayed in Table 3.2.1. The high frequency of D class stabilities (30.2%) indicates that emissions will disperse quickly for a significant proportion of the time. Joint wind speed, wind direction and stability class frequency tables for the data set are presented in Appendix A of the HAS report in Annexure 4.2.1

Table 3.2.1: Frequency of Occurrence of Stability Classes at Coleambally

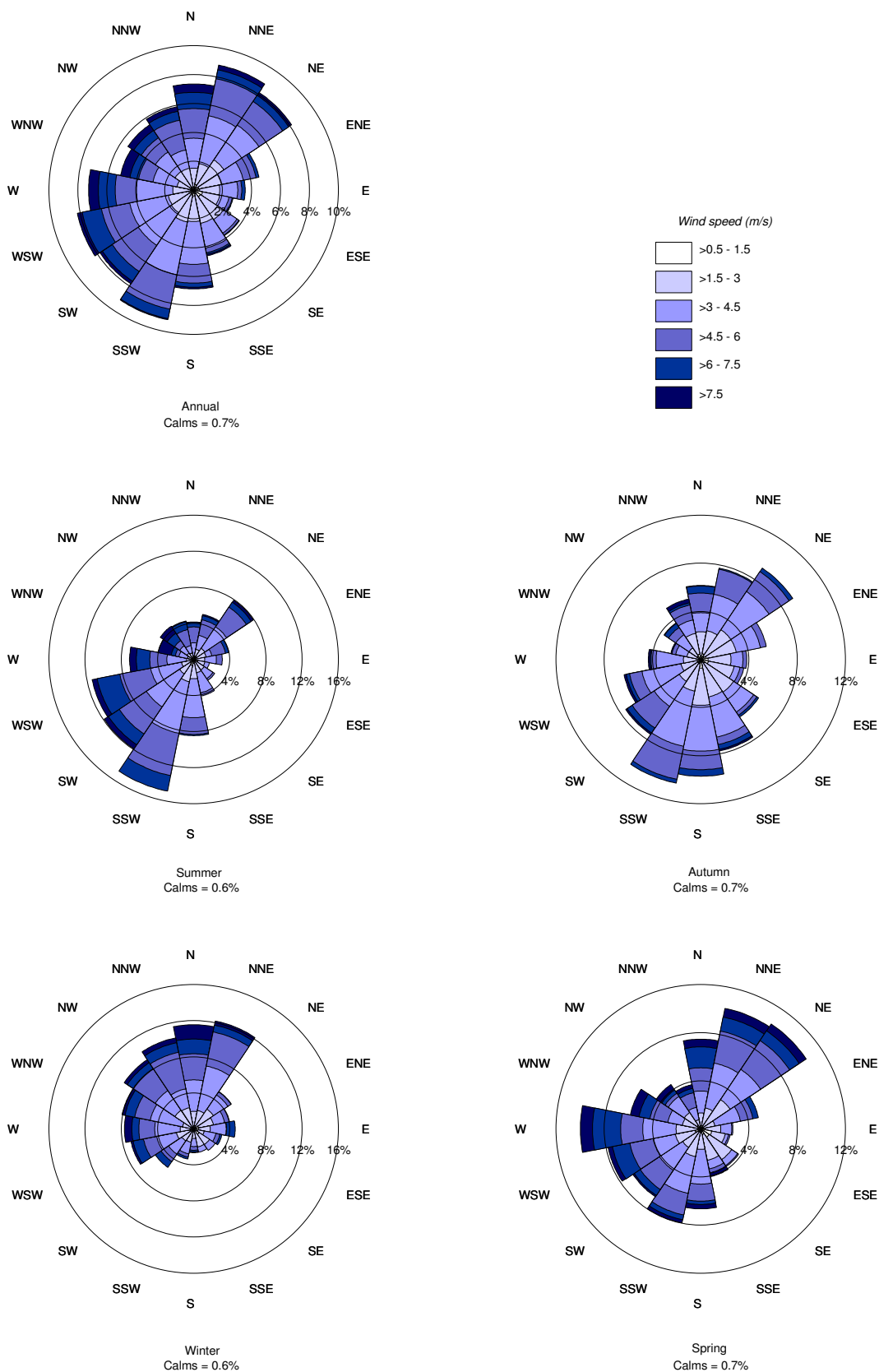
Table 1 – Frequency of occurrence of stability classes at Coleambally	
Stability class	Percentage frequency of occurrence
A	5.7
B	10.4
C	15.8
D	30.2
E	19.9
F	18.0
Total	100.0

3.2.3

Annual and Seasonal Windroses for
Coleambally 2005

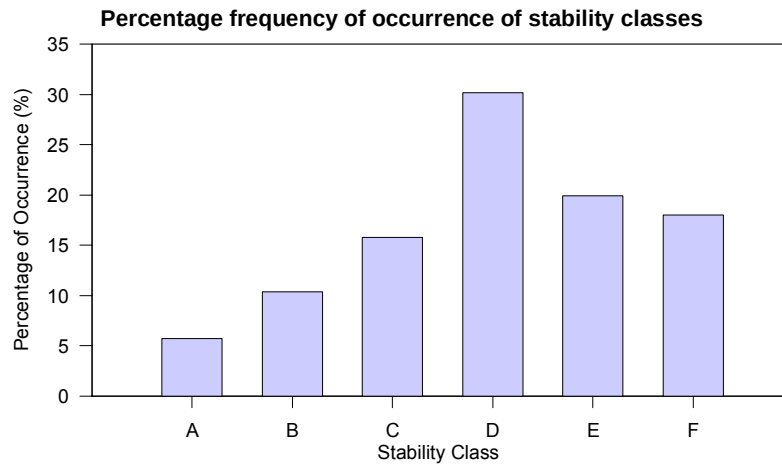
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Graph 3.2.1



3.2.3.3 Climate

Climate averages including 9 am and 3 pm data are available from Leeton Caravan Park, Griffith CSIRO and Griffith Airport. Graph 3.2.2: *Temperature and rainfall data from weather stations near the project site*, presents the average monthly temperature and rainfall data from these three stations. The graph shows that there is little variation between the long term average climate data at the three weather stations. The following description of climate in the study area is based on the Leeton climate averages. The Leeton data represent the longest period of data collection, including 89 years of rainfall data.

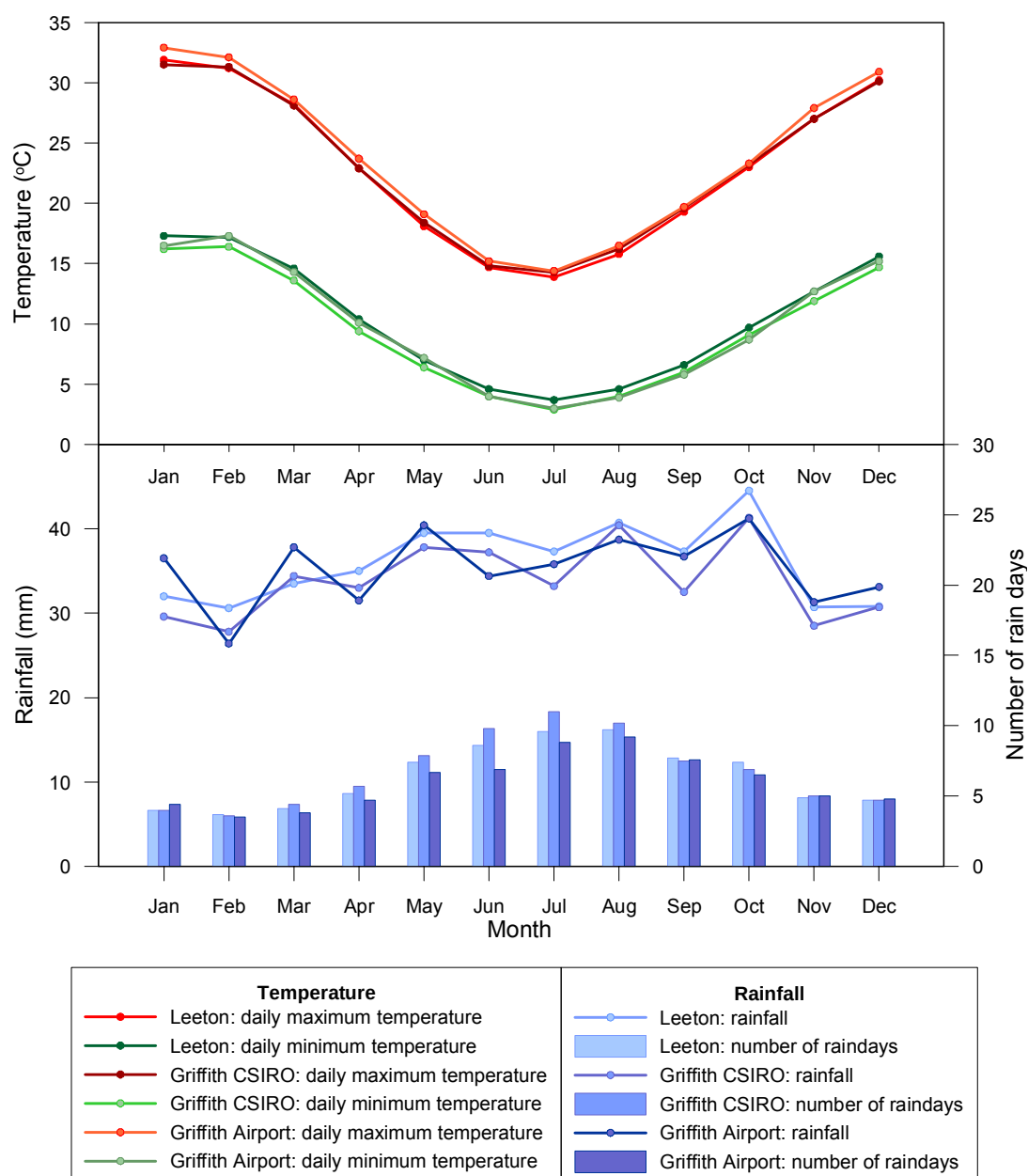
**Graph 3.2.2: Temperature and rainfall data from weather stations near the project**

Table 3.2.2 presents the temperature, humidity and rainfall data for Leeton (Bureau of Meteorology, 2006). Temperature and humidity data consist of monthly averages of 9 am and 3 pm readings. Also presented are monthly averages of maximum and minimum temperatures. Rainfall data consist of mean and median monthly rainfall and the average number of rain days per month.



Table 3.2.2: Temperature, Humidity and Rainfall Data for Leeton

Temperature, humidity and rainfall data for Leeton													
(Station number 075041; Commenced: 1960, Last record: 2004; Latitude (°S): -34.2487; Longitude (°E): 146.0695)													
	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Year
9 am Mean Dry-bulb and Wet-bulb Temperatures (°C) and Relative Humidity (%)													
Dry-bulb	24.2	23.4	20.6	16.2	11.6	8.3	7.4	9.3	13.1	16.9	20.4	23.1	16.2
Wet-bulb	17.1	17.2	15.5	12.6	9.5	7.0	6.1	7.4	9.9	12.4	14.3	16.4	12.1
Humidity	46	51	56	65	75	82	82	76	64	57	48	47	62
3 pm Mean Dry-bulb and Wet-bulb Temperatures (°C) and Relative Humidity (%)													
Dry-bulb	30.5	29.8	27.3	22.5	17.2	14.6	13.3	14.9	18.1	21.5	25.4	28.3	21.8
Wet-bulb	18.9	19.3	18	15.3	12.3	10.6	9.5	10.2	12.2	14.3	15.9	17.5	14.4
Humidity	29	34	37	43	53	59	61	53	47	43	33	31	44
Daily Maximum Temperature (°C)													
Mean	31.9	31.2	28.2	22.9	18.1	14.7	13.9	15.8	19.3	23.0	27	30.2	23.0
Daily Minimum Temperature (°C)													
Mean	17.3	17.2	14.6	10.4	7.0	4.6	3.7	4.6	6.6	9.7	12.7	15.6	10.3
Rainfall (mm)													
Mean	32.0	30.6	33.5	35.0	39.5	39.5	37.3	40.7	37.3	44.5	30.7	30.8	431.3
Median	18.8	20.0	20.4	24.6	31.4	37.3	36.9	40.0	32.8	34.4	24.3	22.1	441.4
Rain days (Number)													
Mean	4.0	3.7	4.1	5.2	7.4	8.6	9.6	9.7	7.7	7.4	4.9	4.7	77

Source: Bureau of Meteorology (2006)

The annual average maximum and minimum temperatures experienced at Leeton are 23.0°C and 10.3°C respectively. On average January is the hottest month with an average maximum temperature of 31.9°C. July is the coldest month, with average minimum temperature of 3.7°C.

The annual average humidity reading collected at 9 am from the Leeton site is 62 percent, and at 3 pm the annual average is 44 percent. The highest humidity on average is in June and July with a 9 am average of 82 percent, and the lowest is January with a 3 pm average of 29 percent.

Rainfall data collected at Leeton shows that October is the wettest month, with an average rainfall of 44.5 mm over 7.4 days. The average annual rainfall is 431.3 mm with an average of 77 rain days. On average there are a higher number of rain days in the winter months, however the rainfall is not significantly higher.



3.3 Infrastructure

3.3.1 Original Draft Site Plan

The development of the EA is undertaken before any detailed design level investigation for the ethanol and dairy enterprise infrastructure are available. To enable some form of analysis of impacts from the proposed development, a preliminary site plan was created to identify, quantify, and qualify rough estimates of the footprint for each component of infrastructure required for the development and integrate the components of the project and to define.

Below is a summary of the anticipated footprint for each component of the development as per the preliminary site plans.

Table 3.3.1: Original Draft Site Plan Details

Infrastructure	Figure Colour	Footprint (metres)	No.	Capacity
Ethanol Plant		390 x 320	1	n/a
Grain Bunkers		200 x 30	8	150,000 t
Workshop		150 x 150	1	n/a
Commodity Shed		50 x 100	1	n/a
Cattle Yards		250 x 150	1	n/a
Freestall Sheds		600 x 90	4	7,200 head
Dry Pens		500 x 450	1	10,800 head
Sick Shed		250 x 50	1	n/a
Dairy		150 x 50	1	n/a
Milk Storage		20m diameter	6	n/a
Administration/Carpark		250 x 150	1	n/a
Visitor Centre		200 x 150	1	n/a
Run off wetland		530 x 500	1	300 ML
Sedimentation Basins		120 x 25	8	36 ML
Storm Surge		250 x 120	1	45 ML
Anaerobic Ponds		300 x 150	2	300 ML
Aerobic Ponds		700 x 500	1	1,200 ML

The information contained in the table above is graphically represented over page in Figure 3.3.1 *Original Draft Site Plan*. Subsequent investigation during of the EA indicated particular issues that warranted changes to the original draft site plan. These changes are notarised in Section 3.3.2 (Amended Draft Site Plan). Following the investigation of these specific site issues, the original draft site plan for the ethanol and dairy infrastructure layout was amended to incorporate changing requirements based on soils and geotechnical information, cattle and herd management issues, traffic ability around site, occupational health and safety, and the need for increase in habitat management for flora and fauna both utilising and migrating through the development site.

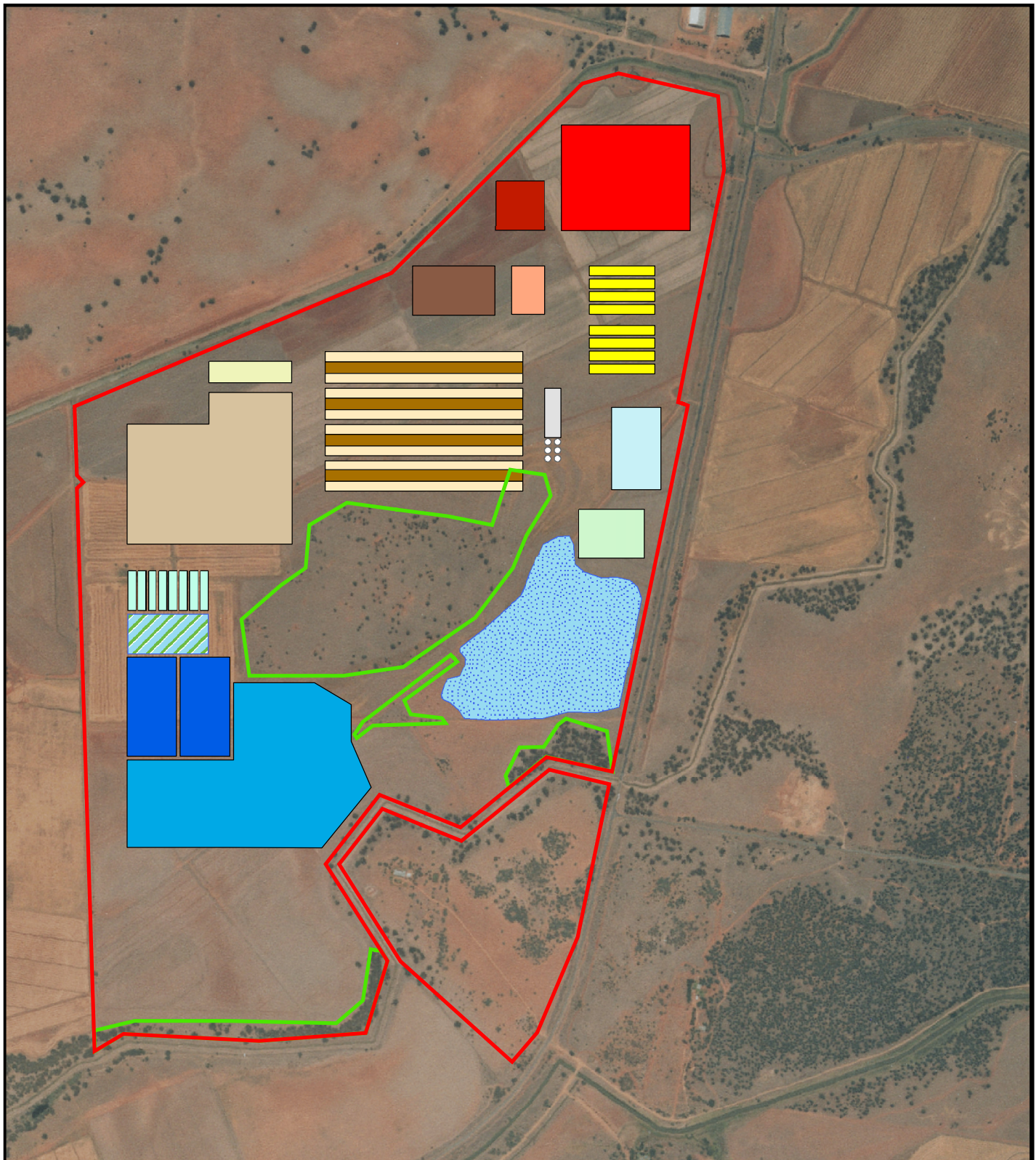
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- | | | | | |
|---|--|---|--|---|
| ■ Proposed Site | ■ F/S Yards | ■ Dry Pens | ■ Runoff wetland | ■ Admin/carpark |
| ■ Remnant Vegetation | ■ F/S Sheds | ■ Sick Shed | ■ Sedimentation Basins | ■ Visitor Centre |
| ■ Ethanol Plant | ■ Dairy | ■ Commodity | ■ Storm Surge | ■ Anaerobic Ponds |
| ■ Grain Bunkers | ■ Milk Storage | ■ Workshop | ■ Aerobic Ponds | |
| ■ Cattle Yards | | | | |

0 0.125 0.25 0.5 0.75 1
Kilometers





3.3.2 Amended Draft Site Plan

The majority of the changes made to the original draft site plan are minor and are specific to the following points:

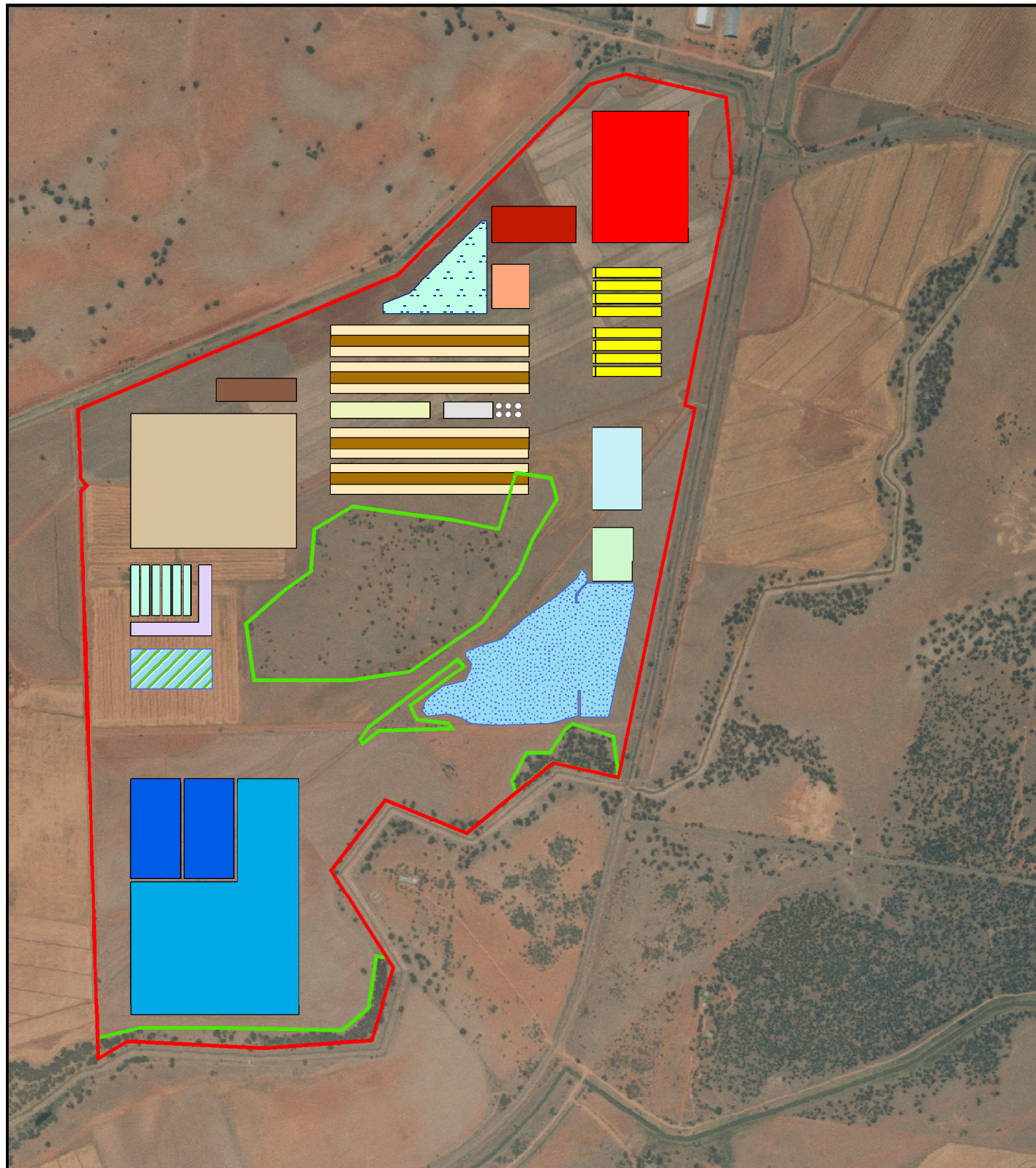
- Movement of the infrastructure into the site away from the boundary areas for the installation of buffer plantings (50 metres wide),
- The movement of effluent and anaerobic and aerobic ponds to avoid areas of sand in the soil profile prone to allowing accession of water to ground table, and
- Additional infrastructure added to the amended draft site plan identifying areas for short term manure storage post sedimentation ponds treatment.

Figure 3.3.2: *Amended Draft Site Plan* provided over page illustrates the changes made to infrastructure layout. The most notable of the changes illustrated in Figure 3.3.2 is the movement south of both the anaerobic and aerobic effluent treatment ponds. When viewed in conjunction with Figure 4.7.1 the need for this amendment becomes apparent.

The soils map presented as Figure 4.7.1 and tabled in Section 4.7 of this EA identifies the sand area which runs from the remnant vegetation central the development site across to the western boundary. This area of sand now runs between the storm surge and anaerobic and aerobic ponds, and Figure 5.9.1 in Section 5.9 of this EA identifies this area as proposed site for habitat restoration.

Table 3.3.2: Amended Draft Site Plan Details

Infrastructure	Figure Colour	Footprint (metres)	No.	Capacity
Ethanol Plant		390 x 320	1	n/a
Grain Bunkers		200 x 30	8	150,000 t
Workshop		250 x 110	1	n/a
Commodity Shed		150 x 100	1	n/a
Cattle Yards		250 x 70	1	n/a
Freestall Sheds		600 x 90	4	7,200 head
Dry Pens		500 x 400	1	10,800 head
Sick Shed		300 x 50	1	n/a
Dairy		150 x 50	1	n/a
Milk Storage		20m diameter	6	n/a
Administration/Carpark		250 x 150	1	n/a
Visitor Centre		160 x 120	1	n/a
Run off wetland		550 x 450	1	300 ML
Category 1 Storage		280 x 300	1	100 ML
Sedimentation Basins		150 x 25	6	33 ML
Storm Surge		250 x 120	1	45 ML
Anaerobic Ponds		300 x 150	2	300 ML
Aerobic Ponds		700 x 500	1	1,200 ML
Manure Pad		250 x 200	1	n/a



- | | | | | |
|---|--|---|--|---|
| Proposed Site V2 | F/S Yards V2 | Dry Pens V2 | Runoff wetland V2 | Category 1 Water Storage |
| Remnant Vegetation | F/S Sheds V2 | Sick Shed V2 | Sedimentation Basins V2 | Admin/carpark V2 |
| Ethanol Plant V2 | Dairy V2 | Commodity V2 | Storm Surge V2 | Visitor Centre V2 |
| Grain Bunkers V2 | Milk Storage V2 | Workshop V2 | Anaerobic Ponds V2 | |
| Cattle Yards V2 | Manure Storage | Aerobic Ponds V2 | | |

0 0.125 0.25 0.5 0.75 1
 Kilometers





3.3.3 Guiding Principles for Infrastructure

In the design and construction of the proposed infrastructure, the Four Arrows Ethanol Group will adhere to the objectives and guidelines that pertain to the specific components of the project site to ensure all relevant State requirements are met.

The ethanol production facility and sundry infrastructure is not bound by any specific design parameters other than those required to meet with OH&S policies, and to ensure the mitigation strategies outlined in subsequent sections of this EA can be achieved.

The dairy facility will be designed to meet the standards required for both animal health and welfare and the protection of the environment both within and surrounding the project site.

Whilst the Department of Primary Industries and fisheries in Queensland (DPI&F) have prepared the “*Queensland Dairy Farming Environmental Code of Practice*” (DPI&F 2000), this document is currently under review, and as such, it is more appropriate at this stage, to base design and engineering stage development on an alternative DPI&F publication, known as the “*Reference manual for the establishment and operation of beef cattle feedlots in Queensland*”. The DoP have also indicated that this publication is a vital reference for their agency to set parameters for intensive cattle developments.

The infrastructure for the dairy and supporting herd will thus be designed to meet the requirements of this publication, and specific investigations undertaken in regards to air quality and odour have been undertaken to reflect the standards required of a “Feedlot Class 1”. Feedlot Classes range from 1 to 4, with a Class 1 feedlot presenting the most stringent requirements for feedlot siting, design, construction and operational specifications to limit odour nuisance at nearby sensitive receptors.

3.3.4 Supporting Infrastructure

3.3.4.1 Gas

A feasibility study has been conducted for a variety of scenarios to supply natural gas to the township of Coleambally (see Annexure 3.3.1).

Recently the supply of natural gas was extended to Griffith and this pipeline also supplies the towns of Junee, Coolamon, Narrandera and Leeton. A secondary main runs to Willbriggie, however it is considered it is now reaching its maximum delivery potential. If this line was extended the capacity of the main would have difficulty in supplying any meaningful load to Darlington Point and would be completely inadequate to supply Coleambally.

The relatively small demand for natural gas by the combined populations of Darlington Point and Coleambally has, up until now, made any additions or upgrades to the existing pipeline an uneconomical proposition. However, with the additional load demanded by the proposed ethanol plant further development is considered viable.

A NSW gas supply to Darlington Point and Coleambally would originate from the Australian Pipeline Trust's Riverina pipeline which currently terminates at the Yoogali trunk receiving station approximately 4km east of Griffith. An exact route from this location to Darlington Point and onward to Coleambally is yet to be determined. The expected run would be approximately 67km. An EA would be required for assessing any proposed route.



The closest natural gas pipeline in the case of a Victorian supply is the Gasnet's Chiltern Valley pipeline terminating at Koonoomoo approximately 151km from Darlington Point and approximately 118km from Coleambally. The Envestra Company has a secondary main running 31km from Koonoomoo to Finley; however this pipeline would need to be upgraded to cater for the combined Coleambally, proposed development and Darlington Point demand. It has been suggested within the feasibility study this option may be too expensive.

The NSW option is more viable than the Victorian option in terms of the overall capital costs involved.

The townships of Darlington Point and Coleambally would benefit significantly from the supply of natural gas. It is unlikely the pipeline would have been supplied under the current population conditions. However, with the inclusion of the ethanol plant this has meant a natural gas supply could be now a viable option to these townships.

Gas will be available for both domestic and commercial use. Domestic supply will provide alternatives for heating and cooking. At present energy for domestic users is only available from gas cylinders and/or reticulated electricity. Gas availability to commercial enterprises has the potential to attract more industry to both the Coleambally and Darlington Point areas, therefore providing economic benefit to these townships.

3.3.4.2 Electricity

Country Energy has deemed that no further infrastructure external to the property boundary is required to deliver an electrical supply to the combined ethanol and dairy enterprise under the current loading assessments that can be established at this stage of the proposal. A 33KV line already exists adjacent to the project property, running parallel to the eastern boundary and which supplies electricity to the Coleambally township. Other electrical infrastructure requirements such as mains, transpower stations, underground supplies and internal wiring will be established during the design and planning stages.

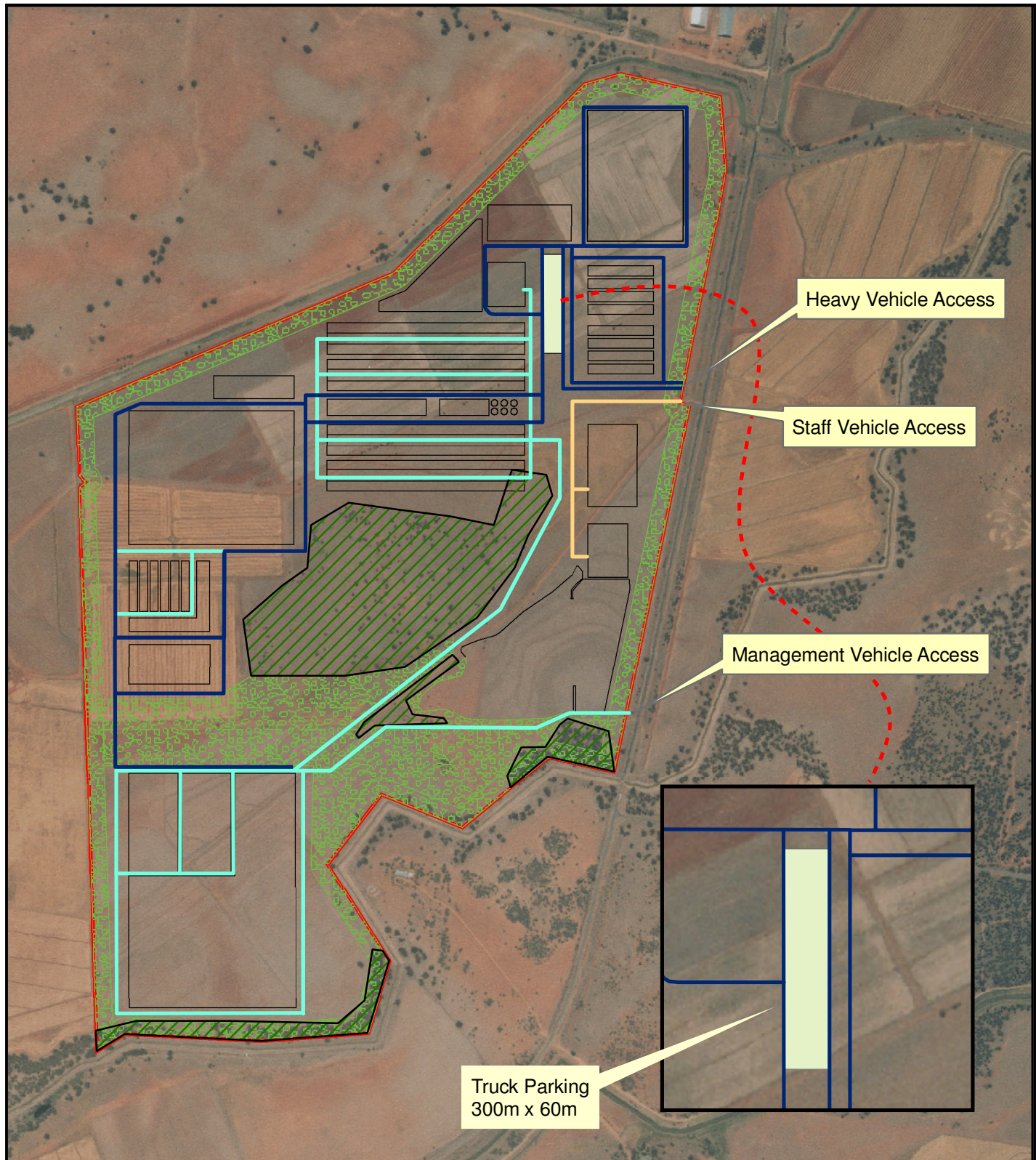
3.3.4.3 Roadways

Figure 3.3.3: *Access, Egress and Internal Roadways* indicate roadways access point and egress points within and from the proposed development site. The roadways have been broadly classified under three (3) grades, namely:

- Heavy vehicle access;
- Staff/visitor vehicle access; and
- Management vehicle access.

Heavy Vehicle Access

Heavy vehicle access and movement within and to and from the site is a key component of the investigation of the EA (investigation undertaken in detail in Section 4.4). The preliminary design of roadways for heavy vehicle access on-site has been developed under the premise that heavy vehicle movement should, where possible, be maintained in a singular directional flow to avoid the risk of collision and/or injury. With this in mind dual heavy vehicle access has been provided as an internal/access point and an exit/egress. This has been undertaken not only to avoid possible risk of collision or injury, but to ease the efficiency of heavy vehicle access on to and off site in light of the large numbers anticipated as part of the operation of the development.



- | | | |
|---|--|--|
| Proposed Site V2 | Roadways (major) | Skeleton of Proposed Infrastructure |
| Remnant Vegetation | Roadways (minor) | Truck Parking |
| Proposed Habitat Restoration | Roadways (staff/visitors) | |





Staff Vehicle Access

Staff vehicle access is limited to a singular access point for access on to and off the proposed development site and is provided as separate entry to heavy vehicle access and egress. Once again, this proposal has been developed to minimise the possible risk of collision, accident or injury in the unlikely scenario that staff vehicle would collide with heavy vehicles entering and exiting the site. Staff vehicle access is predominantly limited to singular driveway access to the administration buildings and carpark. This access would also be utilised by visitors to the site and for access to the visitor and information centre identified on Figures 3.3.1 and 3.3.2.

Management Vehicle Access

Whilst it would be anticipated that management vehicles may utilise heavy vehicle accesses within the proposed development site, there is also a separate management vehicle access proposed near the southern extremity of the development site border with the Kidman Way. These access points and roadways would be designed with a view of utilisation by 2WD and 4WD light commercial vehicles and utility type vehicles. These access lanes are provided for the day-to-day management and movement around the intensive areas of the site as well as providing access and management track provision for maintenance of pumps, effluent storages, water recirculation, pipes and other sundry miscellaneous infrastructure.

3.4 Description of Operations

3.4.1 Ethanol Operations

High starch grains shall be the major feedstock for the ethanol plant. Grains of particular interest are wheat, barley, maize and sorghum although other high starch grains will be actively considered. To the grain are added yeasts, enzymes, acids, water, heat, etc to maximise the process. A succinct overview of the process in a dry mill as proposed is as follows:

- Milling – the grain passes through a hammer mill to grind it into a fine powder known as meal;
- Liquefaction – the meal is mixed with water and alpha-amylase and the resultant mash passed through cookers where the starch is liquified. Heat is applied to facilitate the process;
- Saccharification – when the mash is cooled in the liquefaction process the secondary enzymes are added to convert the starch to fermentable sugars;
- Fermentation – yeast is added to ferment the sugars to ethanol and carbon dioxide. A continuous process allows the fermenting mash to flow through several fermentors until the mash is fully fermented and finally leaves the fermentation tank;
- Distillation – the fermented mash (also called beer) contains approximately 10% alcohol plus all the non-fermentable solids from the grain and yeast cells. The mash is pumped to a continuous flow multi-column distillation system where the alcohol is removed from the solids and water. The alcohol is taken off the top of the final column at approximately 96% strength and the residual mash (stillage) is transferred from the base of the column to the co-product processing area;
- Dehydration – the alcohol is taken from the top of the column and passed through a dehydration system where the remaining water is removed. It is expected a molecular sieve will be used to capture the final small amount of water remaining in the ethanol;
- Denaturing – the ethanol must be denatured to make it unfit for human consumption. This is achieved with approximately 2% to 5% of gasoline at the ethanol plant; and



- Co-products – the two (2) main co-products are distillers grain and carbon dioxide. The distillers grain may be used either wet or dry and is widely sought after as a highly nutritious livestock feed. One regional intensive animal industry business has made direct approach to purchase distillers grain which is not likely to be used by the project dairy enterprise. Carbon dioxide is given off in great quantities and it is expected this by-product will be collected, compressed and sold for use in other industries.

Understanding the logistics surrounding the operations of the ethanol plant are important in understanding how the inputs and outputs relate to the overall process and the resultant impacts on the wider operations for all the service and product suppliers and purchasers of co-products.

Energy is required for heating the meal in particular for the liquefaction or Stage 2 process and again for the removal of water at the end of the ethanol making process. Water removal from distillers grain enables the distillers grain to be delivered to a wider range of buyers at competitive prices.



Plate 2:
Indicative Ethanol Plant Construction

Electricity is available to the immediate north of the proposed project. Natural gas is available near Griffith and can be distributed south to the proposed project, pursuant to infrastructural amendments.

The next major requirement is water and will need to be delivered on a regular basis throughout the year. The location of the proposed development is within the bounds of the Coleambally Irrigation Area and major supply channels pass the northern and western boundaries of the property. CICL have agreed to ensure the ethanol plant has its regular water supply. Currently CICL close down their water delivery system for winter maintenance from late May until late July. CICL are investigating all worthy options to ensure a constant supply even through this winter shut down period. Water supply will need to be enhanced on-site to ensure the quality of the water does not interfere with the ethanol production process. The need to enhance water quality will be required almost irrespective of the source.

High starch grains will be required in vast amounts with a predicted total of 725,000 tonnes being required to produce the proposed 300ML of ethanol. The grain will be delivered by the following methods:

- At winter cereal harvest over November and December grain will be delivered direct to the site for storage on the proposed grain bunkers. These bunkers are depicted on accompanying figures within this EA. A total of 150,000 tonnes grain storage capacity is proposed;
- When the summer cereal crops such as maize are harvested from March to May/June, deliveries will be direct from local properties to the project site;
- For the remainder of the year it is proposed a direct relationship with a major grain purchasing company will be operational. The grain purchaser will undertake the accumulation of grain within existing regional storages over southern and eastern NSW and in northern Victoria. The grain would then be delivered on a staged delivery process, with the majority of movements expected to be by rail to the rail head at Willbriggie between Darlington Point and Griffith. The grain will then be transferred by trucks most likely B-Doubles direct to the project site; and
- The carbon dioxide generated from the ethanol plant will be accumulated into on-site pressurised storage tanks ready for freight off-site to end users. Regular deliveries will be required to minimise the volume of carbon dioxide being stored and to manage the business to its optimum.



Distillers grain is to be redistributed as follows:

- The high moisture content product will be partially dried before delivery direct to the feed mill at the dairy on a daily basis;
- The remaining wet distillers grain is expected to be dried by centrifuging and for belt press down to estimated 50% to 70% moisture. The final moisture content will be subject to the relative financial costs associated with moving the product off-site to regional intensive animal industries; and
- Professional engineers are expected to be employed to ensure the ethanol plant operates to its maximum efficiency and the plant is maintained at an optimum level in line with best commercial practice.

A full graphical representation of the ethanol production process, highlighting all inputs and outputs is provided in Section 4.1 of this EA.

All the other components of operations and the management of resources are discussed in appropriate detail in other sections of this EA.

3.4.2 Dairy Operations

There are two (2) distinct components to the dairy enterprise, these being:

- Sustaining a milking herd of 6,000 cows will require an additional herd of 1,200 dry cows and/or first calf heifers to ensure at least 6,000 cows are being in milk;
- A heifer raising and marketing business which maximises the rate of genetic selection for the milking herd and optimises the heifer marketing opportunities, comprising a further 10,800 cattle onsite; and
- Total of 18,000 head onsite.



Plate 3:
Freestall Dairy Misting System

3.4.2.1 The Milking Herd

The milking cows are proposed to be housed in four (4) freestall sheds with separate sections in the sheds for feeding, bedding, manure removal and exercise/loafing areas. The sheds will have a high pitched roof with relatively high eaves and no walls. It is possible to include blinds on parts or all of the walls to cut down wind in winter/early spring if needed. The high pitched freestall shed will have misting nozzles to ensure the cows are cooled when the temperature rises above a pre-determined level (generally 20°C to 25°C) to optimise cow well-being.

The cattle are fed regularly and will always have feed available to optimise their milking performance and ensure their overall well-being. The feed rations will be assessed and varied on an “as needs” basis by a qualified nutritionist under the supervision of the project veterinarian. The project feed mill will be built on site as well as the commodity shed for short term storage and mixing of feed rations.

The project veterinarian will constantly monitor the milking herd and separate out those cows which are indicating less than optimum health and place same into a hospital herd in a separate freestall shed. The veterinarian will treat the sick cows within this area.



As the cows approach calving they will be monitored by the project veterinarian who will separate the cows at the correct time and take them to the separate maternity shed for close supervision through the calving process. All cows will be joined by artificial insemination with sexed semen which has demonstrated the ability to produce 90% heifers from all calves dropped. The calving percentage is expected to be 90% based on industry criteria.

The cows will be milked three (3) times/day in a hi-tech milking barn and the daily production is expected to average no less than 35L/cow/day. Prior to each milking, the cows are held within a wash down bay where they are wetted from both underneath and on top. After wash down the cows are aggregated in a holding area before entering the actual milking parlour. Each cow will be identified by an electronic leg band which is read by a data reader in the milking stall so each cow is able to be individually monitored for its performance and for any variation in its trend production. This variation in trend production will be an excellent indicator for the health status of each individual cow and will enable the veterinarian to seek out those cows which may be suspected of being in less than best health.

The milk is cooled and pumped direct to a series of storage tanks for collection by milk tankers. Eventually and beyond the scope of this project is the potential to include a milk value-adding business to the overall project. This additional project will minimise the freight of product by removing the excess water contained in the milk.

3.4.2.2 *The Heifer Herd*

The second component to the dairy enterprise is the raising of heifer calves. This component enterprise will be operated in an associated “dry lot”, structured similarly to a normal beef feedlot and situated to the west of the freestall sheds housing the milking herd. The intent is to cull out the obvious cull calves early in their life for sale off farm and to retain all the heifer calves which have potential for entering a milking herd whether that herd be within this project or within some other dairy business. Because of the use of sexed semen, the number of bull calves will be minimal and the genetic selection on the milking herd will be enhanced for optimum milking performance. Some significant points to comment upon are as follows:

- Bull calves are separated from the heifer calves and are fed according to a diet driven by the project nutritionist and monitored by the project veterinarian. The bull calves are sold off to the dairy beef market at around three (3) months of age. The heifer calves are assessed for obvious faults at three (3) months of age. Those displaying unacceptable faults will be sold and the remaining heifer calves will be transferred to the next age group;
- The first heifer age group is for those animals between 3 and 9 months of age. These heifers are grown out on a ration determined by the project nutritionist and monitored by the project veterinarian. Any heifer calves displaying new obvious faults or less than desirable characteristics shall be sold on a progressive basis to minimise the numbers held within the project. At 9 months the remaining heifers will be moved into the next age grouping;
- The 9 to 15 months aged group of heifers is assessed for their worthiness to carry forward into the project milking herd. Those which display appropriate characteristics will be joined to sexed semen when they reach the appropriate age, condition and body weight. The remaining heifers will be jointed to non-sexed semen and at an appropriate time will be marketed to, most likely, the Asian dairy market. Those surplus heifers calves, not going to the Asian market, will be attractive to the wider dairy industry in Australia;
- The next age group is for those heifers between 15 and 22 months, consisting of the best quality heifers with the potential to be brought into the project milking herd. These heifers are closely monitored and assessed for any significant faults and/or less than desirable characteristics. Those displaying faults will be progressively sold. By the time the remaining heifers reach 22 months, the core group of heifers to take into the milking herd has been separated from other lesser heifers. Those not considered the best for the milking herd will be sold at 22 months of age;



- Heifers reaching the 22 month age group will be slightly in excess of those needed to replace the ageing and ailing milking cows. This will enable the final review of the ability of these first calf heifers to actually calve and to undergo an early milking capability assessment; and
- Finally, the best performing of all the selected heifers are the ones retained within the milking herd with the remainder being sold.

Such a high selection pressure will result in a high genetic improvement which will ensure optimum production within the herd and best conversion of feed to milk.

3.4.2.3 *Herd Start-up*

To commence the dairy enterprise, cattle will be selected from a range of respected high quality dairy herds by project staff and supported by qualified and experienced stock and station agents. Also included within the selection process for the initial herd will be external professionals with long-standing and peer respected capabilities within the dairy industry and who have knowledge of the appropriate herds from which to source the cattle.

3.4.3 *Other Project Operations*

The remainder operations are the support to the ethanol plant and the dairy enterprise. These additional operations are as follows:

- **Management.** An overall site management office is proposed to be constructed near the main entry to the project site and will minimise vehicle and people movements on and around the main project areas. The administrative building will house all staff amenities and be linked to the site entry point for all transport and other ingress and egress movements. Visitor parking areas will be included near the administrative building and no one shall pass beyond this point unless previously authorised, and logged as being on the site and wearing appropriate means of identification;
- **Grain storage facility.** The grain storage is proposed to be tarpaulin covered bunkers located in the north-east corner of the project for ready transport access and will facilitate the moving of grain to the ethanol plant;
- **Workshop and truck wash down.** The project workshop shall be equipped to be able to undertake all reasonable site and equipment repairs at short notice. This capability will ensure constant operation of the facility at its maximum efficiency levels. The workshop will also service the project plant, equipment and vehicles and will ensure transports are not held up on site through breakdown. It is not intended the workshop be a means of keeping the transport industry moving, but more to ensure no unserviceable transports delay the on-site operations. Adjacent or near to the workshop area will be a truck, vehicle plant and equipment wash down facility which will be constructed in such a way as to segregate appropriate materials and ensure safe site operating practices;
- **Visitor information centre.** It is expected a visitor information centre will be constructed on the site. Initially such a facility may be associated with the proposed administration building provided that area does not interfere with the operations of the administration team. Ultimately, the visitor information centre would be a separate building and/or attached to a milk value adding facility which could eventually have its own retailing component. This value adding facility for milk products will be the subject of further investigation and application at an appropriate time in the future;
- **Water feature.** Near the value adding facility and visitor information centre, will be the Category 2 water storage (see Section 4.5.2.4) with flat berms and relatively shallow depth to incorporate habitat for aquatic flora and fauna and aid site aesthetics;



- Commodity sheds and feed mill. Situated near the north-east corner of the freestall sheds will be a commodity shed where bulk supplies of cattle feed components will be held ready to deliver in their right proportion to the feed mill. The feed mill will be immediately adjacent to the commodity shed and will mix sufficient feed to have it ready for the cattle on a regular basis. The commodity shed will have a steeply sloping roof to allow semi-trailers to tip loads into each bin. Each bin will be separated by a concrete wall and have a concrete floor. A large concrete apron in the front area of the commodity shed will ensure feeding operations are not compromised by difficult weather conditions;
- Water management system. This has been described in significant detail in Section 4.5; and
- Beyond the site facilities and operations will be separate but complementary operations working in a commercial relationship. The dairy enterprise requires a total of approximately 90,000 tonnes of high quality maize silage for inclusion in the cattle rations. It is expected local irrigators as well as the “Tubbo” irrigation systems will produce the silage. Under contract the silage will be stored on the contracted farms. The silage will be collected and carted to the project site throughout the year. This production, storage and delivery procedure will avoid the accumulation of large quantities of silage on the project site. Similar arrangements will be undertaken with some regional grain suppliers, whereby growers may wish to produce winter cereals and/or maize, yet store in their own on-farm facilities and supply on a regular basis to the project. Such arrangements would be actively considered on the milling commercial and operational merits.



4.0 ENVIRONMENTAL ISSUES

4.1 Mass Balances and other Calculations

4.1.1 Overview

The intent of this section is to draw together the issues and calculations which drive the remaining sections of this EA. This section also facilitates a comprehension of the integration of each of the component parts of the project and the drivers of the environmental issues and their means of management.

Each of the separate sub-sections listed below will be supported by detailed annexures.

4.1.2 Ethanol Plant

Annexure 4.1.1 are the detailed calculations on the inputs required for and the outputs generated by the ethanol plant. The spreadsheet model has been driven by a number of data sources and verified in personal communications with research staff at University of New South Wales and University of Melbourne.

Ethanol plants require starch from varying sources. In this instance it is presumed to be a mix of wheat, barley and corn. The grains require several additives in order to generate the ethanol:

- Sodium hydroxide (NaOH) at approximately 0.040%;
- Sulphuric Acid (H_2SO_4) at approximately 0.040%;
- Anti-foaming agents at approximately 0.020%;
- Enzymes at 0.200%;
- Yeast at 0.011%;
- Clean-in-place (CIP) chemicals at 0.010%; and
- Urea/DAP at approximately 0.010%.

NB: Urea is a common manufactured agricultural fertiliser
: DAP is di-ammonium phosphate, a commonly manufactured agricultural fertiliser.
: Each batch of grain will require specific variation in the ratios and quantum of additives.

The above additives may be varied for any one batch of ethanol, particularly in relation to the composition of the grain products being used. The final additive is water which averages approximately 3.15m³/tonne of starch in the grain.

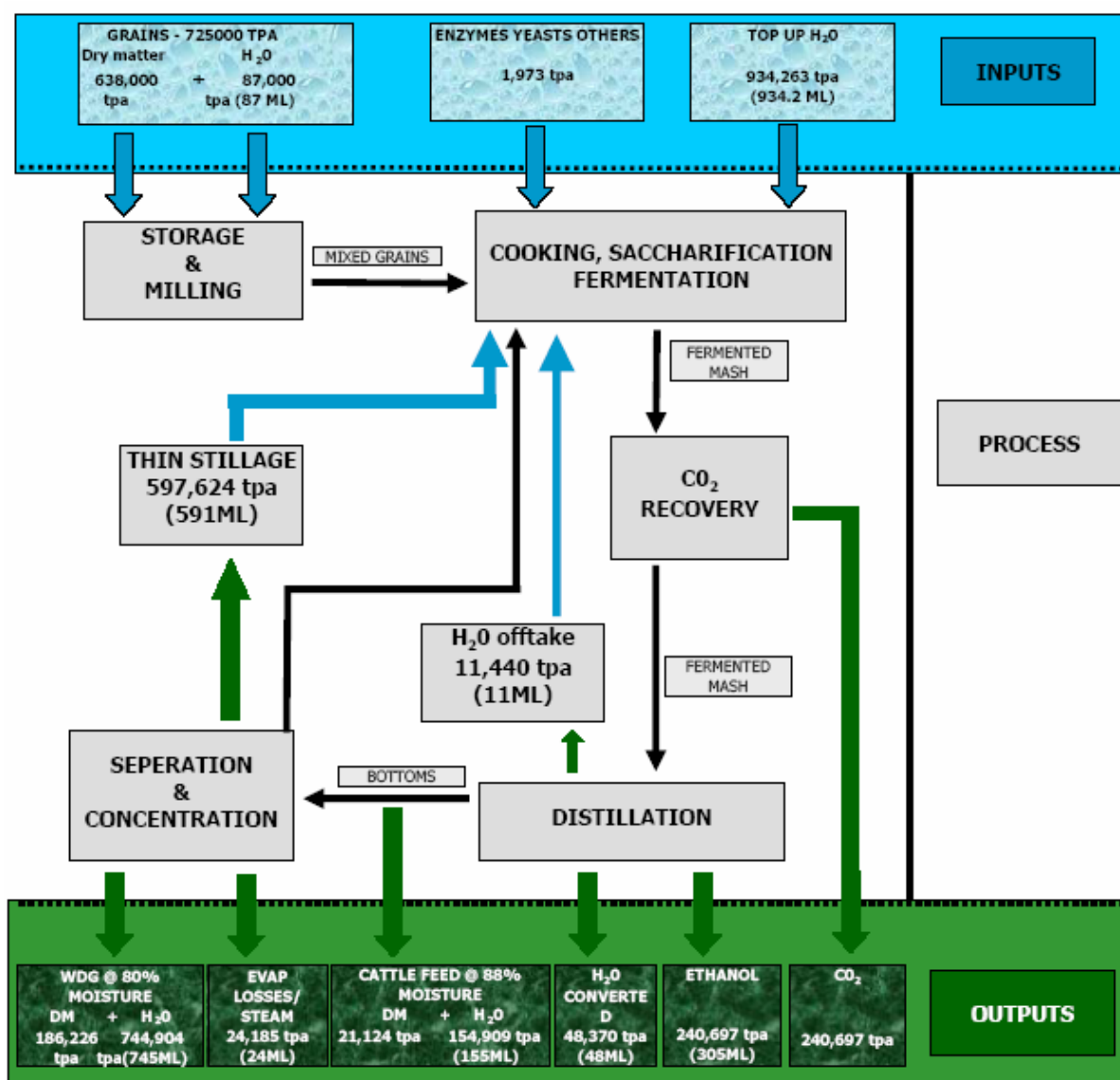
The Bread Research Institute (*pers comm*) advises starch levels in grains can vary significantly from 60% to in excess of 70%. Selected varieties of wheat, barley, corn, etc. are likely to average 70%.

The spreadsheet model at Annexure 4.1.1 calculates that it requires approximately 725,000 tonnes of grains plus approximately 1,973 tonnes of additives and 1,525ML of water (plus the 87,000 tonnes (87ML) of water contained in the grain at 12% by weight) in order to generate just on 300ML of ethanol.



Other outputs generated by the ethanol plant are approximately 207,350 tonnes (DM) (176,033 tonnes @ 88% moisture for on-site cattle feed and 931,130 tonnes @ 80% moisture for sale off-site) distillers grain plus approximately 240,700 tonnes of carbon dioxide with smaller amounts of yeast, mixes of glycerol and acidic acid (totalling approximately 53,030 tonnes) contained within the wet distillers grain. Excess water extracted totals an estimated 591.05ML which is recycled back through the ethanol plant. This leaves a net demand for imported water of 934.26ML/year. Recycled water will be cycled through the ethanol plant effluent treatment systems in a closed loop for total effluent management.

The diagram below, details the ethanol process, and maps all inputs and outputs, graphically depicting the figures identified above.



Of the wet distillers grain generated on-site a total of 21,124 dry tonnes or 176,033 wet tonnes at 88% moisture is estimated to be used by the dairy enterprise. The remainder will be required to be sold off-site most likely to the local beef feedlot industry, sections of which have already expressed an interest in the product.

The sourcing of grain and the disposal of wet distillers grain will be a major issue as will the sale of compressed carbon dioxide captured during the ethanol production processes.



4.1.3 Dairy Cattle

Attached as Annexure 4.1.2 is a livestock trading account with attached notes, guiding principles and driving parameters.

The livestock trading account and guiding principles were arrived at in direct discussion with Dr Ian Lean of Strategic Bovine Services. Dr Lean is experienced in freestall dairies and the dairy industry in general.

The following points are noted:

- To maintain 6,000 cows constantly in milk requires 7,200 cows in the dairy herd with 1,200 cows dry at any one point in time;
- The cows are assumed to be artificially inseminated with sexed semen which historically has resulted in 90% heifer calves from a 90% calving rate;
- Bull calves are sold at under three (3) months of age to the bull calf raising market;
- Obvious cull heifers are sold at three (3) months of age and the retained heifer calves are placed into the young heifer grouping;
- The young heifer grouping are further culled at close to nine (9) months with the culls of this group being disposed of immediately;
- The next groups of heifer calves, those in the 9 to 15 month age bracket, are artificially joined to a mix of sexed and unsexed semen. The sexed semen is applied to the heifer calves which are deemed to be the select or high quality heifers and the unsexed semen is the heifer calves of a lesser standard. The lesser standard heifers are then sold to the Asian heifer market for transfer offshore; and
- The quality heifers are retained, ultimately introduced to the dry cow herd prior to calving. Later another culling down to approximately 1,900 head of best quality and best performing animals.

The herd is under constant selection pressure, for not only the best performing heifers and cows constitutionally, as well as in milk performance.

The livestock trading account in Annexure 4.1.2 displays a total herd requirement to keep 6,000 cattle in milk of 14,400. This EA has detailed that up to a total of 18,000 head could be expected to be kept on site at any one time.

The disparity between figures is explained thus:

- By provisioning for a herd on site larger than that normally required, it allows management of the herd to utilize more rigorous selection pressure on the milking herd;
- Affords more flexible choices to be made with cattle selected for culling from the replacement stock; and
- Culls can be retained longer to maximise positive market trends and prices.

With this in mind, all potential impacts and management requirements have been modelled and mitigation prepared based on a 18,000 head herd, so all impacts demonstrate the “worst case” scenario.

In all up to 18,000 head of cattle may be to be on-site at any point in time. Of these 7,200 are held in the freestall sheds. Those in the freestall sheds are a mix of cows both milking and dry, and cattle in the maternity section and/or in the hospital section, where they will be under the attention of the on-site veterinarian.



All the heifer calves and the heifers selected into the milking herd will be held in a series of dry pens which are the same as those which would be found in a normal beef cattle feedlot. All cattle will be fed a ration similar to that found in Annexure 4.1.3 which has been provided by Dr Ian Lean. The initial calculation is in dry matter as is the case with any ration. To this has to be added a provision for the moisture content which, in the case of wet distillers grain, shall be substantial. The main components of the ration are:

- Distillers grain - carted direct from the ethanol plant at an average of 88% moisture for a total of 176,033 tonnes of wet product per annum;
- Fresh grain - of which there is an estimated 16,800 tonnes;
- Silage – preference given to corn silage grown under contract by Coleambally farmers and/or the adjoining “Tubbo”. A total of approximately 90,000 tonnes of corn silage would be required in any one year; and
- Remainder - the remaining products total approximately 10,000 tonnes in aggregate include components such as cotton seed, molasses and the normal additives.

In total there is a need for in excess of 300,000 tonnes of fodder for the cattle rations. The cattle will always have feed available to them on a 24 hours, 7 days, 365 days basis to optimise milking and reproductive performance and to optimise growth rates and early maturity in heifers. At no time will the cattle be allowed to be without immediate access to feed as to do so will seriously compromise their milking and calving performance, their recovery after calving and the growth rates in the heifers. Without optimal cattle performance the commercial viability of the dairy project will also be seriously compromised.

The movements of sale cattle and fodder products into and out of the feedlot will be covered in the traffic section, Section 4.4.

A full time project veterinarian will constantly monitor and manage the dairy herd and ensure its optimal well-being and performance.

4.1.4 Manure Production

At Annexure 4.1.4 is a summary of the calculations driving the amount of manure being generated each year. From the 18,000 head of cattle it is estimated the total tonnes of manure produced per day will be 454 tonnes for a total annual production of 165,700 tonnes. Assuming 70% of all excreta is fresh faeces of which 25% is averaged out as dry matter there is a total 29,000 tonnes/year of dry matter being produced. On top of this the urine being generated at approximately 3% dry matter for a total of just under 2,000 tonnes/year of extra dry matter. This gives a total of 30,700 tonnes of dry matter produced per year mixed with nearly 135,000 tonnes of water.

The recovery of manure as dry matter from the freestall sheds (with 95% recoverable) is just under 18,000 tonnes plus a further 8,400 tonnes recovered from the dry lots with 70% recoverable. At 12.5% moisture, the total recovery is just less than 30,000 tonnes of solid manure.

When added to irrigation lands at 80% of the accepted upper limit of 15 tonnes/hectare there is a total of 2,500ha of irrigation required to accept all the manure in any one year. Alternatively, if the entire disposal is to be on the dryland agricultural lands, a total of 5,000ha is required at 6 tonnes/ha (*NSW Feedlot Manual, 1997*).

All the manure will be disposed to the irrigation and/or dryland farming areas on “Tubbo” and/or its associated Coleambally farms which are managed in conjunction with “Tubbo”.



Annexure 4.1.5 calculates the amount of run-off which could occur in the wettest month, assuming all the rain in the wettest month runs off, is received in one event in each of:

- Decile 1 or the driest year in 100 years;
- Decile 5 or middle year of a 100 year rainfall sequence;
- Decile 9 or 10th wettest year in 100 years; and
- Decile 10⁺⁺ or DX (extreme) being 40% wetter than or the wettest year in 100 years.

In a Decile 9 or standard year for wet sequence assessment, and assuming the above rainfall characteristics with an elevated runoff coefficient of 0.95 instead of the standard 0.8, the dry lot of 20ha would generate a runoff volume of 16.2ML. On these extreme parameters the dry lot section of the dairy enterprise would require a linear length of sedimentation basins of 700m assuming each are 25m wide (see Annexure 4.1.5)

The milkers and dry cows in the freestall sheds would have a daily run-off volume of 7ML requiring a linear length of 320m of sedimentation basins, each 25m wide and 0.9m deep.

Therefore the total linear length of all sedimentation basins to cover all eventualities would need to be 1,000m long.

To buffer the runoff from a severe rain event an additional surge storage is required downstream of the sedimentation basins. Calculations in Annexure 4.1.5 indicate the surge storage and would require a capacity of 45ML to capture all runoff on in Decile 9 month. The surge storage will allow sufficient time for a pump station to lift the captured water after sedimentation settling has occurred and direct this water to the anaerobic ponds.

4.1.5 Anaerobic Ponds

At Annexure 4.1.6 are the calculations to determine the minimum size of the anaerobic ponds which would be required to handle all effluent from the dairy enterprise. Annexure 4.1.6 consists of both Part A and B. Part A is initial calculations for storage depth, and Part B is the same calculations undertaken to minimise the depth below natural surface level (NSL). The calculations are based on the *Dairy Feed Pad Guidelines for the Goulburn Broken River Catchment* and documentation provided by Strategic Bovine Services. The calculations indicate the minimum volume required in the anaerobic ponds is 262ML. The required volume has been then arbitrarily increased to approximately 350ML to ensure a realistic margin of safety until the future final design level investigations have been undertaken.

Also included at Annexure 4.1.6 is a calculation of the dimensions of the anaerobic ponds at a minimum depth of 5m of water.

The anaerobic ponds have been broken into two (2) separate ponds, each of 175ML capacity to enable maintenance work to be carried out on alternative ponds if required including cleaning out of sedimentation in the bottom of the ponds. As calculated in Annexure 4.1.6A, each of these ponds is expected to have an external dimension of 272m at the outside toe of the embankment and 122m wide with a common bank separating the ponds to minimise earthworks. The calculations in Annexure 4.1.6B indicate pond dimensions of 270m at outside toe of the embankment and 120m wide, once gain with a common bank. The pumping station at the northern end will direct water from the surge storage discussed in the previous sub-section to the northern end of the long and narrow anaerobic ponds. The water can then move slowly south as it heads towards the next stage of water treatment, the aerobic ponds.



4.1.6 Aerobic Ponds

The aerobic ponds receive water from the southern end of the anaerobic ponds where it is allowed to gravitate into the aerobic pond through a common embankment. The calculations for sizing of the ponds are based on a minimum surface area to optimise the aeration process and it is expected water will be mechanically aerated from time to time whilst in this pond.

Annexure 4.1.7 is the calculation for the minimum surface area and as for anaerobic storages, is broken into Part A and B to identify an initial calculation and a second calculation to minimise depth below NSL. The calculations are based on the “*Dairy Feed Pad Guidelines for the Goulburn Broken River Catchment*” and the Strategic Bovine Services documentation provided independently. The calculations in Annexures 4.1.7A, and 4.1.7B both indicate the minimum surface area should be 15ha which has been arbitrarily expanded to 25ha given the water from the aerobic ponds will need to be recycled through the freestall sheds for the flood wash-down. Furthermore, the aerobic pond can receive additional water direct from CICL to maintain a level of dilution within the storage. Surplus rain water can also be directed to this storage as major on-site buffer storage. The calculations indicate a need for a total footprint at the outer toe of the embankment of 38.2ha and would have a total capacity of approximately 1,100ML.

For the purposes of practical management, total capacity would be 1,200ML to achieve a slightly larger surface area and to provide additional storage buffer capacity when managing extreme storm events and to keep all water on site. This spare capacity would further dilute and aerate of the water within the aerobic ponds for best site and water management.

The final volume and surface area would be determined by more detailed design level investigations following the approval of the project.

4.1.7 Other Water Storages

For identification purposes the water storage facilities have been divided into three (3) categories as follows:

- Category 1 – water which, with relatively minimal filtration and treatment, would be of potable standard and would be useable in the ethanol plant;
- Category 2 – water which is of a relatively sound quality but needs noticeably more effort and cost to enable substitution of Category 1 water. Has significant potential for irrigation of landscaped areas, truck washdown, site washdown, etc; and
- Category 3 – water contaminated with excreta and/or other high BOD loadings.

Each of the above three (3) categories can be captured separately as run-off and directed to separate water storages as required.

There is a potential to construct two (2) other water storages on site (i.e. beyond the combined aerobic anaerobic storages) to manage the project water requirements.

The first of these facilities is the Category 1 water storage which, if no arrangements for winter delivery from CICL can be achieved, would need to be in the order of 800ML. At the date of this EA, CICL intend constructing their own enroute water storage which will be fast-tracked to ensure the proposed ethanol and dairy project receive delivery of water required during CICL winter channel shutdown periods. The calculation for the footprint of water storage is to be found in Annexure 4.1.8. Water storage with a surface area of approximately 5.9ha, measuring approximately 185m x 185m would carry water up to 3.45m deep with a free board of 1m. If a satisfactory winter delivery arrangement



with CICL can be negotiated, this storage could be substantially reduced to between 100ML and 200ML capacity.

The second water storage is required for managing the Category 2 water and needs to be approximately 300ML capacity. The calculations for this facility are included in Annexure 4.1.8. The Category 2 water storage has initial design dimensions of approximately 550m x 350m carrying water to a depth of approximately 2.4m with 0.8m free-board. The Category 2 water storage is depicted on the project site Figure 3.3.2 and could be extended in size and reduced in depth with a number of terraces or berms up the embankment and will act as a project wetland area and to enhance the overall site landscape.

4.1.8 Nutrients

The amount of nutrients generated by the manure from the dairy enterprise is calculated in Annexure 4.1.9. The total mass of manure has been calculated as 30,000 tonnes of dry matter with a standardised 12% moisture content. This manure has a typical nutrient concentration with the adopted data for Annexure 4.1.9 being interpreted from the ranges depicted in:

- Feedlot Waste Management Conference Papers, Queensland (1995);
- Feed Pad Guidelines for the Goulburn Broken Catchment Management Authority (2002); and
- New South Wales Feedlot Manual, (1997).

It is intended that none of the drainage and/or reclaimed water emanating from the project site will be used for irrigation purposes

Annexure 4.1.9 also includes a series of nutrient balance calculations for three (3) intended land use scenarios for the “Tubbo” irrigation. Those land usages are maize for silage production, maize for grain and winter cereals (oats) for silage.

The only source of nutrients for the calculations in Annexure 4.1.9 is the intended manure application at 12 t/ha DM which is less than the guidelines limit of 15 t/ha. There is no nutrient input from any reclaimed water since that water will not be used for irrigation purposes. Even though there is an obvious need for artificial fertiliser supplementation with the proposed summer crops, the calculations in Annexure 4.1.9 purposely omit any possible supplementation in order to highlight the impacts of manure application. Other factors in relation to the nutrient balance calculations requiring comment are:

- There is no solid consistency in the available reference documentation as to what uptake rates there are for various nutrients by each different crop. In fact, there is some significant divergence in the data;
- Significant proportions of the applied nitrogen will be required for the breakdown of organic matter in both the applied manure and in crop residues. In addition, there will be significant loss of nutrients by way of identification. Both factors have been included in the calculations contained in Annexure 4.1.9;
- Some nutrients and other salts will be locked-up in the soil itself, and this factor has been addressed in the calculated balances; and
- Other salts include many beneficial elements such as Ca, Mg, S, Na, Bo, Cu, Mo, etc. They are not all detrimental elements and no solid data is available to enable an accurate balance.



At this point in time, quantifiable evidence on other salts contained within manure as constants requiring management is not readily available.

A summary of the calculated outcomes found in Annexure 4.1.9 is presented in Table 4.1.1 below:

Table 4.1.1: Nutrient calculation content of silage

	Maize (Silage)			Oats (Silage)			Maize (grain)		
	Sources	Sinks	Balance	Sources	Sinks	Balance	Sources	Sinks	Balance
Nitrogen	300	483	-183	300	281	19	300	362	62
Phosphorus	96	90	6	96	67	29	96	78	18
Potassium	240	361	-121	240	38	202	240	69	171
Salts	240	144	96	240	289	-49	240	90	150

Comments arising from the nutrient balance calculations summarised in Table 4.1.1 above are as follows:

- Nitrogen – winter cereals for silage will accumulate a modest 19Kg/ha of nitrogen which will be then utilised by the maize (silage) and maize (grain) crops being grown in rotation. In fact, both maize crops would require N supplementation with artificial fertilisers with maize silage requiring the most supplementation;
- Phosphorus – this nutrient is inherently deficient in the majority of Australian soils including the Riverina soils found at “Tubbo”. A national 40Kg/ha is assumed to be locked into the soil CEC with a calculated 6Kg/ha to 29Kg/ha accumulating and continuing to be available to subsequent crops. In practice, a high proportion of the 6Kg to 298Kg would be locked into the soil CEC if not used by crops. Given past experiences with regional vegetable crops receiving and benefiting from annual P applications well beyond the rates applied in the project manure, the potential for environment concerns with “accumulating” P is considered to be very low;
- Potassium – the calculations indicate a potential to accumulate K under both the maize for grain and the winter cereals for silage land use options. However, the maize for silage options indicates a potential net deficiency to accumulate K in the soil profile; and
- Other Salts – these are not exclusively NaCl or other potentially adverse elements. Other beneficial elements such as Cu, Mg, Ca, Ba, Mo, S etc. will be included. There is no reliable information available to enable a reliable assessment to be made.

At this point in time, quantifiable evidence on other salts contained within manure as constants requiring management is not readily available.

Additional trace nutrient elements contained within manure are present based largely on feed components etc., thus some knowledge can be derived from analysis of feed components in calculation of ration requirements, and conversely targeted soil testing post manure application and incorporation into soils. Fertilisers applied can thusly be manipulated to manage any “other salt” content evidenced in soil tests.

Given the wide divergence in the net balances for each of the nutrients under differing crops with differing yield potentials, there is no definitive outcome from those balances other than to state:

- All nutrients can be sustainably managed under the appropriate land management regime; and
- With the appropriate mix of irrigated crops in rotation, the nutrients within the manure may be sustainably managed on-site.



All the calculations in this EA are based on the spreading of manure on the “Tubbo” irrigation only. In addition to the “Tubbo” irrigation, the Four Arrows Group has available the nearby “Belvedere” irrigation and a substantial number of CIA farms all of which form the “Tubbo” aggregation of irrigation properties. Furthermore, a number of CIA irrigators verbally have requested access to the manure for spreading on their own farms.

Therefore, the option of rotating the lands which receive the project manure at no more than 12Kg/ha/yr is a viable alternative.

The conclusion is to continue with the proposed option of spreading the manure on the “Tubbo” irrigation, and to regularly performance monitor the changes in soil nutrient status, matching that data with nutrient export data with grain and/or forage and/or silage analyses.

The performance monitoring program would form part of the project environmental management plan to ensure an appropriate and timely response to the emerging data.

4.1.9 Project Water Balances

These are discussed in detail in Section 4.5.

Even in the decile 9 or very wet year (the standard scenario required for feedlot assessments), all water can be kept on site and managed through the proposed water storage facilities. Hence, there is no movement of water and/or associated nutrients or salts off-site or to unfavourable locations in and around the project site. The water models indicate even in a decile 9 year there is still a need to purchase temporary transfer water or utilise water which has been permanently purchased to replenish the water storages following the evaporation which will occur until such time as it becomes economically viable to place or apply those product which will minimise and/or substantially reduce evaporation from free water surfaces.

Given the need to reliably demonstrate the capacity of the project water storages to manage even extreme rain events, a non-standard decile “extreme” or decile DX scenario has been provided. The decile DX model further supports the view the designed water storages are able to cope with a sequence of rainfalls yielding 40% more than that in the wettest recorded year to date. The decile DX outcomes are also discussed in detail in Section 4.5.

4.2 Air Quality

4.2.1 Introduction

Both prior to and throughout the consultative process, air quality has been identified as one of the key potential issues to arise from the proposed development. To this end, Booth Associates contracted the services of Holmes Air Sciences (HAS) to undertake a detailed investigation to quantitatively assess the air quality impacts of the proposed development. The report assesses the impact of gaseous emissions and odour from both the proposed ethanol plant, and odour emissions from the proposed intensive dairy, and it attached as Annexure 4.2.1.

The EA has been undertaken at a stage that precludes any physical measurement of impacts on air quality, and as such, the impacts of emissions have been assessed by comparing estimated odour and criteria pollutant concentrations with relevant air quality criteria. Modelling was undertaken in accordance with the Department of Environment and Conservation (DEC, formerly NSW EPA), “Approved Methods for the Modelling and Assessment of Air Pollutants in NSW” (NSW DEC, 2005) using CALPUFF and a wind field prepared using CALMET.



That notwithstanding, real world testing of similar facilities has been undertaken by HAS to ensure accuracy of potential impacts calculated by the CALPUFF and CALMET models.

Section 3.2.3 details the meteorological and climatic conditions from a series of surrounding weather station locations, and is considered by HAS as being representative of those found on-site.

4.2.2 Air Quality Issues

Typical air emissions from ethanol plants include the criteria pollutants:

- Carbon monoxide (CO),
- Nitrogen dioxide (NO₂),
- Particulate matter,
- Sulphur dioxide (SO₂)

As well as minor emissions of hazardous air pollutants, irritants and odorous chemicals including:

- Acrolein,
- Acetic Acid,
- Butyric acid,
- Lactic acid,
- Furfural
- Glycerol,
- Carbonyl Sulphide
- Dimethyl Sulphide,
- Carbon Disulphide,
- Hydrogen Sulphide

The minor emissions do not constitute a health effect but combine to form an odorous emission which has been assessed separately.

4.2.2.1 Gaseous and Particulate Emissions

The DEC has historically noted air quality goals for nitrogen dioxide, carbon monoxide and particulate matter determined by the World Health Organisation (WHO), the United States Environmental Protection Agency (US EPA) and the National Health and Medical Research Council of Australia (NHMRC).

The National Environment Protection Council of Australia (NEPC) has determined a set of air quality goals for adoption at a national level, which are part of the National Environment Protection Measures (NEPM). In its publication "Action for Air" (NSW EPA, 1998), the NSW EPA adopted new air quality goals for particulate matter and nitrogen dioxide. These make the NSW standards for these pollutants consistent with the NEPM standards. The DEC set assessment criteria for assessing the effects of air pollution from a specific project in their 'Approved Methods for the Modelling and Assessment of Air Pollutants in New South Wales' (DEC, 2005) as shown below (Table 4.2.1).

**Table 4.2.1: DEC air quality goals and impact assessment criteria for New South Wales**

Pollutant	Goal	Averaging Period
Carbon monoxide	30 mg/m ³	1-hour maximum
	10 mg/m ³	8-hour maximum
	246 µg/m ³	1-hour maximum
	62 µg/m ³	Annual Mean
Particulate matter	50 µg/m ³	24-hour maximum
	30 µg/m ³	Annual mean
< 10 µm (PM ₁₀)	570 µg/m ³	1-hour maximum
	228 µg/m ³	1 day
	60 µg/m ³	Annual average

µg/m³ – micrograms per cubic metre

mg/m³ – milligrams per cubic metre

4.2.2.2 Carbon Monoxide

Carbon monoxide can be harmful to humans because its affinity for haemoglobin is more than 200 times greater than that of oxygen. When it is inhaled it is taken up by the blood and therefore reduces the capacity of the blood to transport oxygen. This process is reversible and reducing the exposure will lead to the establishment of a new equilibrium with a period of three hours being the approximate time required to reach fifty percent (50%) of the equilibrium value.

Symptoms of carbon monoxide intoxication are lassitude and headaches; however these are generally not reported until the concentrations of carboxyhaemoglobin in the blood are in excess of ten percent of saturation. This is approximately the equilibrium value achieved with an ambient atmospheric concentration of 70 mg/m³ for a person engaged in light activity. However, there is evidence that there is a risk for individuals with cardiovascular disease when the carboxyhaemoglobin concentration reaches four percent and the WHO recommends that ambient concentrations be kept to values which would protect individuals from exceeding the four percent level.

The 15-minute, 1-hour and 8-hour goals noted by the DEC provide a significant margin for safety, however this is appropriate for this type of guideline, which is designed to protect a wide range of people in the community including the very young and elderly. The 1-hour and 8-hour goals are 30 mg/m³ and 10 mg/m³ respectively.

4.2.2.3 Oxides of Nitrogen

Nitrogen oxides (NO_x) are comprised mainly of nitric oxide (NO) and nitrogen dioxide (NO₂). Nitric oxide is much less harmful to humans than nitrogen dioxide and is not generally considered a pollutant with health impacts at the concentrations normally found in urban environments. Concern with nitric oxide relates to its transformation to nitrogen dioxide and its role in the formation of photochemical smog. Nitrogen dioxide has been reported to have an effect on respiratory function although the evidence concerning effects has been mixed and conflicting. The DEC has not set any air quality goals for nitric oxide, however it has set 1-hour and annual average goals for nitrogen dioxide. It has adopted the NEPM standard of 246 µg/m³. The annual average goal for nitrogen dioxide is 30 µg/m³. The DEC has also adopted the WHO 1-hour goal of 200 µg/m³ as a long term reporting goal.



4.2.2.4 Particulate Matter

The presence of particulate matter in the atmosphere can have an adverse effect on health and amenity. The health effects of particles are largely related to the extent to which they can penetrate the respiratory tract. Larger particles, that are those greater than 10 μm , generally adhere to the mucus in the nose, mouth, pharynx and larger bronchi and from there are removed by either swallowing or expectorating. Finer particles can enter bronchial and pulmonary regions of the respiratory tract, with increased deposition during mouth breathing which increases during exercise. The very fine particles can be deposited in the pulmonary region and it is these which are of particular concern.

The health effects of particulate matter are further complicated by the chemical nature of the particles and by the possibility of synergistic effects with other air pollutants such as sulphur dioxide.

Much of the recent concern over the health effects of fine particulate matter is based on investigations carried out in the United States, with the view to quantifying the health risks associated with both long-term and short-term exposure to airborne particulate matter. The study is colloquially referred to as "The Six Cities Study" from the original work by Dockery *et al* (1993), which determined a relationship between fine particulate matter (defined as particles smaller than 2.5 μm in diameter) in the air and mortality in six United States cities.

The basic finding of the Six Cities Study is that there is an increase in mortality with increasing concentrations of fine particulate matter. The conclusions appear to be robust and have been supported by subsequent studies and, as far as can be determined, are not confounded by other known variables. In October 2002, NEPC released a draft variation to the NEPM and an Impact Statement for $\text{PM}_{2.5}$ for public consultation (NEPC, 2002 and 2003). The standards proposed are a 24-hour average of $25\text{g}/\text{m}^3$ and an annual average of $8\text{g}/\text{m}^3$. These standards proposed are 'advisory reporting standards' which do not set a time line for compliance. The goal is to gather sufficient data nationally to facilitate the review of the Air Quality NEPM scheduled to commence in 2005. The draft includes a protocol setting out monitoring and reporting requirements for particles as $\text{PM}_{2.5}$. It is not appropriate to compare the predicted concentrations from the proposed upgrade to the draft variation which is still out for consultation and sets no time line for compliance.

The DEC continues to note the NHMRC's $90\text{ }\mu\text{g}/\text{m}^3$ annual average goal for total suspended particulate matter (TSP). This level is recommended as the maximum permissible level in urban environments.

4.2.2.5 Sulphur Dioxide

Sulphur dioxide (SO_2) is a colourless pungent irritating and reactive gas which is soluble in water. It can have harmful effects on the respiratory system as well as on vegetation and building materials.

The main sources of SO_2 are power generation from the combustion of fossil fuels containing significant amounts of sulphur the roasting or smelting of mineral ores containing sulphur, oil refining and industrial plants which burn large quantities of fuel with significant sulphur contents. Motor vehicles are also a source of SO_2 although this is relatively minor.



The DEC ambient air quality standards for sulphur dioxide are:

- 570 $\mu\text{g}/\text{m}^3$ (1-hour);
- 228 $\mu\text{g}/\text{m}^3$ (24-hours); and
- 60 $\mu\text{g}/\text{m}^3$ (1-year).

Exposures to concentrations of sulphur dioxide at or below these values would be expected to protect the health of the community including the most sensitive groups.

4.2.2.6 Odour Emissions

Odour is measured using panels of people who are presented with samples of odorous gas diluted with decreasing quantities of clean odour-free air. The panellists then note when the smell becomes detectable. Odour in the air is then quantified in terms of odour units which is the number of dilutions required to bring the odour to a level at which 50% of the panellists can just detect the odour, defined as one odour unit. This process is known as olfactometry.

The determination of air quality goals for odour and their use in the assessment of odour impacts is recognised as a difficult topic in air pollution science. The topic has received considerable attention in the past five years and the procedures for assessing odour impacts have been refined considerably.

Odour impacts are determined by several factors, the most important of which are:

- the **F**requency of the exposure;
- the **I**ntensity of the odour;
- the **D**uration of the odour episodes;
- the **O**ffensiveness of the odour; and
- the **L**ocation of the source (the so-called FIDOL factor).

In determining the offensiveness of an odour it needs to be recognised that for most odours the context in which an odour is perceived is also relevant. Some odours, for example the smell of sewage, hydrogen sulphide, butyric acid, landfill gas etc., are likely to be judged offensive regardless of the context in which they occur. Other odours such as the smell of jet fuel may be acceptable at an airport, but not in a house, and diesel exhaust may be acceptable near a busy road, but not in a restaurant.

Whether or not an individual considers an odour to be a nuisance will depend on the FIDOL factors outlined above and although it is possible to derive formulae for assessing odour annoyance in a community, the response of any individual to an odour is still unpredictable. Odour goals need to take account of these factors.

The NSW DEC have developed a Draft Odour Policy (NSW EPA, 2001) which includes some recommendations for odour criteria. They have been refined by the DEC to take account of population density in the area. Table 4.2.2 lists the odour certainty thresholds, to be exceeded not more than 1% of the time, for different population densities.

**Table 4.2.2: DEC Odour Certainty Thresholds for Assessment of Odour**

Population of affected community	Odour performance criteria (nose response odour certainty units at the 99 th percentile)
Single residence ($\leq \sim 2$)	7
~ 10	6
~ 30	5
~ 125	4
~ 500	3
Urban (~ 2000)	2

The difference between odour goals is based on considerations of risk of odour impact rather than differences in odour acceptability between urban and rural areas. For a given odour level there will be a wide range of responses in the population exposed to the odour. In a densely populated area there will therefore be a greater risk that some individuals within the community will find the odour unacceptable than in a sparsely populated area. The goals assume that 7 odour units at the 99th percentile would be acceptable to the average person, but as the number of exposed people increases there is a chance that sensitive individuals would be exposed. The goal of 2 odour units at the 99th percentile is considered to be acceptable for the whole population.

There are three residences in the vicinity of the project area; therefore the population density in the area around the Coleambally site would be equivalent to a single residence. On this basis the odour criterion of 7ou has been applied to the project.

It is common practice to use dispersion models to determine compliance with odour goals. This introduces a complication because Gaussian dispersion models are only able to directly predict concentrations over an averaging period of three-minutes or greater. The human nose, however, responds to odours over periods of the order of a second or so. During a three-minute period, odour levels can fluctuate significantly above and below the mean depending on the nature of the source.

To determine more rigorously the ratio between the one-second peak concentrations and three-minute and longer period average concentrations (referred to as the peak to mean ratio) that might be predicted by a Gaussian dispersion model, the NSW DEC commissioned a study by Katestone Scientific Pty Ltd (1995, 1998). This study recommended peak to mean ratios for a range of source types. The ratio is also dependent on atmospheric stability and the distance from the source. A summary table of these ratios is presented in Appendix B of the HAS report. In this case the peaks to mean factors for area sources in the near field are relevant.

The NSW DEC Draft Odour Policy (NSW EPA, 2001) takes account of this peaking factor and the goals shown in Table 4.2.2 are based on non-response time.



4.2.3 Emission Estimates

Emissions from the proposed ethanol plant and intensive dairy will comprise gaseous and particulate emissions from the ethanol plant, and odour and dust from the intensive dairy. The following sections provide some background information on the way gaseous and particulate emissions and odour will be generated and controlled on the project site. Emissions from the ethanol plant will comprise a complex mix of organic components which on an individual basis may have health effects; however they will be present at levels where they will not cause toxic health impacts. The components have been considered as a group within the odour assessment.

4.2.3.1 Criteria Pollutant Emissions

Emission rates for the proposed ethanol plant have been derived from emissions data from an ethanol plant in Dalby, Queensland (PAE, 2004). The Dalby plant was designed to produce 60 ML/y of ethanol, compared with the 300 ML/y production rate of the proposed Coleambally plant. Equivalent emission rates and stack dimensions have been calculated by scaling up the Dalby emission rates by a factor of five. Table 4.2.3 shows the assumed emission rates of CO, NO_x, SO₂, TSP and PM₁₀ from the proposed ethanol plant. It has been assumed that the emission rates will be proportioned to the throughput of the plant.

Table 4.2.3: The assumed emission rates of CO, NO_x, SO₂, TSP and PM₁₀ from the proposed ethanol plant (g/s)

Emission source	Source type	Criteria pollutants				
		TSP	PM ₁₀	SO ₂	NO _x	CO
Steam generation (boilers)	Point	0.602	0.602	-	8.400	6.665
Emergency generation	Point	0.0666	0.0666	0.0920	2.2007	0.1332
Grain hammer milling	Volume	0.206	0.206	-	-	-
Grain receival building, cleaning/separator, and handling	Volume	0.279	0.106	-	-	-

Table 4.2.4 shows the point and volume source parameters used in the model. Projected building heights and widths associated with building wake effects were calculated using the US Building Profile Input Program (BPIP).

Table 4.2.4: Point and volume source parameters

Point source	Stack height (m)	Diameter (m)	Exit velocity (m/s)	Exit temperature (K)	Easting (m)	Northing (m)
Boiler	15	2.24	15	450	404296	6154514
Emergency generation	5	0.67	10	298	404136	6154684

Volume source	Effective height (m)	Base elevation (m)	Initial sigma y (m)	Initial sigma z (m)	Easting (m)	Northing (m)
Grain hammer milling	3	120	2.5	1.5	404133	6154591
Grain receival building, cleaning/separator, and handling	4.2	120	8	2.1	404136	6154579



4.2.3.2 Odour Emissions

Odour emissions from the proposed facility will comprise point source emissions from the ethanol plant and area source emissions from the dairy. Odour emission rates for the proposed ethanol plant were derived from values used for the Dalby plant (PAE, 2004), which were estimated from a report by McGinley Associates (2002) detailing odour concentration of various sources from an ethanol plant in the United States using grain as a feedstock. The proposed ethanol plant will emit odours from the carbon dioxide scrubber. Table 4.2.5 shows the point source emission parameters for the emission points that have been used as input to the model. As in the case of the pollutants, it has been assumed that the odour emission rate is proportioned to the plant throughput. Although feedstock at Coleambally would not be identical to that used in the plant in the United States both plants use grain and it has been assumed that the odour emissions would be similar.

Table 4.2.5: Ethanol plant odour point source parameters

Odour Source	CO ₂ scrubber
Odour concentration (ou)	4,700
Odour emission rate (ou.m ³ /s)	92,285
Peak to Mean ratio (Stability classes A, B, C)	4
Peak to Mean ratio (Stability classes D, E, F)	7
Stack height (m)	15
Diameter (m)	2.24
Exit velocity (m/s)	5
Exit temperature (K)	306
Easting (km)	404.14
Northing (km)	6,154.65
Base elevation (m)	120.1

Odour emission rates from area sources (for example, aerobic ponds, feed sheds) are probably the most difficult to measure for a variety of reasons. Firstly, the source is often heterogeneous. For example, in the case of an anaerobic pond there will be different odour emission rates from different parts of the pond. Secondly, unlike stack emissions, area emission rates are dependent upon atmospheric conditions including wind speed, degree of turbulence, temperature, etc. This adds another level of complexity to odour assessments.

There is no industry database in Australia for odour emission rates from dairy operations. The results from samples taken from a dairy operation in Gooloogong, NSW, have been used in this assessment. Gooloogong is a well run dairy and the odour sampling results sit within values that have been measured at other similar sites. The odour monitoring results have been used previously to assess the impacts of dairy operations at Bowthorne Dairy in Hinton, NSW (Holmes Air Sciences, 2000) and Wirong Dairy in Cowra, NSW (Holmes Air Sciences, 2004).

The Gooloogong samples were collected by Australian Water Technologies (AWT) using an isolation flux hood and analysed for odour using dynamic olfactometry in compliance with the European Standards that were current at the time of the odour measurements. This standard is consistent with the Australian Standards AS/N2S. The odour measurement reports for Gooloogong are shown in Appendix C of the HAS report.



The assumptions were as follows:

- Measurements from the wet weather pond at Gooloogong were used to represent odour generated from the aerobic pond;
- Measurements from the recycling pond at Gooloogong were used to represent odour generated from the anaerobic pond at Coleambally;
- Measurements from the effluent pump at Gooloogong were used to represent odour from the manure storage area at Coleambally; and
- Measurements from bedding pile, free stall sheds, and flush channel at Gooloogong were used to represent odour generated from the cow sheds at Coleambally.

The most significant factor affecting odour emissions from the dry pens will be the condition of the manure pad. Conditions which are conducive to the growth of anaerobic bacteria will give rise to the highest odour emission rates. These bacteria proliferate in warm moist conditions in the absence of oxygen. If the manure pad is deep through infrequent cleaning and there is an episode of high rainfall and warm weather, high odour emission rates are likely to occur. Odours are therefore a function of the factors connected with the state of the feed lot pad and include stocking density, moisture content, temperature of the pad and a function of the number of days since rainfall and the time to peak after rain. Lunney & Smith (1994) used these parameters to develop an odour emissions model. The model has the form shown below:

$$E_1 = \alpha \delta^{1.8} \theta^{0.77 T_p^{0.13}} F(\theta, T_a)$$

Equation 1

where:

- E_1 = emission rate (ou.m³/m²/s)
- α = a constant
- δ = weight in kg per m² of beast
- θ = a measure of moisture content of the pad in percent
- T_p = pad temperature
- F = function based on time after a rainfall event
- T_a = ambient average daily temperature

This equation can be applied to continuous meteorological data to estimate hourly varying odour emissions from a specific feedlot pad. An important factor which the model does not explicitly take account of is the management of the feedlot. Well managed feedlots which have relatively short pen cleaning intervals can have significantly lower odour emissions than those which have longer pen cleaning intervals.

Odour emissions estimates from the dry pens have been derived from Moire feedlot values (Homes Air Sciences, 2005). The average odour emission rate from the feed pen surface at Moira with an assumed maximum manure depth of 50mm and a pen slope of 3% (as will be the case in the dry pens) was 2.0 ou.m³/m²/s. The average emission rate for the dry pens can be calculated from the Moire average emission rate by taking account of the weight in kg per m² of beast. For the Moira feedlot this value was 33.6kg per m² of beast. The average weight of the cattle in the proposed dry pens at Coleambally will be 310kg with a stocking density of approximately 21.3m²/beast. This gives a value of 14.6kg/m² of beast. The adjusted emission rate of the dry pens is then 0.44ou.m³/m²/s.



Odour emission rates were estimated per square metre and the total emissions from the site relate to the size of the source. To correct for the noise response time of one second, peak-to-mean (P/M) factors were applied to emission rates to predict the odour impact at both near field and far field receptors. For the near field, a P/M factor of 2.5 was applied for neutral conditions (stability classes A to D) and a factor of 2.3 was applied for stable conditions (stability classes E and F). The near field emission rates were calculated and used in the dispersion modelling and summarised in table 4.2.6 below.

Table 4.2.6: Near field estimated odour emissions from dairy operations

Source	Specific odour emission rate (ou.m ³ /s/m ²)			Area (m ²)	Total emission rate (ou.m ³ /s)	
	“Actual”	“Nose Response” (far field)			P/M Neutral (2.5)	P/M Stable (2.3)
		P/M Neutral (2.3)	P/M Stable (1.9)			
Aerobic Pond	0.12	5.30	4.90	260,051	72,417	59,823
Anaerobic Pond	0.38	3.40	3.10	90,000	78,660	64,980
Cow Sheds	0.58	1.50	1.30	228,000	112,056	92,568
Manure Stockpiles	1.48	23.60	21.70	16,768	340	281
Sediment Basins	1.48	3.70	3.40	22,980	85,026	78,224
Drv Pens	0.44	1.08	0.99	230,111	247,370	227,580

For the far field, a P/M factor of 2.3 was applied for neutral conditions and 1.9 for stable conditions. The far field emission rates that were calculated and used in the dispersion modelling are summarised in Table 4.2.7.

Table 4.2.7: Far field estimated odour emissions from dairy operations

	Specific odour emission rate (ou.m ³ /s/m ²)			Area (m ²)	Total emission rate (ou.m ³ /s)	
	“Actual”	“Nose Response” (far field)			P/M Neutral (2.5)	P/M Stable (2.3)
		P/M Neutral (2.3)	P/M Stable (1.9)			
Aerobic Pond	0.12	0.28	0.23	260,051	72,417	59,823
Anaerobic Pond	0.38	0.87	0.72	90,000	78,660	64,980
Cow Sheds	0.58	1.33	1.10	228,000	112,056	92,568
Manure Stockpiles	1.48	3.40	2.81	16,768	340	281
Sediment Basins	1.48	3.40	2.81	22,980	78,224	64,620
Drv Pens	0.44	0.99	0.82	230,111	227,580	118,001



4.2.4 Assessment Methodology

The impacts of the criteria pollutant and odour emissions from the proposed facility have been assessed with CALPUFF using the emissions data presented in Table 4.2.1 to 4.2.2 to predict concentrations in the vicinity of the site.

Predictions have been made at a set of receptors arranged in a 10km x 10km square grid, with the ethanol plant and dairy near the centre of the grid. A grid spacing of 250m was used to cover the modelling area. Discrete receptors were located to represent the nearest three residences. The averaging time used in the model was 1 hour. Modelling results were processed using CALPOST and grided to produce contour plots of concentrations. These contour plots are displayed in Figures 4.2.1a to 4.2.1i.

4.2.5 Assessment Results

To correct for the nose response time of one second, a peak-to-mean factor of 2.3 was applied for neutral conditions (stability classes A to D) and a factor of 1.9 was applied for stable conditions (stability classes E and F). The final emission rates that were calculated and used in the dispersion modelling are summarised in Table 4.2.8 below.

Table 4.2.8: Maximum predicted concentrations at residential receptors

Maximum predicted concentrations at receptors within 5000 m of Project boundary														
Receptor	Eastings (km)	Northing (km)	CO		NO ₂		SO ₂			PM ₁₀		TSP	Odour 99 th percentile (ou)	
			1-hour (mg/m ³)	8-hour (mg/m ³)	1-hour (µg/m ³)	Annual (µg/m ³)	1-hour (µg/m ³)	24-hour (µg/m ³)	Annual (µg/m ³)	24-hour (µg/m ³)	Annual (µg/m ³)	Annual (µg/m ³)	Near field	Far field
1	403.513	6152.531	0.031	0.013	76.6	1.07	3.1	0.39	0.023	2.59	0.18	0.24	8.88	-
2	404.432	6152.062	0.050	0.019	76.4	0.88	2.6	0.48	0.015	1.43	0.12	0.15	4.54	-
3	404.254	6151.655	0.031	0.017	57.8	0.72	2.3	0.40	0.013	2.03	0.10	0.13	3.96	-
4	406.241	6152.353	0.045	0.009	63.9	0.51	1.8	0.19	0.009	1.69	0.07	0.10	-	1.56
5	406.242	6151.718	0.035	0.008	59.4	0.45	2.5	0.25	0.008	1.25	0.06	0.08	-	1.30
6	405.885	6151.224	0.046	0.020	58.2	0.48	1.4	0.12	0.006	1.07	0.06	0.08	-	1.49
7	404.488	6155.170	0.046	0.009	148	2.70	6.2	1.06	0.102	19.4	1.29	1.95	10.70	-
8	407.354	6157.196	0.017	0.009	33.3	0.48	1.3	0.13	0.010	1.05	0.07	0.09	-	1.37
9	408.490	6150.838	0.035	0.009	44.5	0.24	0.8	0.10	0.004	0.59	0.03	0.04	-	0.675
10	407.173	6148.301	0.033	0.015	42.0	0.23	0.8	0.06	0.003	0.56	0.03	0.03	-	0.705
11	406.186	6147.990	0.028	0.010	34.6	0.22	0.7	0.09	0.003	0.79	0.03	0.033	-	0.757
12	405.680	6147.764	0.030	0.009	37.2	0.25	0.9	0.12	0.003	0.64	0.03	0.03	-	0.756
13	404.977	6148.434	0.024	0.007	32.7	0.30	0.9	0.14	0.004	0.46	0.03	0.04	-	0.878
14	403.971	6148.859	0.016	0.005	24.3	0.30	0.8	0.10	0.004	0.66	0.04	0.05	-	1.2
15	403.114	6148.314	0.017	0.007	22.9	0.31	0.8	0.06	0.004	0.38	0.03	0.05	-	1.08
16	402.980	6148.056	0.015	0.008	21.2	0.30	0.7	0.05	0.004	0.39	0.03	0.04	-	1.06
17	403.234	6147.879	0.015	0.008	20.7	0.28	0.6	0.05	0.003	0.34	0.03	0.04	-	0.917
18	401.488	6147.839	0.025	0.011	39.4	0.34	0.8	0.08	0.004	0.76	0.04	0.05	-	0.17
19	400.075	6148.087	0.016	0.005	29.5	0.28	0.8	0.14	0.005	0.52	0.04	0.05	-	1.29
20	399.727	6149.111	0.016	0.006	40.8	0.31	1.7	0.09	0.006	0.72	0.04	0.06	-	1.97
21	399.281	6149.392	0.015	0.004	27.7	0.28	1.1	0.13	0.006	0.69	0.04	0.05	-	1.79
22	398.928	6150.241	0.032	0.010	42.8	0.29	0.9	0.15	0.005	1.12	0.04	0.05	-	1.73
23	398.573	6150.856	0.018	0.007	26.0	0.25	1.1	0.08	0.005	0.69	0.03	0.05	-	1.74



Maximum predicted concentrations at receptors within 5000 m of Project boundary														
Receptor	Easting (km)	Northing (km)	CO		NO ₂		SO ₂			PM ₁₀		TSP	Odour 99 th percentile (ou)	
			1-hour (mg/m ³)	8-hour (mg/m ³)	1-hour (µg/m ³)	Annual (µg/m ³)	1-hour (µg/m ³)	24-hour (µg/m ³)	Annual (µg/m ³)	24-hour (µg/m ³)	Annual (µg/m ³)	Annual (µg/m ³)	Near field	Far field
24	399.067	6151.415	0.028	0.006	35.6	0.29	1.3	0.10	0.006	0.84	0.04	0.06	-	2.07
25	400.551	6156.257	0.024	0.006	39.5	0.26	1.5	0.17	0.007	1.14	0.04	0.07	-	3.29
26	400.434	6156.342	0.023	0.006	36.1	0.25	1.4	0.16	0.006	1.16	0.04	0.06	-	3.1
DEC Goal			30	10	256	62	570	228	60	50	30	90	7	2

Note: Bold figures represent the highest concentrations modelled

4.2.5.1 Criteria Pollutants

4.2.5.1.1 Carbon Monoxide

Figure 4.2.1a: *Predicted 1 Hour and 8 Hour Average CO Concentrations* displays the predicted 1-hour and 8-hour average CO concentrations from the project. The DEC 1-hour criterion of 30 mg/m³ and 8-hour criterion of 10 mg/m³ were met at all off-site receptors. The highest 1-hour average CO concentration at a discrete receptor was 0.050mg/m³ predicted at Receptor 2, and represents 0.2% of the DEC goal. The highest 8-hour average CO concentration at a discrete receptor was 0.020 mg/m³ predicted at Receptor 6. This value represents 0.2% of the DEC goal.

The main source of CO emissions will be from motor vehicles, particularly on the adjacent Kidman Highway. However, even in busy suburban areas such as Blacktown in Sydney, 1-hour average CO concentrations in the past 10 years did not exceed 8.8 mg/m³. It is therefore unlikely that the total CO emissions, including the predicted incremental concentration plus the background concentration, will exceed the DEC criteria.

4.2.5.1.2 Nitrogen Oxides

As discussed in Section 4.2.2.3, NO_x is comprised mainly of NO and NO₂. In this assessment it has been conservatively assumed that all of the NO_x is emitted as NO₂. In reality only about 20% of NO would be converted to NO₂ at the location of the maximum predictions. Figure 4.2.1b: *Predicted 1 Hour and Annual Average NO₂ Concentrations* displays the predicted 1-hour and annual average NO₂ concentrations from the project. All off-site receptors were within the DEC 1-hour NO₂ criterion of 256 µg/m³ and annual average NO₂ criterion of 62 µg/m³. The highest 1-hour average NO₂ concentration at a discrete receptor was 148 µg/m³ predicted at Receptor 7 and represents 60% of the DEC goal. The highest annual average NO₂ concentration at a discrete receptor of was 2.70 µg/m³ predicted at Receptor 7 and represents 4% of the DEC goal.

As with CO, the main source of NO₂ will be from motor vehicles in the local area. Even in suburban areas, NO₂ concentrations rarely consume more than half of the 1-hour NO₂ goal. The background concentration of NO₂ will be lower than this in a rural area such as Coleambally. It is therefore unlikely that the DEC goals for NO₂ will be exceeded as a result of the proposed facility.

FIGURE

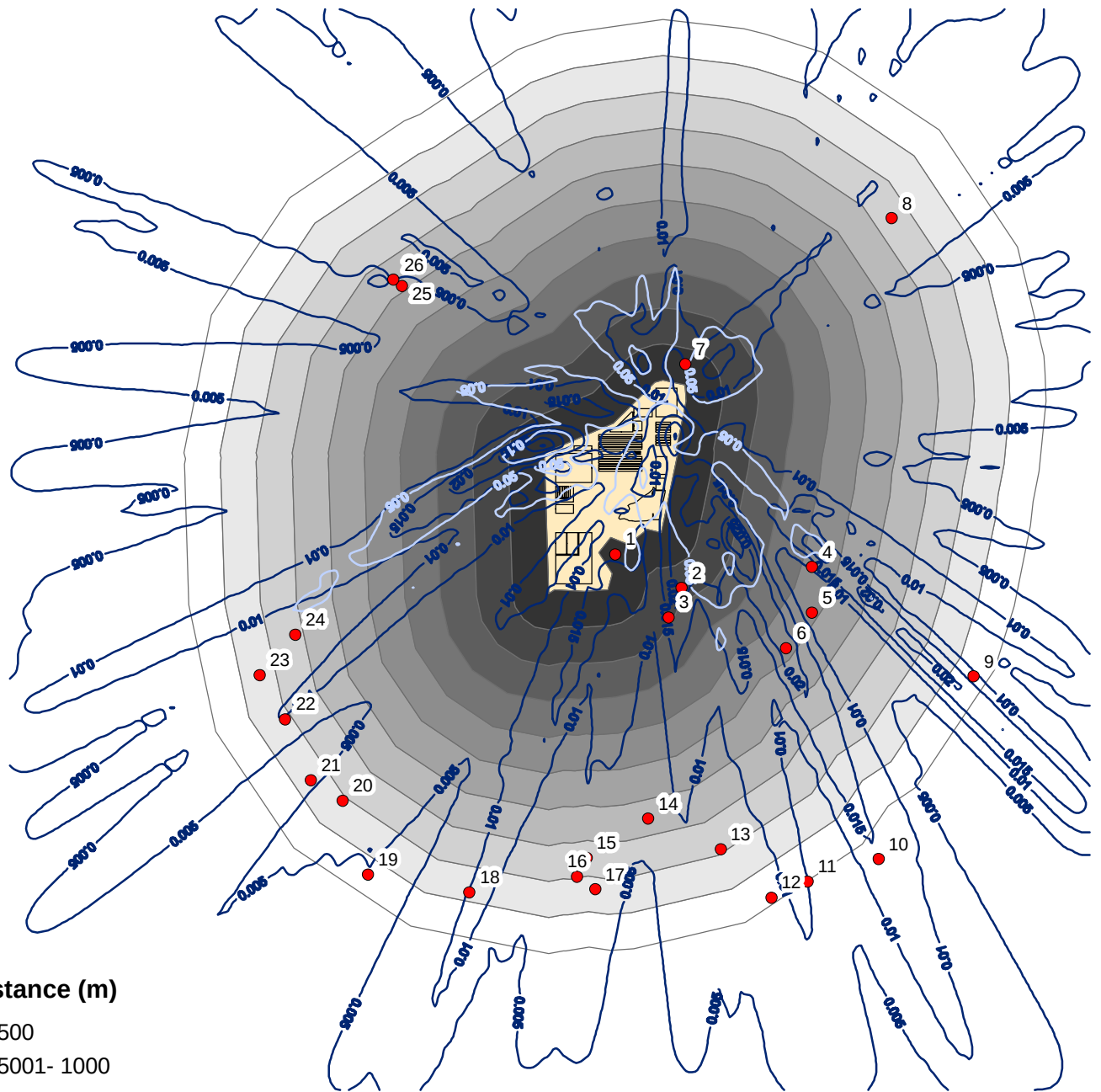
4.2.1a

Predicted 1 Hour and 8 Hour Average CO Concentrations

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Distance (m)

- 500
- 5001- 1000
- 1001 - 1500
- 1501 - 2000
- 2001 - 2500
- 2501 - 3000
- 3001 - 3500
- 3501 - 4000
- 4001 - 4500
- 4501 - 5000

- Proposed Site
- Odour Receptors within 5km
- Infrastructure Skeleton
- CO 1 Hour
- CO 8 Hour

0 0.5 1 2 3 4
Kilometers



FIGURE

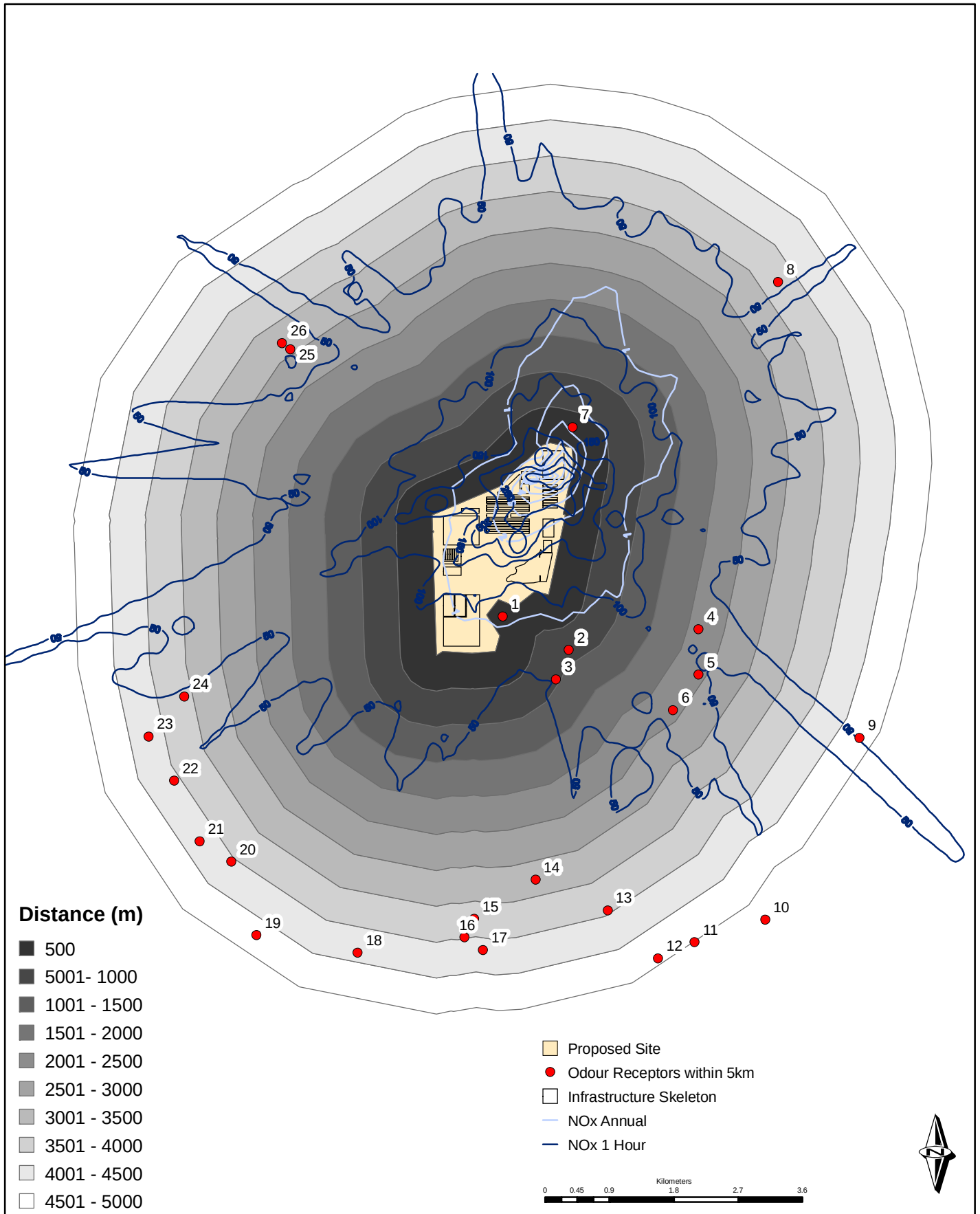
4.2.1b

Predicted 1 Hour and Annual Average NO₂ Concentrations

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4.2.5.1.3 Sulphur Dioxide

Figure 4.2.1c: *Predicted 1 Hour and 24 Hour Average SO₂ Concentrations* displays the predicted 1-hour and 24-hour average SO₂ concentrations from the project. The DEC 1-hour criterion of 570 µg/m³ and 24-hour criterion of 228 µg/m³ were met at all receptors. The highest 1-hour average SO₂ concentration at a discrete receptor was 6.2 µg/m³ was predicted at Receptor 7 and represents 1% of the DEC goal. The highest 24-hour average SO₂ concentration of 1.06 µg/m³ predicted at Receptor 7, and represents 0.5% of the DEC goal.

Figure 4.2.1d: *Predicted Annual Average SO₂ Concentrations* displays the predicted annual average SO₂ concentrations from the proposed ethanol plant. The DEC criterion of 60 µg/m³ was met at all off-site receptors. The highest annual average SO₂ concentration of 1.02 µg/m³ was predicted at Receptor 7 and represents 0.2% of the DEC goal.

As there are no industrial sources of SO₂ in the local area, it has been assumed that the background concentration of SO₂ is zero. Therefore it is predicted that the SO₂ emitted from the proposed facility will not cause exceedances of the DEC goals.

4.2.5.1.4 Particulate Matter

Figure 4.2.1e: *Predicted Annual Average TSP Concentrations* displays predicted annual average TSP concentrations from the proposed ethanol plant. The DEC annual criterion of 90 µg/m³ was met at all off-site receptors. The highest annual average TSP concentration of 1.95 µg/m³ was predicted at Receptor 7 and represents 2% of the DEC goal.

Figure 4.2.1f: *Predicted 24 Hour and Annual Average PM₁₀ Concentrations* displays the predicted 24-hour and annual average PM₁₀ concentrations from the proposed ethanol plant. The DEC 24-hour criterion of 50 µg/m³ and annual criterion of 30 µg/m³ was met at all off-site receptors. The highest 24-hour average PM₁₀ concentration of 19.4 µg/m³ was predicted at Receptor 7 and represents 39% of the DEC goal. The highest 24-hour average PM₁₀ concentration at a residential receptor was 2.57 µg/m³ at Receptor 1, which represents 5% of the DEC goal. The highest annual average PM₁₀ concentration of 1.29 µg/m³ was predicted at Receptor 1 and represents 4% of the DEC goal.

Background levels of particulates in the local environment will come from a multitude of sources, and will be predominantly comprised of wind-blown dust. The predicted TSP and PM₁₀ concentrations represent a small percentage of the DEC goals and are unlikely to cause any additional exceedances.

The particulate emissions were found to be dominated by the fugitive emissions from the dryer grain handling buildings. Of these sources, the dryer has the highest emission rates as shown in Table 4.2.3. It will therefore be important to minimise the fugitive particulate emissions from these buildings and in particular the dryer.

4.2.5.1.5 Odour

The predicted 99th percentile compliance odour levels for the ethanol plant are presented in Figure 4.2.1g. Figure 4.2.1h shows the predicted 99th percentile compliance odour levels for the Dairy for the near field receptors and Figure 4.2.1i for the far field receptors. Figure 4.2.1j and 4.2.1k show the combined predicted 99th percentile compliance odour levels for the proposed development for both near and far field receptors. The predicted odour level at Receptor 1, the residence closest to the facility, was 8.8 ou and is above the peak 1-hour average compliance level of 7 ou, however the property is owned by the proponent and may be discontinued as a residence. The predicted odour level at Receptor 7 is 10.7 ou, however this receptor is the Walsh Rice Shed, and is only utilised seasonally during rice harvests. It is expected that the odour impact on this facility represents only a limited exposure to the modelled odour levels. The predicted odour levels at the other two receptors near the facility comply with the DEC Draft Odour Policy guidelines outlined in Table 4.2.2 is estimated

FIGURE

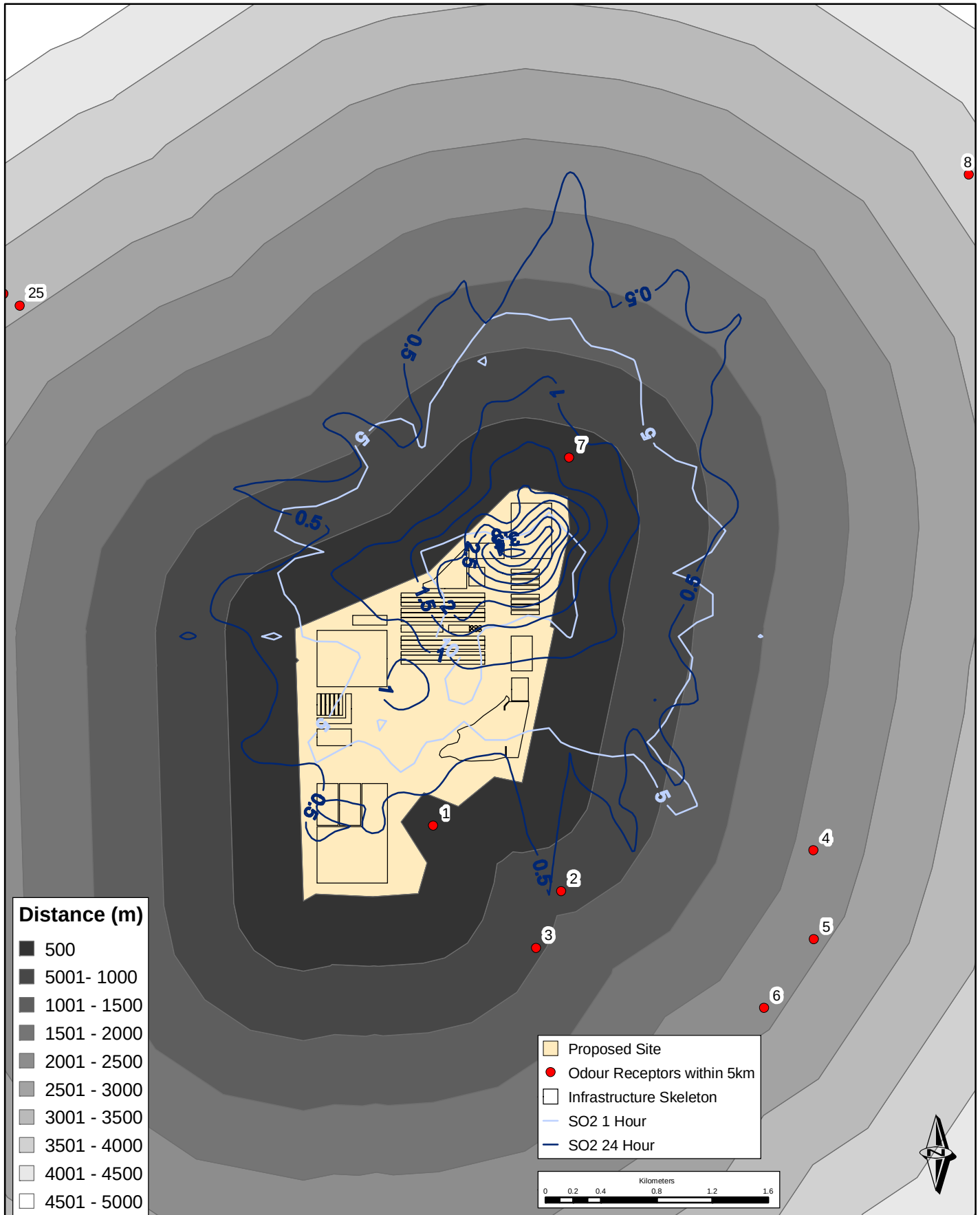
4.2.1c

Predicted 1 Hour and 24 Hour Average SO₂ Concentrations

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FIGURE

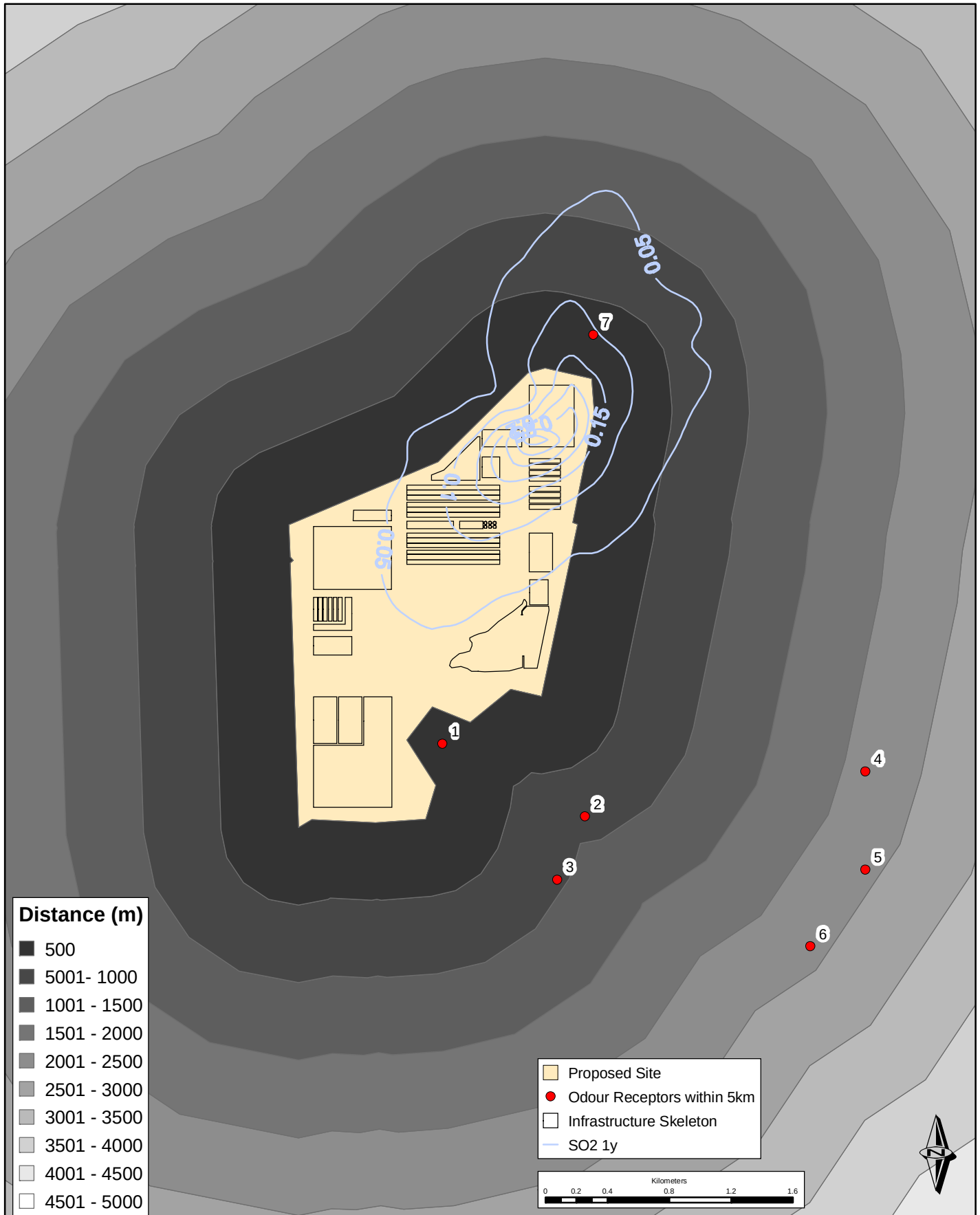
4.2.1d

Predicted Annual Average SO₂ Concentrations

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FIGURE

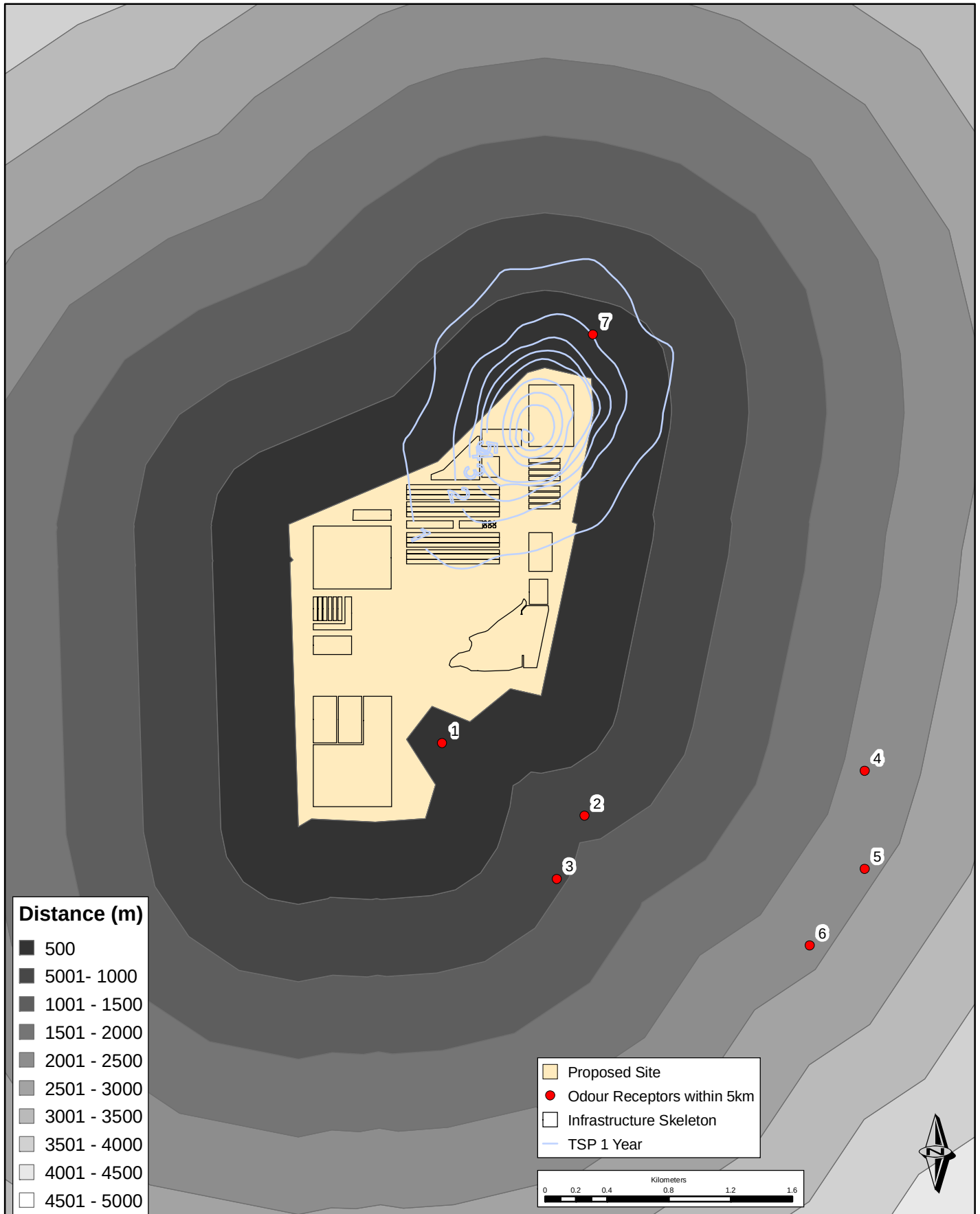
4.2.1e

Predicted Annual Average TSP Concentrations

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FIGURE

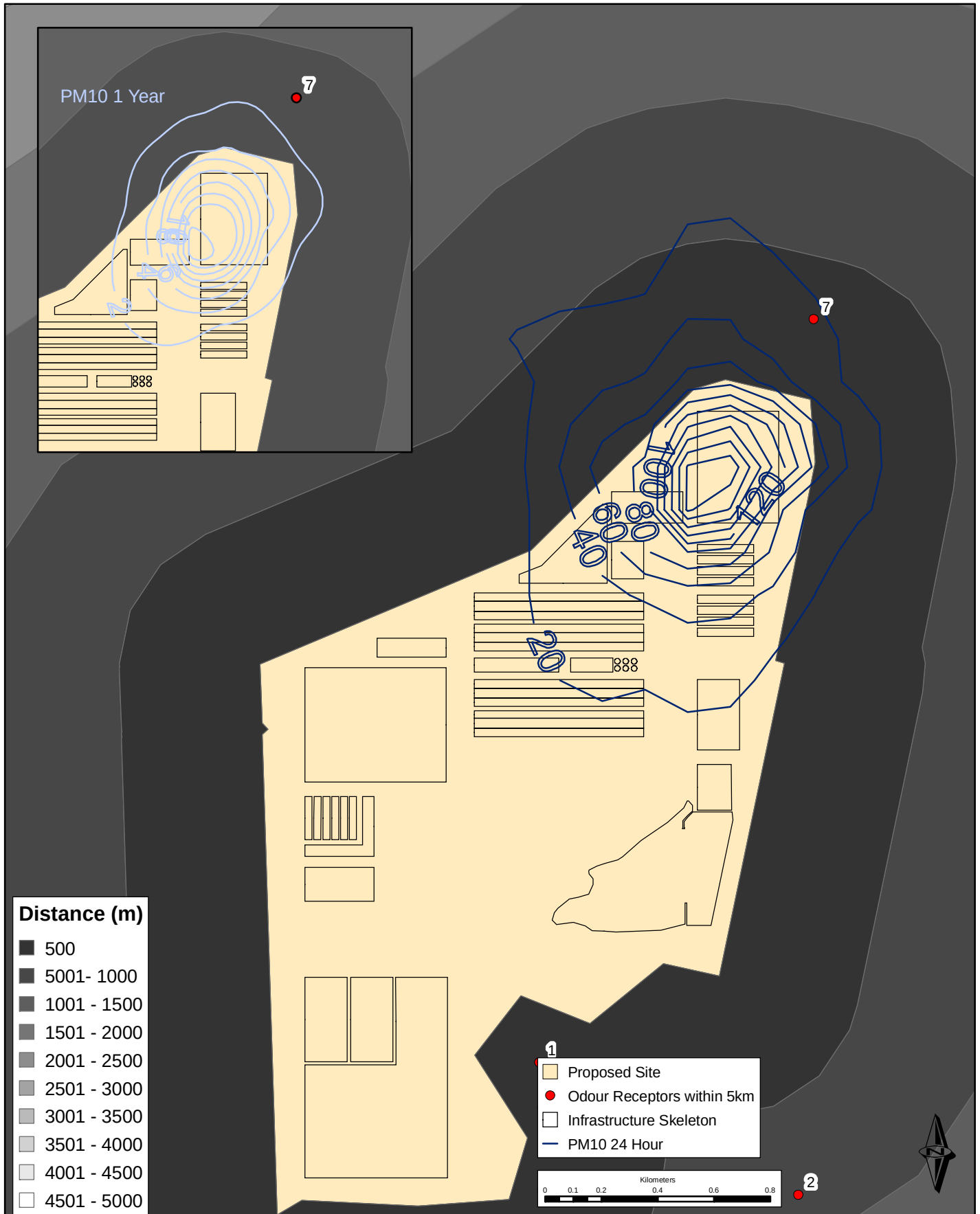
4.2.1f

Predicted 24 Hour and Annual Average PM10 Concentrations

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FIGURE

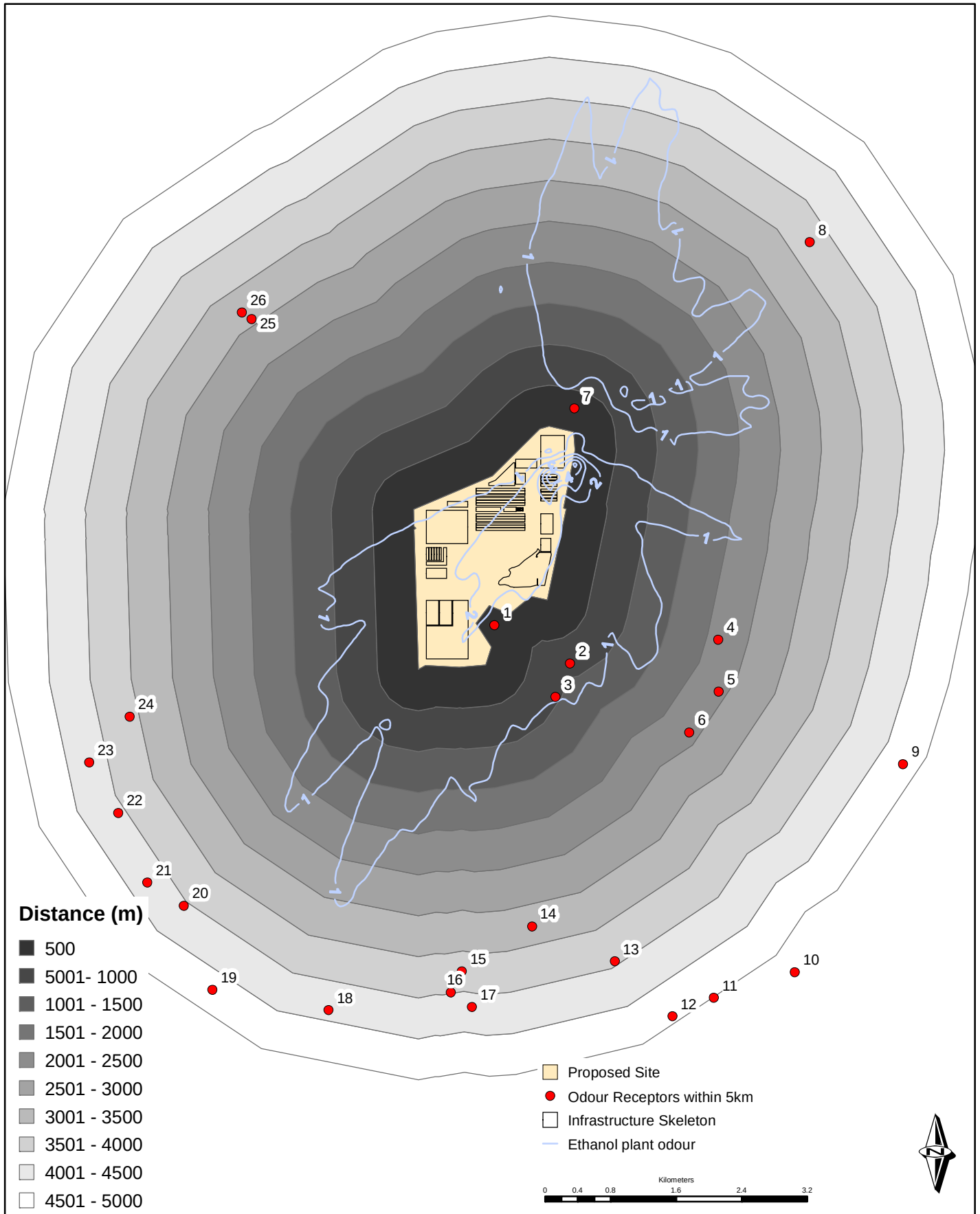
4.2.1g

Predicted 99th Percentile Compliance Odour Levels (Ethanol Plant)

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FIGURE

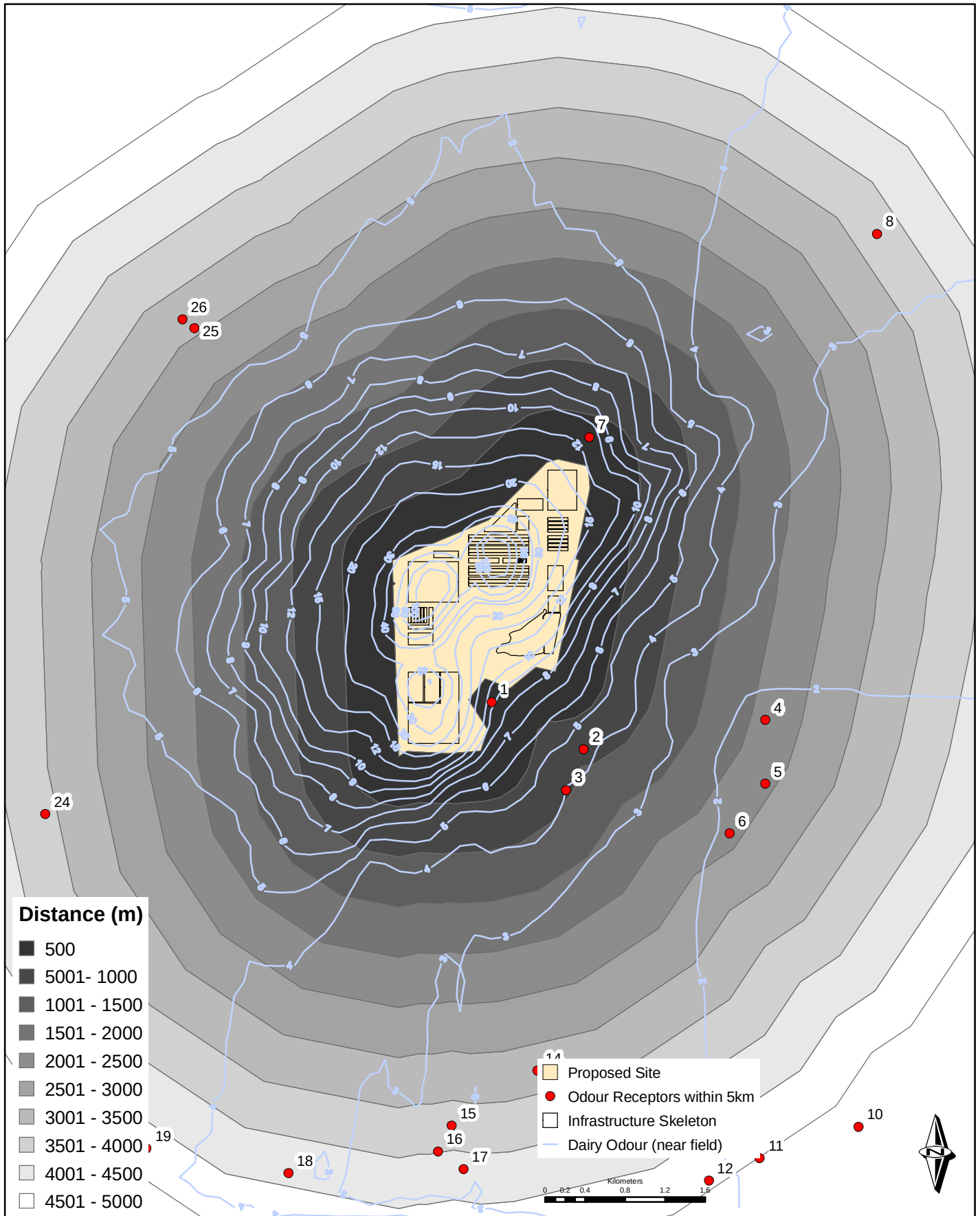
4.2.1h

Predicted 99th Percentile Compliance Odour Levels (Dairy - Near Field Receptors)

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FIGURE

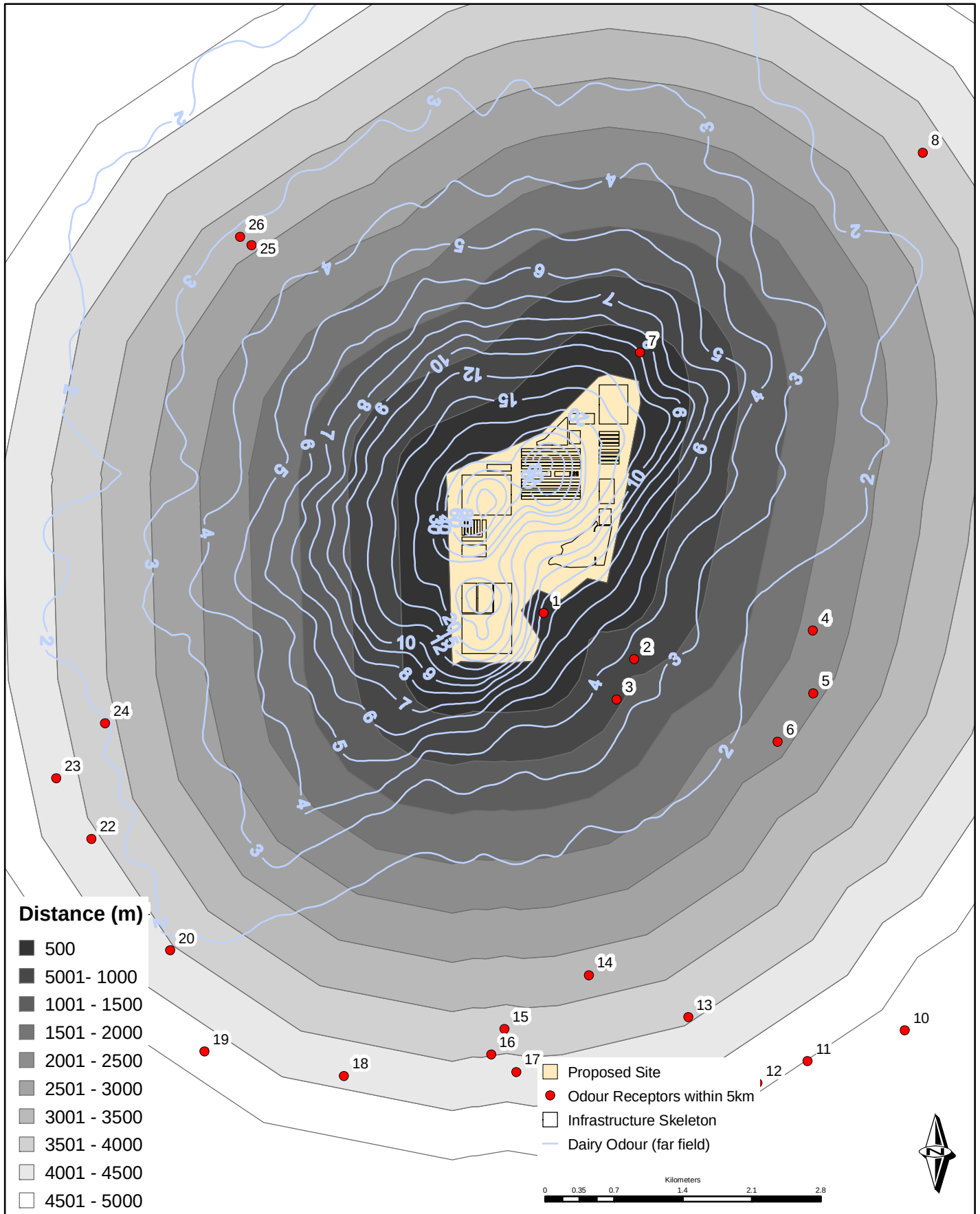
4.2.1i

Predicted 99th Percentile Compliance Odour Levels (Dairy - Far Field Receptors)

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FIGURE

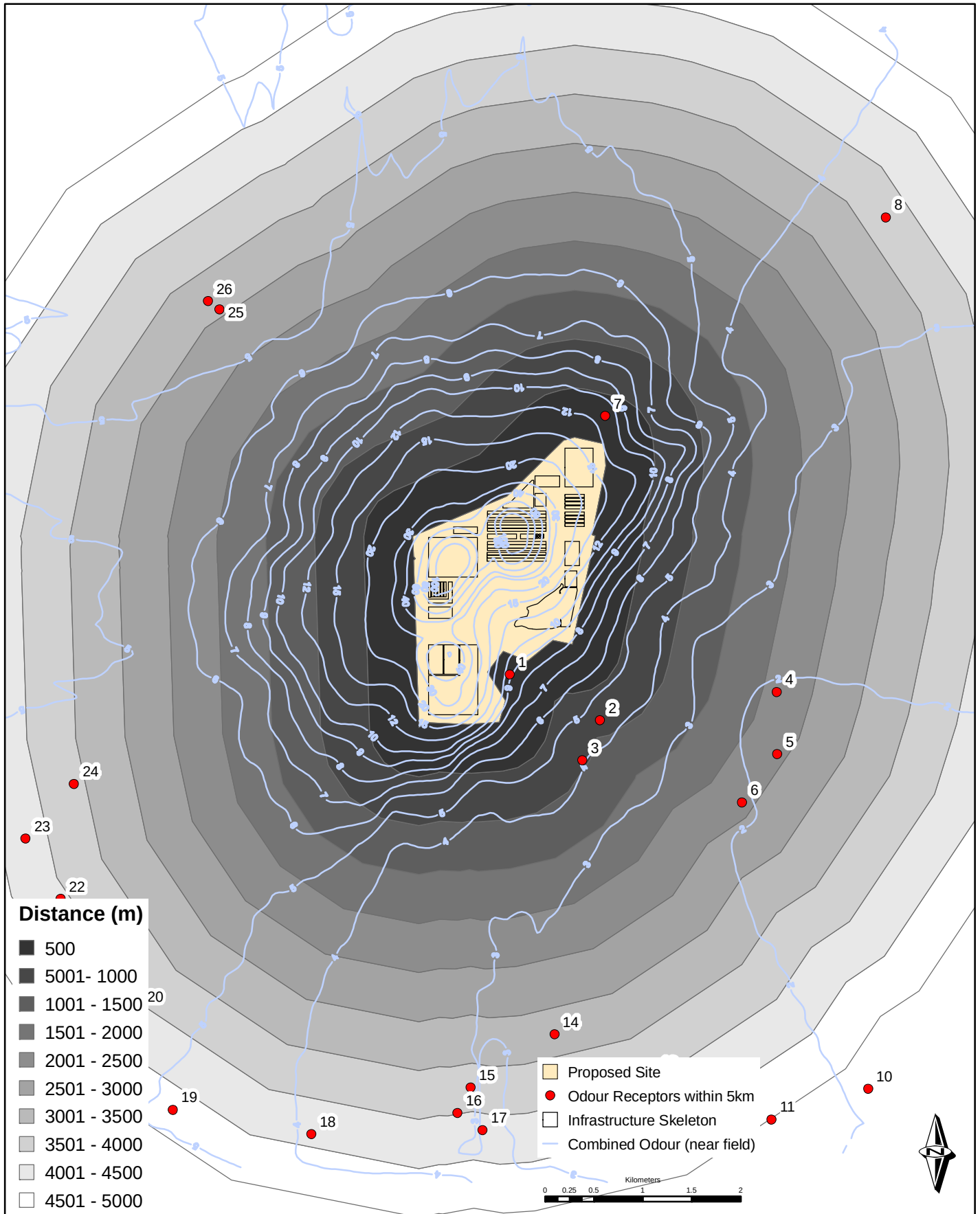
4.2.1j

Predicted 99th Percentile Compliance Odour Levels (Combined - Near Field Receptors)

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FIGURE

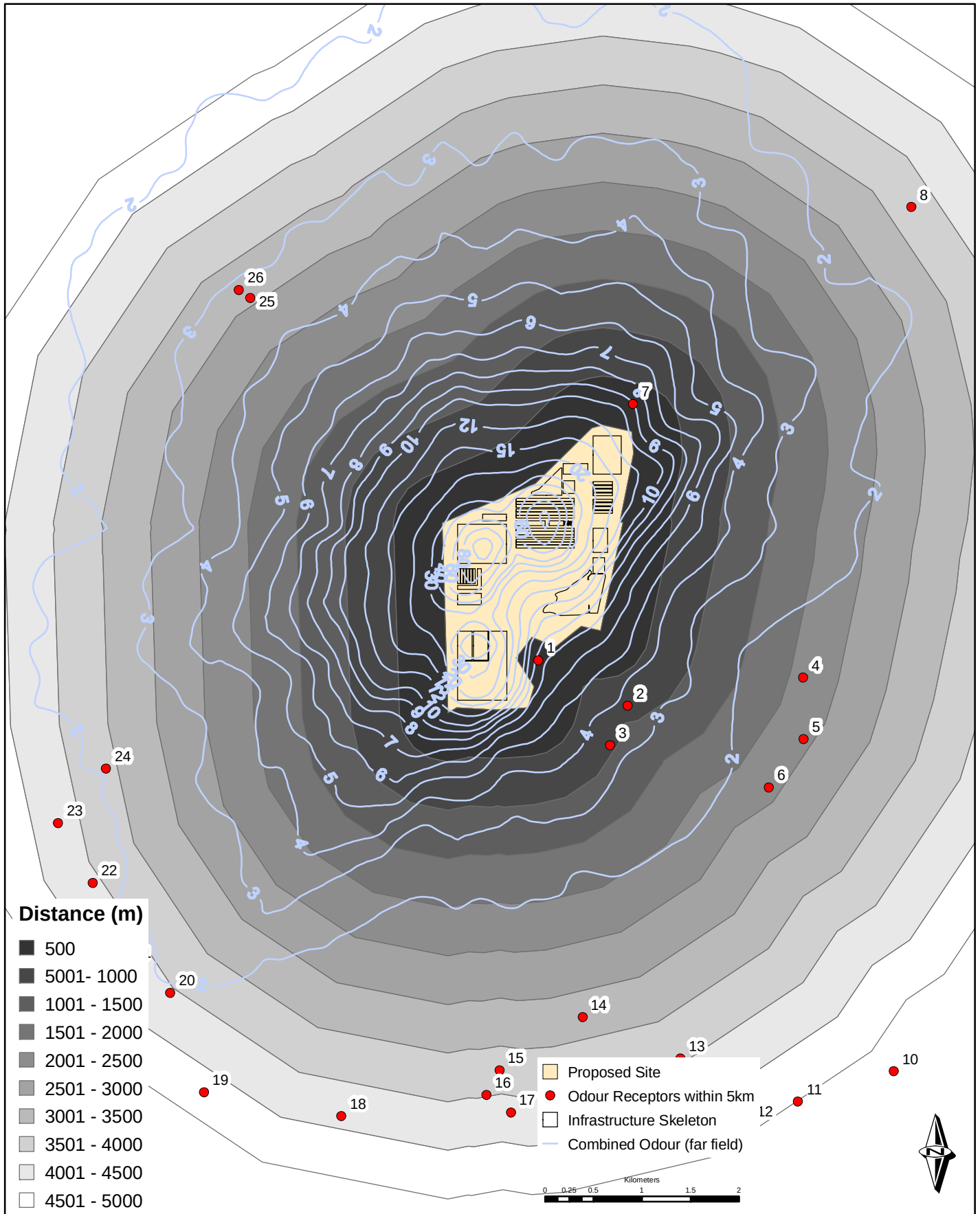
4.2.1k

Predicted 99th Percentile Compliance Odour Levels (Combined - Far Field Receptors)

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that there will be occasions when odour levels will be higher than 7 ou, but these occurrences are predicted to occur for less than 1% of the time.

4.2.6 Conclusion

Emissions of odour and criteria pollutants from the proposed Coleambally ethanol plant and intensive dairy were modelled using the CALPUFF dispersion model. In the absence of a complete set of site specific meteorological data, the TAPM prognostic model was used to provide meteorological predictions for the project site.

On the basis of predictions of odour and gaseous concentrations from the dispersion model, it is concluded that the proposed ethanol plant and dairy will comply with the DEC impact assessment criteria for gaseous and odour emissions.

4.3 Noise /Vibration

In the assessment of noise as a potential impact of the proposed development, Ken Scannell of “Noise and Sound Services” was contracted to carry out a Noise Impact Statement (NIS). This NIS is for the proposed construction and operation of an ethanol manufacturing plant with a production capacity of 300 ML of ethanol per year and a free stall dairy operation with the capacity to milk 6,000 cows. The in-field recording period for the NIS was begun on Thursday 2 March 2006, and finished on Monday 13 March 2006 and further supplemented on 2nd July 2006. The full report prepared by “Noise and Sound Services” can be viewed as Annexure 4.3.1.

4.3.1 Existing Amenity

The surrounding area of the proposed expansion is a quiet rural zone and is surrounded by farmland and a few sparsely spaced dwellings. The closest surrounding property is Farm 641 known as ‘Karinya’ which is occupied by a Four Arrows Rural Group employee. The nearest neighbouring residential properties are Farm 641 at approximately 170 metres from the boundary of the site and two residences on the opposite side of the Jerilderie-Darlington Point Road which are approximately 1,100 to 1,500 metres from the nearest boundary of the site. The main ethanol plant is approximately 2,000 metres from the nearest residential property and approximately 300 metres from the nearest industrial premises.

Strong wind patterns exist in the area. In the summer months, these are commonly south-westerly in the afternoons and prevailing north-easterly to easterly in the mornings. In the winter months, winds are commonly influenced by westerlies ranging from south-west to north-west. Temperature inversions are likely to occur between May and October with an average of six per month. The highest known recording of surface temperature inversions has been 15 days in July 1987.

4.3.2 Noise Assessment Criteria

Noise criteria are provided by the NSW State Government and issued via the Department of the Environment and Conservation (DEC). These criteria are generally in line with criteria given in other States of Australia and many countries of the world. This includes the:

- Industrial Noise Policy (2000) (INP 2000); and
- Environmental Criteria for Road Traffic Noise (1999).



These criteria cover noise in urban, suburban and rural areas. Although specific local conditions can affect the criteria, convincing justification (for example the noise only produced over a limited period in any one year) must be given for any variation to State Government guidelines.

4.3.2.1 *The Industrial Noise Policy (2000)*

The assessment procedure for industrial noise sources given in the State Government's Industrial Noise Policy (2000) has two components:

- Controlling intrusive noise impacts; and
- Maintaining noise level amenity.

In assessing the noise impact of industrial or commercial noise sources all components must be taken into account for residential receivers, but, in most cases, only one will become the limiting criterion. The project-specific noise goals reflect the most stringent noise level requirement. It is derived from intrusive and amenity criteria and this is used to set a benchmark against which noise impacts and the need for noise mitigation are assessed. The overall aim of the policy is to allow the need for industrial activity to be balanced with the desire for quiet in the community. The noise criteria in the policy are not mandatory and numerous other factors need to be taken into account including local conditions, economic consequences and the social worth of the development.

Intrusive Noise Impacts

The Industrial Noise Policy (2000) states that:

"The intrusiveness of an industrial noise source may generally be considered acceptable if the equivalent continuous (energy-average) A-weighted level of noise from the source (represented by the L_{Aeq} descriptor) measured over a 15 minute period, does not exceed the background noise level measured in the absence of the source by more than 5 dB".

Thus, when considering the environmental consequence of noise from a specific source, any increase above the background sound pressure level, which exceeds 5 dB, may be offensive.

The perception of noise and its level of offensiveness depend greatly on the broader situation within which it occurs. Noise that might intrude into a resting or sleeping place may be found offensive whereas the same noise occurring in a market place or noisy working area may pass unnoticed. The concept of '*background + 5 dB*' derives from this consideration.

The Industrial Noise Policy (2000) states that where the existing background noise level at the receptor is less than 30 dBA, as may occur in a quiet suburban or rural area, then 30 dBA should be assumed to be the existing background noise level.

Where the noise source contains characteristics such as prominent tonal components, impulsiveness, intermittency, irregularity or dominant low-frequency content, adjustments to the measured level are applied to allow for the increase in the annoyance value.



Maintaining Noise Level Amenity

In the Industrial Noise Policy it is stated that:

"To limit continuing increases in noise levels, the maximum ambient noise level within an area from industrial noise sources should not normally exceed the acceptable noise levels specified in Table 2.1".

Table 4.3.1: Table 2.1 from "The Industrial Noise Policy (2000)".

Type of Receiver	Indicative Noise Amenity Area	Time of Day	Recommended L_{Aeq} Noise Level (dBA)	
			Acceptable	Recommended Maximum
Residence	Rural	Day	50	55
		Evening	45	50
		Night	40	45
Residence	Suburban	Day	55	60
		Evening	45	50
		Night	40	45
Residence	Urban	Day	60	65
		Evening	50	55
		Night	45	50
Residence	Urban/Industrial Interface – for existing situations only	Day	65	70
		Evening	55	60
		Night	50	55
Commercial premises	All	When in use	65	70
Industrial premises	All	When in use	70	75

4.3.2.2 Environmental Criteria for Road Traffic Noise (1999)

The NSW Government has produced criteria for road traffic noise 'Environmental Criteria for Road Traffic Noise' (May 1999). This provides criteria for land use expansions with potential to create additional traffic on collector roads. Here the criterion ($L_{Aeq, 1 \text{ hour}}$) is 60 dBA for day time (7:00 hours until 22:00 hours) and 55 dBA for night time (22:00 hours until 07:00 hours).

Where criteria are already exceeded, traffic arising from the expansion should not lead to an increase in existing noise levels of more than 2 dB.

4.3.2.3 Rail Infrastructure Corporation/State Rail Authority – Interim Guidelines for Applicants November 2003

Rail Noise

The Rail Infrastructure Corporation/State Rail Authority has produced interim guidelines for applicants and Councils giving consideration to rail noise and vibration in the planning stage (November 2003). This states that new residential buildings should be designed and constructed to comply with the design criteria (see Table 4.3.2) in habitable rooms, with external windows and doors closed.

Table 4.3.2: Recommended design sound level for residential buildings

Internal Space	Time Period	Railway Noise Level ($L_{Aeq, 1 \text{ hour}}$)
Living and Sleeping Areas	Day (7:00 am to 10:00 pm)	40 dBA
	Night (10:00 pm to 7:00 am)	35 dBA



Rail Vibration

Floor vibration levels in habitable rooms should comply with the criteria in British Standard BS 6472: 1992 'Evaluation of Human Exposure to Vibration in Buildings (1 Hz to 80 Hz)'.

Whole body vibration is assessed in terms of frequency weighted root-mean square (rms) acceleration. The frequency weighting is based on the base curve as given in the British Standard referenced above and also the Australian Standard AS 2670 'Evaluation of human exposure to whole body vibration' (2001) and, in particular, AS 2670 part 2 (1990).

The base curve, given in the Standard, represents an overall frequency-weighted rms acceleration magnitude of 0.005 m/s^2 . Criteria for residential premises are overall frequency-weighted magnitudes of 0.007 m/s^2 to 0.01 m/s^2 for continuous vibration (night and day respectively) and 0.1 m/s^2 to 0.3 m/s^2 for intermittent or impulsive vibration (night and day respectively).

4.3.2.4 Construction Site Noise

Noise policy and criteria for construction noise are currently being revised by the Department of the Environment and Conservation (DEC) NSW State Government. Government license conditions would emphasize work practice approach rather than noise limits. A license would set achievable conditions based on what was both feasible and reasonable and target community consultation. However until the new guideline is published guidelines in the 'Environmental Noise Control Manual' (1994), Chapter 171 would apply. These states:

"Where there is likelihood of annoyance due to noise from construction sites, conditions such as the following may be specified in a development consent or building application".

This applies particularly to non-scheduled premises such as commercial buildings where a long construction time is not likely.

Variation should be made according to local conditions.

Level Restrictions

- i Construction period of 4 weeks and under.
The L_{10} level measured over a period of not less than 15 minutes when the construction site is in operation must not exceed the background level by more than 20 dB(A).*
- ii Construction period greater than 4 weeks and not exceeding 26 weeks.*

The L_{10} level measured over a period of not less than 15 minutes when the construction site is in operation must not exceed the background level by more than 10 dB(A).

Time Restrictions

Monday to Friday, 7 am to 6 pm, Saturday, 7 am to 1 pm if inaudible on residential premises, otherwise 8 am to 1 pm.

No construction work to take place on Sundays or Public Holidays

Silencing

All possible steps should be taken to silence construction site equipment."



4.3.3 Noise Sources

The potential sources of noise can be summarised in a series of sub-groups, relating specifically to the construction phase, and processes and infrastructure specific to each of the production types onsite.

4.3.3.1 Ethanol

Onsite Mobile Plant

Specific noise generating onsite mobile plant to be used for the ethanol production has been identified during visits to similar sites within NSW. These are:

- Large fork lifts (usually 1);
- Small fork lifts (usually 1 to 2); and
- Trucks (usually 2 to 3).

On-site Stationary Plant

Specific noise generating onsite stationary plant to be used for ethanol manufacture is assessed to be:

- Cookers;
- Hammermills;
- Centrifuges;
- Compressors;
- A multi-column distillation system;
- Fermenters;
- Fans;
- Pumps with electric motors;
- Vacuum dryers; and
- Loading and unloading infrastructure.

Of these, centrifuges and hammermills should be located within concrete or brick buildings. Pumps with electric motors and vacuum dryers are to be located well within the site, thus significant acoustic shielding is achieved from proposed on-site building structures.

On-Road Mobile Plant

The on-road mobile plant will consist of trucks (usually B-doubles or semi-trailers) and staff vehicles. The trucks are required to deliver grain to the site and collect milk, ethanol, waste and sundry from the site. The average worst case scenario number of truck movements is 418 per day (no backloading - Annexure 4.4.8a), with Annexure 4.4.8b identifying the actual traffic scenario as being an average number of truck movements per day of 358.

***Rail Traffic***

Details of the required rail traffic movements are not known at this stage. However it is estimated that at this point in time a maximum of two trains per week bringing grain to the site will be used. It is also suggested that train movements would be limited to daytime hours of operation. The numbers of train movements and operating times would be developed pursuant to negotiations between stakeholders (such as Four Arrows and GrainCorp) and the NSW Department of Planning.

4.3.3.2 Dairy***Dairy Equipment Description***

The equipment involved in the various processes normally used at these types of facilities consists of:

- Chiller;
- Pasteuriser;
- Homogeniser; and
- Separator.

In addition to the main chiller, processing plant and associated compressor for any hydraulic/pneumatic components, a refrigeration condenser will be required for running the cool room.

Proposed Building Description

A series of buildings are normally required consisting of the following areas:

- Processing room;
- Packing room;
- Dry room;
- Cold room;
- Laboratory;
- Office;
- Amenities; and
- Loading and unloading infrastructure.

Herd Description

The site, whilst not constantly housing full capacity, can carry up to 18,000 herd of cattle, the breakdown of which is:

- 6,000 milking;
- 1,200 dry herd; and
- 10,800 replacement stock.



4.3.3.3 Waste Water Treatment

A waste water treatment plant including aerobic ponds and anaerobic ponds is proposed. Although no details have been finalised at this stage, pond capacities are described in detail in Section 4.5 and Annexures 4.1.5, 4.1.6 and 4.1.7. The plant involved in managing waste waters would be aerators and pumps. The proposed wastewater treatment plant is likely to be in operation, when required, for seven (7) days per week and 24 hours per day. The ponds are likely to be located at least 600 metres from the nearest residential boundary.

4.3.3.4 Construction Plant

Although not an exhaustive list, the specific noise generating construction plant, to be used for the construction of the proposed development, has been identified as:

- Water carts;
- Dozers;
- Graders;
- Scrapers;
- Excavators; and
- Trucks

4.3.4 Existing Noise Impacts

The assessment background noise level ABL (L_{A90}) is determined by the tenth percentile method for each period (ie day, evening and night) and for each day is shown in Tables 4.3.3 and 4.3.4 below. The rating background noise levels RBL (L_{A90}) over the monitoring period is found from the median ABL value for the day time, evening time, and night time respectively. This is shown in Table 4.3.5 below together with the logarithmic average of the existing ambient noise (L_{Aeq}).

Table 4.3.3: Existing Noise Levels – On Site (Weather Station – Approximately 135 metres from the road)

Date	Time of Day	Assessment Background Noise Levels (L_{A90})	Existing Ambient Noise Levels (L_{Aeq})
2/03/06	Day	29	48
2/03/06	Evening	35	50
2-3/03/06	Night	26	47
3/03/06	Day	28	47
3/03/06	Evening	32	48
3-4/03/06	Night	26	45
4/03/06	Day	27	44
4/03/06	Evening	29	46
4-5/03/06	Night	26	43
5/03/06	Day	27	41
5/03/06	Evening	29	46
5-6/03/06	Night	26	43
6/03/06	Day	28	49
6/03/06	Evening	33	46
6-7/03/06	Night	26	44
7/03/06	Day	31	48
7/03/06	Evening	28	46
7-8/03/06	Night	26	46
8/03/06	Day	27	46
8/03/06	Evening	33	47
8-9/03/06	Night	26	48
9/03/06	Day	27	52
9/03/06	Evening	27	48



Date	Time of Day	Assessment Background Noise Levels (L _{A90})	Existing Ambient Noise Levels (L _{Aeq})
9 - 10/03/06	Night	27	48
10/03/06	Day	27	46
10/03/06	Evening	30	47
10 - 11/03/06	Night	27	46
11/03/06	Day	27	46
11/03/06	Evening	27	46
11 - 12/03/06	Night	27	44
12/03/06	Day	28	53
12/03/06	Evening	31	46
12 - 13/03/06	Night	27	47
13/03/06	Day	28	44

Notes - All levels rounded to the nearest whole decibel. The survey started on Thursday 2 March 2006 and finished on Monday 13 March 2006.

Table 4.3.4: Existing Noise Levels – At the Rear of Farm 641.

Date	Time of Day	Assessment Background Noise Levels (L _{A90})	Existing Ambient Noise Levels (L _{Aeq})
2/03/06	Day	31	45
2/03/06	Evening	36	43
2-3/03/06	Night	37	44
3/03/06	Day	29	44
3/03/06	Evening	38	44
3-4/03/06	Night	36	42
4/03/06	Day	35	43
4/03/06	Evening	39	43
4-5/03/06	Night	35	42
5/03/06	Day	27	43
5/03/06	Evening	35	44
5-6/03/06	Night	32	43
6/03/06	Day	29	49
6/03/06	Evening	36	41
6-7/03/06	Night	32	41
7/03/06	Day	35	46
7/03/06	Evening	36	41
7-8/03/06	Night	31	40
8/03/06	Day	27	43
8/03/06	Evening	36	44
8-9/03/06	Night	33	43
9/03/06	Day	27	46
9/03/06	Evening	41	61
9-10/03/06	Night	32	41
10/03/06	Day	27	46
10/03/06	Evening	41	44
10-11/03/06	Night	39	42
11/03/06	Day	27	47
11/03/06	Evening	42	49
11-12/03/06	Night	36	42
12/03/06	Day	32	57
12/03/06	Evening	42	46
12-13/03/06	Night	29	46
13/03/06	Day	44	39

Note - All levels rounded to the nearest whole decibel. The survey started on Thursday 2 March 2006 and finished on Monday 13 March 2006.

**Table 4.3.5: Summary of Noise Levels – On Site at Weather Station and Rear of Farm 641**

Time of Day	Rating Background Noise Levels (L_{A90})	Log Average Existing Ambient Noise Levels (L_{Aeq})	Data Logger Site
Day	27	48	Weather Station
Day	27	45	Rear of Farm 641
Evening	30	47	Weather Station
Evening	36	45	Rear of Farm 641
Night	Less than 26	46	Weather Station
Night	32	42	Rear of Farm 641

The measurements from the unattended noise loggers include noise from all sources including local road traffic, animal noise, insect noise, etc. Many of these noises are not constant enough to affect the background noise ($L_{A90, 15 \text{ minute}}$), which need to be present 90% of the 15-minute measurement time to have an effect. However they can have a large effect on the ambient noise ($L_{Aeq, 15 \text{ minute}}$), which is a simple (although logarithmic) average of all of the sound energy levels received at the microphone position.

The higher evening and night time noise levels recorded at the rear of Farm 641 are thought to be due to the outdoor air conditioning units at the farm premises. Therefore the INP minimum 30 dBA is used for all project specific noise goals.

4.3.5 Predicted Noise Impacts

Assessment has been made of the noise levels predicted to emanate from the proposed development both during and post construction against parameters set out in International Standard ISO 9613-2 (1996(E)) "Acoustic – Attenuation of sound during propagation outdoors Part 2 General method of calculation".

This Standard specifies methods for the description of noise outdoors in community environments. The method described in the Standard is general in the sense that it may be applied to a wide variety of noise sources, and covers the major mechanism of attenuation. The method allows for downwind propagation conditions namely:

- Wind direction within an angle of $\pm 45^\circ$ of the direction connecting the centre of the dominant sound source and the centre of the specified receiver region with the wind blowing from source to receiver; and
- Wind speed between approximately 1 m/s and 5 m/s measured at a height of 3 m to 11 m above the ground.

The Standard also states that:

"These equations also hold, equivalently, for average propagation under a well-developed moderate ground based temperature inversion, such as commonly occurs on clear, calm nights".

Coupled to the calculations undertaken, physical investigation and measurement of similar developments have been made to 'ground truth' the calculations, and ensure accuracy of predicted noise levels. The full details of the calculations and predictions made for the various construction and development processes can be viewed in Annexure 4.3.1, though Table 4.3.6 below summarises the results from these calculations.

**Table 4.3.6: A Summary of Noise Goals and Predicted Levels**

Noise Source/ Receiver	Time of Day	Noise Goal	Noise Prediction
		L _{Aeq, T} (dBA)	
Industrial/Residential	Day/Evening	35	34
	Night	35	34
Industrial/ Industrial	When in Use	70	57
Industrial/ Commercial	When in Use	65	57
Road/ Residential	Day	55	55*
	Night	50	50*
Rail/ Residential	Day	50	50*
	Night	45	Not Applicable
Construction/Residential	Day	40 ⁺	54 ⁺
	Night	Not Applicable	Not Applicable

4.3.6 Mitigation Measures

The predicted noise levels are very close to the goals at the nearest residential receiver due to industrial noise and could exceed the limit assuming a ± 4 dB confidence of the predicted results. The industrial noise is predominantly due to the hammermill which can be reduced by a further 5 dB with a better designed enclosure than the one measured during ground truthing. This will provide a 4 dB overall noise reduction and hence meet the noise goal within the 95% confidence limits. Other plant and equipment can be enclosed as required. Exceedances will then only be likely to occur under extreme wind or temperature inversion conditions.

The construction noise is predicted to significantly exceed the day time noise goal (i.e. by 14 dB) at the closest (170 metres) residential receiver (Farm 641). The noise goal is unlikely to be met until the construction works are at a distance of at least 900 metres from the residential dwelling. It is therefore recommended that an acoustic barrier in the form of an earth bund (mound) or fence is constructed between the construction works and Farm 641. A 2 metre high barrier constructed on the residential boundary line is likely to provide a noise reduction of approximately 5 dB if it cuts out the line of sight between the construction works and the residence.

On road traffic will exceed noise goals for receptors within 40 meters of the road in areas with speed limits in excess of 80km/h. Figure 4.3.1: *Noise receptors close to 40 meter buffer of roadway*, identifies six (6) receptors that have been measured as being close to the 40 meter buffer distance. Only one (1) receptor, (Receptor No. 2) is within the 40 meter buffer (39m) and is sited at the transition from 80 to 100km zone immediately south of Darlington Point.

Based on the assumption that 15% of 80,000 cattle would be vocal for 30 seconds in any 15 minute period, the predicted noise level at 20 meters would be 80dBA (see Annexure 4.3.1). At an average distance of 1,000 meters, this would reduce to 35dBA, within EPA noise goals.

4.3.7 Conclusion

Based on the information provided by "Noise and Sound Services" and summarised above, the following conclusions are able to be drawn:

- The noise goals will be met for on-site stationary and mobile plant noise from the proposed development (with a suitable acoustic enclosure for the hammermill);
- The noise goals will be exceeded for the day time use of construction plant for the proposed development when operating relatively close to the nearest residential dwelling. An acoustic barrier will help to minimize the noise impact;

FIGURE

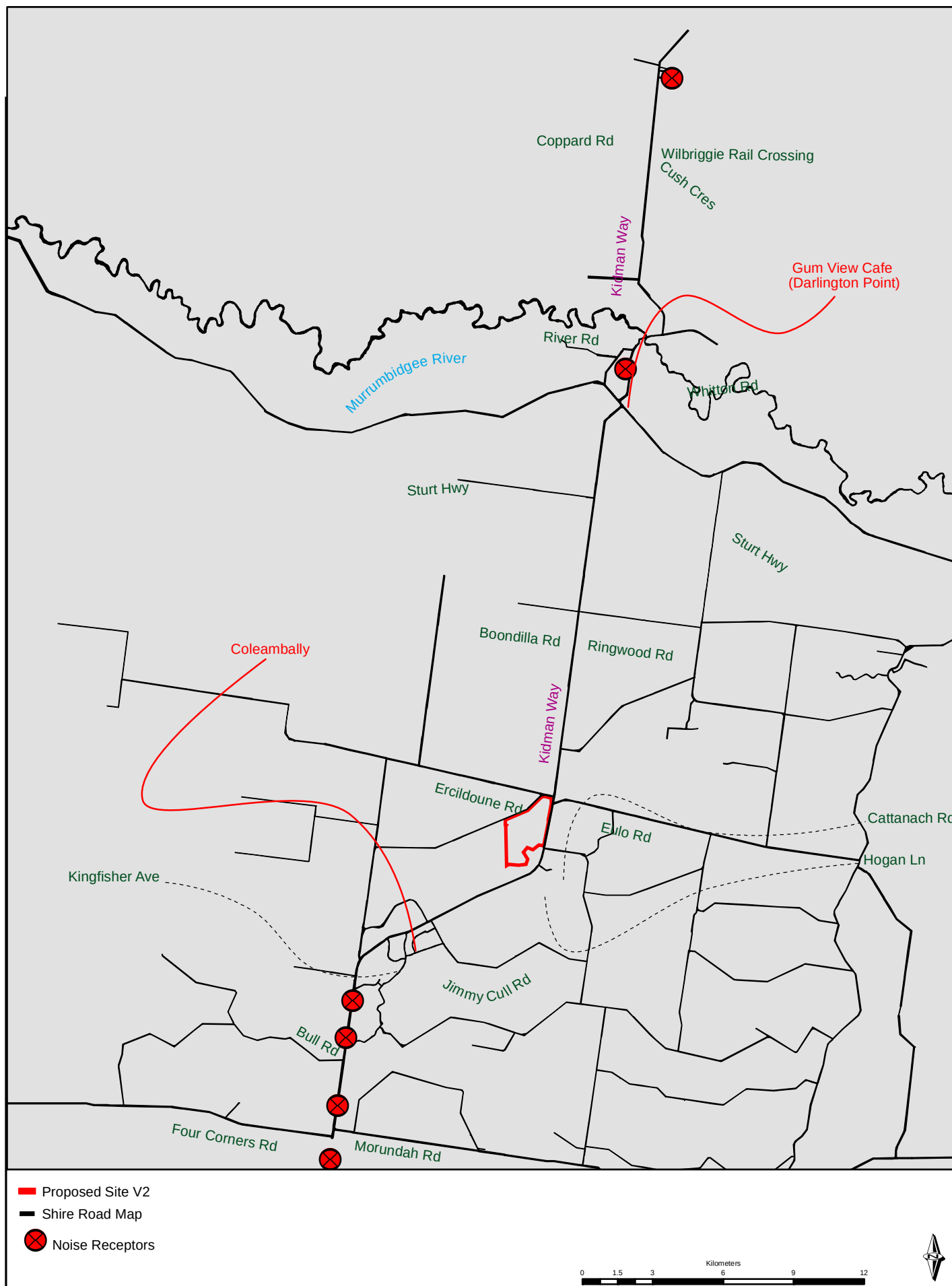
4.3.1

Noise Receptors Close to 40 Meter Buffer of Roadway

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- The noise criteria for road and rail traffic from the proposed development will be met for residential dwellings forty (40) metres or more from the road or railway line respectively; and
- The cattle noise level is predicted to meet the noise goal at an average distance of 100m from the nearest residential boundary.

Beyond the mitigation options discussed for housing of the hammermill and barriers to limit construction noise during the construction period only, no other mitigation is required for the proposed development.

4.4 Traffic/Transport

4.4.1 Introduction

This section of the EA has been prepared and presented in accordance with the specific assessment and reporting requirements of the NSW RTA.

4.4.1.1 Description of the Proposed Activity

The proposed development is a bio-fuel processing plant producing ethanol from high starch content cereal grains which can then be blended with traditional fossil fuels. It is intended that the plant will produce 300ML of ethanol per year achieving approximately 85% of the Federal Government's Biofuel Action Plan production target of 350ML/year of all biofuels by the year 2010.

The proposed development will include an integrated dairy enterprise producing approximately 76ML of milk per year. The dairy enterprise will involve approximately 18,000 head of cattle with 6,000 head producing milk at any given time. The remainder of cattle will be dry cows and heifers. The dairy will utilise a portion of the brewer's grain by-product from the ethanol plant as a component of the feed ration with the remainder transported off-site to other intensive enterprises.

The proposed development will involve major building works consistent with an ethanol processing plant and associated intensive dairy (refer to Figure 3.3.2). The largest buildings will be the ethanol processing plant and the cattle housing areas. Other significant constructions will be the grain bunker area and the milking dairy. Buildings such as administration and workshops will house the necessary resources to support the main activities.

Development will involve infrastructure to control water run-off from buildings, sheds and roadways, and wastes from the dairy enterprise. Figure 3.3.2 gives details of storm water storage and mitigation areas waste water management system as well as representing the manure processing areas. These sections of the project site will be low activity precincts compared with the rest of the development.

Access roadways and related loading, unloading, wash-down, vehicle servicing, parking, etc. will accommodate the easy flow of bulk deliveries and the transportation of product off-site. The internal road network will also service the movement of heavy vehicles, and equipment around the site. The capacity of the road network will allow for the safe movement of staff vehicles entering and exiting the facility as well as light support vehicles moving in and around the installation, as illustrated in Figure 3.3.3.



4.4.2 Background

With respect to traffic issues the selection of the proposed project site has been based upon the following broad criteria:

- Four Arrows Ethanol Pty Ltd already owns the lands assigned to the project and has further substantial holdings in the immediate vicinity for optimum integration of management and operations for especially the dairy with the supply of feed and waste products management;
- The other Four Arrows rural aggregations at Wagga Wagga and Hay are to the east and west respectively and linked by their virtual frontage to the Sturt Highway for rapid and cost effective supply of input products to the proposed ethanol plant;
- The proposed project site is situated between the intensive, highly productive and now privatised large irrigation regions known as the CIA and the Murrumbidgee Irrigation Area. The Murray Irrigation Areas and Districts to the south are also relatively close;
- Surrounding the irrigation districts are large private irrigation developments and extensive tracts of dryland farming areas for supply of input products. The mix of irrigation and dryland grain products will provide relative surety of grain supplies and major public roads and highways link. There is sufficient room on site to incorporate truck parking areas off the public roads;
- Discussions with grain traders will enhance the relative reliability of grain supplies via rail freight to the Willbriggie siding and originating from existing grain storages over southern and central New South Wales and from northern Victoria. This commercial relationship will limit the road haulage distances and optimise the rail haulage component;
- The potential to lease and/or contract store grain within existing and nearby private and kindred industry grain storage facilities will optimise deliveries direct to the project site by regional grain producers and limit long distance haulage to sea-board; and
- All weather road access is already available with the Kidman Way passing the front gate of the proposed lands. Electrical power and water are already adjacent to the site and natural gas is nearby at Griffith. Other necessary services are available from the nearby communities of Griffith, Narrandera, Leeton, Jerilderie, Coleambally and Darlington Point. Services and support for road haulers is already well developed in the local area and the region.

The Four Arrows Ethanol Pty Ltd senior management have determined the proposed ethanol development, is of the scale necessary to achieve the optimal commercial critical mass and operational efficiencies required for long term commercial sustainability. A lesser scale risks the loss of those efficiencies and a consequence marginal unit cost which is too high to be competitive in the longer term.

Finally, the proposed site will have room for expansion in later years if deemed commercially and environmentally sound.



4.4.2.1 *Scope of the Report*

The scope of this traffic impact study encompasses all sections considered appropriate and relevant to the proposed development as are detailed under the requirements of Section 2 *Traffic Impact Studies of the RTA's Guide to Traffic Generating Developments* (Annexure 4.4.1).

In conjunction with the above is the inclusion of specific issues to be addressed as stipulated by the RTA within the Director General's Specifications for the EA report (Annexure 1.6.1 and 2.1.3). The RTA specific issues include but are not limited to the following points:

- Types and volumes of vehicles to be used;
- The direction of travel of all vehicles entering and exiting the site;
- AADT (average annual daily traffic) on key streets (roads);
- Peak period traffic volumes and congestion levels at key adjacent intersections;
- Hours and days of operation;
- Safety and efficiency of the internal road layout;
- Impact of generated traffic on key adjacent intersections, the environment and other major traffic generating developments in close proximity;
- Accident history of the road network within the area;
- Access location and width;
- Sight distance at access location;
- Safety and efficiency of access to the site from adjacent road network; and
- Assessment of traffic noise and dust effects.

All issues under investigation have been applied to the major and minor roads likely to be affected by the impact of the development. The most impacted principal roadways to be considered are:

- The Kidman Way past Coleambally to points south of the proposed development;
- The Kidman Way from the proposed development to Darlington Point to the north and through Darlington Point to the Willbriggie rail siding; and
- All other intersecting minor and major roads in the vicinity of the development.

4.4.3 *The Current Conditions*

4.4.3.1 *Description of the Site*

No structures, sheds or dwellings exist on the site. The land is currently utilised for irrigated agricultural production purposes only. Properties in the vicinity of the proposed development reflect similar land use characteristics. Irrigated crop and pasture enterprises are common in the local area with a predominance of rice based rotations. Areas which cannot or have not made use of the water infrastructure are normally associated with grazing or dryland cropping systems.

The current site access is via the Kidman Way. It is a dirt/gravel entrance off the main bitumen roadway with the property and the road table drain separated by a farm gate. There are secondary roads bordering the property as depicted on Figure 3.3.3. However these secondary roads are not used for access to the site and are not envisaged to be utilised in the future.



Current traffic flows in and out of the property are minimal due to the uninhabited and relatively low operational intensity of agricultural activities on the site. Farm vehicles visit the site to inspect crops; however the main activities are during planting and harvest when heavier machinery is moving onto and off the site. At present accrued traffic movement events can be seen as negligible as these are restricted to machinery moving onto the property at specific times of the year, remaining there until current farming operations are complete and then exiting the property.

4.4.3.2 *Average Annual Daily Traffic*

The following information will provide current conditions for those roadways considered within the scope of this study. Stations which supplied the latest AADT information (2003) have been chosen. Stations in the study area present traffic data as vehicle counts and axle pairs and will be referred to as such where appropriate.

The Kidman Way being a main road with predominantly 100km/hour speed limit will be the main route to and from the site. Current data can be noted from permanent station No. 97.119 located just south of the Sturt Highway and associated with major traffic flows to and from the development giving axle pair counts as being 1,516 AADT (refer Figure 4.4.2: *Traffic counting stations*).

Traffic to the north of this site may accrue and disseminate from the Kidman Way along the Sturt Highway sections to end from Wagga Wagga and/or Hay. One station to the west 97.122 (Carrathool-East of Conargo Road) gives vehicle counts at 1,418 AADT. A station to the east of Kidman Way 95.021 (Murrumbidgee Shire Body) gives vehicle counts as 1,651 AADT.

Other northern stations are 97.162 (Darlington Point at Murrumbidgee River) with 2,517 vehicles AADT. It must be noted this station is situated within the town of Darlington Point and counts multi-directional vehicles and therefore will always produce a high value due to internal trips within the town.

One of the more noteworthy traffic counting stations is at Willbriggie rail crossing, as this is the point where much of the grain to supply the ethanol plant and dairy enterprise will be off-loaded. There will be a major flow of heavy vehicles from here to the plant. Vehicle counts are currently noted as 1,927 AADT.

Traffic moving north of Willbriggie along the Kidman Way will be destined for and beyond Griffith. Some associated traffic may exist along Section 80 of the Kidman Way to Hillston.

The study area also included Sections 321 to the south of the development, crossing the Highway intersection and section along the Newell Highway 17 down to Jerilderie. These stations are 97.035 (Jerilderie-N of MR59, Urana Road) with vehicle counts of 3,114 AADT and station 97.246 (Coleambally-S of MR596, Morundah Road) with vehicle counts of 1,075 AADT respectively. Traffic will accrue and disseminate at Jerilderie along various major and minor roads.

4.4.3.3 *Classification of Vehicles*

Class Speed Matrix data, supplied by Murrumbidgee Shire Council, and has been included as Annexure 4.4.3. This data has been generated as part of MetroCount Analysis 2005. The data has been derived from several locations along Kidman Way (MR 312) being between Hogan's Lane and Cattnach Road, north of the Gumview Cafe, in Darlington Point, north side of Darlington Point township, and north side heading into Griffith.

FIGURE

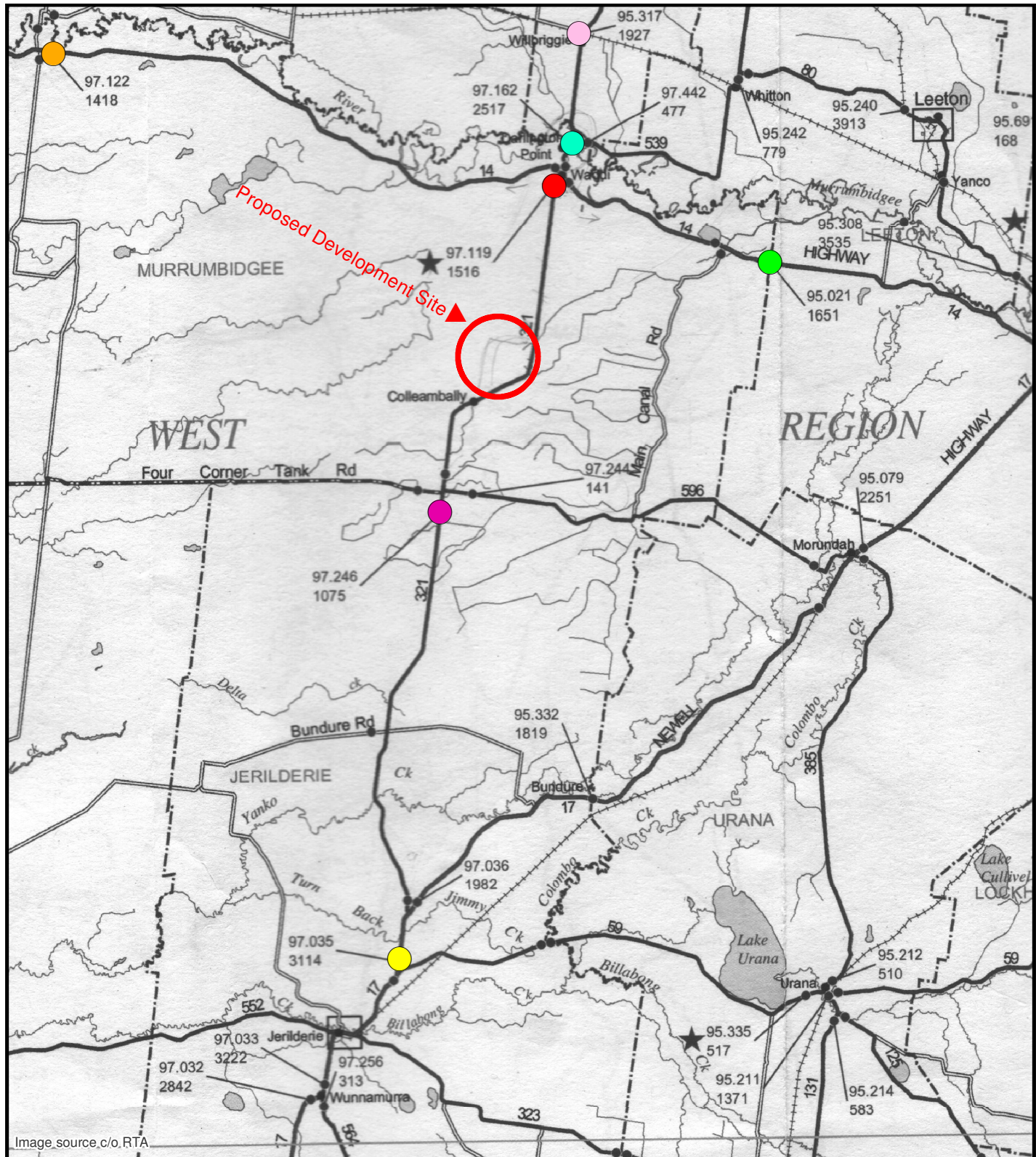
4.4.2

Traffic Counting Stations

Note : Booth Associates and its employees do not guarantee that this publication is without flaw of any kind or is wholly appropriate for your particular purposes and therefore disclaims all liability for any error, loss or other consequence which may arise from you relying on any information in this publication.

Creation Date: 05/04/2006
 File path : D:\Clients-Mapping\4Arrows\ethanol_mar06
 Created by : Simon Lee, GIS Administrator, Booth Associates
 Project : Four Arrows Ethanol Pty Ltd Ethanol Plant &
 Intensive Dairy Environmental Assessment

Booth Associates



- Station # 97.119
 ● Station # 95.021
 ● Station # 95.317
 ● Station # 97.246
- Station # 97.122
 ● Station # 97.162
 ● Station # 97.035





The focus of this survey is directed at two (2) main vehicle classes. One being light vehicles which include sedans, station wagons, 4WD utility, light van, bicycles, motor cycles, etc. This is the class of vehicle which is anticipated to convey labourers, administration staff and technical staff to and from the combined enterprises on a daily basis. The other class includes B-doubles or heavy truck and trailer. These heavy transport vehicles will deliver all resources necessary for the ethanol and dairy production, and will transport end product and derivatives plus wastes from the site.

These two (2) groups are considered the main vehicle classes which will make up total vehicle movements. There may be some derivation to passenger vehicle types and numbers if a public transport service is offered to employees whether that may be a small bus owned by the company or a larger vehicle made available by the current bus service proprietor operating within the area.

Bulk transports will primarily utilise the largest possible vehicles which are considered practical for movement onto, within and off the site. Road weight restrictions en-route will be a limiting factor to the type of vehicle which may be used. The B-double will be typical of the bulk transport vehicles utilised by both proposed project enterprises with some smaller vehicles used less frequently for such purposes as the removal of dead stock and delivery of hardware items, etc.

4.4.3.4 *Hourly Traffic Volumes*

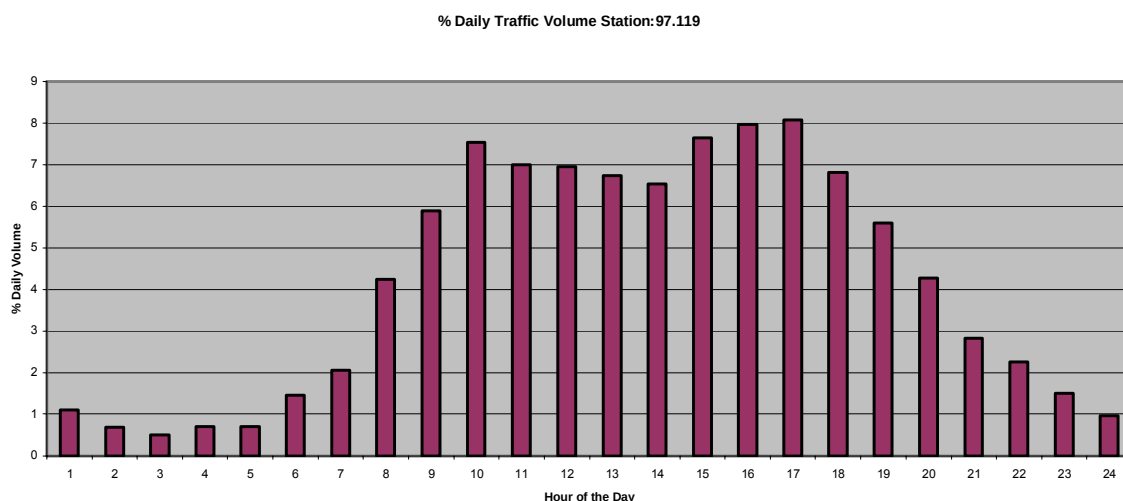
The following graph represents the percentage of hourly traffic volumes for station 97.119 for the week commencing 11 August 2003. The weekend has also been included as the development is expected to operate seven (7) days a week. Data readout can be viewed from Annexure 4.4.4.

Assuming this is a typical traffic week, peak volume periods are between 10.00am and 6.00pm maintaining above 6% of the daily peak traffic movements within any one (1) hour period. The highest traffic volumes are experienced at 10.00am and again within the period between 3.00pm to 5.00pm with over 7% of peak daily traffic being experienced.

The lowest traffic flows for the week being under 2% of any one (1) hour were experienced between the period of 11.00pm and 6.00am.

The period between 7.00am to 9.00am and 7.00pm to 10.00pm represent shoulder periods tapering between low and high traffic volumes.

Graph No. 4.4.1: Station 97.119 – Week commencing 11/03/2003





4.4.3.5 *Public Transport*

There has been only one (1) public transport company identified as operating around the development area. This is TA & RJ Robertson. The company operates a bus service from Darlington Point to Coleambally and return each Monday to Friday. This route has been included as Annexure.4.4.5.

The bus runs twice daily departing Coleambally 7.05am and 3.30pm. The trip is approximately 91km each way.

4.4.3.6 *Intersecting Roads*

There are a number of intersecting roads along the Kidman Way (Road 321). Photographs of intersecting roads falling within the scope of this Traffic Impact Study being from the Willbriggie rail crossing to the north through to the Four Corners Tank Road in the south are included as Annexure 4.4.6.

4.4.3.7 *Traffic Accident Report*

The RTA Traffic Accident Report for the Kidman Way Section 1 of Route 321 for Local government Area of Carrathool through to Jerilderie has been included as Annexure 4.4.7. This report includes all accidents along the Kidman Way within the scope of the area from March 2000 through to June 2005.

The data states that most incidents occurring along the Kidman Way and within Murrumbidgee LGA involved vehicles heading in a straight line. Total accidents involved thirty-six (36) traffic units, ten (10) injury crashes and fourteen (14) non casualty crashes. Of the ten (10) injury crashes a total of twelve (12) people have been significantly hurt.

There has only been one (1) fatal accident in the five (5) year recording period when two (2) people were killed at the Kidman Way/Bull Road intersection. This fatal accident was between a semi-trailer and a station wagon turning right onto the Kidman Way. All other accidents involved right-hand turning vehicles either off the Kidman Way into adjacent cross-roads or from those cross-roads into the main thoroughfare.

4.4.4 *Impact of Proposed Development*

Three (3) spreadsheets have been included as Annexures 4.4.8a and 4.4.8b. Annexure 4.4.8a are calculations prepared initially for the project impacts, however with modifications to project inputs and outputs identified during the preparation of this EA it has been necessary to alter traffic impacts arising from the project. These amendments are outlined in Annexure 4.4.8b, and form the basis for this section of the EA. It must be noted however, that noise impacts from traffic are based on the "worst case" scenario as outlined in Annexure 4.4.8a.

Spreadsheet 1 demonstrates an increase of 358 heavy vehicle movements per day and also an increase of 200 light vehicle movements per day. This will result in a total of an extra 558 vehicle movements along the Kidman Way per day. However, this assumes all trucks delivering resources to the ethanol plant and dairy enterprise will exit the site unladen. The more accurate assumption is that a percentage of these vehicles will be backloaded and therefore result in less heavy vehicle movements per day.



Spreadsheet 1 of Annexure 4.4.8b details this potential backloading scenario whereby 50% of heavy vehicles are backloaded resulting in a decrease in the average annual daily movements to 297 heavy vehicles. This scenario also assumes light vehicle movements in reality will be decreased overall as staff will tend to carpool. This carpooling will result in only 100 light vehicle movements per day at the development site resulting in a total of 397 vehicle movements comprising both light and heavy vehicles.

The percentage increases to annual average daily traffic (AADT) figures at a number of measuring stations along the Kidman Way have been noted on Spreadsheet 2 of Annexure 4.4.8b. The station positions include:

- The Willbriggie railway crossing;
- Darlington Point at the Murrumbidgee River;
- Darlington Point 0.4km south of the Sturt Highway;
- Coleambally south of the Morundah Road junction; and
- A station south of the proposed development on the Newell Highway at Jerilderie north of Urana Road.

The station on the Sturt Highway at the Carrathool township turn off to the west of Kidman Way has been noted as well as the station east of the Kidman Way on the Sturt Highway at the Murrumbidgee Shire boundary. Calculations for these stations have been included. However it is not considered that there will be major traffic generated from the development which will travel along these thoroughfares, as it is anticipated the Willbriggie rail will be upgraded and reopened benefiting the development and being a boon for neighbouring enterprises. Partnerships between the proponent and local government are currently lobbying for State approval for this initiative indicating towards a positive prognosis. Main traffic flows will be north of the development, along Kidman Way to and from the Willbriggie railway crossing and beyond and south along Kidman Way through to Jerilderie and beyond.

Vehicle movements have been divided into a 60/40 split as these are the anticipated vehicle ratios which will travel north and south to access resources and markets. With 60% of the maximum vehicles travelling north past existing traffic measuring stations, there will be an increase at Willbriggie and Darlington Point (Murrumbidgee River), of 17% and 13% respectively. Therefore, the range will be between 13% to 19% of increased vehicle movements passed these locations involving both heavy and light vehicle classes. A more realistic scenario using figures adjusted for backloading and carpooling would be at Willbriggie and Darlington Point (Murrumbidgee River) being 14% and 9% increases respectively. This results in a range between 9% to 12% increase of both heavy and light class vehicles past these points.

Extrapolation of speed matrix data detailed within Spreadsheet 3 provides the forecasted percentage increases for each vehicle class at several locations. This traffic flow includes vehicles servicing both the ethanol plant and the dairy enterprise. It is assumed the majority of heavy vehicles will be B-doubles, while light vehicles will be used for the transportation of staff. Information from four (4) measuring stations has been utilised for this exercise located:

- Between Hogan Lane and Cattnach Road on the Kidman Way;
- North of the Gumview Cafe on the Kidman Way;
- North side of Darlington Point on the Kidman Way; and
- Heading into Griffith along the Kidman Way.



The Griffith station will not be commented upon as it is assumed heavy and light vehicle movements would have depleted substantially at this location due to alternate and truncated routes.

The worst case scenario would involve the maximum number of vehicles, which includes 60% of those which move in the northerly direction travelling past existing measuring stations. This would constitute an increase of 41% in heavy vehicles and 8% in light vehicles at the GumView Cafe. There will also be an increase of 63% of heavy vehicles and 9% of light vehicles on the north side of Darlington Point.

The more accurate scenario would involve backloading of heavy vehicles and carpooling of staff vehicles which would translate into a 34% increase in heavy vehicles north of the Gumview Cafe and 4% in light vehicles per day. There would be a 52% increase in heavy vehicles and 4% increase of light vehicles north side of Darlington Point. Southern bound vehicles moving past Hogan Lane and Cattanach Road will involve an increase of 62% in heavy vehicles and 6% of light vehicle class.

Hours of operation of both the ethanol plant and dairy enterprise will have an affect on the peak volume traffic periods on the Kidman Way. The highest volumes of daily traffic on the Kidman Way are experienced between the hours of 10.00 am to 5.00pm as demonstrated on Graph 4.4.1 in Section 4.4.3.4. The likelihood of heavy trucks and light vehicles entering and exiting the site during this time is high. Timings of shifts could be altered if deemed best practice at a later date.

Light vehicle movements will occur at the start and finish of the shift and assuming a carpooling scenario, this will involve 50 movements onto the site at the start of the shift and 50 movements off-site at the completion of the shift (Spreadsheet 1). This means a high volume of light traffic onto and off of the Kidman Way during these periods. Truck movements over a fifteen (15) hour period are stated in Spreadsheet 1 of Annexure 4.4.8b which will involve on average twenty (20) truck movements per hour. If the enterprise operated over a 24 hour period the average truck movements could be decreased to twelve (12) per hour.

There are a number of intersecting roads along the Kidman Way which will be affected by increased traffic volumes. A table detailing road direction, GPS position and road surface plus photographs of all intersections along Kidman Way from the Willbriggie rail crossing to the Four Corners Road south of Coleambally has been included as Annexure 4.4.6. Details of the locations are included in Figure 4.4.3: *Kidman Way Intersections*. Intersections within the town of Darlington Point have not been included.

The Willbriggie rail crossing has been identified as an area which may require attention if there is an increase of vehicles along the Kidman Way. This is a particularly busy area at harvest time when it experiences high volumes of heavy vehicle class traffic. Heavy vehicle movements will increase appreciatively as this will become a strategic pick-up point for the inputs for the proposed development. The Willbriggie area has a number of intersecting roads, which carry large amounts of heavy vehicles, these being Coppard Road and Cush Crescent which is the main entrance to the Willbriggie Sheds and rail siding.

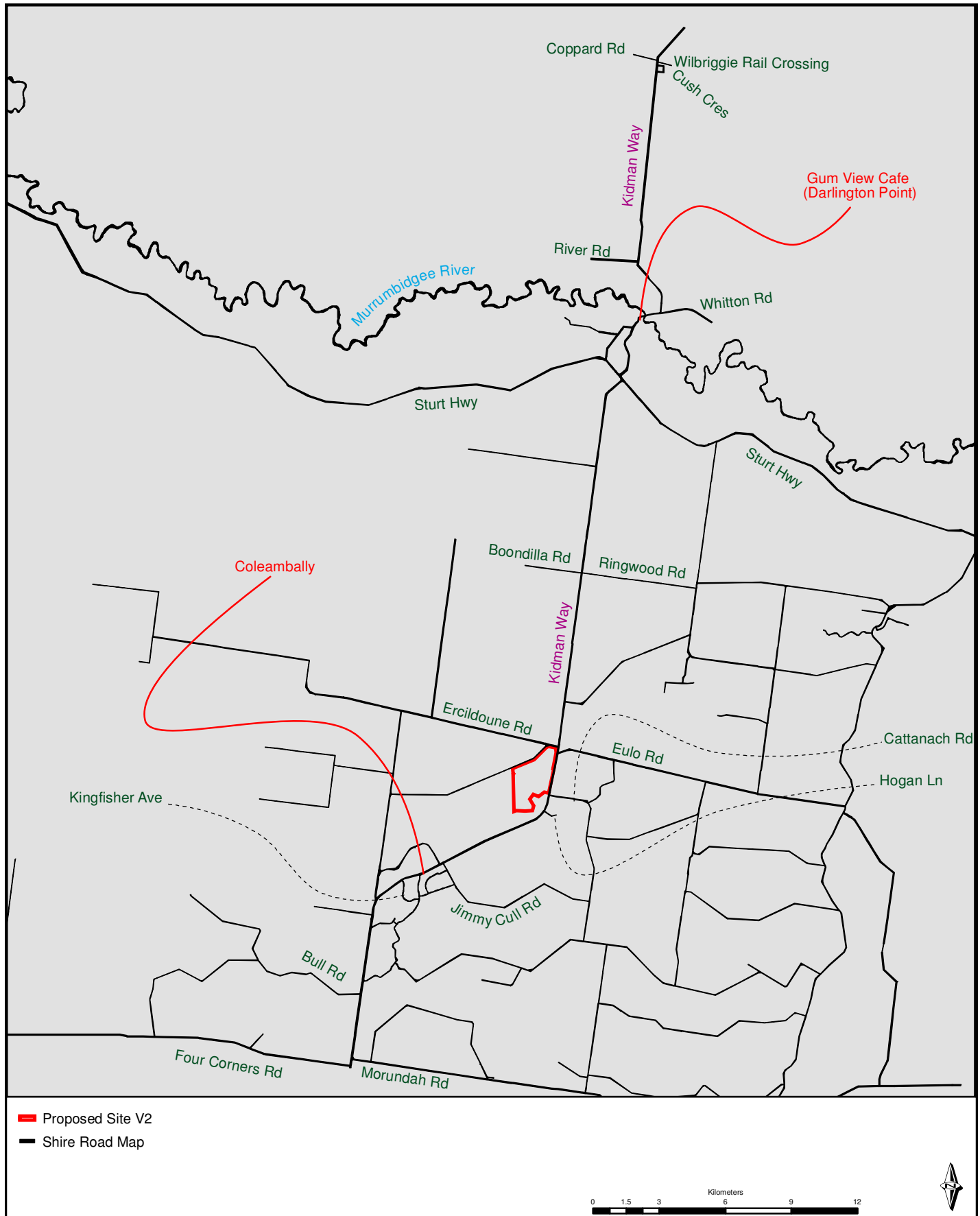




Plate 4:
Kidman Way/Coppard Road Intersection
(southern approach)



Plate 5:
Kidman Way/Cush Crescent
(southern approach)

All intersections within the Darlington Point area or town boundary will be affected to some degree with the increase in vehicles. However, the safety issue will be ameliorated due to the 50km/hr speed limit being enforced throughout the town.

The Kidman Way at the Sturt Highway intersection will experience minimal interruptions and increased movements are not considered of high impact due to traffic efficiencies which have been observed at these points. Right hand turn lanes at the eastern and western intersection of the Sturt Highway and the Kidman Way currently assist with traffic flow.



Plate No. 6:
Sturt Highway/Kidman Way Intersection West
(eastern approach)



Plate 7:
Kidman Way/Sturt Highway Intersection West
(northern approach)

It is not envisaged that the Ringwood Road and Boondilla Road intersection on the Kidman Way will experience major impacts from the increased volume of traffic. However, it is observed that there is a bus stop at this location as well as several other points along the Kidman Way. A bus stopping bay has been provided which is a typical upgrade to accommodate the pick-up and drop-off of passengers. Annexure 4.4.5 provides a map of the local bus route which services the area from Coleambally to Darlington Point. It is noteworthy that the Ringwood Road and Kidman Way intersection is used by this bus service approximately twice a day. This usage frequency by the bus is also the case with Ercildoune Road as the bus utilises this intersection for entry to and exit from the Kidman Way.



Plate 8:
Kidman Way / Ringwood Road Bus Stop
(southern approach)



Plate 9:
Kidman Way / Ringwood Road Intersection
(northern approach)

The Ercildoune and Eulo Road intersection on the Kidman Way may be affected by increased traffic volumes. Ercildoune Road caters for traffic entering the Walsh rice sheds and the Murrumbidgee Shire Farm demonstration site. There is also an indication that a caravan park/camping area also exists on Ercildoune Road however, local information reveals this area is no longer used regularly and any access is from roads to the west of the development along the Kidman Way closer to Coleambally. Although consistent high volumes of traffic are not apparent at the Ercildoune Road and Kidman Way intersection, this may occur at certain times of the year due to crop harvest.



Plate 10:
Kidman Way / Ercildoune Road Intersection
(northern approach)



Plate 11:
Kidman Way / Eulo Road Intersection
(northern approach)

The access and egress configuration at the proposed development site will have a significant impact on vehicle movements and safety. This will be discussed further in section 4.4.5.

Further to the south at the Coleambally rice sheds, as is the case with the Walsh rice sheds, high volumes of traffic are not consistently experienced. However, traffic flow will increase at certain periods during the year. Kingfisher Avenue being the main entrance into Coleambally township has been upgraded to a point where it provides turning, passing and vehicle merging lanes and is considered appropriate and adequate to cater for increased traffic loads.



Plate 12:
Kidman Way / Morundah Road Intersection
(northern approach)

A number of minor roads exist between Kingfisher Avenue and to the south however these experience fairly low traffic volumes and even with increased vehicle movements along the Kidman Way, it is not considered to have a significant impact on these roadways. Morundah Road entering the Kidman Way from the east is a major thoroughfare. There are no appreciative road improvements at this intersection. This intersection may be affected by the increase in vehicle movements.

Eulo Road will be utilised for the transportation of manures for use as fertiliser on “Tubbo”. Eulo Road has been assessed by an independent report which has reviewed bridges along the Eulo Road and notes that these structures are not suitable to carry B-Double vehicles. A copy of this report has been included as Annexure 4.4.9.

The current rating of these bridge structures is for a single bogie comprising of three (3) 7.5 tonne axles at 1.4 metres centres. If the development is to utilise B-doubles for the purpose of transporting of biosolids, the appropriate bridge structures will need to be replaced or strengthened in such a way that they achieve a B-Double loading rating. Otherwise smaller trucks of suitable rating will have to be utilised.

4.4.5 Access and Egress

A profile of the Kidman Way road surface adjacent to the proposed ethanol plant development site is included as Annexure 4.4.10. The Kidman Way along the western property boundary is in poor condition with an undulating surface. Potholes and depressions have been made good with temporary repairs.

It is envisaged entry and exit to the site will be along the eastern boundary (Figure 3.3.3). Traffic movements generated by the site will necessitate roadwork upgrades to the Kidman Way to make entry and exit from the development efficient and safe. Roadwork additions will be required to be sufficient to handle the consistent volume of heavy vehicles throughout the day and peak movements of staff at the beginning and end of shifts.

It is intended these upgrades be consistent with those of other significant intersections along the Kidman Way, including the River Road intersection north of Darlington Point and Kingfisher Avenue intersection into the township of Coleambally. Annexure 4.4.10 contains an indicative representation of the type of upgraded profile which may be applied and would include:

- Turning lanes from the north into the development;
- Speed up merging lanes for vehicles exiting the development traveling south;
- Passing lanes for vehicles traveling south;
- Slow down entry lanes for vehicles entering the development from the south; and
- Speed up merging lanes for vehicles heading north.



Conceptual designs of access and egress to the site for both heavy and light vehicles have been developed by Xeros Kendall Consulting Engineers, and their designs are included as Annexure 4.4.11. These designs are only preliminary examples of the access and egress modifications required for the union of site access to Kidman Way, and more detailed consultation with RTA engineers would need to be undertaken post approval of this EA.

The following photographs detail sight lines from the northern and southern approach. The roadway is predominantly straight running parallel to the development's eastern boundary. This allows for good vision for all vehicles using the Kidman Way and the proposed development. This inherent feature significantly reduces the risks of accident and injury.



Plate 13:
Kidman Way adjacent development site
(northern approach)



Plate 14:
Kidman Way adjacent development site
(southern approach)

Figure 3.3.3 details the proposed internal road layout. Roads will be classified into three (3) basic categories:

- Major roadways;
- Minor roadways; and
- Staff/visitor's roadways.

This is to ensure the safe movement of vehicles throughout the site.

All roads will be of sufficient width and load rating to accommodate the appropriate vehicles. The roadways reserved for B-double and heavy traffic will be adequate to allow for their efficient and safe movement to all necessary facilities and to conduct activities including the delivery of resources and the exportation of products and wastes.

Service vehicles and light trucks will operate on minor roadways. Staff and visitor's vehicles will be restricted to light vehicle roads which will lead to and from administration buildings and car-parks. Pedestrian movements will be along pathways and designated sections on the shoulders of roadways.



4.5 Water

4.5.1 Proposed Development Requirements

4.5.1.1 Overview

Water is crucial for the ethanol plant and proposed dairy enterprise. The requirements are as follows:

- Ethanol plant:
 - o For each tonne of starch the averaged requirement is some 3,150L of clean water; and
 - o A major proportion of the water is recycled as thin stillage during the ethanol production process, and the remainder may be recycled after drying down of the brewer's grain which is the main by-product of the ethanol production.
- Dairy Enterprise:
 - o Approximately 1,000L/cow/day are required to flush the excreta from the freestall sheds;
 - o Drinking water for the cows and heifers;
 - o Dust control in the dry lot pens for the growing heifers; and
 - o Heat management within the freestall shed and dry lot pens.
- General Usages:
 - o Truck wash-down;
 - o Landscape management; and
 - o General workplace requirements of drinking, toilets, showers, etc.

The ethanol plant is projected to require a total of 1,525ML/year for the proposed 725,000 tonnes of grain to be processed for ethanol manufacture. In addition, the ethanol plant will require a further 320ML of water for the needs of general office staff, workshop, landscaping and sundry demands. There is a relatively even usage of water throughout the year of approximately 131ML per month.

The dairy enterprise has a demand of approximately 310ML in total for December and January when the drinking requirement, as well as heat management, is at its peak. June is the month of lowest water demand when drinking and cooling requirements are at their minimum. In total the dairy enterprise will require approximately 3,500ML/year.

The month by month water requirements are depicted in the spreadsheets within Annexure 4.5. The change in demand requirements of water across a range of decile climatic years is relatively small.

A total project water budget will be addressed in Section 4.5.2.5 of the EA where the integrated water management will be discussed in greater detail including the recycling of water and its impacts on total demands.

The Four Arrows Group of Companies has available to its "Tubbo" aggregation of properties the following sources of water:

- Surface water allocations totaling 20,000ML;
- Bore water allocations total 20,000ML; and
- Total 40,000ML.



There is a variation in the annual supply of water and in the possible changes to bore entitlements which are yet to be settled by the Catchment Management Authority (CMA) under the new legislation and water sharing plans. At present:

- High security surface water is expected to have a 95% level of security and supply over the foreseeable ten (10) years under the water sharing plan for the regulated streams in the Murrumbidgee Valley;
- General security water access will vary according to the annual rainfall and supply of water from the catchments. On average, it is projected such water supplies will be in excess of 70% of the face value of the allocation license entitlement. In recent years, allocations have been as low as 30% for general security surface water; and
- Bore water or groundwater is expected to be reduced to approximately 50% of current face value entitlement. Bore water entitlements are still subject to finalisation by the CMA.

In any one year there is commercial trading in the annual access entitlements to water. The market trades actively with an annual access entitlement being available by way of temporary transfer with prices varying between a low of \$10/ML to a high of \$200/ML and with a broad average of \$60/ML. Lesser values are achieved within the CIA and MIA but present other balance sheet implications for the Murrumbidgee River.

A further option available to the project is to buy water under permanent transfer and add to the entitlements already owned by the Four Arrows Group of companies. General security surface water has been trading recently for \$800/ML and high security for \$1,600/ML.

A recent development and one which is an emerging market is the reaching of agreement with other owners of water to manage water supply to a specific project. This is to be achieved through water brokers and/or other interested entities that will contract to supply water for a set fee and off-set that contract with a matching security instrument. This market is thin at present but will emerge over time and add to the security of water to the project.

The access to water beyond existing entitlements held by Four Arrows Group of companies will ensure continuing production of irrigation crops and other produce which would continue to be available to the ethanol and dairy projects.

These water supply constraints include the capacity of the CICL channels to supply water to the project site. CICL closes down the water supply system from late May to late July in the majority of years. This shutdown period enables CICL to undertake channel and infrastructure maintenance. Recent discussions with CICL in regards to the ethanol and dairy projects has lead to the Co-operative actively seeking options to manage supply specifically to this project through the normal shutdown period. Their initial response is attached hereto as Annexure 1.4.1.

There is also the option to recycle water on site from rain capture off rooves and other paving areas.

All the above components of water management will be discussed further in Section 4.5.2 of this EA.



4.5.2 Surface Water

4.5.2.1 Overview

The primary issues associated with the establishment of an ethanol plant and integrated dairy enterprise businesses at the project site are as follows:

- Management of water coming onto the site;
- Management of rainfall for events on the site and in surrounding region;
- Management of drainage from the site; and
- Management of deep percolation from the site to groundwater.

All the water delivery issues and demands have been discussed in the description of the project as presented in Section 4.5.1 of this EA. However, to manage water supply risk it is proposed small buffer storages could be constructed on the site at a location to be determined after design level investigation.

The buffer storage will be designed on the basis that:

- CICL shall be able to deliver water in a series of surge flows from on-route storage within the CIA water delivery system; and
- CICL is able to repair any breaches of the supply system or other breakdowns within 72 hours and have delivery reinstated.

Thus the buffer storage for delivery would only need to be for a maximum of seven (7) days supply net of evaporation. Finally it is assumed that 90% of the water not contained in the wet distillers grain delivered off site shall be able to be recycled through the ethanol plant.

Based on the above assumptions and modelling of the project water balances, a buffer storage of 100ML is deemed adequate for sound risk management even though the modelling conservatively assumes a capacity of 150ML. This buffer storage can be seen on Figure 3.3.2 *Amended Draft Site Plan*.

Excess water not able to be realistically captured within the project site drainage management system shall be able to be directed to DC 400 located immediately south of the proposed development site. Direct discussions with CICL have resulted in the Co-operative's acceptance of receiving drainage water under agreed site management circumstances.

Rain water management will be discussed further in Section 4.5.2.5 as will the management of the various categories of water quality which will be generated from the site through normal operations and from the management of rain events.



4.5.2.2 Local Area

Being part of the CIA, the project site is located within a landscape whereby the local hydrology has been substantially modified to direct regional overland flows into a regional integrated drainage system. This integrated drainage system leads to the Coleambally outfall drain which heads west to the village of Boorrooban some 100km west and even beyond. The reason for integrating the regional drainage is that irrigation systems will generate significant drainage and irrigation farms may only operate effectively when drainage is assured. Furthermore, the regional and local area natural drainage systems are interfered with through the construction of water supply systems (mostly open channels), extra public roads and surface irrigation systems in general.

Reference has been made to the following sources of information in interpreting the local area's hydrology:

- Aerial photograph as found in Annexure 4.5.1;
- Topographic map as found in Annexure 4.5.2; and
- Site inspections with particular reference to surface hydrological issues and constraints.

The project site is bounded on the east by the Kidman Way which is the main thoroughfare linking Melbourne via Jerilderie, passing through Griffith to places north into south west Queensland. This is a major sealed public highway, able to be trafficked in all but the most extreme wet conditions. Between the Kidman Way and the project area is a spur delivery channel running from the north east corner paralleling the Kidman Way to a point near the north-east corner of the lands known as "Additional Farm Area 25" depicted in Figure 3.3.2. This spur delivery channel is currently higher than the Kidman Way and will divert any overland flow which may normally cross the Kidman Way and flowing directly south to enter DC 400 also depicted on the aerial photograph and topographic map attached as Annexures 4.5.1 and 4.5.2.

Along the northern and north western boundary of the project site is a main delivery channel owned and operated by CICL. The banks of this main delivery channel are substantially above the elevation of the surrounding countryside and will deflect any overland flow which may be generated to the north towards the west and south-west.

The project site itself, sits within a landscape in which the general trend in the surface topography slopes to the south-west. Thus any flow from the site would move to the south-west unless otherwise managed. Of particular note is any water generated to the south-west of the project site will flow away from the site rather than towards the site.

Any other local drainage will end up in DC 400.

The net outcome is the project site will not:

- Interfere with the local area hydrology;
- Be adversely impacted by water generated outside the project area; and
- Be adversely impacted by water not purposely held on site.



4.5.2.3 Project Site

The hydrology of the project site is dominated by the presence of a sandy rise in the centre with a ridge of relatively high land running from the rise to the east towards the Kidman Way. Any rain or other water accumulating or originating on the northern side of the rise and eastern ridge will tend to flow initially to the north and then to the north-west before inevitably to the south-west, running around the western side of the rise, towards the main community drainage line known as DC 400. Any rain falling on or to the south of the ridge will likewise run south towards the regional drain known as DC 400.

To best manage water on the site, it will be necessary to contain all drainage within the site with appropriately designed embankments which could duplicate as access roads. This design criterion will ensure there is no drainage from the site other than that water which is:

- Designed to move from the site in a controlled manner; and
- Be of a quality acceptable to be received into the regional drainage system via DC 400.

These issues will be discussed further in Section 5.5.

4.5.2.4 Water Quality Categories

There are essentially three (3) key water quality categories which may need to be separated during the operation and management of the integrated project of ethanol production and dairy enterprise. These categories are broadly reiterated as follows:

- Category 1 – Water which is run off from roofed areas and which is clean rain water for potable usage;
- Category 2 – Water which runs off any landscape that may be irrigated with reclaimed waste water and water which may run off from dedicated paved or other nominated landscaped areas; and
- Category 3 – Water which has a high loading of waste material and which is generated as the run off from the dairy dry lots, freestall pens and associated areas.

In developing the above categories it has been assumed the surplus water coming from the ethanol plant and not being removed from the distillers grain will be recycled immediately back through the ethanol plant to minimise the demand on water from external sources. This recycling is discussed in greater detail in Section 4.8.8.2.

Rainfall run off from any of the sheds (Category 1) water may be immediately diverted direct to the water storage for the ethanol plant or to a local contained storage which would allow the water to be used for specialised purposes (eg potable usages) after it is appropriately filtered and/or treated as depicted on the draft project layout in Figure 3.3.2. Any surplus water could also be directed back to the ethanol plant if required and/or mixed with drinking water for the dairy cattle.

Category 2 water would be directed to the small pond in the south-east corner of the project site, as depicted on the project draft layout in Figure 3.3.2. Category 2 water would accumulate in the dedicated storage and be usable if required for:



- Landscape irrigation purposes; and/or
- Sustaining pondages integrated into the aesthetics of the site and containing appropriate aquatic habitats.

Subject to future design level of investigations following approval to the project development, it is expected there will be a need for a limited number of water accrual points and/or small surge areas where water can accumulate before being pumped to the Category 2 water storage.

Category 3 water containing high nutrients, *E. coli* and BOD loadings will need to be specifically contained within the dedicated areas by a bund embankment running around the commodity sheds, freestall dairy sheds, maternity shed, sick cow shed, cattle yards, truck wash-down areas, dairy dry lots, milking parlour and associated wash-down area, sedimentation basins, manure heaps, surge storage, and abutting up to the engineered anaerobic and aerobic ponds associated with the management of the Category 3 water.

The above water categories and their management have been discussed in more detail within Section 4.8 Waste Disposal and again in Section 5.5.

Key Issue:	All water storages to be constructed and managed to engineering.
	: Standards which reduce deep percolation losses to no more than 1×10^{-9} m/sec.
	: Category 3 water storages shall incorporate leakage detection equipment, and leakage capture and collection structures.

4.5.2.5 Water Modelling

Attached hereto as Annexures 4.5.3, 4.5.4, 4.5.5 and 4.5.6 are four (4) integrated and dynamic water balances which incorporate the dynamics of the water movements in monthly time steps onto, around and potentially off the site over a range of seasonal circumstances. Each of these models is succinctly described as follows:

- Decile 1 (D1) A decile 1 year represents a 1 in 10 year dry or drought year to ascertain the requirements for water under extreme drought conditions. This model also enables the risk assessment on Category 1 water storage sizing for servicing the ethanol plant is kept operating and the dairy cattle are appropriately managed and their well-being ensured;
- Decile 5 (D5) Represents an average or median year;
- Decile 9 (D9) This model represents a 1 in 10 wet year and enables the assessment of some large rainfall events occurring on top of each other over a season; and



- Decile 10⁺⁺ (DX)

This model is not a true decile 10 year or wettest year on record where the total annual rainfall would be 700mm. This model assumes an as yet to be recorded extreme wet year with a total annual rainfall of 1,000mm which is 40% more rain than a true D10 year. For the purposes of this EA this model will be designated DX for “decile extreme”;

The reason for incorporating such an extreme situation is to demonstrate that the proposed Category 3 water storages needed for effectively managing all highly loaded water have the capacity to contain all such water, even in an as yet to be experienced extreme wet year.

A major issue is to determine whether or not the size of the storages are adequate and under what circumstances drainage from the site will be required into the main drainage channel of DC 400. From the Decile 9 model will arise the parameters for determining policies for management of any irrigation of the project landscape or irrigation generally with any potential surplus water.

Each of the models contains four (4) separate but integrated worksheets comprising the following:

- Water demand by the project site (Annexures 4.5.3, 4.5.4, 4.5.5 and 4.5.6);
- Water runoff from the dairy enterprise (Annexure 4.5.7a);
- Water runoff from the ethanol plant (Annexure 4.5.7b); and
- A consolidated water budget bringing together all the components and recognising the water quality categories as discussed in Section 4.5.2.4 (Annexure 4.5.8).

For the modelling exercise it is assumed that each of the water storages will open the calendar year with approximately 50% of their full capacity being utilised. This modelling policy ensures substantial air space is available to capture run-off from major storm events. The assumed air space policy is managed with purchases of CICL water to regularly top up and dilute the water in storage but not exceeding approximately 50% of maximum capacity in doing so. With the final versions of the models used for this EA the assumed opening balances for January were:

- Category 1 – 50ML stored or 33% of capacity;
- Category 2 – 150ML stored or 50% of capacity; and
- Category 3 – 700ML stored or almost 60% of capacity.

In each case, the closing stored balances were targeted at a level close the opening balance. The only significant exception is the outcome of the decile DX scenario where the closing balances were 49ML, 268ML and 1,150ML for the Category 1, 2 and 3 storages respectively. The increased closing balances will need to be reflected in the operating decisions for the subsequent year to ensure an increase in air space before the following autumn/winter period. For the decile DX scenario a total 2,100ML is projected to be lost off site into DC400 but that would only be from May onwards when DC400 could be expected to be running full with drainage from upstream irrigation farms. By that time the level of dilution would be high and only natural run off of best quality Category 2 water would be leaving the project site.

With the future benefit of operational experience, it may be found to be a practical and environmentally sound option to vary the above assumptions up or down.



The most notable comments in relation to water demand models are:

- The dairy enterprise will require an estimated total of 3,500ML/year with a seasonally low of approximately 270ML for the month of June. Monthly demand rises to approximately 315ML for both December and January when the requirements for drinking water has increased as will have the need for dust and heat control. For a decile 1 year, the water demand increases only marginally on that in a decile 5 year nor does it materially diminish in a decile 9 year; and
- For the ethanol plant, the water demands vary marginally up or down 100ML in total per year in decile 1 and 9 years on the requirement for a decile 5 year. This is only dependant upon the extremes of seasonal wetness or dryness.

The water demand models calculate the integrated outcome which flow on to the mass balance models and the consolidated worksheets within the individual models.

In a decile 5 year the run-off from the dairy enterprise is estimated to total 3,067ML in total of which approximately 130ML is Category 1 water, 155ML is Category 2 water and a total of 2,780ML is Category 3 or heavily contaminated water (see Annexure 4.5.7a). In a decile 1 drought year there is a small reduction in the volume of Category 3 run-off water with a relative significant reduction in the volumes of Category 1 and Category 2 water although in total the relative volumes are minor. In the decile 9 year the increases in volumes of water running off are not as significant as would be expected with a relatively small increase in the Category 3 water, but significantly larger volumes running off in Category 1 and 2 water. In total the volumes of Category 1 and 2 water are relatively minor and able to be managed on-site.

The water run-off from the ethanol plant in a decile 5 year is estimated to total 550ML, all of which is Category 1 water (see Annexure 4.5.7b). In a decile 1 or drought year run-off is reduced to 325ML all of which is Category 1 water. However, in a decile 9 year the quantum of run-off from the ethanol plant is 750ML of which is all best quality or Category 1 water.

The fourth worksheet in each of the water models depicts the consolidated water budget for each of the decile 1, decile 5, decile 9 and decile DX years. The models are structured as follows:

- Across the top of the consolidated water budget is the relevant climatic data for each of the representative years;
- Category 1 water assumes the project water storage capacity will total 150ML, will average 5.9m deep and have a surface area of 2.5ha. The opening water balance will be 50ML and will contain all the Category 1 water generated as run-off from the site and from rain on top of the water storage itself;
- When there is a deficiency within the storage, it is assumed water will be purchased from CICL with the monthly volumes depicted in the total sources of water;
- From the Category 1 water storage will be water lost from evaporation or used by demands from the dairy and the ethanol plant and with their associated support facilities;
- When there is excessive water beyond what the Category 1 storage can hold, it is assumed there will be a management decision to transfer water to the Category 2 water storage as depicted in Figure 3.3.2. The Category 2 water has a calculated maximum capacity of 300ML with a maximum water depth of 2m and a surface area of 15ha;
- The additional water into the storage includes the capture of run-off from the ethanol plant, (beyond the capacity of the Category 1 storage), rainfall onto the storage and purchases from CICL to ensure the water remains within the storage at no less than the assumed minimum level;
- Losses from the Category 2 water storage will be from evaporation and the usage of water for dust control within the dairy enterprise and associated landscape. This category water will also be used for dust control in and around the roads, the wash-down facilities and to irrigate the landscape around the ethanol plant and administration areas;



- When there is excessive water beyond which the Category 2 water storage may hold there is the ability to transfer water to the Category 3 storage and/or in extreme circumstances, to the main drain DC400 (subject to CICL operational concurrence). Mitigation measures associated with the management of surplus Category 2 water and its integration with surplus Category 3 water is discussed in detail in Section 5.5; and
- The Category 3 water follows the same pattern for assessing the capacity and usage of the water storage as is used to manage the Category 2 water.

Table 4.5.1 below summarises the consolidated water model outcomes in Annexure 4.5.8.

Table 4.5.1: Summary of dynamic water (consolidated) balances presented in Annexure 4.5.8

	Source		Sinks	
Decile 1	CICL access entitlements	3,175 ML	Cattle and surrounds	3,579 ML
	Capture - dairy	2,929 ML	Ethanol and surrounds	2,296 ML
	- ethanol	324 ML	Evapotranspiration	804 ML
	- storage	105 ML	Site Run-off	0
	Rounding and Inventory	146 ML	Rounding and Inventory	0
		6,699 ML		6,679 ML
NB: With 1,000ML re-cycled at the ethanol plant, CICL deliveries decline to 2,175 ML				

	Source		Sinks	
Decile 5	CICL entitlements	2,800 ML	Cattle and surrounds	3,564 ML
	Capture - dairy	3,067 ML	Ethanol and surrounds	2,220 ML
	- ethanol	549 ML	Evapotranspiration	811 ML
	- storage	180 ML	Site Run-off	0 ML
	Rounding and Inventory	0	Rounding and Inventory	1 ML
		6,596 ML		6,596 ML
NB: With 1,000ML re-cycled at the ethanol plant, CICL deliveries decline to 1,800ML				

	Source		Sinks	
Decile 9	CICL access entitlements	2,025 ML	Cattle and surrounds	3,551 ML
	Capture - dairy	3,196 ML	Ethanol and surrounds	2,153 ML
	- ethanol	760 ML	Evapotranspiration	494 ML
	- storage	245 ML	Site Run-off	0
	Rounding and Inventory	0	Rounding and Inventory	28 ML
		6,226 ML		7,001 ML
NB: With 1,000ML re-cycled at the ethanol plant, CICL deliveries decline to 1,025 ML				

	Source		Sinks	
Decile DX	CICL share entitlements	700 ML	Cattle and surrounds	3,649 ML
	Rain Capture - dairy	5,810 ML	Ethanol and surrounds	2,133 ML
	- ethanol	1,841 ML	Evapotranspiration	479 ML
	- storage	475 ML	Site Run-off	2,100 ML
	Rounding and Inventory	0	Rounding and Inventory	465 ML
		8,826 ML		8,826 ML
NB: With 1,000ML re-cycled at the ethanol plant, CICL deliveries decline to 325 ML.				
NB: All run off is Category 2 water only and after DC400 is running full.				



Comments: Extracting water from the wet distillers grain (WDG) requires substantial energy for the operation of a combination of belt presses, centrifuges and direct heat.

- : Cartage of WDG to on-site dairy is minimal and thus WDG used on-site shall not require any drying.
- : The extent of drying for WDG sold off-site will be a running calculation of all costs and benefits at that time.
- : The expected sale at 50% moisture to a regional feedlot is a fair compromise for this EA.
- : Thus the 1,000ML re-cycled is a fair estimate.
- : Deep percolation loss is based on water storage area with a maximum and worst case rate loss of 1×10^{-9} m/sec.

Aerobic pond	31.0 ha
Anaerobic ponds	6.6 ha
Category 2 pond	12.4 ha
Total	50.0 ha @ 30mm/ha/year = 15ML/year
- : The calculated 15ML maximum of deep percolation is off set by the extensive and non irrigation of 114ha x 375mm rain x 10% ÷ 100 = 43ML intercepted by the tree and shrub landscape plantings.

The key issues to arise out of the dynamic and integrated water balance modelling may be summarised as follows:

- In a decile 5 or average year a total of 2,800ML of purchases will be required from the CICL system and will need to be covered in accordance with the current license condition agreements; and
- Those agreements are standard as per normal for all CICL shareholders and the Four Arrows Group including Four Arrows Ethanol Pty Ltd are already bound by those shareholder agreements.

Water would be accessed:

- Directly from the license entitlements already owned by the Four Arrows Group of companies and/or;
- Purchases of permanent transfer water; and/or
- Purchases of temporary transfer water in accordance with the license conditions and agreements with CICL.

There is a minimal variation on a month-to-month basis for the required and averaged water deliveries of approximately 310ML/mth with no a balloon requirement to cover the CICL water shutdown once the CICL enroute storage is completed. If this CICL shutdown is not required, the monthly winter requirements will be static at approximately 200ML/month or 7ML/day.

In a decile 1 or extreme drought year, the demands of water to be purchased through CICL may increase marginally to nearly 3,175ML. In such years the availability of water is expected to be dramatically reduced across the whole valley and hence, substantial purchases of temporary transfer water and/or permanent transfer water will need to be considered. The commercial value and the desire to pay for water in dry years will be driven by economics at the time. The purchase of permanent high security water in sufficient volumes cover a decile 1 year could be considered which, whilst an expensive exercise, would enhance the risk management and add to the overall balance sheet of the business. There is the ability to temporarily transfer excess water to other associated company operations within the valley, and in particular the adjacent "Tubbo" and it's affiliated operations in the more normal years.



The model for a decile 9 year indicates a need for a total of 2,025ML to be purchased through CICL to ensure the business continues to operate to achieve full production.

When driving the above models, it has been conservatively assumed that very little of the water available at the end of the ethanol production process can be recycled.

A separate mass balance to be found in Annexure 4.1.1 which depicts that it is most likely a total of nearly 600ML of water may be able to be recycled within the ethanol production process in any one year. This recycling will minimise the necessary capacity of the Category 1 storage down to approximately 200ML in the presence of a system shut down by CICL for winter maintenance and to as low as 100ML for minimal risk management in the event an alternative secure strategy of winter water supply is able to be devised.

4.5.2.6 *Summary of Surface Water Issues*

The detailed modelling and mass balancing associated with managing all surface waters on and around the project site may be succinctly summarised as follows:

- Local area hydrology is not adversely impacted if all site generated and managed water is able to be contained on site as is proposed;
- Project site hydrology is able to be managed within the site without any need to transfer water off site except in extreme rainfall events beyond the limits of the normal “worst case” modeling undertaken in accordance with normal rainfall expectations over a series of rainfall years;
- There are three (3) categories of water quality identified on the project site. It is expected these categories could be reduced to two (2) key categories; namely water with minor to negligible contamination and water with significant contamination. The Category 1 water of minimal contamination (essentially roof runoff) may be segregated for minimal increased cost in deriving potable water for staff facilities and similar requirements on site;
- The Category 1 water storage size needs to be:
 - o 100ML maximum in capacity if CICL or other entity is able to ensure water supply in the winter shutdown period;
 - o 800ML if the impacts of the CICL winter shutdown are not able to be avoided;
- The Category 2 water storage at 300ML is more than adequate for the proposed usage and is frequently providing a buffer in the capture extreme storm even runoff; and
- At 1,545ML for the major Category 3 water storages (45ML storm surge, 300ML anaerobic and 1,200ML aerobic) these facilities enable all but extreme storm events in a decile 9 year to be captured and managed on site, and

The issues of managing extreme storm events will be covered in detail in Section 5.5 of this EA. In essence all unavoidable drainage water would be of a quality equal to or better than what would be coming off all other Coleambally irrigation farms in a decile 9 year and/or under extreme rainfall events, based on dilution factors and the nature of containment of contaminated waters resulting in minor contaminated water only leaving the site.

The design of the project and its intended construction criteria ensures appropriateness of segregation and management of the project site under all foreseeable seasonal circumstances.

The issue of mitigation and details of management will be discussed further in Section 5.5 Water Mitigation herein.



4.5.3 Groundwater

4.5.3.1 Regional Aquifers

The project site is located within an area known as the Lower Murrumbidgee Groundwater Management Area (LMGMA). The area covers 33,000km² and is also known as the Murrumbidgee Alluvial Fan. The recharge zone is to the east and in particular near the commencement of the alluvial fan situated near the township of Narrandera. There are three (3) geological units in which the groundwater is located, these being:

- Shepparton Formation –the shallowest unit located from natural surface to a depth of up to 75m below natural surface level (NSL). The aquifers in this formation are of low to moderate permeability and provide some recharge to deeper aquifers;
- Calivil Formation – this unit is located at depths of approximately 75m below NSL to 150m NSL. The permeability in this formation is high and it is the formation from which many production bores are used to pump water for irrigation purposes; and
- Renmark Group – This unit is below the Calivil formation and has a thickness of up to 280m westward towards Balranald. This unit can yield groundwater for deep production bores.

The geological formation of interest for this EA is the Shepparton Formation. The upper sections closer to natural surface level may contain areas of perched water tables from other activities such as regional irrigation development. The past agricultural operations within the CIA have resulted in a perched water table in the middle to Upper Shepparton Formation. This water table issue is being addressed through the implementation of the Coleambally Land and Water Management Plan.

4.5.3.2 Regional Groundwater Trends

Attached as Annexure 4.5.9 are a series of maps depicting groundwater piezometer levels for the upper Shepparton Formation from 1986 to 2003. The location of the project site is depicted in the top section of each of the maps.

The following observations of trends in groundwater are as follows:

- Groundwater closest to the NSL tends to be in the central and eastern sections of CIA; and
- The project area is in a section of the CIA where groundwater levels are between 4m and 10m below NSL.

Also attached as Annexure 4.5.10 are a series of maps depicting the amalgamated piezometer level readings from 1986 to 2003 for the Lower Shepparton formation. The observations from these maps are as follows:

- The project area is located in an area where the piezometer level readings from the Lower Shepparton formation were greater than 10m below NSL;
- For periods within the 1990's the standing water levels in the Lower Shepparton piezometers rose to less than 10m below NSL; and
- In more recent years the trend is for these water table levels to fall again in response to the CIA LWMP implementation and no doubt aided by the on-going run of dry seasons.

Observations from Annexures 4.5.9 and 4.5.10 are that there does appear to be linkages in the hydraulic head between the upper and lower Shepparton aquifers and there are direct linkages between the water bearing formations.



The figures found in Annexures 4.5.9 and 4.5.10 demonstrate there has been a significant contribution to regional groundwaters and perched water tables by farming activities within the CIA. The preparation and implementation of the Coleambally Land and Water Management Plan has made significant inroads into reducing the quantum of accessions to water tables through deep percolation and the reduction in the area of shallow water tables of concern.

4.5.3.3 Groundwater Dynamics in the CIA

In 2000 the now CIEL commissioned the Commonwealth Scientific and Industrial Research Organisation (CSIRO) Land and Water, Griffith to assess and document groundwater changes within the CIA. The CSIRO consultancy report titled “Groundwater Dynamics in the Coleambally Irrigation Area” was completed in November 2000. The “Dynamics” report identified and mapped four (4) sub-regions in the CIA as depicted on the diagram below.

Plate 15: Groundwater sub-regions in the CIA

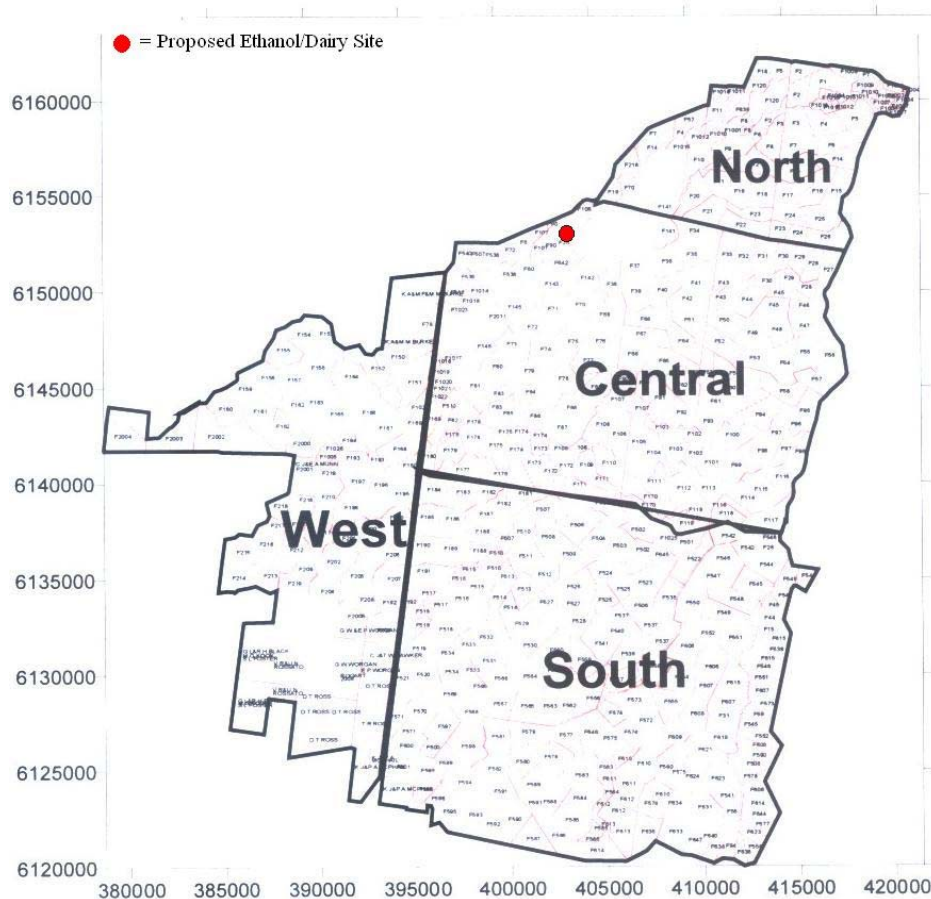


Figure 2: Boundaries between sub-regions of the CIA

Source: Figure at Page 8 in “Groundwater Dynamics in the Coleambally Irrigation Area”

Table 4.5.2 below depicts the differences in average water usage CIA by rice crops over a six (6) year period to the 1999/2000 rice season inclusive.

**Table 4.5.2: Rice water use in ML/ha extracted from CICL records**

	94-95	95-96	96-97	97-98	98-99	99-00	Average
North (ML/ha)	17.11	15.31	14.96	15.65	15.39	13.69	15.35
Central (ML/ha)	14.26	12.30	12.70	13.31	12.96	11.68	12.87
West (ML/ha)	14.21	12.14	12.23	13.27	12.57	12.18	12.77
South (ML/ha)	12.59	11.20	12.03	12.20	11.47	11.00	11.75

Source: Table 1 at Page 11 in "Groundwater Dynamics in the Coleambally Irrigation Area"

From Table 4.5.2 it is obvious that water usages by rice crops in the northern sub-regions are consistently higher than that in the other sub-regions. The project area is located within the central sub-region but almost adjacent to the northern sub-region and hence must be considered as "at risk" of significant deep percolation losses.

Table 4.5.3 is a summary of the changes in the percentage areas of shallow groundwater (<2.0m below NSL) in each of the four (4) sub-regions of the CIA.

Table 4.5.3: Percentage of shallow groundwater by CIA sub region during the late 1990's

Area	1995	1996	1997	1998	Average
North	0.0	0.0	0.0	0.0	0.0
Central	8.6	25.3	10.0	3.5	9.4
West	1.2	7.2	1.4	10.2	5.0
South	10.2	10.7	21.4	8.2	12.6

Source: Table 2 at Page 11 in "Groundwater Dynamics in the Coleambally Irrigation Area"

From the above tables the CSIRO consultancy report broadly concluded that:

- The extra deep percolation loss under rice crops in the northern sub-region was most likely continuing down through the soil profile and not creating an obvious water table;
- The increased areas of shallow water tables in the central, southern and western sub-regions was minimising deep percolation losses but increasing the risk of salinisation; and
- The significant number of irrigation production bores to the north and north west of the CIA with some 30GL to 40GL of annual extraction was assisting in reducing groundwater levels in the northern sub-region and the north western sections of the central sub-region.

Given that the project area is on the north west corner of the central sub-region and adjacent northern sub-region it is highly likely that any deep percolation loss from the proposed project could:

- Impact upon groundwater quality in the general area;
- Eventually impact on groundwater quality for the nearby bore irrigators; and
- Adversely impact on any shallow groundwater being extracted for domestic and/or any future industrial or other specialized usages.

Plates 15, 16 and 17 over page provide the groundwater elevation contours and flow vectors under the CIA as at September 1999. The plates have been taken directly from Figures 5, 6 and 12 in the CSIRO report and are for the following aquifers respectively:

- Upper Shepparton;
- Lower Shepparton; and
- Calivil.



Plate 16: Groundwater sub-regions in the CIA

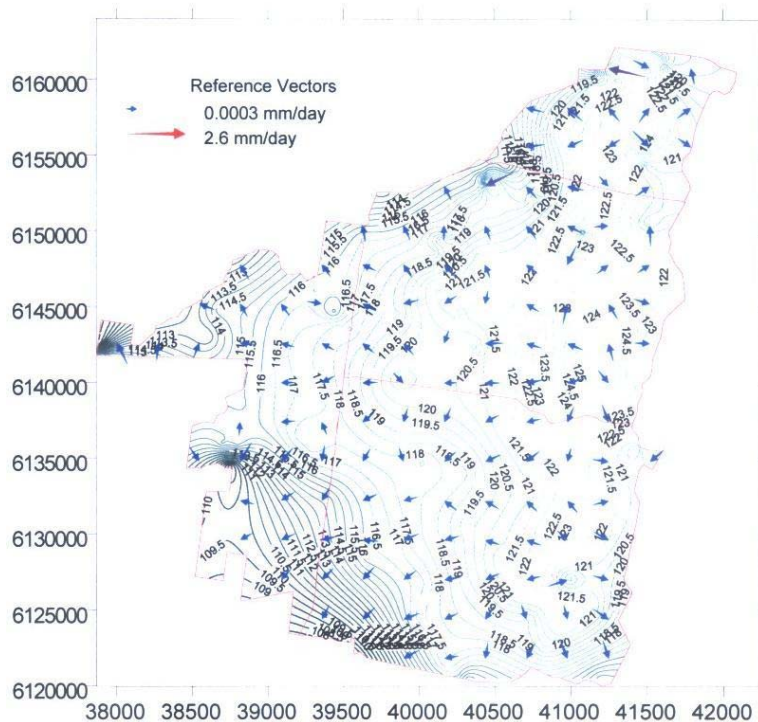


Figure 5: Groundwater elevation contours and flow vectors for the Upper Shepparton aquifer under CIA, September 1999.

Source: Figure at Page 8 in "Groundwater Dynamics in the Coleambally Irrigation Area"

Plate 17: Groundwater sub-regions in the CIA

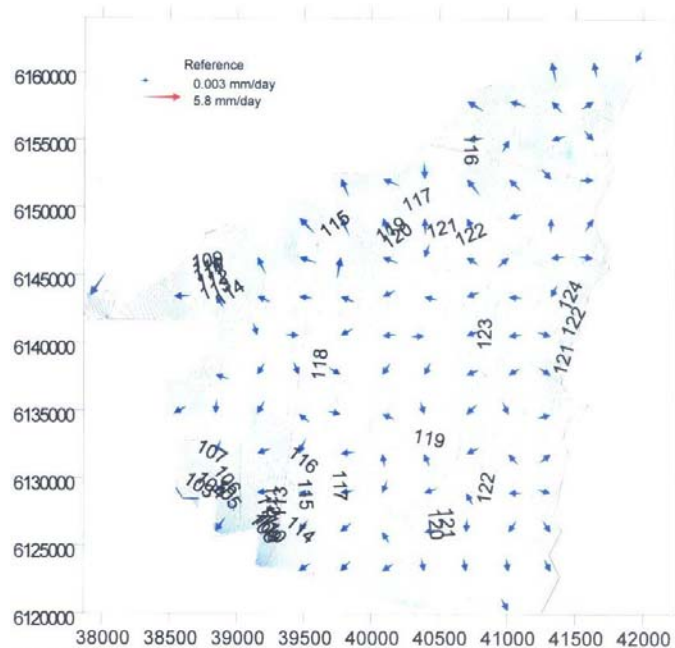


Figure 6: Groundwater elevation contours and flow vectors for the Lower Shepparton Formation under the CIA, September 1999.

Source: Figure at Page 8 in "Groundwater Dynamics in the Coleambally Irrigation Area"

Plate 18: Groundwater sub-regions in the CIA

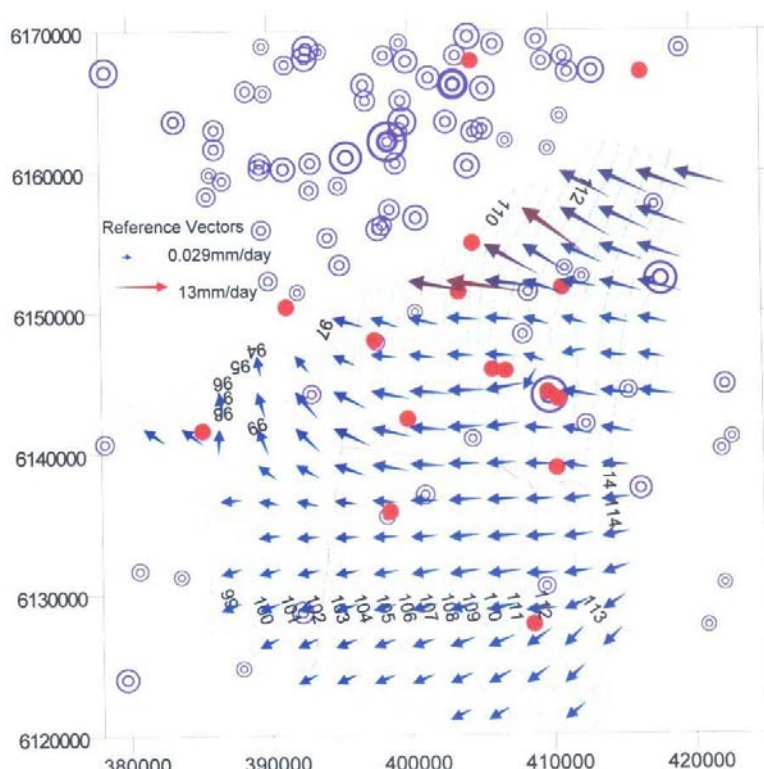


Figure 6: Groundwater elevation contours and flow vectors for the Calvil aquifer under the CIA, September 1998. Purple dots indicate locations of pump bores and are scaled to represent pumping rates from a minimum of 0 to a maximum of 6000ML/year.

Source: Figure at Page 8 in "Groundwater Dynamics in the Coleambally Irrigation Area"

The only broad comment that can be made for the two (2) Shepparton formations is that in the vicinity of the proposed ethanol/dairy project the general trend in groundwater flows is to the northwest and that some linkages do exist between the upper and lower formations.

Within the Calvil formation however, the general trend in groundwater flows is to the west with an inflection to the north west of an increasing flow rate in response to the effects of the bore irrigation pumps.

No documented evidence of groundwater trends under "Tubbo" Station is available but, from the trend data in Plates 15, 16 and 17, the following assumptions are considered reasonable:

- For the upper Shepparton formation the impact of the irrigation practices within the CIA will diminish with distance eastwards from the CIA. That the water table will be >4m below NSL and more likely >10m below NSL;
- There will be some connections between the upper and lower Shepparton formations; and
- The groundwater flows in the Shepparton and Calvil formations will be generally westward.

The risks of impacting upon local and regional groundwaters and the recommended risk mitigation strategies will be discussed in Section 5.5.



4.5.3.4 Groundwater Trends at Project Site

4.5.3.4.1 General

Attached as Annexure 4.5.11 are the annual piezometer readings taken by CICL staff from twelve (12) piezometers within and surrounding the project site. The location of each of these CICL piezometers is depicted on the map in Annexure 4.5.12 and on Figure 4.5.1: *Piezometer and Groundwater bore Test Sites*. Screened intervals for each piezometer can be assumed as occurring two (2) meters above the depth of piezometers listed in Table 4.5.4 below. There was limited missing data within the information provided by CICL and with their permission (Mr M Rowe *pers comm* 10/03/06) the data for the previous and subsequent years was averaged for determining the “reading” in the intervening year when the data was missing.

Table 4.5.4: Piezometer depth and assumed screened interval

Piezometer No.	Depth (meters below NSL)	Assumed Screened Interval (meters below NSL)
208	35.40	33.40
806	34.70	32.70
807	20.40	18.40
808	Unknown	Unknown
1165	32.30	30.30
1166	9.20	7.20
1590	Unknown	Unknown
1596	9.70	7.70
17.01	23.00	21.00
1775	12.10	10.10
1780	10.80	8.80
12166	31.83	29.83
12171	16.00	14.00
12188	9.70	7.70

The data presented in the table at the beginning of Annexure 4.5.11 is also depicted in a series of 12 graphs at Annexure 4.5.13. The data may be summarised as follows:

- Groundwater levels in and around the project site were originally between 2m and 20m below NSL in September 1970;
- The three (3) readings less than 10m below NSL in 1970 were all adjacent to CICL irrigation channels where CICL suspected there was significant leakage;
- In the 1990's there was a general rise in groundwater levels before a subsequent decline;
- The rise in groundwater levels until the 1990's represented the outcomes of the past high intensity of irrigation and the relative availability of water for irrigation purposes and, in particular, for rice. It also represented the then ability to irrigate CIA lands which have subsequently proved as unsuitable for rice; and
- Following the peak in groundwater levels in the 1990's there has been a consistent decline as more efficient irrigation practices have been implemented in response to the Coleambally Land and Water Management Plan.

This information is pictured below in Graph 4.5.1, and displays an overlay of all hydrographs in Annexure 4.5.13. Graph 4.5.2 is a combined average of all recordings from surrounding piezometers at any one recording period. This averaging helps to remove wildly varying records due to errors in recording, or a lack of any record at all. It can be seen that the majority of piezometers in Graph 4.5.1 highlight a peaking of groundwater levels in the mid 1990's at approximately 6 meters below NSL.

4.5.1

Piezometer and Groundwater
Test Bore Sites

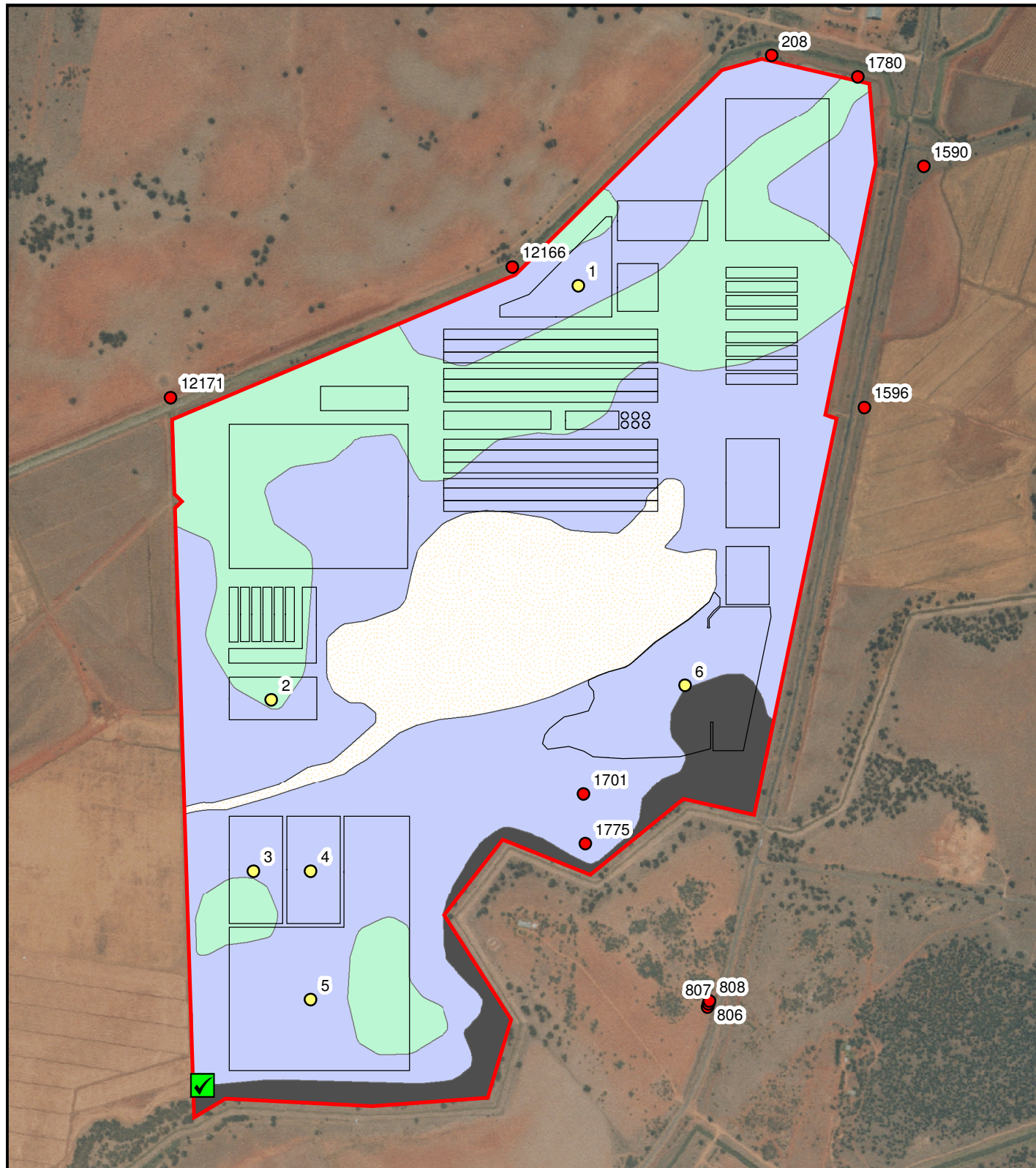
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Project : Four Arrows Ethanol Pty Ltd Ethanol Plant &
Intensive Dairy Environmental Assessment



- | | | | |
|--|--|--|--|
| Proposed Site V2 | Sand | Grey Transitional Soil | Skeleton of Proposed Infrastructure |
| Groundwater Test Bores | Black Self Mulching Clay | Red-brown Earth | ✓ Project Site Lowest Point |
| ● CIEL Piezometers | | | |

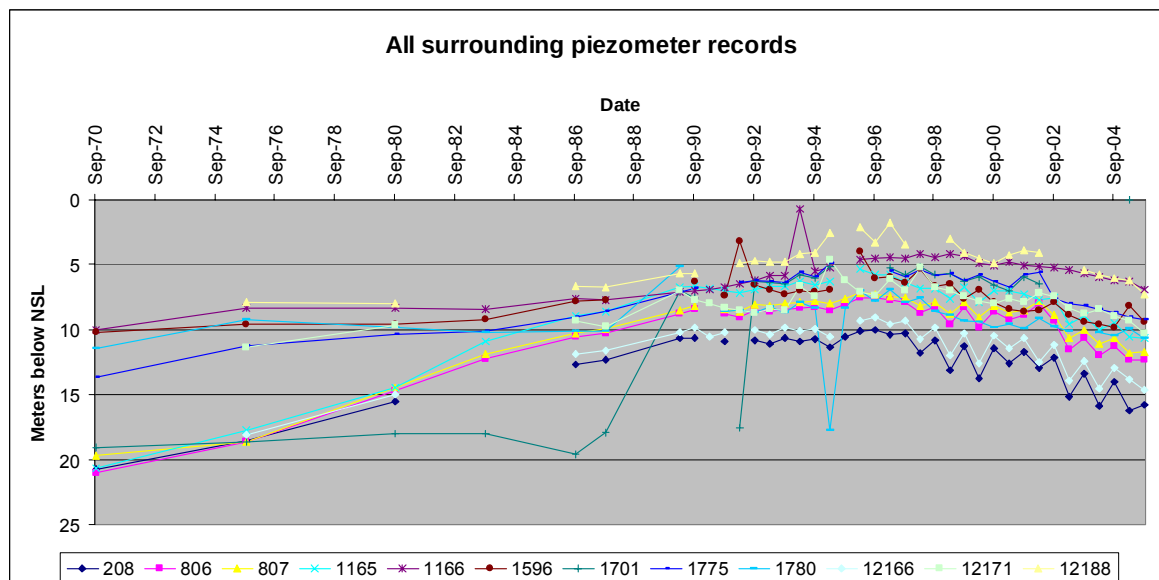
0 0.1 0.2 0.4 0.6 0.8
Kilometers



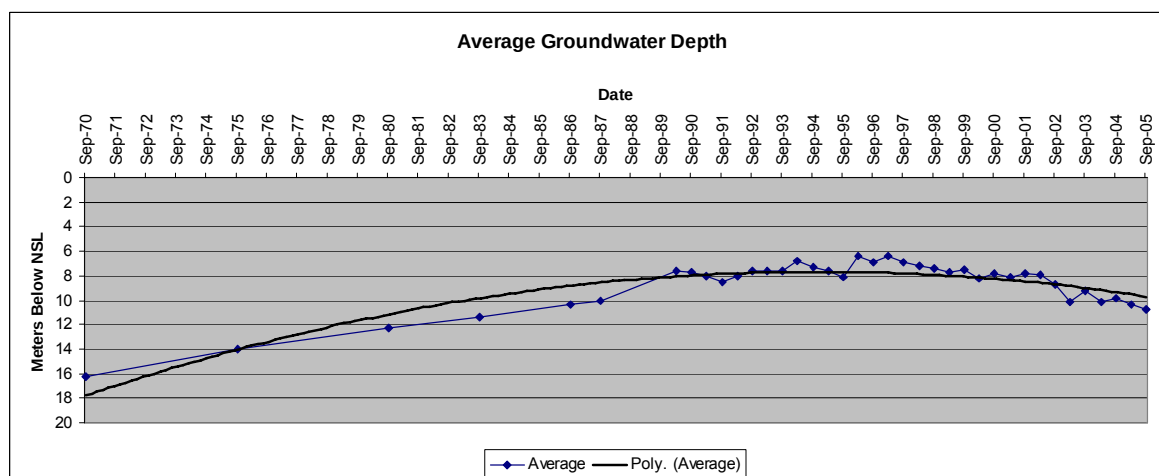


This is further illustrated in the trendline in Graph 4.5.2, which identifies the shallowest groundwater readings as approximately 7.75m below NSL in 1995.

Graph 4.5.1



Graph 4.5.2





The above comments and the attached data indicate there is significant potential for adverse impacts on groundwater from a range of less than desirable management practices at any point over the regional and local area landscape.

Importantly, the data also depicts that if appropriate site specific land management practices are applied to the relevant sections of the landscape, groundwater impacts can be minimised and may in fact be reduced to below historical levels for net gains.

4.5.3.4.2 In-field Testing

To establish the most accurate groundwater level data for groundwater tables under the project site, ground water level readings from CICL piezometers were taken on the 6 July, 2006. The readings are listed in Table 4.5.5 below. The locations of the piezometers are identified on Figure 4.5.1 *Piezometer and Groundwater Bore Test Sites*.

Table 4.5.5: Surrounding Piezometer groundwater levels below NSL – 06/07/06

Piezometer No.	Water Level (Meters Below NSL)
12166	14.68
208	15.93
1596	9.93
807	11.90
806	12.22
1775	9.78

In addition to the piezometer readings, 6 test bores were drilled on the project site in early July 2006. Each test bore was located at a point approximately central to each of the water storage, pondage or treatment areas onsite, and information on soil horizons, textures and presence or absence of moisture were recorded. Full details of the bore logs and an analytical report prepared by Associate Professor Roger Wrigley, project geotechnical engineer and hydrogeologist are attached as Annexure 4.5.14 and 4.5.15 respectively.

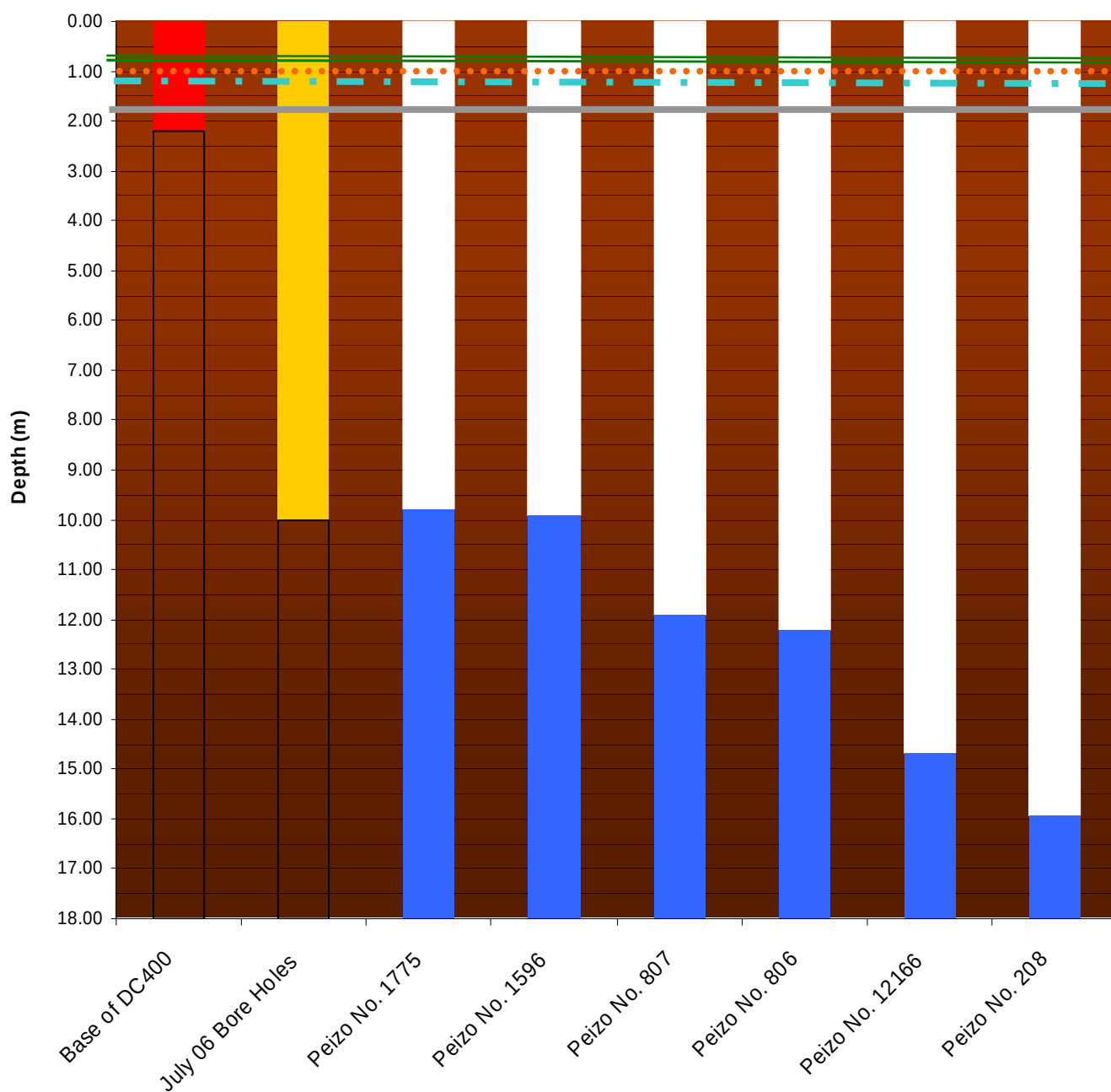
Table 4.5.6 below, indicates the July 2006 test bore depths and describes the test bore depths in relation to the depth of the base of DC400 (designed invert level) adjacent to the lowest point of the project site (see Annexure 4.5.16).

This below table relationship is also graphically represented in the diagram below for the July 2006 test bores, the CICL piezometers and the invert of DC400.

Table 4.5.6: Natural Surface Levels (NSL) for the test bores drilled in July 2006

Test Bore No	Test Bore Depth (m)	NSL Based on AHD	
		Imperial	Metric
1	10	402' 0"	122.76m
2	10	402' 0"	122.53m
3	10	402' 3"	122.61m
4	10	401' 9"	122.45m
5	10	401' 6"	122.38m
6	10	402' 6"	122.68m

Note : Original map details were in imperial measurements
: AHD is Australian Height Datum

**Natural Surface Level (Average) At Bore Holes (= 122.53 m (AHD))**

Category 3 Storage = 1.0 m

Category 2 Storage = 0.89 m

Category 1 Storage = 1.03 m

Depth of deepest Cut = 1.83m (800mm added to cut depth to achieve 600 mm compacted layers)



Based on this review, the following comments can be made:

- The NSL's of the July 2006 bore numbers 1 – 6 only vary in topographic elevation by a maximum of approximately thirty (30) centimeters and are at 122.53m (AHD) on average;
- The drainage channel invert adjacent to the lowest point within the proposed development area (south west corner – see Figure 4.5.1) is approximately one hundred and seven centimeters (107cm) below NSL;
- The lowest point on the proposed development site is 121.39m (AHD) thus the channel bed is 120.32m (AHD);
- The average NSL of test bores is 2.20 metres above the base of DC400 at its lowest point adjacent to the proposed development site;
- No free water was found in the six (6) bore holes drilled. Therefore there is no groundwater within 8m of the invert of DC400; and
- Current piezometer level readings from surrounding CICL piezometers would indicate that the groundwater is currently at a minimum of 7.58m below the base of DC400.

The soil samples (disturbed core basis) taken during the groundwater bore testing have identified a site which is dominated by a deep sand foundation overlaid with a mantel of clay which is gradually thinning from east to west across the project site. The sandhill central to the proposed development site is a recharge area for what are possibly unconfined aquifers in the west and confined aquifers to the east. At present water tables are depressed, most likely in response to the combination of the current drought conditions and the enhanced regional irrigation practices under the CICL LWMP. The evidence obtained from soil sample interpretation, and supported in historical piezometer readings, is that the water tables have been higher in the past than present representation.

Table 4.5.7 below identifies some broad explanatory comments by Associate Professor Roger Wrigley from each of the six (6) bore sites. His comments further highlights the outcome that sites tested on the western side of the proposed development are generally less suited to water storage infrastructure than the proposed Category 2 storage on the eastern side of the proposed development site.

Table 4.5.7: Bore Log Analysis

Site	Soil Type	Depth of Clay	Waterlogging evident	Comments
1	Clay over sand.	1m	Y - Sample is too small to be representative	▪ Evidence of profile waterlogging possibly exacerbated by channel seepage. ▪ No concern with groundwater contamination but confined aquifer conditions likely.
2	Clay over deep layer of sand.	1.5m	N	▪ Watertable here is depressed after 8 years of drought: has been higher based on CIA data. ▪ Groundwater contamination is a potential risk. ▪ Aquifer is likely to be unconfined. ▪ No disturbance of the 0.5m clay mantle should be advocated in order to reduce accession risk, unless engineering solutions employed.
3	Clay over increasing level of sand.	1.5m	N	▪ The watertable is depressed after 8 years of drought: has been higher based on CIA data. ▪ Groundwater contamination is a potential risk. ▪ Aquifer is unconfined. ▪ No disturbance of 1.5m layer is recommended unless engineering solutions employed.
4	Clay overlaying sand and gravel.	4m	Y – Is possible although sample is too small to be representative	▪ Watertable here is depressed. ▪ Groundwater contamination is unlikely with what is potentially a confined aquifer.
5	Mantle of clay overlaying sand.	3.5m	Y – Possible with some discolouration in soil profile. Unlikely to be representative	▪ Watertable is depressed. ▪ Some concern with potential groundwater contamination risk – especially if clay layer is reduced as a result of earthworks.
6	Thick mantle of clay overlaying sand and gravel.	4m	Y – Leading to mottling. Mottling apparent in soil profile: possible result from flooding from drainage line rather than high water tables.	▪ Watertable here is depressed. ▪ Groundwater contamination is unlikely with what is potentially a confined aquifer. ▪ Contamination risk is low given nature of overlaying clay.



Notwithstanding the presence of sandy layers, independent recommendations have been made by Associate Professor Roger Wrigley as to suitable engineering solutions to alleviate the issues with potential groundwater accession through exposure of sandy soil horizons. Section 5.5 of this EA and further subsequent sections on specific infrastructural mitigation strategies on groundwater management identifies specific solutions for the monitoring of potential groundwater accession, water quality and present solutions to avoid project water entering groundwater systems,. The broad principles are:

- The establishment of compacted earthen liners of at least 600mm depth with a replicated and demonstrated permeability of not exceeding 1×10^{-9} m/sec for all water storages, settlement ponds and storage areas;
- If these criteria cannot be met then geosynthetic liners should be installed to alleviate all potential permeability of water and storage areas;
- The geosynthetic liner to be most likely 1.5mm thick and installed by qualified technicians, and verified by the project engineer prior to commissioning;
- Upon approval and during design level investigations that more detailed soil suitability investigations be undertaken for all areas proposed for water storage and effluent management;
- The decision on whether to rely on a >600mm compacted clay liner and/or geosynthetic membrane liner will be made by the project geotechnical engineer, in full consultation with DNR staff, both with the benefit of the future detailed design level investigation prior to construction/installation; and
- Provision to be made to monitor and capture any leakage from at least the Category 3 water storages.

As identified above, these particular broad solutions to the potential for groundwater accession are discussed in greater detail in Sections 5.5.1 and 5.5.2. These recommendations are also outlined in the Statement of Commitments contained within Section 7.0 of this EA.

4.5.3.5 *Groundwater Risks*

Virtually irrespective of site, whether it is at the proposed site or any other site in this or any other region, there will always be potential to adversely impact on groundwaters by any type of project.

This EA has identified and discussed the nature of potential adverse and beneficial impacts for this particular project at the proposed site. The next question is to determine whether or not those risks are significant and whether or not some measure of adverse impact may or may not be acceptable. In making the determination, the following observations are made:

- Groundwaters have been a significant issue in that for many years post development, the whole of the CIA has been at varying degrees of threat with rising water tables from past irrigation practices plus significant contributions by natural rainfall;
- Whilst not evidenced in available documentation, it is assumed that nutrients, chemicals and detrimental salts have already entered the groundwater as a consequence of past land use practices and concurrent natural events;
- It is recognised that the implementation of the Coleambally Land and Water Management Plan (LWMP) has resulted in substantially reduced accessions to regional groundwater and that the LWMP would have also resulted in reduced levels of nutrients, chemicals and detrimental salts entering water tables; and
- It is also recognised that surrounding bore irrigators have had beneficial impacts on groundwater levels in at least the north west sections of the CIA.



Despite the apparent recent and significant improvements in regional groundwater levels it is considered that any project driven accession to local and regional groundwaters is undesirable from all perspectives.

Figure 4.5.2: *Surrounding Groundwater Extraction/Use Points*, identifies twenty-eight (28) surrounding groundwater users and points of extraction within a five (5) kilometre radius of the proposed development site. These extraction point uses are identified as either stock, domestic, irrigation monitoring points, exploratory extractions or unknown.

Analysis of groundwater flows indicates a propensity for groundwater to move from south-east to north-west, so the greatest risk area (as identified on Figure 4.5.2) for potential groundwater contamination to affect users contains four (4) stock bores, three (3) irrigation bores, one (1) exploratory bore and one (1) domestic bore.

It is imperative that risks to groundwater contamination be minimised to protect groundwater resources for the above identified users. The use of compacted clay liners, and where necessary (ie anaerobic and aerobic storages) membrane liners, will ensure no possible accession to groundwater from the project site. In addition, groundwater monitoring systems, and leakage monitoring and collection systems will need to be put in place to identify any possible accession or contamination of groundwater resources immediately upon such an event. More detail for a groundwater monitoring plan is outlined in Section 5.5.4.

Accordingly, the project must set out to mitigate against all potential impacts at each stage of the project evolution, viz;

- Planning and design;
- Construction and commissioning;
- Operations and performance monitoring; and
- Periodic reviews and project enhancements.

The above issues and the appropriate mitigation measures will be addressed in subsequent sections of this EA.

4.5.3.6 *Project Impacts on Groundwater*

From the previous sub-sections in this EA, it is obvious there is potential for adverse impacts by the project on groundwater at a quantitative and qualitative level. At the qualitative level the impacts can only occur if the quantitative impacts are allowed to occur. That is, by not preventing project water accessing the local and regional groundwater the deep percolation movement of that water will enable nutrients, salts and potentially chemicals to access groundwater.

In recognition of the potential impact by inappropriate and/or unaware management, sub-consultants with longstanding, specific and peer respected experience in planning, designing and operating projects with potential to access groundwater were engaged.

By being aware of the potential for impacts, the chosen sub-consultants (Wrigley-Dillon) were instructed to and have undertaken their investigations for this EA in such a manner as to:

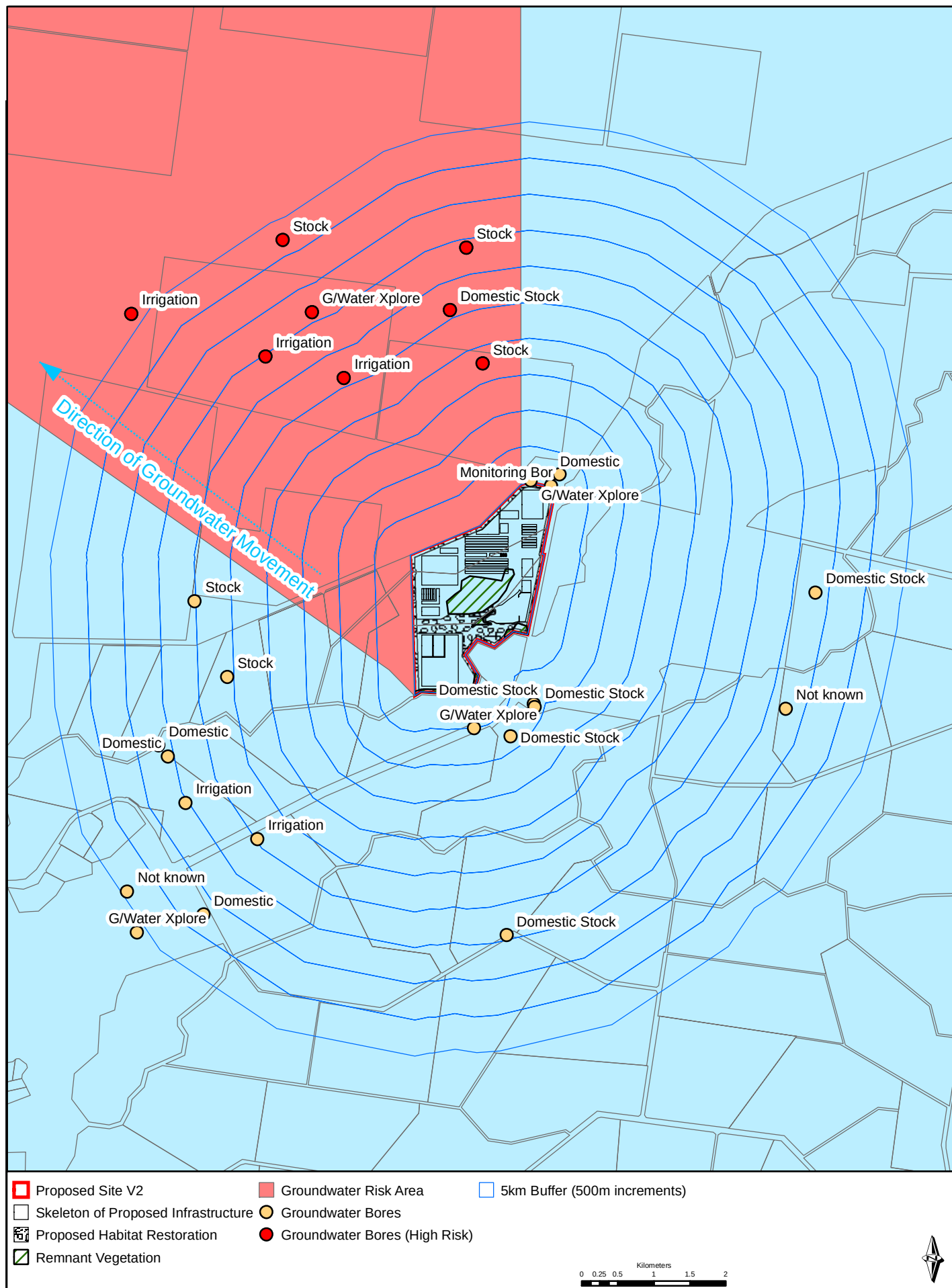
- Ensure adverse impacts are unlikely to occur;
- Ensure appropriate procedures are in place for the design level investigations, construction procedures, commissioning standards; and
- Pre-commissioning performance monitoring procedures are documented.

4.5.2

Surrounding Groundwater
Extraction/Use Points

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Project : Four Arrows Ethanol Pty Ltd Ethanol Plant & Intensive Dairy Environmental Assessment





The outcomes of the investigations for this EA by the sub-consultants are:

- There are sections of the site where water from the project site may potentially access groundwaters;
- There are sections of the site which, when developed and engineered appropriately, will effectively mitigate the potential for accessions to groundwater;
- There are other sections of the site which will require specialist attention such as the installation of appropriate geosynthetic membrane liners to effectively alleviate risk;
- Appropriate planting and management of some 114ha of native tree and shrubs will further reduce the risk of groundwater accessions; and
- Certain design level investigations will be required after approval for the project is received and which will need to be undertaken for the construction and operation of the project.

The scoping level project design and layout of the site in Figure 3.3.2 reflects the appropriate responses the advice and recommendations by the geotechnical and soil specialist sub-consultants and affirm the integrity of the site when appropriately managed to minimise the risk of accession to groundwater by project activities.

Since no absolute guarantee may be given at any site that accessions to water tables can never occur, an appropriate performance monitoring system and an assured response procedure will need to be installed before the project can be commissioned. At this stage, a series of piezometers and an environmental management plan and system will need to be detailed as an outcome of the detailed design level investigations. The performance monitoring procedures will need to incorporate procedures which will identify at an early stage any emerging potential risk for early and rapid re-appraisal which will result in appropriate adjustments to the project.

Finally and to ensure all possibilities are covered, it is recommended that a leakage detection and collection system be installed on the high contaminant Category 3 storages.

Key Issue:	All water storages, the dry lot feed pens and earthen water conveyance system to be engineered to standards which ensure deep percolation rates do not exceed 1×10^{-9} m/sec.
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The recommended mitigation measures and relevant issues have been documented more appropriately and in further detail in Section 5.0 Mitigation Measures and subsequent sub-sections.



4.6 Hazards and Risks

4.6.1 Preliminary Hazard Analysis

4.6.1.1 Introduction

As per State Environmental Planning Policy No. 33 (SEPP33) and the Director General's specifications (Annexure 1.6.1) the proposed ethanol and integrated dairy project requires the preparation of a Preliminary Hazard Analysis (PHA). The project is considered as potentially hazardous since it will exceed the threshold levels for dangerous goods stored on site. The PHA has identified the following on-site hazards and corresponding risks:

- Grain receipt and storage – explosive dusts;
- Ethanol manufacture – spillage, fire, explosion;
- Ethanol storage/transfers – spillage, fire, explosion; and
- Petrol receipts/storage – spillage, fire, explosion.

Moore Consulting and Engineering (MCE) were engaged to develop the PHA using the Department of Urban Affairs and Planning (DUAP), Multi-level Risk Assessment, IT Guidelines for Hazard Analysis – Hazardous Industry Planning Advisory Paper No. 6.

A full copy of the MCE report is included as Annexure 4.6.1 with a summary of the key issues provided in the following sub-sections of this EA.

4.6.1.2 Methodology

The development of the PHA included the following:

- Identification of potential hazards – evaluate the chemicals utilised and processes undertaken on site. Identify each of the resultant hazards and potential sources of loss;
- Quantitatively estimate the consequences of major hazardous events;
- Determine the nature of on-site consequences and risks; and
- Evaluate the risks for major hazardous incidents.

The MCE methodology commenced with a process description and operational assessment for both the ethanol plant and the dairy enterprise. The hazardous materials were identified as:

Table 4.6.1: Hazardous materials in the production of ethanol

Chemical	General Description	Quantity
Ethanol	In distillation process	267 m ³
Ethanol (de-natured)	Stored flammable liquid	8,000 m ³
Petrol	Flammable liquid	400 m ³

Source:

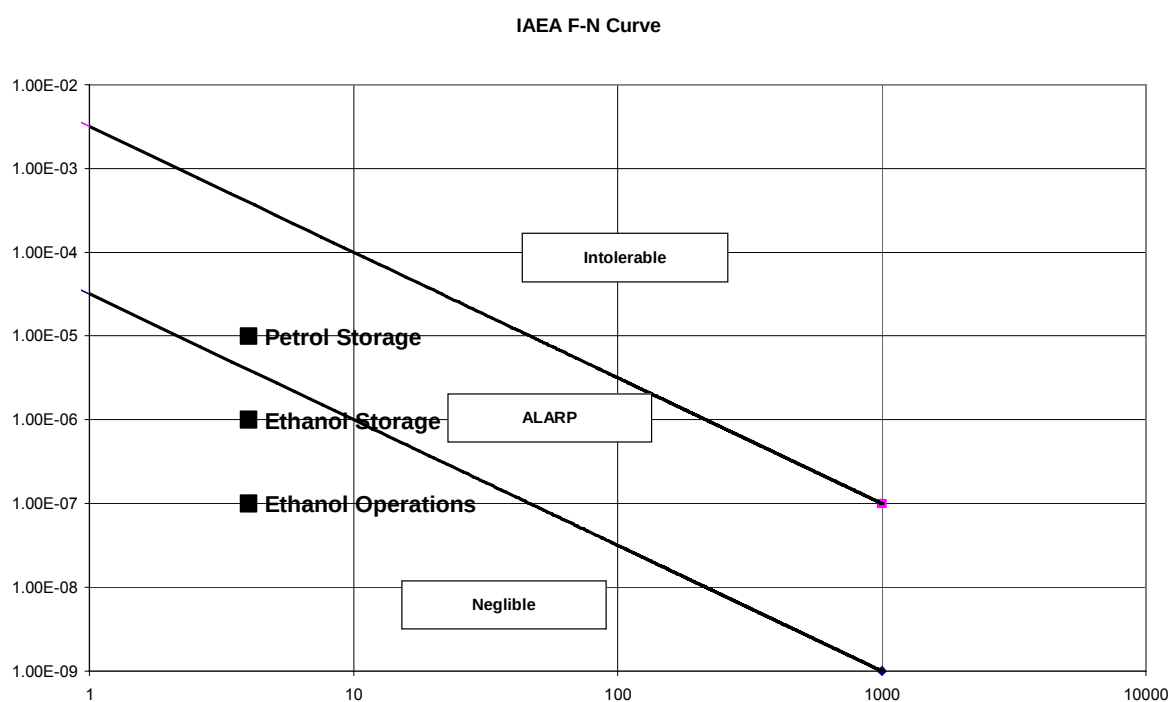
MCE Report Annexure 4.6.1



The International Atomic Energy Agency (IAEA) consequence analysis on the above tabled areas of concern concluded that the external consequences at a rating of 4 for all three (3) areas of concern were low.

- The likelihood of a major hazardous incident involving ethanol and petrol storage is directly related to the number of loading and unloading activities undertaken; and
- The likelihood of a hazardous event occurring with petrol is increased due to its high partial pressure and lower flammatory limit compared to ethanol.

The MCE report included the following graph as Figure 5.1: *Ethanol operations, ethanol storage and petrol storage* to summarise the IAEA assessment.



Source: Figure 5.1 from MCE report Annexure 4.6.1

In summary the MCE report concluded that frequency (F) was heavily dominated by the petrol storage and that care must be taken to not dominate the hazard analysis with ethanol operations and storage whilst neglecting petrol operations.

The PHA addressed each of the hazards and risks separately and provides a platform for appropriately managing the identified risks.



4.6.1.3 Hazard Identification

Table 4.6.2 below is a summary of the nature, sources and causes of hazards with potential to be experienced within the proposed project.

Table 4.6.2: Hazard Types, Losses and Causes

Nature	Potential Loss Sources	Typical Causes
Kinetic energy	Death or injury to people	Fire
Potential energy	Damaged to property	Explosion
Chemical energy	Damage to the environment	Toxic escape
	Loss of production/profits	Loss of utilities
	Loss of reputation	Electrical accident
		Structural collapse/damage
		Natural disaster
		Sabotage/vandalism/terrorism/etc.

Source: Section 6.1 MCE report Annexure 4.6.1

The MCE report identifies twenty one (21) potential hazards within thirteen (13) operational areas associated with the proposed project. Those operational areas and the number of sub-areas are summarised in Table 4.6.3 below:

Table 4.6.3: Operational and Sub-area Potential Hazard Location

Grain	Ethanol	Petrol	Other
Receival (1)	Distillation (2)	Storage (3)	Boiler (1)
Storage (2)	Molecular sieve (1)	Receipt (1)	Commodity Shed (1)
Conveying (1)	Storage (3)		CO ₂ compression (1)
Milling (1)	Loading (3)		

Source: MCE Preliminary Hazard Assessment Report (see Annexure 4.6.1)

: Bracketed numbers are the relative qualitative assessments (DUAP guidelines)

The MCE table also dissects and discusses each potential hazard as to its own particular nature, cause, possible consequence and proposed prevention, mitigation and control measures. From the hazard identification table MCE proceeded to categorise and analyse the consequences of the significant potential hazardous incidents.

4.6.1.4 Consequence Analysis

The outcomes of each of the separate MCE consequence analyses are as follows with the “MCE”: reference being the MCE concluding comments:

- Grain dust explosions – normally confined specific buildings or areas. People within a building may experience over-pressure blast leading to injury or death. Equipment could also be damaged.

MCE: *Unlikely to have significant off-site effects.*

- Grain storage fires – will not be as extensive as those fires caused by the release of flammable liquids.

MCE: *Unlikely for heat radiation to have significant off-site effect.*



- Vapour cloud explosion (distillation) – the release of ethanol vapour from the distillation column could result in a vapour cloud. The modeled 300m³ building containing an ignited vapour cloud could result in severe damage and personal injury. Maximum isopleths of 18m to 50m at overpressures of 70KPa to 21 KPa respectively.

MCE: Off-site effects to be very low and can be managed by separation, engineering and best manufacturing practices.

- Vapour cloud explosion (ethanol) – potential release in the storage area with an assumed 200m³ at a low level of congestion. Maximum isopleths distances varied from 16m to 44m for overpressures of 70KPa down to 21KPa respectively.

MCE: Comparable outcomes to the VCE for the ethanol distillation bunding.

- Pool fire (ethanol) – these fires may arise from the liquid from the distillation process, molecular sieve, storage and loading. A TRACE 9.0 model has been used for the scenarios of a small pool fire and an ethanol bund fire. The bund fire is a more severe fire with thermal radiation not declining to 1.2KW/m until the 248m isopleths.

MCE: Further design level details are required for the bundled fire scenario.

- Tanker rupture (ethanol) – assumes the release of 27.5KL covering 34.2m in diameter to 0.03m deep. Thermal radiation falls to 1.2KW/m² at the 66m isopleths.

MCE: Not as significant as the full bundled fire and the correct location of site roads and drains can limit off-site impacts.

- Vapour cloud explosion (petrol) – a modeled 200m³ gas cloud at a low level of congestion reduces to an overpressure of 21KPa at 44m isopleths.

MCE: Distance effect manageable by separation distance from site boundary.

- Pool fire (petrol) – a bundled fire would cover 26m x 26m and the resultant thermal radiation decline to 1.2KW/m² at the 97m isopleths. A tanker rupture releasing 30KL would pool at 0.03m over 36m diameter for effectively the same isopleths at 1.2KW/m² of thermal radiation.

*MCE: Bunded fire consequences manageable through separation.
Petrol pool fires have a larger area of impact than ethanol pool fires.*

- Carbon dioxide release – the CO₂ cloud would move close the ground and displace atmospheric oxygen with >10% CO₂ by volume causing death by suffocation. The model release of 10t of compressed CO₂ reveals that the 10% CO₂ concentration dissipates at < 20m.

MCE: Unlikely that a significant off-site impact will occur with separation from the site boundary.

The potential hazards with the greatest consequence off-site are those arising from bundled petrol and ruptured petrol tanker fires. Ethanol bundled and storage rupture fires have substantially lower off-site impacts.



4.6.1.5 Frequency Analysis

The MCE report determined that the use of separation distances from site boundaries will mitigate the consequence effects and MCE concluded there was no need to undertake a frequency analysis (Section 8 of Annexure 4.6.1) MCE report).

4.6.1.6 Conclusions

The off societal risks of the proposed facilities will be negligible, with a level 1 qualitative assessment meeting (DUAP) guidelines. This negligible effect is based on the use of separation distances in the plant layout confining all the consequences within the site (DUAP, Multi-Level Risk Assessment, Page 15), the surrounding land use remaining rural with a low population density, the implementation of a traffic management policy, and design and operation of the facility to the appropriate Australian standards.

The MCE report concluded:

"The use of chemicals throughout the development will be unavoidable although it is desired to keep these applications at a minimum. Chemicals will be used right throughout production process and within support activities. This will encompass all areas of the facility including buildings, roadways and vegetated areas. It is envisaged remnant areas will not require chemical applications once natural balances have been achieved. A rabbit baiting program will be maintained as part of the native flora and fauna management regime".

4.6.1.7 Major Findings

The major findings by MCE are replicated herein as follows:

- i *"The major consequences in the ethanol production facilities and the ethanol storage are:*
 - o Vapour Cloud Explosion (VCE) in the distillation building
 - o Pool Fire in Ethanol Storage
 - o Pool Fire in Petrol Storage
- ii *The distillation facilities should use best industry practice to minimise the opportunity of an release of flammable liquid.*
- iii *The heat radiation distances established in this report be utilised in the placement of equipment on the site. Through the use of separation distances the effects of an incident, both in site and on neighbouring land, can be minimised.*
- iv *There are a large number of trucking and traffic movements proposed in this development. A traffic management policy and application is critical in reducing the likelihood of the incident involving a flammable liquid tanker and therefore reducing the likelihood of a release from a flammable liquid tanker".*



4.6.2 Chemical Use

The dairy enterprise will use a quantity of mixed agricultural and veterinary chemicals including those required for animal husbandry purposes, and would include but not be limited to;

- Mastitis treatments (veterinary);
- Antibiotics (veterinary);
- Fertility treatments (veterinary);
- Vaccines (veterinary);
- Antiseptics (veterinary);
- Alkali washes (washdown); and
- Lodophores (washdown).

All the above products will be used in a QA program audited by an independent auditor. The products used will be registered and approved for use by the National Registration Authority (NRA).

The ethanol plant will use a significant amount of chemicals in production and support of plant. Other chemical uses will be for the maintenance of support facilities where normal practices such as detergents, etc will be used. These areas will include a truck washdown bay which will be utilised by heavy vehicles when required, particularly when backloading.

Surrounding vegetated areas may also be applied with chemicals including fertilisers, herbicides and pesticides for the maintenance of landscaped and regenerated zones.

Chemical issues are generated from four (4) main areas being:

- Storage;
- Application;
- Residues; and
- Disposal.

Chemical stores on-site have been previously commented upon within this EA. They will involve design and positioning in accordance with Australian Standards and Occupational Health and Safety (OH & S) requirements. Chemical storage areas and/or structures will be of the design to allow for safe access and manoeuvrability. The areas will be positioned such that in the occurrence of any hazardous event, appropriate buffers will allow for the effective protection of staff and the environment.

Chemical applications present the greatest risk at any stage of chemical throughput in both commercial and agricultural enterprises. Normal concerns such as the accurate labelling including instructions in packaging is noteworthy, however it is accepted that labelling is normally sufficiently detailed and accurate under current legislative requirements.

Attention will be paid to the training of personnel who are responsible for and will apply a range of chemicals in a number of situations. All foreseeable training and education programs and those required under OH & S guidelines and legislation such as HAZCHEM courses will be attended by these personnel. This will ensure correct application and management of any chemical compounds required within the activities of the development. This will minimise the risks of over application or misuse of chemicals which may present a hazard to staff and environment.



Even with appropriate applications some chemical residues may result. This is particularly so in the case of detergents and other solvents used within the dairy enterprise and support facilities. An effective waste management system, including drainage and waste water evaporation ponds has been included in the conceptual design of the development. This will ensure the expeditious removal of chemical residues from areas which may create hazardous issues if left exposed.

The disposal of all packaging and outdated chemicals will be handled in a responsible and conscientious manner. This will take into account all legislative requirements and OH & S guidelines. This will include participation in chemical drum replacement programs and other state and national initiatives to reduce the risk of exposure to individuals and adverse affects on the environment which occur due to the inappropriate disposal of chemicals and their packaging.

The proponent is fully aware of the issues which can arise during the throughput of chemicals within the ethanol production system. The application of appropriate risk management will alleviate any of the issues or potential hazards which may present. It is understood any inappropriate handling or misuse of chemicals has the potential to contribute towards personal, environmental and economic adversities.

4.6.3 Occupational Health and Safety

Occupational Health and Safety (OH & S) on site is a key consideration in the safe and efficient running of both the ethanol and dairy facilities appropriate. OH & S policies and procedures would be developed for both the construction and operational phases of the development based on legislative requirements, guidelines and best management practices at the time of development of said policies and procedures.

4.7 Soil

4.7.1 Soil Resources

Attached as Annexure 4.7.1 is a copy of the initial soil suitability assessment for the proposed Ethanol plant and freestall dairy. The report has been prepared by Wrigley-Dillon, agricultural, geomorphological and geotechnical soils specialists. The field investigations by Wrigley-Dillon were undertaken on 21 December, 2005 and again on 16 March 2006 with fine weather governing the first inspection and slightly inclement weather for the second inspection. There were a total of twenty-one (21) deep slot drenches dug for the purposes of appraising the site and cross-referencing to prior soils documentation made available through CIEL and other soils reports for the region.

The soils brief was to assess the site and make recommendations with regard to the most appropriate parts of the landscape on which to construct the various components of the proposed infrastructure. Comment was also to be made on those parts of the landscape which were deemed unsuitable for any particular usage without major engineering and/or operational changes.



4.7.2 Field Methodology

A total of twenty-one (21) soil profile inspection pits were excavated to depths of approximately 3m each. The locations of the pits are delineated on the site plan attached as Appendix B to the Wrigley-Dillon report. Figure 4.7.1: *Soil Types and Test Pits* also indicates the locations of soil pits and major soil types as identified in the attached report.

At each slot trench the following soil physical characteristics were appraised:

- Depth of each soil horizon;
- Soil texture;
- Soil colour;
- Soil structure;
- Mechanical resistance to root penetration;
- Porosity;
- Infiltration status;
- Drainage status;
- Soil compaction;
- Depths to an amount of soil, lime and/or gypsum; and
- Presence of any layers which may restrict water penetration.

The above assessments were recorded on appropriate soil log sheets, with the typical soil profiles being provided within the Wrigley-Dillon report.

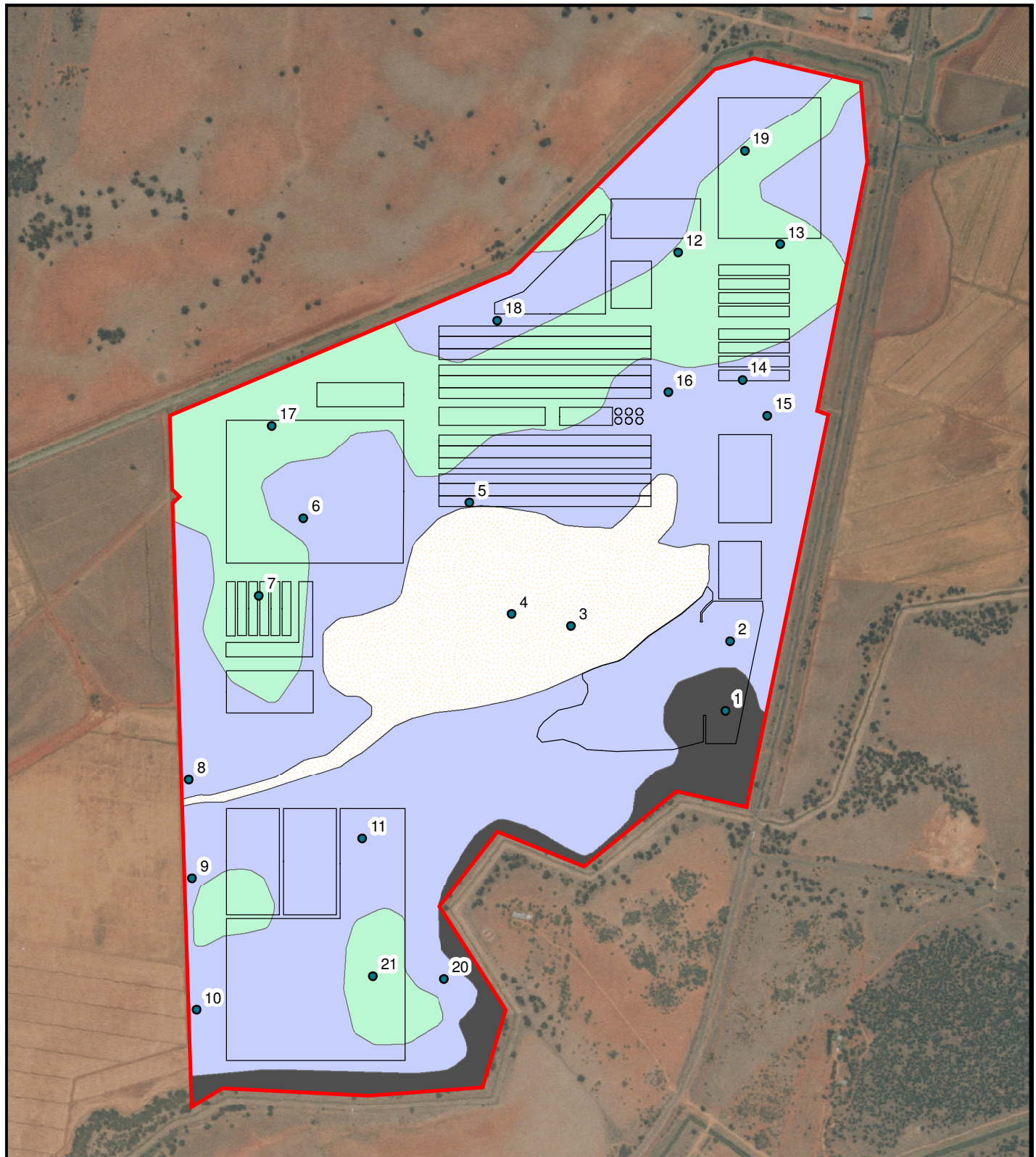
The above information was compared to other detailed information provided by CICL. The CICL information was amalgamated into a comprehensive document which is included:

- A soil map sourced from Stannard (1970) (Appendix C to the Wrigley-Dillon report);
- EM 31 surveys of the site with the exception of the central sand hill area (see Figure 4.7.2: *EM31 Raw Data (ECa (mS/m))*);
- Ground truthing of the EM 31 data through disturbed core drilling at selected locations over the project area;
- Bore hole texture logs on and in the vicinity of the site; and
- Groundwater monitoring data on and in the vicinity of the site.

No soil chemistry analysis or soil geophysical assessments have been undertaken at this stage. These additional tests will take place at the detailed design investigation stage, following approval of this EA and prior to the commencement of construction.

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 Intensive Dairy Environmental Assessment



- Proposed Site V2
 Sand
 Grey Transitional Soil
 Skeleton of Proposed Infrastructure
● Soil Profile Inspection Pit
 Black Self Mulching Clay
 Red-brown Earth

0 0.1 0.2 0.4 0.6 0.8
 Kilometers



FIGURE

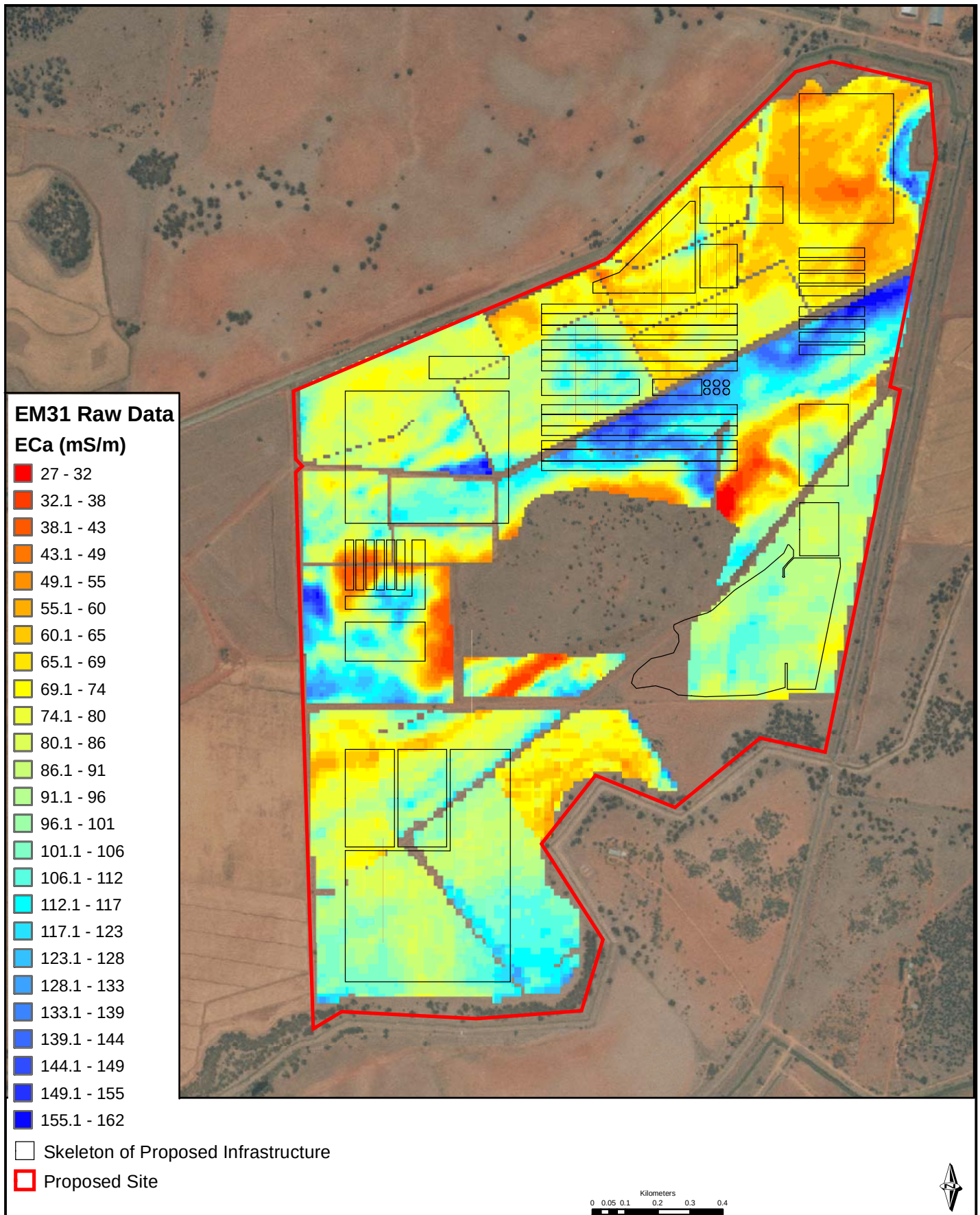
4.7.2

EM31 Raw Data (ECa (mS/m))

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4.7.3 Geology and Soils Information

The project area is classified as being part of the Riverine Plain of the Murray-Darling Basin, which is a flat depositional plain extending north and west from the highlands to the east. A series of prior streams are found throughout the region, and sediments in this district range from 150 to 250m deep above bedrock. The upper most sediment consists of the Shepparton Formation which is approximately 80m thick.

The prior stream alluvial deposition of the Shepparton Formation sorted and deposited gravel, sands, silts and clays with additional aeolian sand deposited over these sediments. Localised aeolian sand hill formations and alluvial floodplain and swamp depositions also occurred as a result of the complex or fine motion processes. The deeper soil layers (1.08m to 30.0m depth below NSL) can exhibit significant texture variation in both the vertical and horizontal plains.

Prior work by *Stannard* (1970) classified the broad soil types (or soil associations) as follows:

- Sands;
- Red/brown earths;
- Transitional red/brown earths;
- Non self-mulching clays; and
- Self-mulching clays.

These categories are consistent with other Riverine Plain topo sequences.

4.7.4 Project Soil Types and Distribution

Wrigley-Dillon identified four (4) main soil types as present on the project site. Their approximate distribution is:

- Sands covering approximately 12% of the project area;
- Red/brown earths covering approximately 57% of the project area;
- Grey transitional soils covering approximately 25% of the project area; and
- Black self-mulching clays covering approximately 6% of the project area.

While a range of soil variations occurred in these soil types, the above classifications provides a fair representation of the soil types of this particular site. The soils evinced considerable variation ranging from sands to duplex soils to vertisols and typically contain natural lime and gypsum in the soil profile with the depth of these depositions dictated by leaching and the solubility of the lime and gypsum.



4.7.5 Soil Descriptions

The following succinct statements are a brief summary of the soil types to be found:

- Sands – these sands are located on a rise in the centre of the site with a thin strip extending through to the western boundary as depicted on Figure 4.7.1. The typical sands within the project landscape are very permeable with a low water holding capacity. The typical profile is:
 - o The A1 horizon – 0cm to 10cm – red/grey/brown and very friable sandy loam with a weak coherent structure;
 - o The A2 horizon – 10cm and 100cm sub-angular blocky (SAB) or being red/brown, very friable sandy loam with weak coherent structure;
 - o B1 horizon – 100cm to 200cm being bright orange/red/brown light sandy clay loam with a slightly sub-angular blocky structure but mainly coherent;
 - o B2 horizon – 200cm to 320⁺cm – yellow/brown friable sandy loam with weak coherent to massive structure with some powdery and concretionary calcium carbonate.
- Red/Brown Earths – these soils are distributed across the majority of the site and have a sandier topsoil texture in the vicinity of the sandy soil. Clayier topsoil is evident in the north of the site and in the vicinity of the grey transitional soils. Topsoil is underlined by well structured dull red/brown medium clay subsoil which grades into medium clay with from 1% to 5% natural lime. The permeability in the topsoil and the lighter textured sandy layers at depth was generally good. In the first subsoil layer permeability was moderate to low. The remainder clay layers permeability was generally low. A typical profile was as follows:
 - o A1 horizon – 0cm to 12cm – brown to grey/brown mostly friable loam with a weak SAB coherent structure;
 - o B1 horizon – 12cm to 40cm – dull red/brown semi-friable/semi-plastic medium clay with moderate to strong SAB structure;
 - o B2 horizon – 40cm to 100cm – orange red/brown mostly plastic medium clay with moderate SAB structure with 1% to 5% CaCO₃;
 - o B3 horizon – 100cm to 170cm – grey/brown semi-friable/semi-plastic medium clay with moderate SAB structure with 5% to 10% CaCO₃ and CaCO₄;
 - o B4 horizon – 170cm to 220cm – grey mostly friable/medium light to medium clay with moderate to strong SAB. Trace CaCO₃ and 80% mottling;
 - o B4 horizon – 220cm to 280cm – this layer not always present. Yellow/brown to yellow/grey brown friable sandy clay loam to sand with a weak to moderate SAB to coherent structure. Occasional trace CaCO₃ and 60% mottling;
 - o B6 horizon – 280cm to 320cm – grey friable light to medium clay with moderate to strong fine SAB and 90% mottling.
- Grey Transitional Soils – identified across the north and north/west of the site and also in several other small areas. Slight gilgai layer consists of 10cm to 20cm of grey friable light clay or occasional clay/loam which has typically significant self mulching and cracking characteristics. The permeability in the topsoil and in any lighter textured sandy layers at depth was generally good with permeability in the first two (2) subsoil layers being poor and in the medium clay layers at depth permeability generally moderate.



- o A1 – 0cm to 15cm – light friable clay loam to light clay. Moderate SAB structure with self mulching and cracking and gilgai characteristics;
 - o B1 – 15cm to 60cm – dark grey, tough, dense, plastic, heavy clay with moderate to strong SAB to columnar structure. Occasional traces of powdery and nodulated CaCO_3 ;
 - o B2 – 60cm to 120cm – light grey, orange/grey or yellow/grey slightly friable but mostly tough, dense, plastic, medium clay. Moderate to strong SAB. Traces of gypsum, powdery and nodulated CaCO_3 ;
 - o B3 – 120cm to 200cm – orange grey/brown, mostly friable, medium or light to medium clay with moderate SAB structure. Up to 5% gypsum with some powdery and nodulated CaCO_3 and 50% mottling;
 - o B4 – 200cm to 300+cm – grey friable medium or light to medium clay with moderate SAB structure. Traces gypsum and CaCO_3 . Approximately 80% mottling.
- Black Self-Mulching Clays – occur in a limited area of the site on lower elevations adjacent to the creek and DC400 along the southern boundary. The service water on the first sub-soil layer has shrink/swell potential and significant cracking extended from as deep as 100cm to the surface.
 - o A1 – 0cm to 25cm – dark grey friable medium clay with moderate to strong SAB. Significant self-mulching and cracking with a gilgai micro relief;
 - o B1 – 25cm to 100cm – dark grey tough dense plastic heavy clay. Moderate to strong SAB to columnar structure. Traces of CaCO_3 nodules;
 - o B2 – 100cm to 160cm – light yellow/grey mostly plastic medium clay. Moderate SAB. 1% to 5% CaCO_3 powder and nodules. 20% mottling;
 - o B3 – 160cm to 200cm – yellow/grey friable sooty light clay. Moderate SAB. Traces CaCO_3 powder and nodules. 50% mottling;
 - o B4 – 200cm to 340cm – grey friable light to medium clay. Moderate to strong fine SAB. 70% mottling.

With the exception of pits 1, 9, 10, 15, 17, 18, 19, 20 and 21 various coarse (sandy) soil layers were identified in the remaining soil profile inspection pits. As expected in the sandy soil type, sandy layers extended to the full depth of the slot trenches. In the remaining soil types the coarse layers typically ranged from sand to fine sand veins to light to medium clay and occurred between 2m and 3m below NSL.

The EM31 survey drilling covered approximately sixty-nine (69) sites drilled to a depth of 3.6m each. The logs from these sites indicated presence of various coarse soil layers.

Bore hole texture logs was undertaken as part of prior separate work to identify sites for groundwater and monitoring and/or extraction. Sandy soil layers were identified at depths 1.8m to 6.3m and extended in depth to 13m.

4.7.6 Soil Features and Limitations

The sandy soils were considered highly permeable and this limited potential uses to those which are not likely to contribute to leaching losses and groundwater impacts. The majority of this soil type is not considered suitable for construction and operation of water storages, the dairy freestall sheds and/or dry heifer pens.

The red/brown earths offer varying potential depending on a range of factors with particular emphasis on surface drainage being continuous so that none of the area becomes excessively wet for any extended period of time.



It is envisaged land forming or grading will be required to ensure the potential for continuous drainage to designated collection and management points for water runoff. The initial B1 sub-soil in the red/brown earths is not considered suitable for material for water storages or foundation construction. However, the deeper sub-soil layers, particularly extending from 0.4m to 2.0m contain natural lime and are more stable containing sufficient clay for water storage or foundation construction.

Some coarse sandy layers are found at depths of approximately 2.0⁺m. These layers can occur at shallower depths and in the central area of the site. The latter feature could limit some land usages such as water storage construction unless more suitable foundation material was imported to enhance soil properties and/or create compacted liners.

The grey transitional soil have good prospects for water storages or effluent storages and these conclusions are enhanced by the fact that this soil type is thought to occur on lower lying areas. As this soil type is prone minor cracking, construction and earthworks must take into account the shrink/swell potential of the soil.

The black self-mulching clays are close to the southern creek and DC400. This soil type could provide opportunities for water storage or storage lining provided a strong structure of the upper soil layers is considered.

4.7.7 CICL Soil Suitability

Reports prepared by CICL for the proposed site may provide further information on the chemical properties of soils on site by default. Two (2) reports prepared by CICL, entitled “*EM-31 Soil Surveying for Farmers: Farm 25 additional and Farm 26 additional*”, and “*EM-31 Soil Surveying for Farmers: Farm 108 additional*”, (see Annexure 4.2.7a and 4.7.2b) outline parameters for identifying soils suitable for rice production on the proposed development site. The following parameters for rice growing soils are detailed in a three-stage classification system:

- Include the soil as suitable if the EM-31 ECa measurement is equal to or greater than 150mS/m;
- If ECa<150, include the soil as suitable if the Exchangeable Sodium Percentage (ESP) of the top 60cm of soil is greater than 6, or the ESP of the depth interval between 60 and 150cm is greater than 12; and
- All other soils are excluded from rice growing.

Figure 4.7.3: *Soil deemed unsuitable for rice production (CICL)*, illustrates soils as determined by CICL as not suitable for rice production, and thus also shows areas of the proposed development site that by default, must meet the above outlined three-stage classification system. The EM-31 data in Figure 4.7.2, and bore logs indicate that areas of the property do not meet the criteria of ECa>150mS/m (a sound indicator of clay depth) and thus must meet criteria 2 of elevated ESP for them to have been mapped as suitable for rice production. Increased ESP levels, or sodicity, results in restrictions to the ability of water to infiltrate soils, and thus, the potential for the soils on-site to have elevated ESP can further act to reduce risks of accession to groundwater of effluent and waste waters managed on-site.

FIGURE

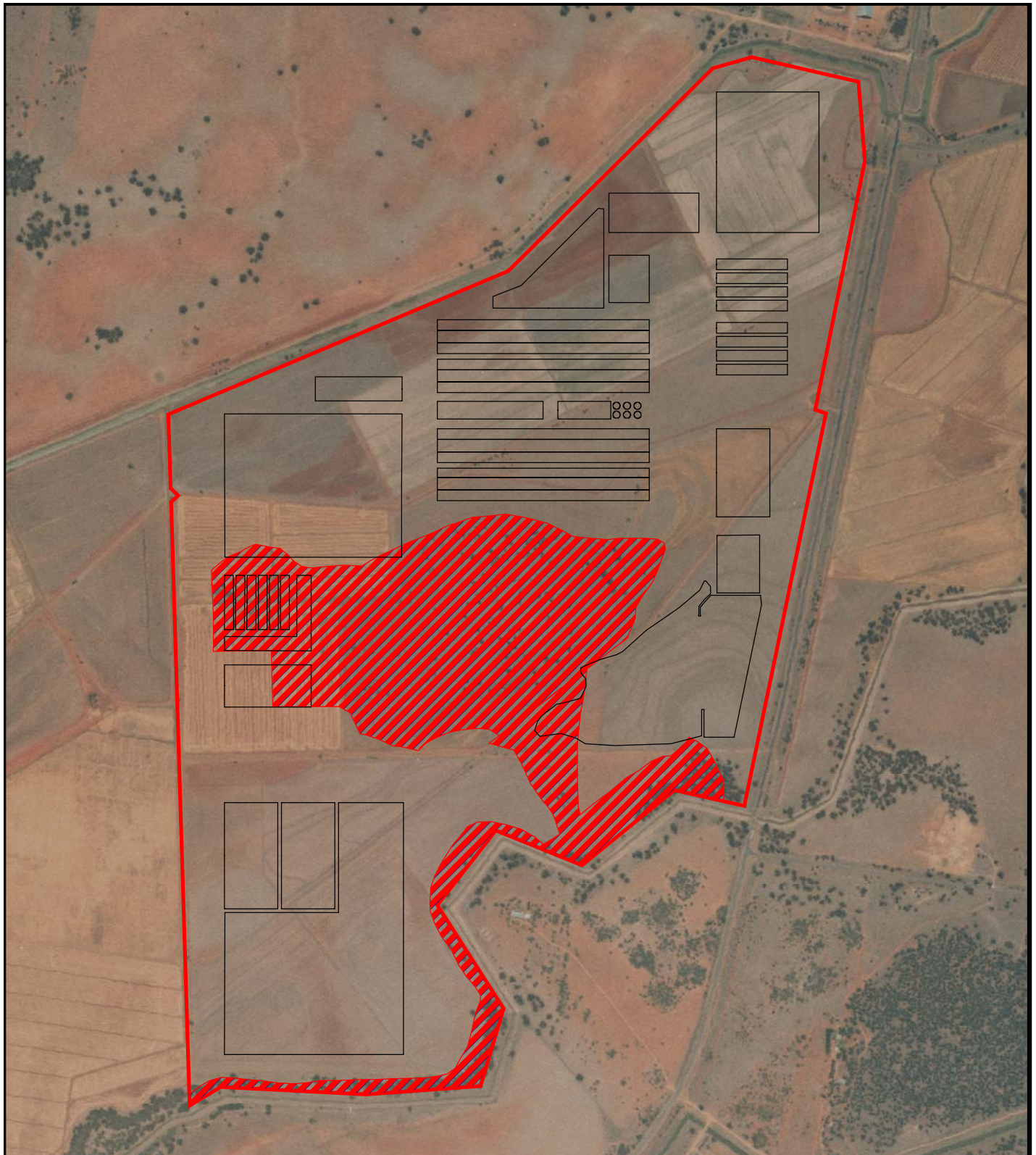
4.7.3

Soil deemed unsuitable
for rice production (CICL)

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-  Proposed Site
-  Skeleton of Proposed Infrastructure
-  Determined unsuitable for rice production (CICL)

Kilometers
0 0.05 0.1 0.2 0.3 0.4





4.7.8 Conclusion

The Wrigley-Dillon report concluded that the majority of the initial site development plan is compatible with the soil types in those areas. However, it is considered a critical requirement prior to construction to work in wherever possible with the existing site topography and soil types. Accordingly, the Wrigley-Dillon report recommends some adjustment in the location of various infrastructure components.

The initial site development plan is included as Figure 3.3.1 with Figure 3.3.2 being an alternative site development plan in response to the findings of the Wrigley-Dillon soil survey.

It is therefore concluded that further detailed soils investigations will be required in the detailed site design phase with close monitoring during the construction phase of particularly:

- “Dry pen” pads for the heifer pens;
- Water storage facilities; and
- Effluent ponds.

4.8 Waste Management

4.8.1 Overview

With the exception of the excess manure generated from the dairy enterprise, the majority of the products and by-products from the ethanol plant and dairy enterprise have a ready market. Those markets will need to be developed and the proponent is already developing those arrangements.

Because the Four Arrows Group also owns and operates the adjoining “Tubbo” station with substantial irrigation and dryland farming areas, the manure from this project site will have a ready outlet onto the irrigation and dryland areas. On these areas the manure will provide substantial volumes of organic matter to improve soil structure and replace a high proportion of artificial fertilisers normally purchased and applied to crops and pastures.

Hence the overall waste management issue is not a significant problem in terms of capacity to manage despite the significant volumes of by-products being generated. These issues will be discussed individually in the following sub-sections.

4.8.2 Ethanol Plant

Besides ethanol, the three (3) main products are:

- Carbon dioxide;
- Wet Distillers Grain; and
- Water.

The carbon dioxide (CO₂) will be captured, compressed and sold to a range of markets including the carbonated beverage market. The volumes of CO₂ are significant and the indications, in the absence of a full market survey, suggest all CO₂ will be sold.



The wet distillers grain requires significant energy to extract the moisture in order to produce dried distillers grain. The proposed associated dairy enterprise will absorb a significant proportion of the wet distillers grain which will be carted directly from the appropriate storage at the ethanol plant to the dairy enterprise on a daily basis. The wet distillers grain will be mixed with the other components of the feed ration for the cattle according to each particular category of cattle's needs and fed on a daily basis.

Excess wet distillers grain will have a ready market to the regional intensive animal industries and in particular the beef feedlot industry. In addition, market opportunities exist in other identified locations for the conversion of wet distillers grain into extruded dry feed products, suitable for long term storage and transport to other pre-existing markets (see Annexure 4.8.1).

The excess water from the centrifuge and/or belt press drying of wet distillers grain will be captured and recycled through the ethanol plant. Water is a costly item and in relatively limited supply for any business reliant upon water. In this project, the ability to recycle water on-site through the ethanol plant will:

- Reduce the volumes needed to be purchased by permanent transfer; and
- Minimise the annual temporary transfer purchases.

The evidence from a range of sources indicates the profitability of the ethanol plant relies on the ready market for surplus resources as much as it does from the sale of the ethanol itself. Therefore it is of paramount importance viable markets be established early and favourably to dispose of these products. In this case the supposed waste streams identified are marketable resources, as opposed to waste products.

4.8.3 Damaged Grain

The only grain becoming a waste product shall be weather damaged material unable to be used effectively in the ethanol plant for mixing in rations for the cattle. These tonnages are expected to be marginal due to the effective storage facility. In this instance the product will be transported off-site to "Tubbo" where the damaged product will be spread thinly and uniformly on agricultural land and decompose.

Damaged grain application on "Tubbo" will be closely monitored to ensure no increases in nutrient and organic matter loading beyond that which may be expected to be removed through standard rotational crop production. In addition to "Tubbo" the Four Arrows Group has available the nearby "Belvedere" and other farms within the CIA. Application and disposal of damaged grain would not be undertaken on irrigated lands except where decomposition of the grain can be complete before irrigation waters applied, to avoid hydraulic movement of grain off site from disposal areas.

4.8.4 Cattle

The cattle will generate three (3) mainstreams of waste products namely:

- Manure;
- High nutrient loaded water; and
- Carcasses of dead cattle.



The project intends to deliver the manure in short term after capture from the sediment ponds and scraping of the dry and wet pens to “Tubbo”. At “Tubbo” the manure will be spread on agricultural lands at rates 20% less than the accepted criteria for land disposal of excess manure. At “Tubbo” the excess manure will replace artificial fertilisers which would normally be purchased to apply to crops. Hence the manure is replacing other purchases and will add to the health of the soil through increased organic matter.

The water carrying high nutrient and organic loadings from the dairy enterprise will be captured in sedimentation basins where the manure will settle out and the high Biological Oxygen Demand (BOD) water allowed to move forward into a surge pond for pumping directly into one of the two anaerobic ponds. After an appropriate time in the anaerobic ponds the water will pass through into a large aerobic pond where regular aeration will be applied.

The sedimentation basin’s surge ponds, anaerobic ponds and aeration ponds have been designed to have substantial excess capacity to meet all requirements for the capture and management of the run-off in extreme rain events. The modelling of the mass balances and calculations of pond sizes and sedimentation basins is attached as Annexures 4.8.2, 4.8.3 and 4.8.4.

Carcasses of dead animals will be transported on a daily basis to a remote section of “Tubbo” where they will be buried in accordance with best management practices for livestock burials. Further information on carcass disposal is detailed in Section 5.5.2.17.

4.8.5 Waste from Administrative Areas

All the surplus grey and other waste waters from the staff amenities and associated facilities will be directed to a packaged effluent treatment system. Following treatment, parts of the landscape will be irrigated using this reclaimed water source in a manner consistent with the EPA policy at the time.

4.8.6 Containers

Chemical and other containers shall be of a returnable and renewable nature. Upon emptying each container they will be rinsed and managed according to the site Environmental Management System (EMS) before returning to the product suppliers. The system of product supply in returnable containers will negate the need to dispose of chemical and/or otherwise containers.

4.8.7 Truck Wash-down

All the accumulated material from the truck wash-down area shall be segregated as required and removed on a regular basis for transport to appropriate sections of “Tubbo”. Components will be soil and other bio-degradable organic material, road grime, oils and petro-chemical products commonly expected to be found on operational transport vehicles.

Where oils and other similar contaminated material from the truck wash is accumulated, that material will be segregated according to its nature and disposed of according to best practice ruling at the time. The procedures will be documented in the project EMS and the EMS will be updated regularly to ensure best practice.



4.8.8 Recycled Water

4.8.8.1 Dairy

The flooding wash in the freestall dairy sheds shall be achieved using the reclaimed aerated water from the aeration pond in the southern sections of the project site. This water will be pumped directly to the freestall sheds where the water will be flushed down each of the flush lanes for recapture and recycling through the waste stream for the dairy cattle enterprise.

4.8.8.2 Ethanol Plant

Water balance calculations presented in Sections 4.5 of this EA identify 591ML/annum of water reclaimed and recycled through the ethanol plant. This water is reclaimed both during the production processes and pursuant to need, from Wet Distillers Grain post ethanol production mechanically utilising centrifuges, belt presses or other appropriate technologies.

Water recycled during the production process is referred to as “thin stillage”, and comprises the bulk of water recycled. This water requires no specific treatment regime other than to be “topped up” with fresh water to compensate for water lost through chemical conversion or exported in wet distillers grain.

Water lost through other process mechanisms (steam, evaporation, chemical conversion, wet distillers grain) is identified in the production process model in Section 4.1.2. Other water captured for recycling within the production facility (during CO₂ capture) will be put through closed scrubber and membrane filtration systems, and reintroduced to the production process, eliminating the need for management of wastes and by-products external to the closed system.

- Package Plants;
- Drinking water systems;
- Waste water treatment;
- Reuse systems;
- Desalination (pre-treatment to Reverse Osmosis); and
- Various industrial systems.

These filters remove finer suspended solids and dissolved salts and excess nutrients and can also incorporate bacterial and biological containment systems.

As these filtration and treatment systems are closed, issues specific to odour emission are alleviated, and the necessity to store large quantities of water pre-treatment is negated. Periodic backflushing of systems is undertaken, and backflush waters can be washed through wet distillers grain prior to removal from the system, allowing suspended solids to be trapped with the wet distillers grain, and reclaimed backflush water to be reintroduced into the thin stillage, or alternatively, processed through the effluent treatment systems in place for effluents from the remainder of the site.



4.9 Visual Impacts

4.9.1 Landscape Values

The proposed development site currently exists in an agricultural landscape and is sited on the west of the Kidman Way. The nature of the landscape, as is common across the central and southern Riverina regions, is one of low elevation, with stands of remnant Myall/Boree (*Acacia pendula*) woodland and White Cypress Pine (*Callitris glaucophylla*) interspersed with agricultural developments.

Presently the site exhibits limited landscape value from an aesthetic perspective. The southern most connection of the site to the Kidman Way is bordered by Coleambally Irrigation Drainage Channel No. 400 (DC 400). This drainage channel traverses by the Boona State forest to the north east, and Black Box woodland depressions, and DC 400 immediate environs currently exhibit the highest value on-site for visual amenity.

Aside from the remnant vegetation on-site there are no other visual aspects to the property which differ from the remainder of the surrounding landscape i.e. it is a standard representation of the irrigated agriculture common to the surrounding properties and region.

The nature of the current landscape is depicted in site photographs in Annexure 4.9.1.

4.9.2 Lighting

At present there is no source of illumination on the project site. The proposed development does require illumination at night and there is potential for outdoor lighting to create obtrusive effects through light spill off-site. *Australian Standard (AS 4282-1997)* provides guidelines and requirements for the control of obtrusive effects of outdoor lighting, and will be referred to in the design phase of the proposed development post approval of the Development Application. Within AS4282-1997 particular reference will be made to Section 2 Sub-section 2.4 Part C:

“in the design and installation of an outdoor lighting system consideration should be given to the potential effects of the lighting on occupants of surrounding properties and on transport uses in the vicinity of the installation. These effects include the following:

- (i) changes to the amenities of an area due to the intrusion of spill light into otherwise dark areas both outdoors and indoors and to the direct view of bright luminaries.*
- (ii) a reduction in the ability of transport system users to see essential details of the route ahead including signalling systems due to the glare from bright luminaries.*
- (iii) changes to night sky viewing conditions due to a general luminous glow i.e. sky glow caused by the scattering of light in the atmosphere”.*

Prior to commissioning the project, the project designers and project managers will need to affirm compliance with the fact and intent of AS4282-1997.



4.10 Security

Security for the proposed development can be considered from a number of different perspectives. The issue of security can be viewed as relevant:

- To the management in the long term of the development; and
- By agencies (in this case the Minister as sole consent authority) in relation to determination of approval for the EA.

To summarise, security issues could be considered from the following perspectives:

- Physical (site itself and the environment in which it is situated);
- Site;
- Environment;
- Chemical/Biological;
- Economic; and
- Political Climate.

Issues relating to each of these perspectives are discussed more fully in the following sub-sections.

Physical

The nature of the location of the site largely precludes major issues in relation to the physical site security and the need for either detailed or intensive closed security system preventing site access from unauthorised personnel. Notwithstanding, site security is of importance both for the protection of intellectual property, animal health and wellbeing, public safety and OH & S. The relative isolation of the site does afford some protection from unauthorised access to the site, and the number of staff constantly operating on site in any given shift results in the rapid recognition of unauthorised access.

Access to and egress from the site are to be limited to two (2) specific points, and would potentially be staffed for 24 hours/day supported by some form of monitoring or security-type system further negating the risk of unauthorised site access. Boom gates will prevent unauthorised access as will secure perimeter fencing.

Physical security from an environmental perspective will be incorporated in the project EMS. Information contained within this EA under various sections details the mechanisms which would be put in place to protect security issues to environmental condition on site.

Chemical/Biological

Chemical and biological securities on site are important factors from the viewpoint of animal health and welfare, and integrity of product from both the ethanol plant and dairy enterprise. Best management practices in relation to production, handling, storage and distribution of all products on site will ensure security of chemical and biological processes, products and storages.

Operating procedures, manuals and guidelines would be adhered to in reference to all chemical and biological aspects of the site, both for quality assurance, third party auditing and security registry.

Registers of all chemical and biological materials will be subjected to constant inventory control procedures with associated audits.



Economic

The Federal Government's recent and on-going commitment to move away from reliance on fossil fuels and commitment to bio-diesels an ethanol production secures the main market for this installation.

Economic security is beyond the scope of the EA; however preliminary assessments and discussions indicate that potential markets for project products ensure economic security well into the future.

Political Climate

It is unfortunate in these times that it is necessary to turn attention to the security issues and risks associated with political duress, radical ideology and terrorism type security hazards. However the nature of the scale and product from the ethanol plant do present an elevated risk to security. Site security procedural development will need to consider operational and management strategies that acknowledge the risk of terrorism and bio-hazard activity, and seek to develop strategies to minimise such risks.

Major industrial developments at the forefront of best management practice and technological implementation are invariably at the risk of security breach in relation to theft of intellectual property, production techniques, etc. Strategies for management of security risk in relation to intellectual property, asset management and industrial espionage would be developed based on the most appropriate models at the time.

4.11 Animal Welfare

4.11.1 Animal Husbandry

The constant comfort of cattle is critical to the sustainable production of high volumes of high quality milk. Accordingly, many of the design features associated with the proposed dairy enterprise are by necessity, designed to provide for the comfort of cattle. The proposed development allows 6,000 milking and 1,200 dry dairy cows to be housed under proven conditions where dust creation, a noted cause of respiratory and ocular disease conditions in the cattle is almost eliminated. The proven design parameters would aim at eliminating conditions that can create a mud-manure interface that causes odour, provides a haven for flies, results in delays to milking, promoting lameness and causing mastitis (mammary gland infections) in cattle.

The proposed development allows for dust areas to be reduced, by use of:

- Concrete floors in the feed shed. The mud-manure interfaces common in traditional dairies will be markedly reduced by the application of the above design and operational criteria;
- Minimum 3% slopes with compacted soil and dust suppression watering in the loafing/exercise pens associated with the freestall sheds and the same for the dry lot pens where the heifers are retained;
- Wetting/washing of access roads to prevent the accumulation of soil and materials prone to becoming sources of dust;
- Landscaped surrounds with trees, shrubs and groundcover to mitigate against wind raised dust;
- Regular cleaning of dry lot pens to remove accumulating manure; and
- Applying maximum speed limits for on-site traffic.



Features of the proposed development that will improve animal welfare are:

- Cows having access to a proven design for the shed system which is directly connected to adjacent exercise paddocks, (see Annexure 4.11.1);
- The sheds are designed to facilitate ventilation and cooling and provide shade and shelter,
- Cows will be able to loaf in custom designed freestalls. These freestalls allow cows to rest on clean materials and minimize contamination of the udder. Rice hulls are a keenly sought product for bedding;
- The proposed dairy is a clean, state-of-the art, comfortable environment for healthy production of quality milk;
- The shed will be flush washed twice daily and the water and solids will be captured in sedimentation basins and recycled to re-flushing and agricultural lands respectively;
- Ample drinking water of high quality will be provided in troughs, which will be cleaned regularly;
- Feed will be delivered to cows three to four times a day and be “pushed up” between each feeding. Cows will be fed to appetite, allowing an excess of 3% to 5% of feed to remain before cleaning. Consequently, cows will not be subject to underfeeding;
- Leftover feed will be removed from the concrete feeding areas daily. This feed will be added to and reformulated to be fed to heifers on the farm. This action reduces feed wastage;
- When the temperatures rise above a pre-determined levels in the sheds, and in the dry lot pens, misting sprays are automatically activated to keep cattle cool;
- The dairy will be serviced by a consulting nutritionist and veterinary surgeon;
- Diets will be designed to minimise risks of major metabolic disease;
- Records of all animal treatments will be maintained;
- A separate sick bay and milking facility will be provided to limit spread of disease and allow isolation of sick cattle; and
- Dedicated maternity sheds will be provided for calving cows.

Poor fertility

New cows are normally purchased as “pregnant” and some may fail to calve. In addition the incidence of vibriosis in a number of herds in recent years is on the increase (I Lean, *pers comm*, 2006). The following steps will facilitate the reduction of risk of purchasing fertility problems:

- Insisting on a whole herd pregnancy test by an Australian Association of Cattle Veterinarians (AACV) accredited pregnancy tester within three (3) weeks of purchase;
- Request written confirmation of pregnancy status and for cows to be tail-tagged (indicating pregnancy status) at the time of testing by the veterinarian;
- Having the vendor confirm if bulls being used have been vaccinated for vibriosis or if the herd has been kept closed (Vibriosis is a substantial abortion risk in bull-bred herds);
- Insisting that breeding information is supplied if available (calving dates (last and projected) and breeding dates are critical); and
- Registering cows not pregnant and over 200 days in milk should be rejected.



The commercial success of freestall dairy businesses is driven by the combination of sustainable high volume milk production and herd fertility. With ready access to the project veterinarian and the application of the following principles, herd health, productivity and fertility will be optimised.

- Loafing pens 30m wide;
- Clean bedding in the freestalls;
- General sound health;
- Best nutrition;
- Effective temperature control; and
- Freedom from disease and predisposition to disease.

The project veterinarian will be crucial in optimising the above and any other necessary best practices.

Lameness

Lame cows have increased risk of travel complications and are more likely to be culled soon after herd entry. Locomotion in all cattle would be inspected prior to purchase and lame cows rejected.

During the operation of the dairy the contract milkers and the senior staff will be monitoring each individual animal no less than three (3) times daily at each milking.

Disease Risk

The issue of disease risks within and management of potential introduction into the herd are discussed in Section 4.11.2.

4.11.2 Disease Outbreak

4.11.2.1 General

The dairy milking and freestall facility designs are a critical component of disease risk reduction. The proposed dairy enterprise will use a series of standard operating procedures to reduce risks of disease based on Hazards Analysis Critical Control Point (HACCP) methods. The major diseases targeted include metabolic disease, acidosis, lameness, mastitis and respiratory disease. A biohazard security protocol – attached hereto as Annexure 4.11.2 will be used to assist in reducing the risks of disease in sourced cattle. Preventive medicine protocols will ensure that appropriate vaccinations are given to reduce risks of disease.

It is essential that strategies for the management of disease risks be in place to manage effectively any risks that may impact upon a major industrial development such as this. Biosecurity risks could occur in relation to cattle wellbeing, asset management, processing production and outputs or within the supporting infrastructure.



Mastitis risk

The major hazard from a biosecurity perspective is from the *Strep. agalactiae* form of mastitis. This infection causes major economic losses in dairies across Australia. The following steps will reduce risk of entry of organisms into and throughout the herd:

- Source cattle from low cell count herds and with good standards of dairy hygiene;
- Source cattle from herds with a history of blanket dry-cow therapy - closed herds are preferable sources of new cattle;
- Inspect the herd and the farm they have come from prior to purchase;
- Request a herd recording procedure be undertaken within 2 - 3 weeks of potential purchase. This can then be used to assess individual cows for production and cell count;
- Negotiate to reject cows with cell counts over 300 000 cells/ml. Any cows to be purchased with counts exceeding this should either be individually milk cultured or be treated with antibiotics prior to mingling with existing herd;
- Request a bulk milk culture from the vat three (3) weeks before purchase;
- Inspection of udders during milking enables the vetting out of other problem cows; and
- Reject cows with unsound udder type or teat lesions prior to purchase.

Johne's Disease and EBL

Recently, programs have been developed to eliminate bovine Johne's disease and Enzootic Bovine Leukosis (EBL) from dairy herds. Johne's disease is a wasting disease in cattle and EBL is a form of leukaemia in cattle. Herds from which new cows are sourced should have tested negative status for both these conditions before entering those newly purchased cows into the herd. Best practice will involve purchase from low risk herds (ie herds with tested free status or provisional free status - Johnes) or may involve testing of milk (EBL) to check the status of the cows.

Other infectious diseases

Other infectious diseases can be introduced from purchased cattle, particularly some of the respiratory viruses and pestivirus. These are difficult to test for and testing of the purchaser's own herd would be required to assess risk from infection. Infection rates in most herds with many of these viruses are already very high. Discussions with the vendor or talking to their veterinarian about the herd (with the vendors permission) in relation to issues such as vaccination and drenching programs, calf health and disease can give some indication of general health status of the herd.

4.11.2.2 *Dead Cattle Disposal*

Some mortality is inevitable in a herd of 7,200 milking and 10,800 associated cattle. Consequently, carcass disposal is an important consideration for site design and both disease outbreak and risk management. It is proposed that there would be a series of disposal sites for burial of carcasses.



The following criteria will be used to identify sites suitable for disposal:

- Clay-based soils of low permeability and high stability;
- Be located more than 100 metres from residences or watercourses;
- The pit will be either lined with impermeable material or be more than 1 metre above any water table;
- Water will be diverted away from the pit site; and
- It is estimated that at least 4 cubic metres per head buried will be required.

Sites used for burial will be renovated according to prevailing conditions of the disturbed area. Transport of all dead cattle will be to “Tubbo” where appropriate methodology for disposal, whether that is burial (preferred) or incineration, would be undertaken. More information on carcass disposal is detailed in Section 5.5.2.17.

4.12 Flora and Fauna

4.12.1 Desktop Review

4.12.1.1 In-House Review

A search of the NSW Government Legislation Website and database provided by the NSW *National Parks and Wildlife Act (1974)* Schedule 12 resulted in no threatened fauna species. This data also states that there will be no listings until such a time as material is inserted in accordance with Section 94 of the Act which allows the Governor to amend the Schedule at any time by adding or omitting the name of any species of protected fauna. However, the list failed to provide any detail as to threatened or endangered status or other requirements.

The NSW *Threatened Species Conservation Act (1995)* Schedules 1, 2 and 3 provides a list with no specific details for habitat or location of endangered or threatened species. The more location specific databases were reviewed to generate an endemic list for the study area during the desktop assessment. The Threatening Processes as listed in Schedule 3 of the *TSC Act (1995)* were noted and considered throughout the assessment.

More comprehensive site specific information was gained for the area covered by Topographic Map 8028 from the NSW National Parks and Wildlife Service Database for lists of any potential threatened and endangered flora and fauna species which may have distributions near the study area. Table 4.12.1 provides a summary of these findings. The NSW NPWS database uses the *Threatened Species Conservation Act (1995)* to determine the legal status of any species sighted.


Table 4.12.1: NSW NPWS Database Results

Family	Scientific Name	Common Name	Status	Last Year of Sighting
Fauna				
Acanthizidae	<i>Pyrrholaemus sagittatus</i>	Speckled Warbler	V	25/09/2005
Acanthizidae	<i>Calamanthus cautus</i>	Shy Heathwren	V	14/08/2001
Accipitridae	<i>Lophoictinia isura</i>	Square-tailed Kite	V	13/02/1985
Anatidae	<i>Oxyura australis</i>	Blue-billed Duck	V	04/04/2002
Anatidae	<i>Stictonetta naevosa</i>	Freckled Duck	V	23/03/2003
Anseranatidae	<i>Anseranas semipalmata</i>	Magpie Goose	V	21/10/2003
Ardeidae	<i>Botaurus poiciloptilus</i>	Australasian Bittern	V	09/11/2002
Burhinidae	<i>Burhinus grallarius</i>	Bush Stone-curlew	E1	05/04/1999
Cacatuidae	<i>Calyptorhynchus lathami</i>	Glossy Black-Cockatoo	E2	21/03/2004
Cacatuidae	<i>Cacatua leadbeateri</i>	Major Mitchell's cockatoo	V	29/09/2005
Climacteridae	<i>Climacteris picumnus</i>	Brown Treecreeper	V	25/09/2005
Climacteridae	<i>Climacteris affinis</i>	White-browed Treecreeper	E2	12/11/1999
Estrildidae	<i>Stagonopleura guttata</i>	Diamond Firetail	V	27/08/2006
Eupetidae	<i>Cinclosoma castanotus</i>	Chestnut Quail-thrush	V	5/04/1995
Falconidae	<i>Falco hypoleucos</i>	Grey Falcon	V	31/12/1996
Gruidae	<i>Grus rubicundus</i>	Brolga	V	05/05/2002
Hylidae	<i>Litoria raniformis</i>	Southern Bell Frog	E1	1/05/2004
Megapodidae	<i>Leipoa ocellata</i>	Malleefowl	E1	18/11/2002
Meliphagidae	<i>Xanthomyza phrygla</i>	Regent Honeyeater	E1	12/10/1935
Meliphagidae	<i>Grantiella picta</i>	Painted Honeyeater	V	04/11/2005
Meliphagidae	<i>Certhioyx variegatus</i>	Pied Honeyeater	V	16/11/2002
Otididae	<i>Ardeotis australis</i>	Australian Bustard	E1	06/07/1985
Pachycephalidae	<i>Pachycephala inornata</i>	Gilbert's Whistler	V	31/01/1996
Pedionomidae	<i>Pedionomus torquatus</i>	Plains-wanderer	E	09/01/2001
Petroicidae	<i>Melanodryas cucullata</i>	Hooded Robin	v	25/09/2005
Phascolarctidae	<i>Phascolarctos cinereus</i>	Koala	V	08/12/2002
Pomatostomidae	<i>Pomatostomus temporalis temporalis</i>	Grey-crowned Babbler (eastern subsp.)	V	28/09/2005
Psittacidae	<i>Polytelis swainsonii</i>	Superb Parrot	V	15/09/2005
Psittacidae	<i>Neophema pulchella</i>	Turquoise Parrot	V	10/07/2004
Rostratulidae	<i>Rostratula benghalensis australis</i>	Painted Snipe (Australian subspecies)	E1	20/10/1999
Scolopacidae	<i>Limosa limosa</i>	Black-tailed Godwit	V	03/12/2001
Strigidae	<i>Ninox connivens</i>	Barking Owl	V	31/12/1998
Thalomyidae	<i>Macrotis lagotis</i>	Bilby	E4	31/12/1898
Flora				
Asteraceae	<i>Brachyscome papillosa</i>	Mossie Daisy	V	05/06/1969
Convolvulaceae	<i>Convolvulus tedmoorei</i>	Bindweed	E1	30/06/1969
Fabaceae (Faboideae)	<i>Swainsona murrayana</i>	Slender Darling Peak	V	07/09/1961
Fabaceae (Faboideae)	<i>Swainsona servicea</i>		V	1/11/2000
Orchidaceae	<i>Caladenia arenaria</i>	Terrestrial Orchid	E1	30/09/2000
Orchidaceae	<i>Diuris pedunculata</i>	Small Snake Orchid	E1	25/09/2000
Orchidaceae	<i>Diuris tricolor</i>	Pine donkey orchid	V	06/10/2000
Key: E = Endangered V = Vulnerable				

Note: This table consists of the combined information sourced for Maps 8028 and 8128
Source: NPWS Atlas of NSW wildlife

A search of the Environmental Protection and Biodiversity and Conservation (EPBC) Database was conducted using the EPBC Protected Matters Search Tool for:

- Any matters of environmental significance;
- Threatened flora and fauna species; and
- Populations, ecological communities and their habitats including migratory species.



A relevant enquiry yielded an EPBC Act (1999) Protected Matters Report specific to the study area including a 20km buffer and adjacent areas of environmental significance.

Threatened species identified within the report have been included in Table 4.12.2. Threatened and Endangered Species under EPBC Database as potentially present within 20km of the project site were added to the targeted list.

Table 4.12.2: EPBC Protected Matters Results

Family	Scientific Name	Common Name	Status
Fauna			
Psittacidae	<i>Lathamus discolor</i>	Swift Parrot	E
Megapodidae	<i>Leipoa ocellata</i>	Mallee fowl	
Pedionomidae	<i>Pedionomus torquatus</i>	Plains-wanderer	V
Psittacidae	<i>Polytelis swainsonii</i>	Superb Parrot	V
Rostratulidae	<i>Rostratula australis</i>	Australian Painted Snipe	V
Meliphagidae	<i>Xanthomyza phrygia</i>	Regent Honeyeater	E
Hylide	<i>Litoria raniformis</i>	Southern Bell Frog, Growling Grass Frog, Warty Bell Frog, Green and Golden Frog	V
Vespertilionidae	<i>Nyctophilus timoriensis</i> (South-eastern form)	Eastern Long-eared Bat	V
Percichthyidae	<i>Maccullochella peelii peelii</i>	Murray Cod, Cod, Goodoo	V
Percichthyidae	<i>Macquaria australasica</i>	Macquarie Perch	E
Flora			
Asteraceae	<i>Brachyscome papillosa</i>	Mossgiel Daisy	V
Orchidaceae	<i>Diuris sheaffiana</i>	Tricolour Diuris	E
Poaceae	<i>Stipa wakoolica</i>		E
Fabaceae	<i>Swainsona murrayana</i>	Slender Darling-pea, Slender Swainson, Murray Swainson-pea	V
Fabaceae	<i>Swainsona plagiotropis</i>	Red Darling-pea, Red Swainson-pea	V
Key: V = Vulnerable E = Endangered			

The EPBC Database lists one (1) threatened Ecological Community as the Buloke Woodlands of the Riverina and Murray Darling Depressions Bioregions. The abovementioned Ecological Community is not represented within or surrounding the development site.

The EPBC Database lists two (2) Wetlands of International Importance as potentially occurring within the study area:

- Fivebough and Tuckerbil Swamps

Fivebough and Tuckerbil Swamps are of international importance because of the presence, abundance and diversity of waterbirds that have been recorded there, including migratory shorebirds and threatened species. Both wetlands function as important waterbird habitat and refuge within an agricultural landscape and in fact gain some of their habitat values from the human uses of the area, such as grazing, flood mitigation, and sewage treatment. Ramsar Site No 1224.

- Ginni Flats Subalpine Bog Complex

Ginni Flats Subalpine Bog Complex is a complex of subalpine, spring-fed, *Sphagnum* bogs, associated wet heath and wet grassland with impeded drainage, ephemeral pools and permanent streams set in a series of interconnected flats. The area includes some of the largest, deepest and best preserved bogs found in mainland south-eastern Australia. The site supports a distinctive fauna that includes many unusual, rare or endemic invertebrates and vertebrates, with many species at the northern limit of their range. The wetland is particularly important for the conservation of the spectacular corroboree frog, a rare, endemic species found only at high altitudes with a limited distribution. Ramsar site no. 793.



The abovementioned Ramsar wetlands are too far from the development site to be impacted by the proposed works. Fivebough and Tuckerbil swamp are near Leeton and the closest urban area to the Sub-alpine Bog Complex is Canberra. The proposed development site does not contain habitat that is similar to these sites.

4.12.1.2 Specific Site Review

Aerial imagery of the proposed site was analysed to identify changes in ecosystem types across the site to enable more accurate and thorough sampling. The site was broken up into four (4) broad landscape types, namely:

- Acacia Community;
- Callitris Community;
- Eucalypt Community; and
- Agricultural Landscape Community.

These landscape types are illustrated in Figure 4.12.1: *Landscape Types Onsite*.

Each of these distinct areas was surveyed for both floristic composition and faunal occupancy. Beyond this landscape level analysis, fielded survey effort was directed to areas surrounding the site so as to gain a more complete perspective on the broader connectivity of the site to the surrounding landscapes and habitats. These vegetation types do not differ significantly from vegetation community types mapped by the NPWS, and displayed in Figure 4.12.2: *NPWS Vegetation Community Distribution*.

The vegetation communities can be described broadly as:

Acacia Community

The Myall Woodland in the Darling Riverina Plains, Brigalow Belt South, Cobar Peneplain, Murray-Darling Depression, Riverina and NSW South Western Slopes bioregions has been listed as an Endangered Ecological Community as per Part 3 of Schedule 1 of the Threatened Species Conservation Act (TSC Act). Typically, the ecological community occurs on red-brown earths and heavy textured grey and brown alluvial soils within a climatic belt receiving between 375 and 500 mm mean annual rainfall.

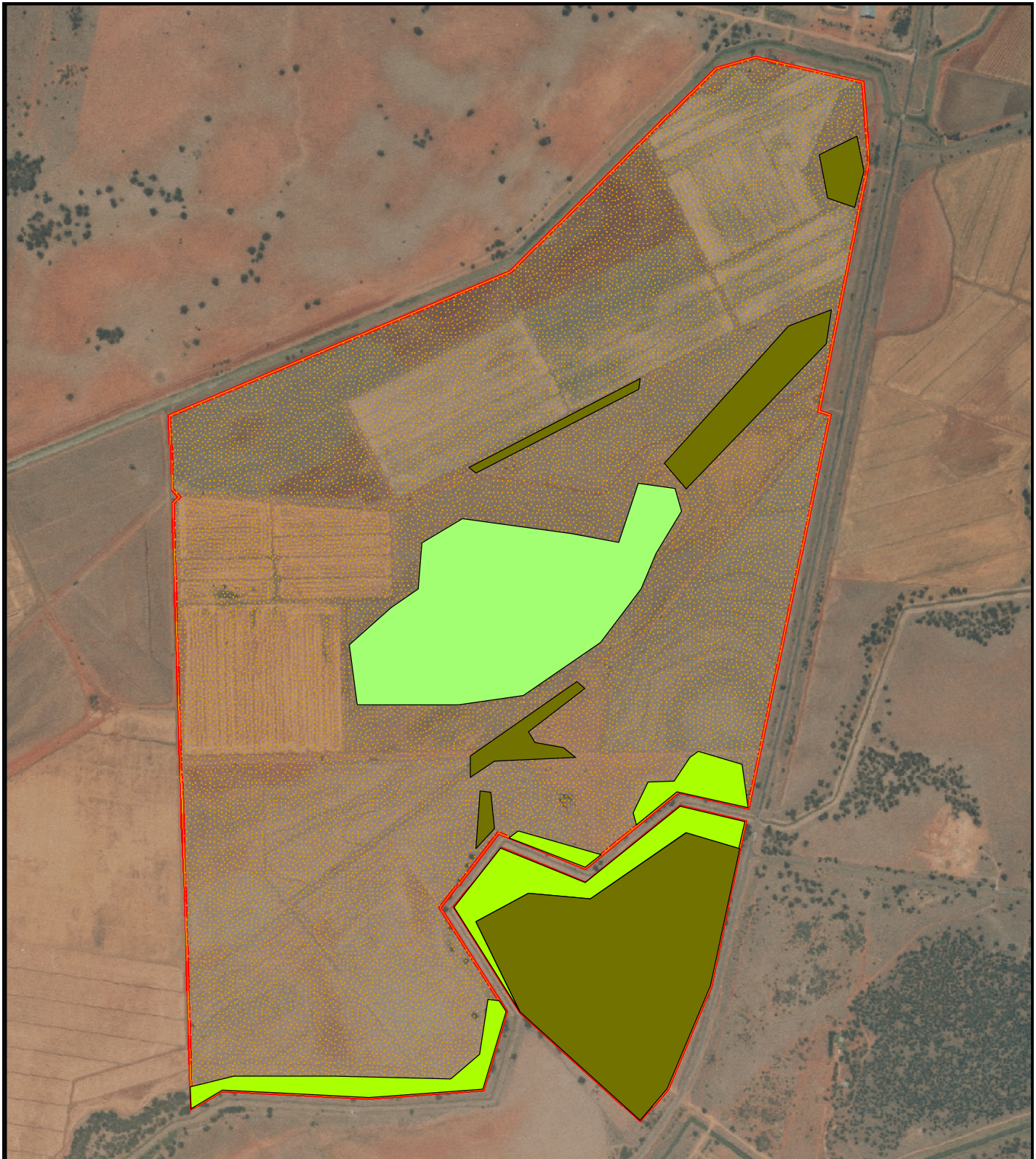
The structure of the Myall Woodland community varies from low woodland and low open woodland to low sparse woodland or open shrubland, depending on site quality and disturbance history. The over-storey layer grows up to a height of about 10 metres and includes *Acacia pendula* (Weeping Myall or Boree) as one of the dominant species or sole over-storey species present.

The understorey layer includes an open layer of chenopod shrubs and other woody plant species, and species numbers and diversity can vary substantially often virtually absent in some stands. Chenopod shrubs, such as *Atriplex semibaccata* (Creeping saltbush), *Enchylaena tomentosa* (Ruby saltbush), *Maireana aphylla* (Cotton bush), *M. decalvans* (Black cotton bush), *M. excavata*, *M. pentagona* (Hairy bluebush), *Rhagodia spinescens* (Thorny saltbush) and *Sclerolaena muricata* (Black rolypoly), are among the most frequent shrubs in the understorey

The ground layer generally displays as an open to continuous groundcover of grasses and herbs. The ground layer includes a diversity of grasses and forbs, including *Chloris truncata* (Windmill grass), *Einadia nutans* (Climbing saltbush), *Enteropogon acicularis* (Curly windmill grass), *Rhodanthe corymbiflora* (Small white sunray), *Solanum esuriale* (Quena) and *Sporobolus caroli* (Fairy grass), *Austroanthonia* spp. (White-top or Wallaby grasses), *Stipa scabra* (Rough speargrass), and herbs such as *Chrysocephalum apiculatum* (Common everlasting), *Goodenia pusilliflora*, *Myriocephalus rhizocephalus* (Woolly-heads) and *Swainsona* spp. (Bladder peas).

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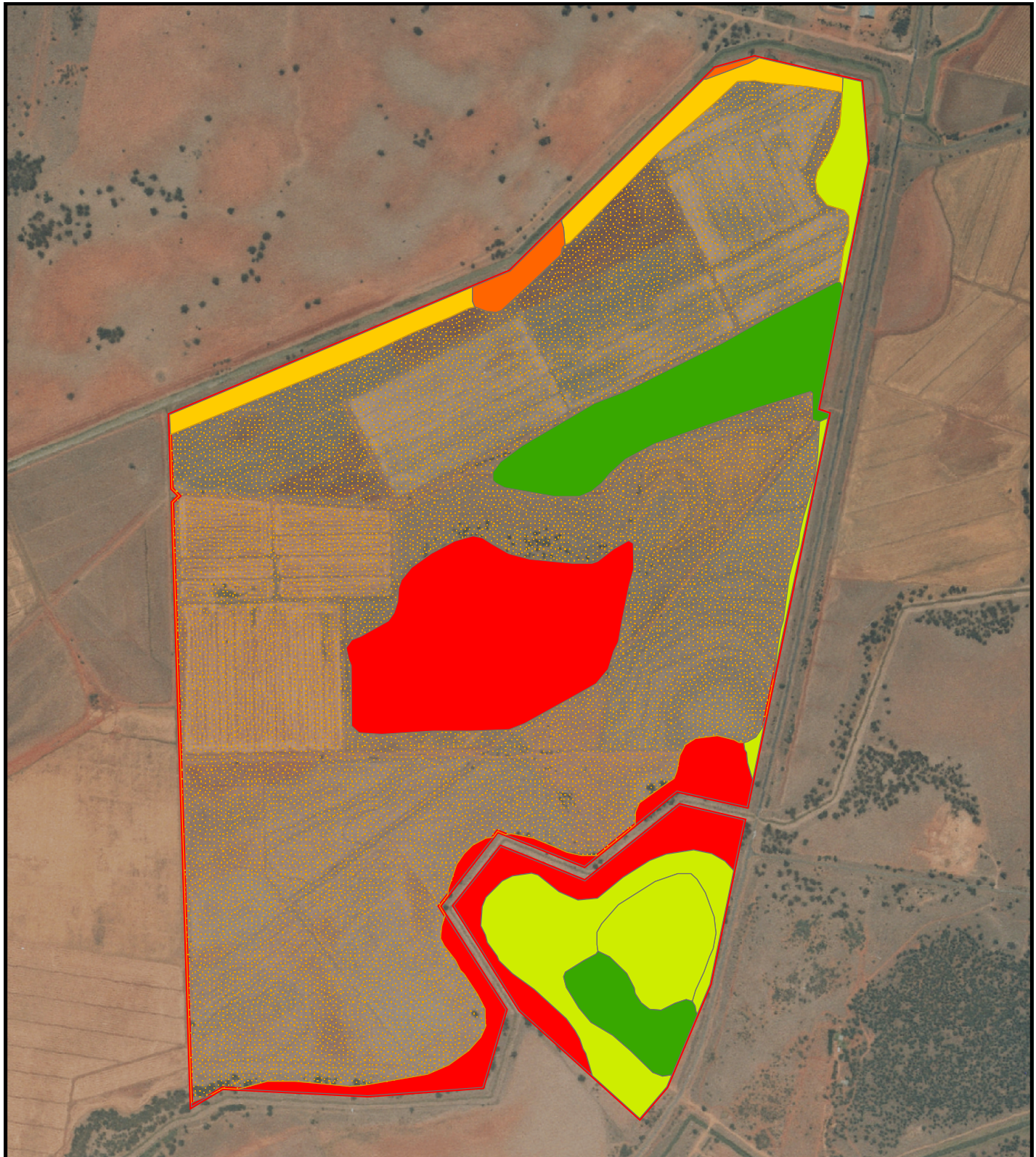
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 Created by : Simon Lee, GIS Administrator, Booth Associates
 Project : Four Arrows Ethanol Pty Ltd Ethanol Plant &
 Intensive Dairy Environmental Assessment



□ Proposed Site
 ■ Acacia Community
 ■ Eucalypt Community
 ■ Callitris Community
 ■ Agricultural Landscape Community

0 0.1 0.2 0.4 0.6 0.8
 Kilometers





 Proposed Site
 GRASSLAND
 OPEN WOODLAND/GRASSLAND
 TILLED, DRY CROPPING AREA - WOODLAND
 IRRIGATION AREA
 TILLED, DRY CROPPING AREA
 WOODLAND

0 0.1 0.2 Kilometers 0.4 0.6 0.8





Myall Woodland communities in the Riverina have been substantially reduced and modified by clearing and grazing over the past 100 years. In the Riverina, NSW NPWS (2003) estimated that 94% of Myall Woodland has been cleared, leaving approximately 780 km².

Myall Woodlands are threatened by clearing and fragmentation associated with cropping, overgrazing by feral and domestic animals, pest and disease outbreaks and weed invasion. Clearing of native vegetation is listed as a Key Threatening Process under the Threatened Species Conservation Act (1995). Consequently, only a small area of Myall Woodland is represented within existing conservation reserves. In the Riverina district, Oolambeyan National Park contains approximately 700 hectares in varying states of recovery, and a further 10 hectares are found in Lake Urana Nature Reserve.

The community is characterised by the presence of the following species:

Table 4.12.3: Myall Woodland Characteristic Community Species

Scientific Name	Scientific Name
<i>Acacia homalophylla</i>	<i>Acacia oswaldii</i>
<i>Acacia pendula</i>	<i>Acacia victoriae</i>
<i>Alectryon oleifolius</i>	<i>Alternanthera denticulata</i>
<i>Amaranthus macrocarpus</i>	<i>Amyema quandang</i>
<i>Apophyllum anomalum</i>	<i>Arthropodium minus</i>
<i>Asperula conferta</i>	<i>Astrebla lappacea</i>
<i>Astrebla pectinata</i>	<i>Atalaya hemiglauc</i>
<i>Atriplex leptocarpa</i>	<i>Atriplex nummularia</i>
<i>Atriplex semibaccata</i>	<i>Atriplex spinibractea</i>
<i>Austrodanthonia caespitosa</i>	<i>Austrodanthonia setacea</i>
<i>Austrostipa aristiglumis</i>	<i>Austrostipa scabra</i>
<i>Boerhavia dominii</i>	<i>Brachyscome lineariloba</i>
<i>Calocephalus sonderi</i>	<i>Calotis hispidula</i>
<i>Calotis scabiosifolia</i>	<i>Capparis lasiantha</i>
<i>Capparis mitchellii</i>	<i>Casuarina cristata</i>
<i>Centipeda cunninghamii</i>	<i>Chloris truncata</i>
<i>Chrysocephalum apiculatum</i>	<i>Convolvulus erubescens</i>
<i>Dactyloctenium radulans</i>	<i>Daucus glochidiatus</i>
<i>Dichanthium sericeum</i>	<i>Diplachne fusca</i>
<i>Einadia nutans</i>	<i>Enchylaena tomentosa</i>
<i>Enteropogon acicularis</i>	<i>Eragrostis parviflora</i>
<i>Eremophila bignoniiflora</i>	<i>Eremophila maculata</i>
<i>Eriochloa sp.</i>	<i>Exocarpos aphyllus</i>
<i>Goodenia glauca</i>	<i>Goodenia pusilliflora</i>
<i>Homopholis proluta</i>	<i>Hypoxis pusilla</i>
<i>Iseilema membranaceum</i>	<i>Isoetopsis graminifolia</i>
<i>Ixiolaena leptolepis</i>	<i>Maireana aphylla</i>
<i>Maireana ciliata</i>	<i>Maireana decalvans</i>
<i>Maireana excavata</i>	<i>Maireana pentagona</i>
<i>Marsilea drummondii</i>	<i>Myoporum montanum</i>
<i>Myriocephalus rhizocephalus</i>	<i>Nitraria billardieri</i>
<i>Oxalis perennans</i>	<i>Panicum decompositum</i>
<i>Plantago varia</i> [complex]	<i>Poa fordeana</i>
<i>Portulaca oleracea</i>	<i>Rhagodia spinescens</i>
<i>Rhodanthe corymbiflora</i>	<i>Rhodanthe floribunda</i>
<i>Rhodanthe pygmaea</i>	<i>Salsola kali</i>
<i>Sclerolaena brachyptera</i>	<i>Sclerolaena muricata</i>
<i>Sclerolaena stelligera</i>	<i>Sida corrugata</i>
<i>Sida trichopoda</i>	<i>Solanum esuriale</i>
<i>Sporobolus caroli</i>	<i>Swainsona procumbens</i>
<i>Teucrium racemosum</i>	<i>Tribulus terrestris</i>
<i>Triptilodiscus pygmaeus</i>	<i>Vittadinia cuneata</i>



Callitris Community

Callitris glaucophylla (White Cypress) woodlands are an important vegetation community over relatively large areas of the Riverina. Originally reserved because of their value to the timber industry, attention is now being placed on the conservation of these woodlands due to their role in providing remnant habitat for native flora and fauna specific to these vegetation communities. The pre-European distribution of *C. glaucophylla* was altered dramatically in the past century because of a combination of grazing by domestic livestock and feral animals, altered fire regimes and weed invasion. Today, the majority of *C. glaucophylla* woodlands are highly fragmented remnants, with many managed as formal forestry reserves. Selective logging during the past 30 years has led to a community that tends to exhibit single-aged stands, often in high densities.

Callitris is tolerant of a wide range of climates and exists in a similar rain belt to that of the Myall Woodland communities outlined above. This species tends to occupy various red-brown sandy loams through to clays, and can tolerate extended periods of drought and is often associated with prior streams. Faunal diversity is high in mixed *Eucalypt/Callitris* woodlands, but faunal diversity drops dramatically in pure *Callitris* stands.

The Threatened Species Scientific Committee (TSSC) has concluded that the ecological community 'Narrow-leaf Ironbark-White Cypress Pine opens grassy forest/arboreal fauna community' is not accurately defined, both with regard to the species composition and geographic extent. As a consequence, *Callitris* woodlands do not classify as a threatened ecological community for listing under the EPBC Act.

Table 4.12.4: Callitris Woodland Characteristic Community Species

Scientific Name	Scientific Name
<i>Abutilon oxycarpum</i>	<i>Acacia excelsa</i>
<i>Acacia salicina</i>	<i>Alectryon oleifolius</i>
<i>Allocasuarina luehmannii</i>	<i>Alstonia constricta</i>
<i>Aristida calycina</i>	<i>Atalaya hemiglauca</i>
<i>Austrostipa scabra ssp scabra</i>	<i>Callitris glaucophylla</i>
<i>Capparis mitchellii</i>	<i>Casuarina cristata</i>
<i>Chloris truncate</i>	<i>Corymbia dolichocarpa</i>
<i>Corymbia tessellaris</i>	<i>Crinum flaccidum</i>
<i>Cymbidium canaliculatum</i>	<i>Einadia nutans</i>
<i>Eremophila mitchellii</i>	<i>Eucalyptus camaldulensis</i>
<i>Eucalyptus populnea</i>	<i>Geijera parviflora</i>
<i>Panicum decompositum</i>	<i>Petalostigma pubescens</i>
<i>Rhagodia spinescens</i>	<i>Sclerolaena birchii</i>

Eucalypt Community

Black Box (*Eucalyptus largiflorens*) Woodlands occur on clay soils on low-lying sites subject to infrequent flooding and as ribbon stands along creeks or in or around swamps. Black Box can exist with either a grassy shrubby understorey depending on flooding frequency and site. There are still significant areas of Black Box in the Southern Riverina.

The structure of these communities varies from tall riparian woodlands to very open 'savanna-like' grassy woodlands with a sparse mid-storey of shrubs and saplings, and form mosaics with grasslands and wetlands. These variations are due mainly to changes in the frequency and duration of inundation by flooding events, be they natural or induced. As a result, there are dramatic variations in species makeup between the highly modified agricultural sections of the floodplain and the less frequently inundated outer parts of the floodplain.



Typically, this community has been extensively cleared and modified, and often contains the following species:

Table 4.12.5: Black Box Woodland Characteristic Community Species

Scientific Name	Scientific Name
<i>Eucalyptus largiflorens</i>	<i>Plantago cunninghamii</i>
<i>Casuarina cristata</i>	<i>Eragrostis setifolia</i>
<i>Acacia stenophylla</i>	<i>Paspalidium jubiflorum</i>
<i>Acacia salicina</i>	<i>Paspalidium distans</i>
<i>Eremophila bignoniiflora</i>	<i>Dactyloctenium radulans</i>
<i>Muehlenbeckia florulenta</i>	<i>Astrebla lappacea</i>
<i>Rhagodia spinescens</i>	<i>Dichanthium sericeum</i>
<i>Eremophila bignoniiflora</i>	<i>Panicum decompositum</i>
<i>Alectryon oleifolius</i> subsp. <i>elongatus</i>	<i>Pycnosorus globosus</i>
<i>Geijera parviflora</i>	<i>Daucus glochidiatus</i>
<i>Alstonia constricta</i>	<i>Marsilea drummondii</i>
<i>Eremophila mitchellii</i>	<i>Dyperus victoriensis</i>

Coolibah-Black Box woodlands are afforded some protection in the northern Riverina region. On 14 May 2004 the TSSC made a final determination to list the Coolibah Black Box Woodlands of the Northern Riverine Plains in the Darling Riverine Plains and Brigalow Belt South Bioregions' as an Endangered Ecological Community under the *Threatened Species Conservation Act 1995*, however this protection does not extend to the area surrounding the proposed development site.

4.12.2 Field Survey Results

4.12.2.1 Conditions

General and targeted flora and fauna surveys were carried out on the site.

Table 4.12.6 provides the climate conditions for the survey before, during and after to give an indication as to any impact on survey results from weather conditions.

Table 4.12.6: Survey Period Climate Conditions

Weather Summary from 28/03/06 to 10/03/06 for Project Site											
Date	Dry Bulb (Deg C)			Relative Humidity (%)			Dew DT (Deg C)	Wind (Km)	Rain (mm)	Radiation (Mj/Sqm)	ET (mm)
	Mean	Max	Min	Mean	Max	Min					
28/02/06	25.0	33.3	18.0	50	74	26	14.0	186	0.0	25.9	8.4
01/03/06	25.6	34.5	16.0	46	75	21	13.0	186	0.0	31.7	9.8
02/03/06	25.4	33.3	17.8	42	73	19	11.6	285	0.0	27.8	10.2
03/03/06	24.3	32.1	17.5	45	73	23	11.7	213	0.0	25.4	8.8
04/03/06	24.3	33.2	15.9	44	77	17	11.3	161	0.0	29.9	9.2
05/03/06	25.6	34.0	17.4	37	59	19	10.0	157	0.0	26.1	9.1
06/03/06	23.8	31.6	15.7	42	63	24	10.0	253	0.0	25.0	9.2
07/03/06	18.2	25.7	11.6	60	85	36	10.3	288	0.0	25.4	7.2
08/03/06	19.2	31.0	9.1	59	92	27	11.2	113	0.0	19.8	5.1
09/03/06	23.2	34.2	11.8	33	79	17	10.4	108	0.0	8.8	5.1
10/03/06	24.6	35.4	12.4	42	70	16	10.7	129	0.0	25.7	8.2

* Bold indicates actual survey days.



The following observations were made:

- The weather prior to the survey had been dry and in drought conditions;
- Temperatures slightly above average for the time of the year;
- Fine and warm days would have meant avifaunal activity would have been highest at dawn and dusk; and
- The weather conditions during the survey would not have had a significant impact on faunal species present.

4.12.2.2 Flora

General Vegetation Description

The floristic composition and richness of some species can vary from year to year and season to season, depending on the climatic conditions experienced at a particular time. The 2005/06 summer received below average rainfall with the trend of a drought. The survey season of summer 2005/06 can be considered a below average season for floristic growth.

The site is typically representative of agricultural lands for the region. The majority of vegetation onsite is composed of exotic pasture and weed species, with fragments and peripheral stands of remnant vegetation in classically highly degraded and fragmented exhibition. The remnant vegetation identified onsite does in this instance however, present as having some value as a linkage and forage habitat for various species apt to migration between other areas of remnant vegetation surrounding the site.

Presented below are vegetation descriptions for the areas mapped on the site and depicted in Figure 4.12.1: *Landscape Types Onsite*.

Acacia Community:	Myall (<i>Acacia pendula</i>) over-storey with an exotic grass understorey and various scattered <i>Chenopodium</i> and <i>Enchylaena</i> species. The ground species are a mixture of native and exotic, comprising Windmill Grass (<i>Chloris truncata</i>) White Top (<i>Danthonia caespitosa</i>) and Barley grass (<i>Hordeum leporinum</i>), Horehound (<i>Marrubium vulgare</i>), Paterson's Curse (<i>Echium plantagineum</i>), Bathurst Burr (<i>Xanthium spinosum</i>) and Wild Oats (<i>Avena fatua</i>).
Callitris Community:	White Cypress (<i>Callitris glaucophylla</i>) over-storey interspersed with Yellow Box (<i>E. melliodora</i>). The ground cover is limited and the majority of the species are exotic grasses and commonly found exotic agricultural weed species. There is some limited regeneration of Myall (<i>A. pendula</i>) and Creeping Saltbush (<i>Atriplex semibaccata</i>), though is subject to intensive grazing pressures from Rabbits (<i>Oryctolagus cuniculus</i>).
Black Box Community:	Black box (<i>Eucalyptus largiflorens</i>) woodland and as with the Acacia community, an exotic grass understorey and various scattered <i>Chenopodium</i> and <i>Enchylaena</i> species. The ground species are a mixture of native and exotic, comprising Windmill Grass (<i>Chloris truncata</i>) White Top (<i>Danthonia caespitosa</i>) and Ruby and Creeping Saltbush (<i>Enchylaena tomentosa</i> and <i>A. semibaccata</i>) and exotic species including Barley grass (<i>Hordeum leporinum</i>), Horehound (<i>Marrubium vulgare</i>) and Paterson's Curse (<i>Echium plantagineum</i>).



Agricultural Landscape Community: This area is described as an open area with no trees. The ground cover is scattered mixed species but dominated by exotic Barley grass, Rye grass (*Lolium rigidum*), and Horehound. Other species present in this area are Black cottonbush (*Maireana decalvans*) and Nitre goosefoot (*Chenopodium nitrariaceum*).

Table 4.12.7 provides a list of the species identified during the survey.

Table 4.12.7: Flora Survey Results

Scientific Name	Common Name
<i>Abutilon (sp)</i>	Chinese Lantern
<i>Acacia pendula</i>	Myall
<i>Acacia salicina</i>	Coobah
<i>Agropyron scabrm (Labill) Beauv</i>	Common Wheatgrass
<i>Amyema quandang</i>	Grey Mistletoe
<i>Apopyllum anomalum</i>	Warrior Bush
<i>Atriplex semibaccata</i>	Creeping Saltbush
<i>Brachyachne convergens</i>	Spider Grass
<i>Callitris glaucophylla</i>	White Cypress
<i>Cardaria draba</i>	Hoary Cress
<i>Chenopodium murale</i>	Nettle Leaf Goosefoot
<i>Chenopodium nitrariaceum</i>	Nitre Goosefoot
<i>Chloris truncata</i>	Windmill Grass
<i>Cirsium vulgare</i>	Spear Thistle
<i>Citrullus colocynthis</i>	Perennial Wild Melon
<i>Dodonaea attenuata</i>	Narrow leaved Hopbush
<i>Emex australis</i>	Spiny Emex
<i>Enchylaena tomentosa</i>	Ruby Saltbush
<i>Eucalyptus largiflorens</i>	Black Box
<i>Eucalyptus melliodora</i>	Yellow Box
<i>Heliotropium europaeum</i>	Common Heliotrope
<i>Heterodendrum oleifolium</i>	Rosewood
<i>Homopholis proluta</i>	Rigid Panic
<i>Lactuca serriola</i>	prickly Lettuce
<i>Maireana aphylla</i>	Cottonbush
<i>Maireana decalvans</i>	Black Cottonbush
<i>Marrubium vulgare</i>	Horehound
<i>Muehlenbekia cunninghamii</i>	Tangled Lignum
<i>Ottelia ovalifolia</i>	Swamp Lily (Channel)
<i>Rhagodia spinescens</i>	Thorny Saltbush
<i>Salsola kali</i>	Prickly Saltbush
<i>Sclerolaena va. Quinquecusps</i>	Black Roly Poly
<i>Solanum nigrum</i>	Black Nightshade
<i>Tribulus terrestris</i>	Caltrop
<i>Trifolium angustifolium</i>	Narrow Leaf Clover
<i>Vittadenia cuneata</i>	Common New Holland Daisy
<i>Xanthium spinosum</i>	Bathurst Burr



4.12.2.3 Fauna

4.12.2.3.1 Impact Assessment

Consent and determining authorities have a statutory obligation under Parts 4 and 5 of the EPA Act (1979) to consider whether a proposal is likely to significantly affect threatened species populations or ecological communities or their habitats. In deciding whether there is likely to be a significant effect on threatened species or their habitats the consent or determining authority must take into account the "Assessment of Significance". The "Assessment of Significance" is a tool to assess the impact of the proposed development and has been prepared for the proposed development pursuant to a series of factors. These factors are:

- Map Sheets No's 8028 and 8128 have been used to compile a list of potential threatened flora and fauna species within and surrounding the proposed development;
- Attention has been paid to the likelihood of suitable threatened species habitat represented onsite; and
- The proposed development will not remove areas of remnant vegetation on site. Some species listed in the data searches of the National Parks and Wildlife Atlas and the EPBC Database do not have habitat requirements identified on or surrounding the proposed development site.

Consequently all species from the databases that are located within a 20 kilometre radius of the proposed development site have been subject to the "Assessment of Significance". Species not having been represented within 20 kilometres of the development site and those without habitat requirements exhibited on site have thus been omitted from subjection to "Assessment of Significance" assessment.

The outcome of the impact assessment process is to ensure that developments and activities are conducted in an environmentally sensitive manner, and that appropriate measures are undertaken to minimise adverse effects on threatened species or their habitats. Development should only proceed when the likely effects of the proposal are able to be mitigated against. For the purpose of the EP&A Act 1979 and in particular in the administration of sections 77, 90 and 112 the following factors must be taken into account in deciding whether there is likely to be a significant effect on threatened species populations or ecological communities or their habitats:

- A: In the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.
- B: In the case of an endangered population, whether the action proposed is likely 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.
- C: In the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:
 - (i) Is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or
 - (ii) 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.



- D: In relation to the habitat of a threatened species, population or ecological community:
- (i) The extent to which habitat is likely to be removed or modified as a result of the action proposed, and
 - (ii) Whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and
 - (iii) The importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality.
- E: Whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly).
- F: Whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan.
- G: Whether the action plan proposed constitutes or is part of a key threatening process or is likely to result in the operation or, or increase the impact of, a key threatening process.

Table 4.12.8 contains the results for Assessment of Significance tests applied to all species previously recorded within 20km of the proposed development site.

Table 4.12.8: Assessment of Significance

A: In the case of a threatened species, whether the action proposed is likely to have an adverse effect on the life cycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.

Species	Response
Blue Billed Duck (<i>Oxyura australis</i>)	No populations of <i>O. australis</i> were observed onsite, and as such, the action proposed is not likely to have an adverse effect on the lifecycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.
Brown Treecreeper (<i>Climacteris picumnus</i>)	No populations of <i>C. picumnus</i> were observed onsite, and as such, the action proposed is not likely to have an adverse effect on the lifecycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.
Bush Stone Curlew (<i>Burhinus grallarius</i>)	No populations of <i>B. grallarius</i> were observed onsite, and as such, the action proposed is not likely to have an adverse effect on the lifecycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.
Grey Crowned Babbler (<i>Pomatostomus temporalis</i>)	Thirteen (13) <i>P. temporalis</i> individuals were identified in the area surrounding the proposed development site. It can be reasonably assumed that the species would utilise the proposed development site and surrounds for foraging and migration between other areas of suitable habitat. The proposed development does not directly remove any of this species potential habitat or limit the species ability to forage or migrate between areas of suitable habitats, and as such, the action proposed is not likely to have an adverse effect on the lifecycle of the species such that the local population of the species is likely to be placed at risk of extinction.
Painted Honeyeater (<i>Grantia picta</i>)	No populations of <i>G. picta</i> were observed onsite, and as such, the action proposed is not likely to have an adverse effect on the lifecycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.
Plains Wanderer (<i>Pedionomus torquatus</i>)	No populations of <i>P. torquatus</i> were observed onsite, and as such, the action proposed is not likely to have an adverse effect on the lifecycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.
Southern Bell Frog (<i>Litoria raniformis</i>)	No populations of <i>L. raniformis</i> were observed onsite, however the species is known to inhabit the area surrounding the proposed development. The proposed action is not of a nature that will affect the lifecycle of the species (eg: native vegetation removal; changes to hydrological processes or overland flows) and as such, the action proposed is not likely to have an adverse effect on the lifecycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.



Superb Parrot (<i>Polytelis swainsonii</i>)	No populations of <i>P. swainsonii</i> were observed onsite, however the species is known to inhabit the area surrounding the proposed development. The proposed action is not of a nature that will affect the lifecycle of the species (eg: native vegetation removal) and as such, the action proposed is not likely to have an adverse effect on the lifecycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.
Silky Swainson-pea (<i>Swainsonia sericea</i>)	No populations of <i>S. sericea</i> were observed onsite, and as such, the action proposed is not likely to have an adverse effect on the lifecycle of the species such that a viable local population of the species is likely to be placed at risk of extinction.
Endangered Ecological Community	Response
Myall (Boree) Woodland	n/a

B: In the case of an endangered population, whether the action proposed is likely 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.

Species	Response
Blue Billed Duck (<i>Oxyura australis</i>)	No populations of <i>O. australis</i> are listed as being endangered on the schedules of the <i>Threatened Species Conservation Act (1995)</i> .
Brown Treecreeper (<i>Climacteris picumnus</i>)	No populations of <i>C. picumnus</i> are listed as being endangered on the schedules of the <i>Threatened Species Conservation Act (1995)</i> .
Bush Stone Curlew (<i>Burhinus grallarius</i>)	No populations of <i>B. grallarius</i> are listed as being endangered on the schedules of the <i>Threatened Species Conservation Act (1995)</i> .
Grey Crowned Babbler (<i>Pomatostomus temporalis</i>)	No populations of <i>P. temporalis</i> are listed as being endangered on the schedules of the <i>Threatened Species Conservation Act (1995)</i> .
Painted Honeyeater (<i>Grantiella picta</i>)	No populations of <i>G. picta</i> are listed as being endangered on the schedules of the <i>Threatened Species Conservation Act (1995)</i> .
Plains Wanderer (<i>Pedionomus torquatus</i>)	No populations of <i>P. torquatus</i> are listed as being endangered on the schedules of the <i>Threatened Species Conservation Act (1995)</i> .
Southern Bell Frog (<i>Litoria raniformis</i>)	No populations of <i>L. raniformis</i> are listed as being endangered on the schedules of the <i>Threatened Species Conservation Act (1995)</i> .
Superb Parrot (<i>Polytelis swainsonii</i>)	No populations of <i>P. swainsonii</i> are listed as being endangered on the schedules of the <i>Threatened Species Conservation Act (1995)</i> .
Silky Swainson-pea (<i>Swainsonia sericea</i>)	No populations of <i>S. sericea</i> are listed as being endangered on the schedules of the <i>Threatened Species Conservation Act (1995)</i> .
Endangered Ecological Community	Response
Myall (Boree) Woodland	n/a

C: In the case of an endangered ecological community or critically endangered ecological community, whether the action proposed:

- (i) Is likely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction, or

Species	Response
Blue Billed Duck (<i>Oxyura australis</i>)	n/a
Brown Treecreeper (<i>Climacteris picumnus</i>)	n/a
Bush Stone Curlew (<i>Burhinus grallarius</i>)	n/a



Grey Crowned Babbler (<i>Pomatostomus temporalis temporalis</i>)	n/a
Painted Honeyeater (<i>Grantiella picta</i>)	n/a
Plains Wanderer (<i>Pedionomus torquatus</i>)	n/a
Southern Bell Frog (<i>Litoria raniformis</i>)	n/a
Superb Parrot (<i>Polytelis swainsonii</i>)	n/a
Silky Swainson-pea (<i>Swainsonia sericea</i>)	n/a
Endangered Ecological Community	Response
Myall (Boree) Woodland	The action proposed will not result in the removal or fragmentation of the Myall (Boree) woodland and this is unlikely to have an adverse effect on the extent of the ecological community such that its local occurrence is likely to be placed at risk of extinction.
(ii) 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.	
Species	Response
Blue Billed Duck (<i>Oxyura australis</i>)	n/a
Brown Treecreeper (<i>Climacteris picumnus</i>)	n/a
Bush Stone Curlew (<i>Burhinus grallarius</i>)	n/a
Grey Crowned Babbler (<i>Pomatostomus temporalis temporalis</i>)	n/a
Painted Honeyeater (<i>Grantiella picta</i>)	n/a
Plains Wanderer (<i>Pedionomus torquatus</i>)	n/a
Southern Bell Frog (<i>Litoria raniformis</i>)	n/a
Superb Parrot (<i>Polytelis swainsonii</i>)	n/a
Silky Swainson-pea (<i>Swainsonia sericea</i>)	n/a
Endangered Ecological Community	Response
Myall (Boree) Woodland	The action proposed will not result in the removal or fragmentation of the Myall (Boree) woodland. There will be modification to the ecological community in the form of enhancement, and consequently there is potential for damage to individual species within the ecological community though not affecting the community composition. Based on this action however, it



can be stated that modification is a net benefit, and as such, is unlikely to substantially or adversely modify the composition of the ecological community such that its local occurrence is likely to be placed at risk of extinction.

D: In relation to the habitat of a threatened species, population or ecological community:

(i) the extent to which habitat is likely to be removed or modified as a result of the action proposed, and

Species	Response
Blue Billed Duck (<i>Oxyura australis</i>)	No area of known <i>O. australis</i> habitat is to be removed or modified as a result of the action proposed.
Brown Treecreeper (<i>Climacteris picumnus</i>)	This species tends to prefer taller Eucalypt woodlands than that represented on the site, though does often forage on the edges of thicker woodland areas. Notwithstanding, <i>C. picumnus</i> is known to occupy woodlands on land surrounding the site. The habitat requirements for this species are reasonably well represented onsite. The proximity of the site to the Boona and Brett's state forests, and NPWS database information of sightings in both these reserves, would indicate that the Black box (<i>Eucalyptus largiflorens</i>) depression on and surrounding the site, is likely to be utilised by this species. No area of existing suitable <i>C. picumnus</i> habitat is to be removed or modified as a result of the action proposed.
Bush Stone Curlew (<i>Burhinus grallarius</i>)	Whilst not observed during survey efforts, the Black box depression areas onsite and along Coleambally Irrigation Drainage Channel 400 to the south of the site do provide suitable habitat for this species for roosting, foraging and migration. No area of existing suitable <i>B. grallarius</i> habitat is to be removed or modified as a result of the action proposed.
Grey Crowned Babbler (<i>Pomatostomus temporalis</i>)	Grey-crowned Babblers prefer to occupy open woodlands dominated by mature eucalypts, with regenerating trees, tall shrubs, and an intact ground cover of grass and forbs, and are often associated with stands of remnant roadside vegetation. The major cause of the decline in this species within the Riverina Bioregion is commonly recognised as clearing of its preferred habitat of drier more open forests, scrubby woodlands, trees bordering roads and farmlands with isolated trees (Simpson <i>et. al</i> 1996) and fragmentation and isolation of populations due to remnant vegetation removal and dieback. <i>P. temporalis</i> habitat is to be modified as a result of the proposed development, however this will present as a net improvement through enhancement activities. Short term disturbance for populations of <i>P. temporalis</i> potentially onsite may be experienced during habitat restoration works, though no existing habitat will be removed as a result of the action proposed.
Painted Honeyeater (<i>Grantiella picta</i>)	Whilst not observed during survey efforts, <i>G. picta</i> is known to occupy woodlands on land surrounding the site. The habitat requirements for this species are reasonably well represented onsite. The proximity of the site to the Boona and Brett's state forests, and NPWS database information of sightings in both these reserves, would indicate that the Black box depression and Myall (<i>Acacia pendula</i>) woodlands on and surrounding the site, is likely to be utilised by this species. No area of existing suitable <i>G. picta</i> habitat is to be removed or modified as a result of the action proposed.
Plains Wanderer (<i>Pedionomus torquatus</i>)	No area of known <i>P. torquatus</i> habitat is to be modified or removed as a result of the action proposed.
Southern Bell Frog (<i>Litoria raniformis</i>)	Whilst not observed during the survey effort, <i>L. raniformis</i> are usually found in emergent vegetation within or at the edges of still or slow-moving water bodies, but are also known to occupy irrigation channels and irrigated crops throughout the CIA. The proposed development site has a history of irrigated landuse, and as such, has in the past contained areas of suitable habitat for the species. The species is also known to inhabit Black box depressions, assuming regular periods of inundation. Consequently, the move from an irrigated property to an industrial and intensive livestock production facility does remove potential habitat for <i>L. raniformis</i> . Notwithstanding, the property's irrigation history is sporadic at best, and the action proposed will have no bearing on the irrigation channels supplying both the site and surrounding properties, and thus the extent to which habitat is likely to be removed or modified as a result of the action proposed is minor.
Superb Parrot (<i>Polytelis swainsonii</i>)	Whilst not observed during survey efforts, <i>P. swainsonii</i> is known to forage and migrate through and around the site. The habitat requirements for this species are represented onsite and provide valuable habitat in an otherwise limited habitat landscape. The proximity of the site to the Boona and Brett's state forests also elevates the value of the habitat onsite as a migratory route between surrounding areas. <i>P. swainsonii</i> habitat is to be modified as a result of the proposed development, however this will present as a net improvement through enhancement activities. Short term disturbance for <i>P. swainsonii</i> may be experienced during habitat restoration works, though no existing habitat will be removed as a result of the action proposed.



Silky Swainson-pea (<i>Swainsonia sericea</i>)	No area of known <i>S. sericea</i> habitat is to be removed or modified as a result of the action proposed.
Endangered Ecological Community	Response
Myall (Boree) Woodland	The action proposed will not result in the removal of the Myall (Boree) woodland. There will be modification to the ecological community in the form of enhancement, and consequently there is potential for damage to individual species where the proposed development site borders roadside remnant vegetation stands of Myall (Boree) woodland.
(ii) whether an area of habitat is likely to become fragmented or isolated from other areas of habitat as a result of the proposed action, and	
Species	Response
Blue Billed Duck (<i>Oxyura australis</i>)	No area of known <i>O. australis</i> habitat is likely to become fragmented or isolated from current inter connecting or proximate areas of habitat as a result of the proposed action.
Brown Treecreeper (<i>Climacteris picumnus</i>)	No area of known <i>C. picumnus</i> habitat is likely to become fragmented or isolated from current inter connecting or proximate areas of habitat as a result of the proposed action.
Bush Stone Curlew (<i>Burhinus grallarius</i>)	No area of known <i>B. grallarius</i> habitat is likely to become fragmented or isolated from current inter connecting or proximate areas of habitat as a result of the proposed action.
Grey Crowned Babbler (<i>Pomatostomus temporalis</i>)	No area of known <i>P. temporalis</i> habitat is likely to become fragmented or isolated from current inter connecting or proximate areas of habitat as a result of the proposed action.
Painted Honeyeater (<i>Grantiella picta</i>)	No area of known <i>G. picta</i> habitat is likely to become fragmented or isolated from current inter connecting or proximate areas of habitat as a result of the proposed action.
Plains Wanderer (<i>Pedionomus torquatus</i>)	No area of known <i>P. torquatus</i> habitat is likely to become fragmented or isolated from current inter connecting or proximate areas of habitat as a result of the proposed action.
Southern Bell Frog (<i>Litoria raniformis</i>)	Although not observed during the survey effort, if we assume occupation by <i>L. raniformis</i> of the surrounding irrigation channels both to the north (supply) and south (drainage) of the proposed development, the removal of previously irrigated land from regular inundation could be considered an action proposed that will result in potential habitat becoming fragmented or isolated from other areas of habitat.
Superb Parrot (<i>Polytelis swainsonii</i>)	No area of known <i>P. swainsonii</i> habitat is likely to become fragmented or isolated from current inter connecting or proximate areas of habitat as a result of the proposed action.
Silky Swainson-pea (<i>Swainsonia sericea</i>)	No area of known <i>S. sericea</i> habitat is likely to become fragmented or isolated from current inter connecting or proximate areas of habitat as a result of the proposed action.
Endangered Ecological Community	Response
Myall (Boree) Woodland	n/a
(iii) the importance of the habitat to be removed, modified, fragmented or isolated to the long-term survival of the species, population or ecological community in the locality.	
Species	Response
Blue Billed Duck (<i>Oxyura australis</i>)	No area of known <i>O. australis</i> habitat is to be removed, modified, fragmented or isolated and hence the long term survival of the species or population in the locality is not likely to be impacted.
Brown Treecreeper (<i>Climacteris picumnus</i>)	No area of known <i>C. picumnus</i> habitat is to be removed, fragmented or isolated and hence the long term survival of the species or population in the locality is not likely to be impacted.
Bush Stone Curlew (<i>Burhinus grallarius</i>)	No area of known <i>B. grallarius</i> habitat is to be removed, fragmented or isolated and hence the long term survival of the species or population in the locality is not likely to be impacted.
Grey Crowned Babbler (<i>Pomatostomus temporalis</i>)	No area of known <i>P. temporalis</i> habitat is to be removed, fragmented or isolated and hence the long term survival of the species or population in the locality is not likely to be impacted.



Painted Honeyeater (<i>Grantiella picta</i>)	No area of known <i>G. picta</i> habitat is to be removed, fragmented or isolated and hence the long term survival of the species or population in the locality is not likely to be impacted.
Plains Wanderer (<i>Pedionomus torquatus</i>)	No area of known <i>P. torquatus</i> habitat is to be removed, fragmented or isolated and hence the long term survival of the species or population in the locality is not likely to be impacted.
Southern Bell Frog (<i>Litoria raniformis</i>)	The proposed development site has a history of irrigation, and as such, does afford <i>L. raniformis</i> potential habitat. This irrigation history has been sporadic at best, particularly in light of the prevailing climatic conditions and uncertainty of water allocation over the last 5 years. Given this history, and the inclination to have used water to fill soil profiles for cereal crop production as opposed to pooling water for rice production potential habitat would have been limited during these irrigation cycles. The action proposed will have no bearing on the irrigation channels supplying both the site and surrounding properties that represent much greater value species habitat and thus the importance of the habitat to be removed, modified, fragmented or isolated is seen as low to the long-term survival of <i>L. raniformis</i> .
Superb Parrot (<i>Polytelis swainsonii</i>)	No area of known <i>P. swainsonii</i> habitat is to be removed, fragmented or isolated and hence the long term survival of the species or population in the locality is not likely to be impacted.
Silky Swainson-pea (<i>Swainsonia sericea</i>)	No area of known <i>S. sericea</i> habitat is to be removed, fragmented or isolated and hence the long term survival of the species or population in the locality is not likely to be impacted.
Endangered Ecological Community	Response
Myall (Boree) Woodland	No area of Myall (Boree) woodland is to be removed, fragmented or isolated and hence the long term survival of the ecological community in the locality is not likely to be impacted.

E: Whether the action proposed is likely to have an adverse effect on critical habitat (either directly or indirectly).

Species	Response
Blue Billed Duck (<i>Oxyura australis</i>)	No critical habitat for <i>O. australis</i> has been listed on the schedules of the <i>Threatened Species Conservation Act (1995)</i> .
Brown Treecreeper (<i>Climacteris picumnus</i>)	No critical habitat for <i>C. picumnus</i> has been listed on the schedules of the <i>Threatened Species Conservation Act (1995)</i> .
Bush Stone Curlew (<i>Burhinus grallarius</i>)	No critical habitat for <i>B. grallarius</i> has been listed on the schedules of the <i>Threatened Species Conservation Act (1995)</i> .
Grey Crowned Babbler (<i>Pomatostomus temporalis temporalis</i>)	No critical habitat for <i>P. temporalis</i> has been listed on the schedules of the <i>Threatened Species Conservation Act (1995)</i> .
Painted Honeyeater (<i>Grantiella picta</i>)	No critical habitat for <i>G. picta</i> has been listed on the schedules of the <i>Threatened Species Conservation Act (1995)</i> .
Plains Wanderer (<i>Pedionomus torquatus</i>)	No critical habitat for <i>P. torquatus</i> has been listed on the schedules of the <i>Threatened Species Conservation Act (1995)</i> .
Southern Bell Frog (<i>Litoria raniformis</i>)	No critical habitat for <i>L. raniformis</i> has been listed on the schedules of the <i>Threatened Species Conservation Act (1995)</i> .
Superb Parrot (<i>Polytelis swainsonii</i>)	No critical habitat for <i>P. swainsonii</i> has been listed on the schedules of the <i>Threatened Species Conservation Act (1995)</i> .
Silky Swainson-pea (<i>Swainsonia sericea</i>)	No critical habitat for <i>S. sericea</i> has been listed on the schedules of the <i>Threatened Species Conservation Act (1995)</i> .
Endangered Ecological Community	Response
Myall (Boree) Woodland	n/a


F: Whether the action proposed is consistent with the objectives or actions of a recovery plan or threat abatement plan.

Species	Response
Blue Billed Duck (<i>Oxyura australis</i>)	No recovery or threat abatement plans have been prepared for this species at this time.
Brown Treecreeper (<i>Climacteris picumnus</i>)	No recovery or threat abatement plans have been prepared for this species at this time.
Bush Stone Curlew (<i>Burhinus grallarius</i>)	The action proposed is not consistent with the objectives or actions of the "Recovery Plan for the Bush Stone-curlew (<i>Burhinus grallarius</i>), February 2003 (Draft for public comment)". That said, 'Action 3.2: Increase the number of properties with conservation agreements, such as Voluntary Conservation Agreements, Wildlife Refuges, and other conservation covenants' (NPWS, 2003), does have the potential for implementation on the proposed development site.
Grey Crowned Babbler (<i>Pomatostomus temporalis temporalis</i>)	No recovery or threat abatement plans have been prepared for this species at this time.
Painted Honeyeater (<i>Grantiella picta</i>)	No recovery or threat abatement plans have been prepared for this species at this time.
Plains Wanderer (<i>Pedionomus torquatus</i>)	The action proposed is not consistent with the objectives or actions of the "Plains Wanderer (<i>Pedionomus torquatus</i>) Draft Recovery Plan, October 2002". The objectives of this draft plan focus on the preservation and enhancement of habitat, both known and yet to be identified, and the encouragement of increases in population numbers. The action proposed does not provide an opportunity to contribute to the objectives and actions of the plan as the site contains no habitat suitable for utilisation by <i>P. torquatus</i> .
Southern Bell Frog (<i>Litoria raniformis</i>)	The action proposed is not directly consistent with the objectives or actions of the "Southern Bell Frog (<i>Litoria raniformis</i>) Recovery Plan, February 2005 (Draft for public comment)". That said, the creation of an artificial wetland as proposed as part of the development does afford alignment with 'Action 2: Habitat Protection' (DEC 2005).
Superb Parrot (<i>Polytelis swainsonii</i>)	No recovery or threat abatement plans have been prepared for this species at this time.
Silky Swainson-pea (<i>Swainsonia sericea</i>)	No recovery or threat abatement plans have been prepared for this species at this time.
Endangered Ecological Community	Response
Myall (Boree) Woodland	No recovery or threat abatement plans have been prepared for this species at this time.

G Whether the action proposed constitutes or is part of a key threatening process or is likely to result in the operation of, or increase the impact of, a key threatening process.

Species	Response
Blue Billed Duck (<i>Oxyura australis</i>)	The action proposed does not constitute or is part of a key threatening process. The action could contribute to the increased potential of predation by the red fox (<i>Vulpes vulpes</i> (L)), or predation by the Feral Cat (<i>Felis catus</i> (L)), both of which are key threatening processes. This increase could potentially be realised via the removal of standard agricultural management practice pressures on red fox and feral cat numbers, or through the potential of increased food sources for these species in the form of rodent occupation of the site, particularly around the grain storage bunkers and freestall cattle feed areas. This potential would only be realised if the action proposed is not managed accordingly.
Brown Treecreeper (<i>Climacteris picumnus</i>)	The action proposed does not constitute or is part of a key threatening process. The action could contribute to the increased potential of predation by the red fox (<i>Vulpes vulpes</i> (L)), or predation by the Feral Cat (<i>Felis catus</i> (L)), both of which are key threatening processes. This increase could potentially be realised via the removal of standard agricultural management practice pressures on red fox and feral cat numbers, or through the potential of increased food sources for these species in the form of rodent occupation of the site, particularly around the grain storage bunkers and freestall cattle feed areas. This potential would only be realised if the action proposed is not managed accordingly.



Bush Stone Curlew (<i>Burhinus grallarius</i>)	The action proposed does not constitute or is part of a key threatening process. The action could contribute to the increased potential of predation by the red fox (<i>Vulpes vulpes</i> (L)), or predation by the Feral Cat (<i>Felis catus</i> (L)), both of which are key threatening processes. This increase could potentially be realised via the removal of standard agricultural management practice pressures on red fox and feral cat numbers, or through the potential of increased food sources for these species in the form of rodent occupation of the site, particularly around the grain storage bunkers and freestall cattle feed areas. This potential would only be realised if the action proposed is not managed accordingly.
Grey Crowned Babbler (<i>Pomatostomus temporalis temporalis</i>)	The action proposed does not constitute or is part of a key threatening process. The action could contribute to the increased potential of predation by the red fox (<i>Vulpes vulpes</i> (L)), or predation by the Feral Cat (<i>Felis catus</i> (L)), both of which are key threatening processes. This increase could potentially be realised via the removal of standard agricultural management practice pressures on red fox and feral cat numbers, or through the potential of increased food sources for these species in the form of rodent occupation of the site, particularly around the grain storage bunkers and freestall cattle feed areas. This potential would only be realised if the action proposed is not managed accordingly.
Painted Honeyeater (<i>Grantiella picta</i>)	The action proposed does not constitute or is part of a key threatening process. The action could contribute to the increased potential of predation by the red fox (<i>Vulpes vulpes</i> (L)), or predation by the Feral Cat (<i>Felis catus</i> (L)), both of which are key threatening processes. This increase could potentially be realised via the removal of standard agricultural management practice pressures on red fox and feral cat numbers, or through the potential of increased food sources for these species in the form of rodent occupation of the site, particularly around the grain storage bunkers and freestall cattle feed areas. This potential would only be realised if the action proposed is not managed accordingly.
Plains Wanderer (<i>Pedionomus torquatus</i>)	The action proposed does not constitute or is part of a key threatening process. The action could contribute to the increased potential of predation by the red fox (<i>Vulpes vulpes</i> (L)), or predation by the Feral Cat (<i>Felis catus</i> (L)), both of which are key threatening processes. This increase could potentially be realised via the removal of standard agricultural management practice pressures on red fox and feral cat numbers, or through the potential of increased food sources for these species in the form of rodent occupation of the site, particularly around the grain storage bunkers and freestall cattle feed areas. This potential would only be realised if the action proposed is not managed accordingly.
Southern Bell Frog (<i>Litoria raniformis</i>)	The action proposed does not constitute or is part of a key threatening process. The action could contribute to the increased potential of predation by the red fox (<i>Vulpes vulpes</i> (L)), or predation by the Feral Cat (<i>Felis catus</i> (L)), both of which are key threatening processes. This increase could potentially be realised via the removal of standard agricultural management practice pressures on red fox and feral cat numbers, or through the potential of increased food sources for these species in the form of rodent occupation of the site, particularly around the grain storage bunkers and freestall cattle feed areas. This potential would only be realised if the action proposed is not managed accordingly.
Superb Parrot (<i>Polytelis swainsonii</i>)	The action proposed does not constitute or is part of a key threatening process. The action could contribute to the increased potential of predation by the red fox (<i>Vulpes vulpes</i> (L)), or predation by the Feral Cat (<i>Felis catus</i> (L)), both of which are key threatening processes. This increase could potentially be realised via the removal of standard agricultural management practice pressures on red fox and feral cat numbers, or through the potential of increased food sources for these species in the form of rodent occupation of the site, particularly around the grain storage bunkers and freestall cattle feed areas. This potential would only be realised if the action proposed is not managed accordingly.
Silky Swainson-pea (<i>Swainsonia sericea</i>)	The action proposed does not constitute or is part of a key threatening process. The action could contribute to the increased competition and grazing by the feral European Rabbit (<i>Oryctolagus cuniculus</i> (L)), which is a key threatening process. This increase could potentially be realised via the removal of standard agricultural management practice pressures on rabbit numbers. This potential would only be realised if the action proposed is not managed accordingly.
Endangered Community	Ecological Response
Myall (Boree) Woodland	The action proposed does not constitute or is part of a key threatening process.



It can be ascertained that from the Assessment of Significance undertaken, no threatened species identified on or surrounding the site, or no threatened species where suitable habitat is represented either on or surrounding the site, or any threatened ecological community represented on or surrounding the site will be impacted significantly by the proposed development.

4.12.2.3.2 Call Playback Results

Call playbacks were undertaken for two (2) species at six (6) different sites over three (3) consecutive nights. The results of which are included in Table 4.12.9: Call Playback Results field records are attached as Annexure 4.12.1. Figure 4.12.3: *Call Playback Sites*, details the location of all call playbacks completed at the site.

Table 4.12.9: Call Playback Results

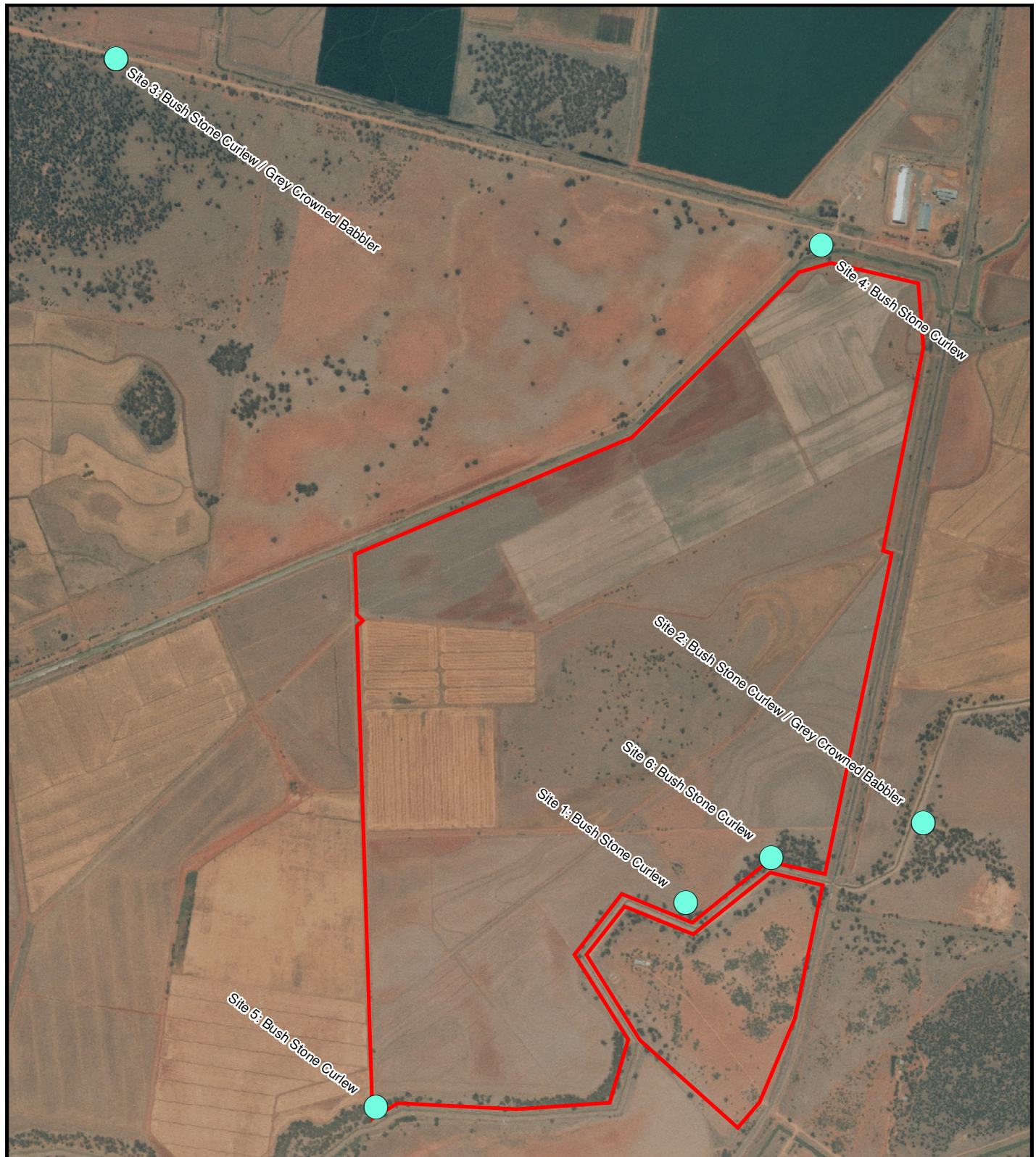
Date	Species	Site No	Response
27/02/06	Bush Stone Curlew	1	No Response
04/03/06	Grey Crowned Babbler	2	No Response
04/03/06	Bush Stone Curlew	2	No Response
04/03/06	Grey Crowned Babbler	3	Genus Species in question
04/03/06	Bush Stone Curlew	3	No Response
05/03/06	Bush Stone Curlew	4	No Response
05/03/06	Bush Stone Curlew	5	No Response
05/03/06	Grey Crowned Babbler	3	Positive species ID
05/03/06	Bush Stone Curlew	6	No Response

The results tabled show no response for Bush Stone Curlew (*B. grallarius*). The results do show positive identification of Grey Crowned Babbler (*P. temporalis*). A population of thirteen (13) individuals located foraging and nesting in roadside vegetation some 3km to the north west of the site along Ercildoune Rd.

4.12.2.3.3 General Avifaunal Observations

Avifaunal observations were conducted across the entire survey area including remnant vegetation, open paddocks and channels. No species observed other than the Grey Crowned Babbler were threatened or endangered, and could be expected to be observed commonly across the region.

Results are displayed in Table 4.12.10.



Proposed Site

Call Playback Sites

0 0.125 0.25 0.5 0.75 1
Kilometers





Table 4.12.10: General Avifaunal Observations provides a summary of individual species identified

No Observed	Family	Scientific Name	Common Name
1	Accipitridae	<i>Milvus migrans</i>	Black Kite
1	Ardeidae	<i>Egretta garzetta</i>	Little Egret
4	Alcedinidae	<i>Dacelo novaeguineae</i>	Laughing Kookaburra
4	Phasianidae	<i>Coturnix pectoralis</i>	Stubble Quail
5	Ardeidae	<i>Ardea pacifica</i>	White-necked Heron
6	Dicruridae	<i>Rhipidura leucophrys</i>	Willie Wagtail
6	Pardalotidae	<i>Gerygone fusca</i>	Western Gerygone
6	Sturnidae	<i>Sturnus vulgaris</i>	Common Starling
7	Corvidae	<i>Corvus coronoides</i>	Australian Raven
9	Columbidae	<i>Ocyphaps lophotes</i>	Crested Pigeon
9	Passeridae	<i>Passer domesticus</i>	House Sparrow
11	Dicruridae	<i>Grallina cyanoleuca</i>	Magpie-lark
13	Hirundinidae	<i>Hirundo neoxena</i>	Welcome Swallow
13	Potatostomidae	<i>Pomatostomus temporalis</i>	Grey-crowned Babbler
15	Meliphagidae	<i>Manorina melanocephala</i>	Noisy Miner
18	Artamidae	<i>Gymnorhina tibicen</i>	Australian Magpie
20	Platyterinae	<i>Psephotus haematonotus</i>	Red-rumped Parrot
45	Psittacidae	<i>Nymphicus hollandicus</i>	Cockatiel
100 +	Cacatuidae	<i>Eolophus roeicapillus</i>	Galah

A total of nineteen (19) species were observed across the survey area. The highest diversity for avifauna was in the Black box woodland areas.

Grey-crowned Babblers were the only threatened avifaunal species recorded during the survey. Grey-crowned Babblers were observed occupying roadside vegetation to the north-west of the site.

4.12.2.3.4 Habitat Search Survey Results

Habitat searches were undertaken to identify presence of the Southern Bell Frog (*Litoria raniformis*). Areas of suitable habitat onsite were limited to the CICL supply and drainage channels, and these habitats were searched by spotlight and where appropriate, call triangulation. No individuals were either seen or heard during the survey effort.

4.12.2.3.5 Other Opportunistic Observations

Whilst conducting the fauna field surveys and during travel inside the study area an effort was made to record all noteworthy fauna species which were observed opportunistically during the execution of surveys and travel within the survey area.

All fauna species that were observed have been included in the Table 4.12.11: Opportunistic Species Observations.

Table 4.12.11: Opportunistic Species Observations

No Observed	Family	Scientific Name	Common Name
1	Scincidae	<i>Ctenotus taeniolatus</i>	Copper tailed skink
2	Myobatrachidae	<i>Limnodynastes tasmaniensis</i>	Spotted Grass frog
2	Canidae	<i>Vulpes vulpes</i>	Fox
30+	Leporidae	<i>Oryctolagus cuniculus</i>	Rabbit
30+	Macropodidae	<i>Macropus giganteus</i>	Eastern Grey Kangaroo

The above table indicates that there were no threatened fauna species opportunistically observed during surveys.



4.12.3 Habitat Value

Having undertaken field surveys for flora and fauna on site, it can be concluded from the species identified when contrasted to the species expected to be present in these types of vegetation communities that, the overall habitat value is extremely poorly utilised. The site is degraded, lacking any real form of understorey or mid-storey and an extremely low prevalence of natural over-storey regeneration. Over-storey age structure for all of the vegetation communities on-site is extremely uniform, with the only evidence of juvenile recruitment of over-storey species being represented in the *Acacia* community. There is reasonable representation within the remnant vegetation on-site of shrub-land species. This representation is composed predominantly of salt bushes, Nitre Goosefoot and various *Chenopod* type shrubs commonly found across the region. Grassland is dominated by exotic grasses and agricultural pasture escapes and weeds with little evidence of healthy stands of native grass.

The remnant vegetation communities on-site showed little to no regeneration due to a number of factors. The most likely of which are the continued agriculture regimes and cropping history of the site, and an extremely high grazing pressure from rabbit populations, particularly in the *Callitris* community. The over-storey species do provide some habitat benefit for avifauna species, which utilise the site for migration between the Boona and Brett's State Forests to the east and west of the site respectively. Surrounding vegetation communities support populations of Superb Parrot, and consequently the area does provide some beneficial forage habitat to the local population.

Beyond these comments, there is little opportunity for occupation by faunal species which classically occupy mid-level and understorey vegetation with the current pressures limiting chance for recruitment. Notwithstanding these points however, there is significant potential for these areas to become valuable habitat provided some form of project site management strategy is put in place to limit grazing pressure, limit weedy competition, increase connectivity and ground cover, and potentially reintroduce a flooding regime to the black box depression areas.

4.13 Heritage

4.13.1 Indigenous Heritage

Both the desktop and an in-field survey have been conducted to identify all known and potential sites of indigenous heritage significance. The desktop search, having involved:

- A review of information contained on the Aboriginal Heritage Information Management System (AHIMS) Database both by Booth Associates; and
- By Steve Meredith of National Parks and Wildlife Service (NPWS) acting on behalf of the Griffith Local Aboriginal Lands Council,

Each search failed to reveal any previously recorded sites of significance both within the project site and the area surrounding the site. Based on previous experience, regardless of AHIMS Database information there was a high potential for particular landforms within the project site to contain sites of indigenous heritage significance.

Steve Meredith acting on behalf of Griffith Local Aboriginal Lands Council was employed to undertake an in-field survey in the month of February 2006. Specific surveying targeted those landforms potentially containing sites of significance namely:

- A sandy ridge running east west through the centre of the property; and
- The remnant vegetation black box woodland depression on the southern boundary of the site.



Following the in-field survey, a number of sites were identified as containing a record of previous indigenous habitation of the area. A potential scar tree was identified on the sandy ridge in the centre of the property. Further discussion as to the nature of this scar tree was to the effect it was created not by indigenous occupation but more likely ancient scarring from bark attack by galahs (*Eolophus roseicapillus*) in a effort to preserve integrity of nesting sites.

A number of scar trees were identified in the Black box depression in the southern part of the property. All evidence of scarring and scar trees identified with the exception of one (1) site in the Black Box Woodland are on fallen timber.



Plate 19:
Galah Scar



Plate 20:
Black Box 1a



Plate 21:
Black Box 1b



Plate 22:
Black Box 2a



Plate 23:
Black Box 2b

In total, three (3) separate scars were found in the Black Box Woodland; however there is the potential for a more exhaustive survey to identify other sites of significance or indicators of occupation of the area. Given that the potential sites are not in an area expected to be impacted by the proposed project, any sites if they do exist will be effectively protected by the project.

In the detailed design and construction phases the potential to impact on previously unknown heritage sites will exist. In accordance with best practice the following procedures will be required:



Plate 24:
Black Box 3

- Stop work immediately;
- Notify NPWS and the Griffith LALC as soon as is possible; and
- Await the NPWS advice before proceeding on their written authority.

The procedure would be documented in the Construction Management Plan. These recommendations are in line with those made by Steve Meredith. The full Aboriginal Heritage Assessment prepared by Steve Meredith is contained as Annexure 4.13.1.

4.13.2 Non-Indigenous Heritage

The Register of the National Estate Database, Australian's national inventory of natural and cultural heritage sites deemed significant and worthy of preservation for future generations, has been searched on the basis of "1:100,000" map sheet. The database is compiled by the Australian Heritage Commission, the Commonwealth Government's advisor on the national estate.

The Register of the National Estate Database was searched using two (2) map sheets, Map Sheet No. 8028 and Map Sheet No. 8128. By searching the database centred on these map sheets all sites listed on the register within a 20km buffer of the proposed development site have been able to be identified. Table 4.13.1 indicates the results of the database search. As can be seen from the table, search of Map Sheet No. 8028 failed to produce any results. Map Sheet No. 8128 identified eight (8) sites.

**Table 4.13.1: Register of the National Estate Database Search Results**

Map Sheet	Description (Name)	List	Class	Legal Status	Register Date	Place ID
8028						
8128	Courthouse Group (former) Darlington Street, Darlington Point NSW	Register of the National Estate	Historic	Registered	18/04/1989	6510
	Dry Lagoon Area, Sturt Highway Narrandera NSW	Register of the National Estate	Natural	Indicative Place		731
	Indigenous Place Darlington Point NSW	Register of the National Estate	Indigenous	Registered	15/05/1990	13709
	Indigenous Place Leeton NSW	Register of the National Estate	Indigenous	Registered	11/08/1987	14807
	Old Warrangesda Mission Darlington Point NSW	Register of the National Estate	Indigenous	Registered	15/05/1990	13708
	Tubbo Station Group Sturt Highway Darlington Point NSW	Register of the National Estate	Historic	Registered	14/05/1991	14328
	Tubbo Station Homestead and outbuildings Sturt Highway Darlington Point NSW	Register of the National Estate	Historic	Registered	14/05/1991	14330
	Tubbo Station Woolshed Complex Sturt Highway Darlington Point NSW	Register of the National Estate	Historic	Registered	14/05/1991	14329

4.14 Greenhouse Emissions

Calculating the net greenhouse emissions from all sources and sinks within and beyond this specific project is a complex procedure and well beyond the requirements of this EA. Despite this complexity there is a need to provide a reasonable and workable broad assessment which generates a practical order of magnitude in the quantum of net emissions. To manage the obvious data deficiencies, a copy of the CSIRO Greenhouse Abatement model was obtained. That model was used to calculate the net emissions from the production and use of ethanol itself. The issues covered by the CSIRO model include:

- Production of grain, its cartage to site;
- Operation of the plant;
- Distribution of the fuel; and
- Impact the ethanol inclusive fuel has on end user emissions.

Attached as Annexure 4.14.1 are two (2) printouts from runs of the CSIRO Greenhouse Abatement Model. The key assumptions for running the CSIRO model were to differentiate the impact of capturing or not the carbon dioxide being generated in the ethanol manufacturing process, viz;

- The first run is based on carbon dioxide emissions being captured, compressed and carted off-site to replace the current usages of carbon dioxide within the Australian economy; and
- The second run of the model assumes the carbon dioxide emissions from the ethanol plant are not able to be captured, compressed and carted off-site.

The above two (2) runs of the model indicate there are net reductions in greenhouse gas emissions from the ethanol component of the proposed development of approximately 275Kt per year and 98Kt per year respectively.

The dairy enterprise itself could be a potential net emitter of greenhouse gases and in particular methane. The supporting operations to the dairy enterprise of silage production could also be potential net emitters of especially nitrous oxide. The importance of these greenhouse gases is best understood when it is realised that a single kilogram of methane emissions equals 21kg of carbon dioxide and a kilogram of nitrous oxide equates of 310kg of carbon dioxide.



An understanding of the incremental changes in these emissions will best place the issues surrounding these greenhouse gases in perspective.

Attached as Annexure 4.14.2 is a spreadsheet which includes calculations on the amount of methane generated from animal digestive emissions and from manure emissions. The calculations for methane digestive emissions are based on 8kg of CH₄/year per dry sheep equivalent (DSE) even though the emitted methane could be a lesser amount under the proposed best practice nutrition in the cattle. The calculated digestive methane emissions total 35.5Kt of carbon dioxide equivalents per year. The manure methane emissions have been discounted significantly on the basis that the majority of the manure will be maintained under anaerobic conditions. By:

- Regularly removing the wet manure from the sedimentation basins;
- Storing same for only a short period of time; and
- Carting direct to “Tubbo” irrigation and/or dryland for immediate spreading on agricultural lands.

This will substantially reduce the quantum of manure methane emissions. Based on best estimates it is expected a multiplier of 0.25 may be conservatively applied to the standard emission allowance of 65kg/dse/year for a beef cattle feedlot. The resultant calculation concludes a net 72Kt/year of manure methane emissions will be generated.

Also included in Annexure 4.14.2 are the calculations for assessing the net emissions from associated farming operations needed to supply input products to the dairy enterprise feed rations. It is expected production of feed, whether it is silage or grain, will replace existing crops and/or pastures on existing irrigation farms. A mid range allowance of 0.5% of nitrogen applications to the “new” feed crops will be converted to nitrous oxide is also assumed. Based on this assumption, there is a potential total emission of 1,286Kt of carbon dioxide equivalents as nitrous oxide. Given the “replacement” assumption may/may not be correct the calculated 1,286Kt has then been multiplied by a realistic 5% to arrive at net incremental increase in emissions. If those displaced crops happen to be rice when will generate methane from the anaerobic conditions in the flooded paddy then the 5% is conservative.

A provision for the carbon dioxide being fixed under the irrigated crops is calculated on the basis that only 5% is potentially sequestered within plant roots and crowns in the technical sense. Under the strict “Kyoto” protocols such an assumption would not be correct. However, through a continual cycle of creating and decaying organic matter being experienced within the soil profile it is a recognised fact that soil organic matter does increase under current management practices.

The model at Annexure 4.14.2 assumes 40% of the carbon dioxide able to be emitted from the ethanol plant is in fact captured and sold as a substitute product into the existing CO₂ market. The assumed 40% has been adopted on the basis that it effectively provides break even point for an essentially no net gain or net loss on greenhouse gas emissions. Therefore, if all the generated CO₂ is able to be captured and sold, then the project is expected to result in a net reduction in overall greenhouse gas emissions.



4.15 Economic and Social Effects

An accurate assessment of all the likely economic impacts would require a totally new and extensive study across a wide section of southern NSW and northern Victoria. Such a study whilst possibly beneficial is not necessary to gain a concept as to order of magnitude of the impacts likely to accrue from this particular project.

The following broad estimates of the economic impacts should be sufficient to indicate that the quanta of impacts are significant and widespread across a diverse range of industries and communities:

- The project expects to employ 100 people on shift work including a diverse range of professionals, quasi professionals and direct labour suppliers. Assuming the average gross wage is \$50,000/annum, the total wages cost would be \$5.0M/year. Assuming the broadly accepted multiplier of 5:1, the gross wages would convert to an economic benefit of \$25.0M/year from wages alone;
- The purchase of 675,000 tonnes of grain per year would equate to the production from 280,000ha to 300,000ha of wheat equivalent cropped hectares in any one year. Assuming the wheat only cropping intensity is say 40%, the 700,000ha of wheat lands are required. Further assuming non-productive areas of 20% (round figures) the farming area needed to supply the wheat would extend to 1M hectares of winter cereal crops (dryland basis) each year. Further assuming only 40% of growers actually deliver their crop to the ethanol project, the total impacted area would extend to approximately 2.5M hectares of arable lands. Given the long standing experience in the Riverina with demands on grain purchases by of the local intensive animal industries, a premium of at \$15/tonne would mean there is \$10.0M/year extra being injected into the economy. On an assumed multiplier of 5:1 this would extend to \$50.0M of additional economic activity;
- The sale of feed products from the ethanol plant of primarily distillers grain is estimated to inject increase revenue of \$15.0M/year. On the assumed multiplier of 5, this revenue stream equates to \$75.0M of additional economic activity. It is noted some of this activity may be a substitute for existing grain purchasing activities and this will be addressed in a later comment; and
- Feed inputs for the dairy cattle. Requiring 90,000 tonnes of silage at \$40/tonnes net equates to a cash generation of approximately \$3.5M/year which, on the multiplier equates to \$15.0M. It is believed most of this activity is a displacement activity for other crops not being grown, therefore the net benefit of feed production for the cattle could be claimed to be zero.

The sum of the above economic activities is \$150.0M/year which is discounted for conservatism to \$100.0M/annum.

The social benefits are diverse and difficult to fully quantify and as a consequence a broad summary could be developed as follows:

- The 100 direct jobs generated at the proposed project could equate to a total of 300 extra jobs in the local communities;
- There will be additional houses required as a consequence of the project in most likely Coleambally and/or Darlington Point;
- The increased economic and social activity will lead to further facilities being available to the local community, which in turn leads into the general feeling of well-being and confidence in the future;



- As has been pointed out by the proponent, the proposed project will be building upon existing substantial investments by the Four Arrows Group. By helping communities help themselves the proponent will be protecting those investments, and provide further encouragement to the proponent for building, yet again upon the already substantial investments in the region; and
- Most importantly, the overall project will be building faith in those communities by the communities themselves.

Any extension of the proposed project beyond the current foreseeable intentions will add to the overall confidence in the communities, the social well-being in the communities and the overall level of continuing economic activity.



5.0 MITIGATION MEASURES

5.1 General Overview

5.1.1 Mitigative Strategy Approach

In the preparation of this EA, specific mitigation strategies have been formulated and assessed for their suitability throughout the investigative process. By undertaking a review of relevant mitigation strategies during the investigation, it is possible to modify the proposed development itself to alleviate as opposed to developing mitigation options that may result in a lesser environmental outcome, or as a worst case scenario, designing a development for which issues raised cannot be mitigated against. If this process is not undertaken at this stage of the project, and it is necessary to develop mitigation strategies for all issues at a later stage of the project development, there would potentially be both lengthy delays to the EA process and the potential to add unjustifiable costs to the project construction and operational total.

The mitigation strategies that have been identified and presented in this EA are only efficient in alleviating environmental, social and economic issues, if the strategies are at the forefront of world best technologies, management strategies and information at hand. The strategies presented within this EA as reviewed are the most appropriate strategies at the time of preparation of this EA and represent the minimum commitment by Four Arrows Ethanol Pty. Ltd. to ensure responsible resource stewardship, economic flow on benefit for surrounding communities and stakeholders, and implementation of leading technologies for the specific project outcomes. That notwithstanding, it may be necessary to modify or alter project specifics at the design level investigations post approval of this EA. In that instance, mitigative strategies will be reviewed and where necessary amended and discussion with relevant stakeholders and agencies would be undertaken to ensure concurrence with desired outcomes. Such amendments to mitigation strategies would be fully documented in the project Environmental Management Plan (EMP), and its sub components the Construction Environmental Management Plan (CEMP) and the Operational Environmental Management Plan (OEMP), as detailed in Section 7 of this EA.

Four Arrows Ethanol Pty, Ltd acknowledge that there are limits and consequences to the way they manage and use their social, economic and environmental assets, and understand that there are critical thresholds that they must ensure are not reached. The mitigation strategies proposed throughout this EA, and summarised in Section 7 are designed to meet this objective.

5.1.2 Monitoring Evaluation and Complaints Management

For any project having an impact on the surrounding environment or community, whether positive or negative, it is necessary to have in place systems designed to allow effective communication between the project developers and the surrounding community or interested parties. Throughout this EA, references are made to ongoing monitoring and review in relation to environmental issues. Prior to the commencement of design and construction of the proposed development, the proponent needs to prepare strategies to report on and respond to issues arising from third parties in relation to on-site operations, mitigation strategies, or other general enquiries or concerns raised by stakeholders and the broader community. Mitigation strategies are only effective assuming a system of regular monitoring, evaluation and auditing is undertaken.



Section 7 of this EA details Four Arrows Ethanol Pty. Ltd. Statement of Commitments (SOC). This serves as a framework to outline the management plans and strategies that will be undertaken prior to the construction and operation of the proposed development. A series of systems of controls and requirements will be developed for this site in the form of an Environmental Management Plan (EMP). Part of this EMP will detail procedures for responding in writing to any and all enquiries and complaints made by stakeholders. This will also include formalised response mechanisms and provision of pathways for further correspondence if unsatisfactory resolutions are not forthcoming to any enquiry or complaint received.

Contained within this EMP will be sub-sections specific to both the construction and operational phases of the proposal namely:

- A Construction Environmental Management Plan (CEMP); and
- An Operational Environmental Management Plan (OEMP).

These plans will detail the nature and frequency of monitoring systems that will be put in place to ensure guidelines specific to various aspects of the proposed development will be monitored. Examples of the monitoring inclusions are:

- | | |
|----------------|---------------------------------------|
| ▪ Air quality, | ▪ Hazards and risk, |
| ▪ Odour, | ▪ Traffic, |
| ▪ Dust, | ▪ Water Quality, |
| ▪ Noise, | ▪ Waste Management, |
| ▪ OHS, | ▪ Habitat and biodiversity monitoring |

This is a vital component of any EMP to ensure some form of public accountability by Four Arrows Ethanol Pty. Ltd. to the community and various local, regional, state and federal agencies. These systems will be developed based on current best practice and complaints management systems will be put in place as a standard operating procedure prior to the commencement of works on the proposed development site.

5.2 Air Quality

5.2.1 Odour

The conclusions formulated by Holmes Air Sciences, and tabled in their report (Annexure 4.2.1) indicate that the proposed development will comply with the DEC impact assessment criteria for gaseous and odour emissions.

If during the design phase of the proposed development there is cause for any reason to relocate or amend the amended draft site layout as displayed in Figure 3.3.2, then remodelling of gaseous and odour emissions would be undertaken. This will ensure re-quantification of any potential impacts from such changes, and results utilised for sensitive site design and layout modifications to reduce impacts to a level that meets DEC impact criteria. In addition, the following recommendations and operating procedures have been made;

- Performance monitoring of air emissions is carried out during operation to monitor ongoing compliance with the DEC criteria;
- In the event of the need to store WDG onsite for periods longer than 24 hours that WDG be stored in an enclosed shed connected to a biofilter for control of any odorous emissions;



- In the event that mechanisms for WDG disposal are halted or negatively affected, that Ethanol production is suspended until alternative disposal mechanisms are identified and implemented;
- Using well maintained high efficiency wet CO₂ scrubber;
- Using thermal oxidizer/heat recovery boiler to control emissions from the distillation system; and
- Minimising VOC emissions from storage tanks using internal floating roofs and utilizing WDG on-site and truck excess WDG from the site as quickly as possible.

5.2.2 Dust

During the production and operation phase of the proposed development dust can and will present as an issue if not managed appropriately. The creation of dust can be reviewed as two (2) separate components and managed as such. These two components namely construction and operation comprise the following issues:

- Construction:
 - o Earthworks;
 - o Industrial refuse and general construction process dust creation; and
 - o Traffic and transport on to and off site.
- Operation:
 - o Dry pens, cattle yards and exercise pads;
 - o Grain storage/transfer/delivery; and
 - o Dry down of effluent management system exposing substrate.

The construction phase of the proposed development is the most likely to generate dust. This dust issue is not specific to concerns of neighbouring residencies and industrial development, but more as an impact on traffic and transport utilising the Kidman Way. Management strategies need to be put into place to manage dust during earthworks and construction of both the proposed Ethanol Plant and Dairy Enterprise. The use of water trucks and various sedimentation and dust capture systems would be utilised. Detailed dust control and general site and environmental management systems are identified in the following publications:

- RTA:
 - o G35 (Ed 2 REV 2) Environmental protection (management plan);
 - o G36 (Ed 2 REV 2) Environmental protection (management system);
 - o G38 (Ed 1 REV 1) Soil and Water Management (Soil and Water Management Plan); and
 - o G39 (Ed 1 REV 1) Soil and Water Management (Erosion and Sediment Control Plan).
- Department of Housing:
 - o Managing Urban Stormwater: Soils and Construction “Blue Book” 4th Edition. Department of Housing, 2004.

These will be referred to during this phase of development.



From an operational perspective there are longer term management systems which will need to be employed to ensure dust does not present as a major issue for surrounding land users. Cattle yards and dry pens, exercise yards, etc. would be expected to create large quantities of dust in dry condition, however the use of misting and sprinkler type systems to control dust and keep dust levels to a minimum, particularly shortly after dawn and before dusk when air movements are most likely to create dust issues, will be utilised. Grain transfer and storage will invariably create issues with dust, however the use of hooded augers and screened transfer sites will minimise potential for grain transfer to create dust.

The effluent management system is not expected to dry down to a point where exposure of bunded surfaces will create a dust issue. The area of highest potential for dust would be in the periodic drying down of the artificially created wetland. It is envisaged, however that a minimum volume of water will be maintained in the wetland for environmental purposes and consequently this should alleviate any issue from substrate exposure creating dust. The movement of transport on to and off site and the movement of management vehicles and delivery services within the site itself will not generate dust as it is proposed that all roadways within and surrounding the property will be sealed.

5.3 Noise

5.3.1 Construction

The potential for the generation of noise during the construction phase of the development is predicted to significantly exceed the day time noise goal (of 40+ dB) by up to 14 dB at the closest (170 metres) residential receiver (Farm 641). The noise goal is unlikely to be met until the construction works are at a distance of at least 900 metres from the residential dwelling. It is therefore recommended that:

- An acoustic barrier in the form of an earth bund (mound) or fence is constructed between the construction works and Farm 641; and
- A two (2) metre high barrier constructed on the residential boundary line is likely to provide a noise reduction of approximately 5 dB if it cuts out the line of sight between the construction works and the residence.

5.3.2 Operations

On-Site

Assuming hammermills and other associated stationary plant onsite are housed appropriately (pursuant to design level investigations), then there are no issues arising from the Noise Impact Statement (NIS). Consequently, there is no requirement to provide mitigative strategies to address excess noise emanating from the proposed development, other than to undertake regular audits of noise levels to ensure operation continues to meet noise goals as established.

Off-Site

Figure 4.3.1 identifies noise receptors close to the 400 meter buffer limit for achieving EPA noise goal limits. Only one (1) receptor is identified as being within 40 meters (39m) off the highway. Hours of operation for transport movements onto and off-site will be limited to daylight hours (7.00am – 10.00pm) to minimise impacts on identified receptors.



5.4 Traffic

Annexure 4.4.4 details that the highest volume of traffic in any one (1) given hour of the week during the sample period was measured at station 977.119 located 0.4km south of the Sturt Highway along the Kidman Way as 165 vehicles per hour. Another station in the area between Hogans Lane and Cattanach Road (Annexure 4.4.3) reveals that approximately 20% of the vehicles travelling along that section of the Kidman Way are of the heavy vehicle class. This equates to a total of 33 heavy vehicles at the highest volume hourly period. With the addition of twenty (20) heavy vehicles generated by the proposed development this results in a total of fifty-three (53) heavy vehicles per hour.

This figure is well under the maximum heavy vehicles per hour recommended within the RTA's *Section 4 – Interpretation of Traffic Impacts* (Annexure 5.4.1) at 15% heavy vehicles to maintain Level of Service B.

It has been assessed that the majority of the Kidman Way currently enjoys free flowing traffic as described within the *Guide to Traffic Generating Developments Section 4 Interpretation of Traffic Impacts* (Annexure 5.4.1) as level of Service A:

“This, the top level is a condition of free flow in which individual drivers are virtually unaffected by the presence of others in the traffic stream. Freedom to select desired speeds and to manoeuvre within the traffic stream is extremely high, and the general level of comfort and convenience provided is excellent”.

This may decline to Level of Service B which states:

“This level is in the zone of stable flow and drivers still have reasonable freedom to select their desired speed and to manoeuvre within the traffic stream, although the general level of comfort and convenience is little less than that of the level of Service A “.

Service Level B will particularly apply to the more built up areas such as Darlington Point

Two major areas have been identified which will incur major impacts by increased traffic volumes from the proposed development. These being:

- The access and egress of the development site which has been discussed in the previous section; and
- The Willbriggie railway crossing.

Access and Egress

Conceptual designs of access and egress to the site for both heavy and light vehicles have been developed by Xeros Kendall Consulting Engineers, and their designs are included as Annexures 4.4.11a. These designs are only preliminary examples of the access and egress modifications required for the union of site access to Kidman Way, and more detailed consultation with RTA engineers would need to be undertaken post approval of this EA.

Willbriggie Railhead

The Willbriggie railhead will be significant to the success of the development as this is where the majority of inputs required by the ethanol plant and the dairy enterprise will be amassed and then transported to the development site. This bulk transport will actively involve a large amount of heavy vehicle movements generated by the proposed enterprise.



Plate 25:
Willbriggie Railway Crossing
(northern approach)



Plate 26:
Willbriggie Railway Crossing
(northern approach)

To minimise the impacts of increased traffic volumes may require the Willbriggie site to undergo alterations or roadway upgrades. This development will be consistent with other improvements along the Kidman Way such as those which can be seen further south at the River Road/Kidman Way and Kingfisher Avenue/Kidman Way intersections. These improvements will include:

- Turning Lanes,
- Slow down entry lanes,
- Passing Lanes,
- Speed up merging lanes.



Plate 27:
Kidman Way/River Road Intersection
(northern approach)



Plate 28:
Kidman Way/Kingfisher Avenue
(southern approach)

Specific engineering designs will be submitted after the development application phase and before the construction approval phase fulfilling all requirements of RTA Guidelines. Recommended configurations are intended to provide a conceptual indication at this stage of the approval process.



The Willbriggie railway crossing also maintains a 100km/hr speed limit which could be considered to be inappropriate should there be an increased of heavy vehicle movements. A sweeping bend on the northern side of the rail crossing adds to accident risk when vehicle movements are increased. Heavy vehicles approaching the Willbriggie siding ingress and egress from the bend have limited vision of the potential activities ahead and reaction time is further limited at high speeds. Attention to limiting vehicle speeds at Willbriggie will go further towards insuring safer vehicle movements. It is not suggested any major works need to occur to realign the roadway; however some roadworks will be required on upgrading road shoulders, etc at this bend.

Intersections throughout the township of Darlington Point will be affected to some degree with the increase of vehicle movements. Some delays may be experienced entering and exiting from minor roads along the Kidman Way within the township's boundaries. Collision risk will be kept at a minimum as the current speed limit throughout the townships is 50km/hr. It is crucial this speed limit be enforced and adhered to by all classes of vehicles.

There are a number of other intersections along the Kidman Way identified as possibly being affected by increased traffic volumes. These being:

- Ringwood Road and Boondilla Road intersection along the Kidman Way;
- Ercildoune Road and Eulo Road intersections along the Kidman Way; and
- To the south of the development, the Morundah Road/Kidman Way intersection.

These intersections may need further review in the future project detailed design phase as to a decision for major roadwork upgrades.

There are a number of bus stops along the Kidman Way and within the affected area and which are considered adequate and appropriate at this time. These bus stops may need further examination and consideration for upgrade when vehicle volumes increase. They are currently stopping bays incorporated into the road shoulders. These areas may require more sophisticated roadwork design including slow down, speed up merging lanes and stopping bays a safe distance from the major thoroughfare.

Mitigating impacts can also be addressed via project management practices as well as engineering solutions. It has been identified that backloading and carpooling can minimise the amount of vehicle movements per day onto and from the site, as well as along the Kidman Way north and south and intersecting roads. Light vehicle movements could be further decreased with the provision of a staff bus service which would alleviate the need for the use of private light class vehicles. This project bus would provide a significant decrease to the impact of high vehicle movements during peak volume periods along the Kidman Way.

Temporary speed limits may need to be addressed for peak volume seasonal periods such as those at the rice sheds etc. during rice harvest in April/May. The majority of the Kidman Way is subjected to a 100km/hr speed limit which is possibly unsafe during these peak grain harvest periods as no turning or passing lanes are present at these sites except for a left hand turn lane for northern approach vehicles at Coleambally rice sheds and passing shoulders for vehicles approaching from the south. Current seasonal traffic coupled with the consistent movement generated by the development may necessitate slower seasonal speed limits being introduced. A review of the Kidman Way speed limits may not be necessary if road upgrades are conducted at these critical positions.



5.5 Water

5.5.1 Surface Water

5.5.1.1 Overview

The key principles in mitigating any adverse impact on or by surface waters are driven by the following parameters:

- Capture and direction of each category of water emanating from the project component operations and from rainfall events to appropriate water receipt and storage points;
- Prevention of all surplus and/or uncontrollable water running off-site into either regional drains and/or onto other lands;
- Preventing any other surplus waters running onto the project site, unless that water naturally flows through the site in of natural drainage courses and there is no other alternative to avoid this occurrence;
- To avoid any contamination of water on site by any means other than that through normal operations; and
- To performance monitor all water movements onto, and within the site, and if event based circumstances demand it, off site.

Of the above guiding principles the available evidence as described in Section 4.5, there is no natural drainage line through the project site and any other surface water which may be generated regionally through either other operations non related to this project or from rainfall events are already prevented from running on site by the pre-existing Kidman Way. Regional drainage is also aided by the presence of the main drainage channel DC 400 running across the southern edge of the site.

Key Issues: The total site topography to be modified to ensure the entire site will freely drain to relevant collection/management points and that no water will accumulate outside designated pondages.

There are no apparent depressions and/or drainage lines which may hold surface water either on an intermittent, frequent or continuous basis on or around the site. However, along the north and north-west boundaries of the proposed development area is a main channel owned and operated by CACL. This main supply channel services an area to the south and south-west of the project site encompassing an unknown but significant number of irrigation farms of an average approximate area between 200ha and 300ha. The full supply level in this channel has not been measured accurately although it is obviously and substantially above the natural surface level of the entire project site. As a consequence, water would be inclined to run from the channel into the project site rather than vice-versa if the channel embankment failed.

There is no obvious means by which water or other contaminants move from the project into the main channel.

Discussions with CACL indicate they do not hold concerns with adverse impacts on the channel by the proposed development.



Discussions with CICL have indicated potential concerns with entry of water into the main drain running along the southern boundary of the project site known as DC 400. Ingress of water into this main drain is addressed further in subsequent sub-sections of Section 5.5.1.11.

A substantial bund or containment bank which could also be used as a site access road is required around the entire dairy enterprise area and its associated waste treatment facilities. That bund embankment should contain all foreseeable spillage and/or rain run-off events. Conversely, the same bund embankment will keep out externally generated water from the most environmentally sensitive parts of the project site. Similar bunding will be developed to encompass operational areas surrounding the ethanol plant, and capture areas for both proposed bunds are displayed in Figure 5.5.1: *Rainfall Capture Bunding*.

5.5.1.2 Chemical Storage

Chemical storage has been identified separately because some of the chemicals stored on site will need to be stored at a convenient central and dedicated storage point. The main issues to consider on chemical storage which relates to surface waters are as follows:

- An appropriately designed shed which has been designed and constructed to full OH & S and to chemical storage best practice;
- Security against entry by unauthorised persons;
- The excluding of excess waters, rainfall, etc from the storage area and dedicated chemical mixing areas;
- An appropriate capture point for any spillages which may occur. This capture point shall be constructed to contain all spillage and allow recovery and appropriate cleaning up,
- Any spillage to be cleaned up and any potentially contaminated areas to be managed in accordance with an appropriate chemical management plan; and
- Training of staff/accreditation and schedule records, signage etc.

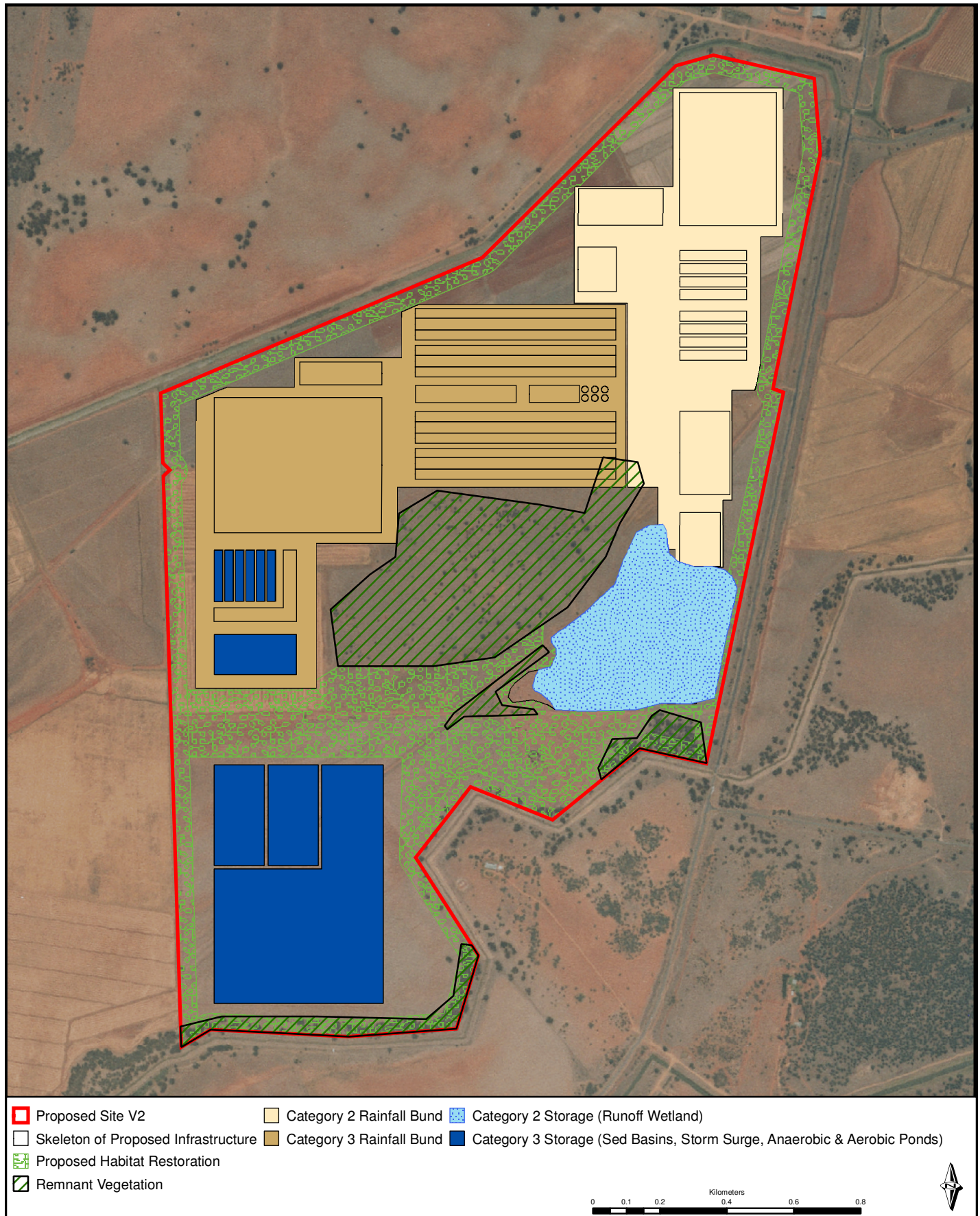
It is expected the chemical storage facility will contain all chemicals in an appropriate manner for the ethanol plant, grain storage facility and any veterinary products and animal health products for the dairy cattle and dairy barn.

A register of all chemicals arriving on site, used on site and removed from the site shall be maintained as per the site environmental management plan.

5.5.1.3 Workshop Area

The workshop area as depicted in Figure 3.3.2 is expected to have a diesel and petrol storage facility with associated oil and lubricant storages.

Each of these storage facilities and their management shall be in accordance with best practice and where appropriate, bunded with an in-built drainage structure designed in such a way as to capture any spillage and to appropriately manage such spillages. In particular, no spillage is to be allowed to move off the immediate section of the project site and the facility designed to prevent any water entering that site, other than that which is introduced purposely for local site management. Any roof or other run-off will be directed to the appropriate category storage facility. In broad terms this would be as follows and would be subject to final detailed design investigations prior to construction. It would include:





- Roof and other elevated surface run-off which would contain good quality or Category 1 water could be first captured into an appropriate storage for eventual upgrading for use in the ethanol plant itself and for use as potable water around the project site as appropriate; and
- Surface run-off from roads and other pavement areas which may be best directed at either Category 1 or Category 2 water capture points would be isolated and directed as appropriate.

5.5.1.4 Ethanol Plant

Any water coming from the wet distillers grain would need to be managed to ensure it does not contaminate any water source. It is believed the wet distillers grain will be partially de-watered in response to a cost benefit assessment according to the market for wet or partially dried distillers grain. The cost of freight, and those associated with extracting the moisture, will be the key drivers of future decisions. Water within the wet distillers grain will have a value for re-cycling back through the ethanol plant and the cost/benefit analyses of either applying more energy to dry the wet distillers grain and/or paying more freight costs will determine the level of drying.

In essence, the surplus water will be directed as appropriate from the site for the short term to appropriate storage facilities, where the water may be managed as is best for the site according to the category of water being generated.

Given the fact that additional water will need to be brought on-site from CIEL, any opportunity to recycle on-site will minimise the cost of purchases in the capital sense and operating sense in any one year. Hence, the water has a major value and shall be contained and stored as appropriate

5.5.1.5 Grain Storage

The grains storage area will be characterised by water resistant tarpaulin covered grain bunkers. These bunkers shall be raised and mounded in the middle to create a modest slope to each side and with a perimeter retaining wall along each side for retention of grain. At the base of the grain walls shall be points where water from rainfalls may run off from those sections of the bunkers which do not have grain stored on them at that point in time. Outside the retaining wall will be a continuation of the same slope with an access road around each and all of the grain bunkers for vehicular movements and general maintenance.

In between each bunker shall be a series of drains which will have an appropriate bed slope to drain the water away to a capture point for recovery into the appropriate water storage (most likely Category 2). Retention of water within the drainage system around each and all of the bunkers shall be of a short duration so the water may be recycled on-site minimising the amount of water needed to be purchased on an operational and permanent transfer basis.

All areas shall be maintained with grass cover to minimise and prevent significant erosion around the grain bunkers.

Grain which becomes mouldy or weather damaged shall be collected, removed and treated as appropriate. The point of usage of such affected grain shall be an area of "Tubbo" where the grain, after breaking down, shall be of benefit to the soil and to the best benefit of the landscape.



5.5.1.6 *Truck Wash and Workshop*

It is expected a truck wash will be established on-site to clean down trucks. The nature of the products being carried onto and off the site are many and varied and hence cleanliness will be a significant requirement to ensure trucks entering with product are able to move back off the site with a range of loads which may be available to them. Some of the product which may need to be cleaned from trucks will be as follows:

- Mud;
- Manure;
- Wet or dry brewer's grain;
- Grain for the ethanol plant and cattle;
- Livestock transports;
- Transports which have carted dead livestock to "Tubbo" for burial;
- A diverse range of other products required for the effective operation for the ethanol plant and the dairy facility as well as general operations and cleanliness of vehicles; and
- General road grime and detritus.

Each of the appropriate categories of product being washed from small vehicles and trucks and equipment will need to be separated and/or managed so the water is able to be directed to the appropriate category storage and the waste products are able to be accumulated and managed appropriately.

By segregating the washdown products, excess water and drainage of the general site, there will be no accumulation of water to impact upon other surface waters and/or groundwater.

5.5.1.7 *Dairy Cattle Areas*

All areas associated with the dairy cattle operation are expected to be bunded to such a height that any foreseeable major storm event can be contained on-site and operations still maintained as normal. The bunding structure is expected to duplicate as a road to enable full access to all areas around the livestock operations. Having a total containment area around the cattle area, will include the following:

- Milking barn with cattle wash-down area;
- Milk storage containers;
- Freestall sheds with associated loafing/exercise yards and laneways;
- Commodity shed for mixing and storing feed for the dairy cattle;
- Short term commodity storage for feed mill;
- Feed mill;
- Maternity sheds;
- Animal health sheds for animals which are sick at any point in time;
- Cattle working yards;
- Dry pens for the growing and joined heifer prior to their entry into the dry cow section of the freestall sheds;
- Sedimentation basins;



- Manure aggregation area;
- Surge water storage; and
- Pumping station from the surge storage into anaerobic ponds.

The southern most alignment of the containment embankments will, along the southern edge of the surge pond and excess waste, be pumped through a pipeline to the anaerobic ponds.

The total containment area is designed to hold all run-off from a 150mm storm event:

- Falling immediately on top of a complete flood wash of the freestall sheds; and
- Prior rain events which have saturated other areas within the total containment area to near field capacity such the run-off factor is approaching 1 rather than the standard 0.8.

All water within the containment area will end up via designed pathways, into the sedimentation basins, and ultimately into the surge storage where the pump station will lift the water into the anaerobic ponds within 12 hours. This short timeframe will enable any future storm even to be likewise managed.

The procedures for effective waste management discusses issues relevant to mitigation and provide further detail on how the mitigation of water run-off may be best managed.

The possible exception to rain falling within the bunded area being directed to the surge storage and anaerobic ponds could be the roof water from the covered areas within the dry pens. Water from the roof area of the freestall pens, commodity shed and feed mill may be collected separately and directed in most likely pipes to a Category 1 and/or Category 2 water storage as the case may be at the time of the event and status of each of the storages.

5.5.1.8 *Manure Management Area*

The manure collected from the bobcat scraping of the flood lanes in the freestall sheds will include:

- Regular maintenance scrapings of the dry pens; and
- Regular cleaning of the sedimentation basins.

The manure shall be stacked on a sealed area with its own separate catchment within a separated bunded area as further discussed in Section 5.5.2.13.

The particular aim for the manure storage area is:

- For the manure to be collected on a daily basis as soon as it has drained sufficient moisture; and
- Carted to “Tubbo” irrigation and/or dryland farming areas for spreading on those areas to enhance farming operations.

Hence, manure storage is not expected to be for any length of time and any run-off from a storm event on the manure heap will be re-captured within the sedimentation basins for reprocessing as per the normal operation of a sedimentation basin area.



When the manure is broadcast on the “Tubbo” irrigation station area such manure is not expected to affect the local area and/or regional surface waters. The reason being “Tubbo” irrigation is effectively a closed system whereby all drainage from the irrigated lands is returned to re-cycling storages and/or to the existing irrigation. It is also expected whatever manure is spread shall be subjected to a cultivation and incorporation into the soil for maximum soil benefit and rapid breakdown of the organic matter within the manure.

On “Tubbo” dryland areas the manure will be broadcast at such a rate (6 tonnes/ha maximum) so as to not run off into nearby surface waters which currently do not exist. During the dry season when manure is broadcast, the soil will be sufficiently dry to accept the first substantial falls of rain into the soil profile rather than run off into drainage lines or other depressions. During the winter period the amount of manure spreading on dryland will be minimised and preferentially directed to the irrigation area. That which is applied to the dryland farming areas will be subject to cultivation to ensure incorporation and thus a reduction in the potential to be carried off-site in a major rain event.

The application of high organic loads in the manure is expected to increase the infiltration rate of water into soils over time. This will reduce any potential run off and minimise potential impacting upon local or regional surface waters.

“Tubbo” is of a size whereby all water running off the manure application areas, even in an extreme storm event, would remain on the property itself.

5.5.1.9 Office, Amenities and Landscape

The total project area will be landscaped to enable drainage lines to direct water flowing off the landscape and other amenity areas to collection points for capture in the appropriate category water storages.

All landscaped areas will be grassed and/or treed along with shrubs placed in an appropriate manner to prevent any erosion and to minimise the rate of water aggregation at the pump stations and/or collection points.

5.5.1.10 Road and Other Infrastructure

All roads will be sealed with appropriate drainage points leading to most likely Category 2 water storages; although it is possible some or a large part of the water may be directed to Category 1 water storages. The final design will be determined before construction commences.

5.5.1.11 Drainage Off-Site

The water modelling depicted in Section 4.5 affirms all water, rain or otherwise will be able to be captured and contained within the water storages proposed for the site. Even in extreme storm events the water shall be captured and stored on-site.

Notwithstanding, there is the potential for an indefinable storm event or series of storm events to occur, where surface waters are unable to be contained on-site and in the proposed water storages.

To manage this potential eventuality the design of the site is such that:

- All initial rainfall events may be captured and stored; and
- It is only once rainfall events beyond approximately 150mm within 24hours are received that potential water may run off-site. Such a rainfall event is yet to be experienced in the CIA.



In such a case this water shall be directed to the main drain DC 400 with the concurrence of CICL. In this instance, initial runoff from non productive areas of the development would not contain any contaminants dissimilar to surrounding farmlands within the region. Given the nature of habitat restoration and native landscape proposed for the site, it could be considered that a process of natural filtration of runoff water would operate, with grasses and forbs removing particulate and nutrient matter from water, pre-site escape.

Post initial runoff of non production dedicated lands, and assuming a rainfall event of a magnitude and scale capable of filling all productions dedicated area bunds and associated water category storages takes place, any escape of waste water offsite would be diluted in the extreme, thus negating issues specific to nutrient and salt loaded water affecting surrounding land and stakeholders.

5.5.2 Groundwater

5.5.2.1 Overview

The assessment of the status of groundwater within and around the project site was presented in Section 4.5.3. The conclusions were:

- Groundwater is present at 10+m below NSL and levels are now consistently falling after a period of rising groundwaters throughout the CIA;
- The falling water tables are due to the combined effects of more appropriate land usages within the CIA following the implementation of the LWMP and the concurrent extended period of lower rainfalls;
- There is evidence of movement of groundwater between the upper and lower Shepparton formations and the Calivil formation; and
- The flow of groundwater is trending to the north west where a significant number of irrigation production bores extract water from principally the Calivil formation.

The groundwater assessment, in Section 4.5.3 concludes that, in the absence of appropriate site management there is a potential for adverse impacts on local and regional groundwaters. The available evidence is that the impacts may be in two (2) broad levels namely:

- Add more water to the existing groundwater; and/or
- Add contaminants to the existing groundwater.

Whilst it may be argued that the nearby bore irrigators could mitigate any adverse impacts of essentially “water only” accession and in fact may benefit from such accessions, it is less than best practice to even consider such options.

In recognition of the potential risks to groundwaters, the project geotechnical engineer/hydrogeologist and soils specialist/geomorphologist were specifically requested to address the issues of:

- Soils/landscape suitability for the proposed project; and
- The capacity and means to mitigate against adverse impacts on groundwaters.

The mitigation capacity and means issues will be addressed in the following sub-sections.



5.5.2.2 *Matching Soils and Infrastructure*

The Wrigley-Dillon investigations (Section 4.7) identified four (4) main soil types on the project site with their approximate distribution as follows:

- | | | |
|-----------------------------|---|---------------------|
| ▪ Sands | ≈ | 12% of project area |
| ▪ Red/brown earths | ≈ | 57% of project area |
| ▪ Grey transitional soils | ≈ | 25% of project area |
| ▪ Black self-mulching clays | ≈ | 6% of project area |

With the exception of the sandy soils which were to be excluded from any development the majority of components of the initial site development plan were considered compatible with the associated soils. The exception was the initial proposed location of the anaerobic and aerobic ponds which were then relocated further south closer to DC400 to avoid an area with inappropriate sandy soils and/or soils with sandy layers and/or sand veins. The readjustment of the site plan is demonstrated in the changes between Figures 3.3.1 and 3.3.2.

Having made the recommended adjustments to the initial site development plan, Wrigley-Dillon has concluded that:

- The soils themselves will, for specific infrastructure components such as water storages, dairy free-stall sheds and heifer drylot pens require site and situation specific engineering to ensure mitigation against accessions to groundwater;
- Further groundwater site and situation specific geotechnical investigations will be required during the detailed design phase to ensure best construction and operational outcomes; and
- The soils matched to each proposed component of the project infrastructure have the capacity and means for mitigating against groundwater accessions.

Each of the individual mitigation measures against adverse groundwater impacts will be addressed in the following sub-sections.

5.5.2.3 *Ethanol Plant*

This project component is to be situated on a mix of red/brown earths and grey transitional soils. The intended mitigation measures are as follows:

- All ethanol manufacturing input materials/chemicals and ethanol/distillers grain storage areas will be constructed on a concrete base and where appropriate to control potential spillages will be bunded to ensure containment;
- Access roads will be sealed with bitumen and/or concrete as needed at each point and will be shaped to deliver any run-off to segregated and dedicated collection points for specific management;
- Roof and other similar run-off will be captured and delivered to the Category 1 water storage with surplus water to the Category 2 water storage;
- The areas in between the ethanol plant infrastructure will be laser leveled to ensure a continuous slope to dedicated capture points for delivery of run-off to the Category 2 storage;
- To manage an extreme or unplannable (spillage) event, each of the run-off capture points shall have sufficient capacity lining to contain the spillage until that spillage has been managed in accordance with best practice procedures;



- Landscaping, with the exception of a limited area around the laboratory/administration area shall be planted to locally indigenous and deep rooted trees, shrubs, and perennial under-storey. The deep rooting species will optimise the interception of water likely to deep percolate into the groundwater and manage changes to regional groundwater imposing on the project site;
- The plantings will not be irrigated beyond the need to ensure establishment;
- The initial and laboratory area irrigation shall be by a designed drip system with applications planned and monitored to ensure soil moisture content does not exceed 50% of maximum readily available water (RAW);
- No fertilisers will be applied to the native vegetation to ensure on-going vegetation health and that periods of sustained heavy rain do not leach nutrients into the groundwater;
- Ground cover will be maintained all year with the level of slashing consistent with best practice fire hazard management; and
- Installation of at least two (2) piezometers, the location of which would be determined by the geotechnical engineer during the footings and other detailed design investigations.

The area in and immediately around the ethanol plant will be performance monitored with the benefit of the on-going operations of the project meteorological station.

5.5.2.4 Category 1 Water Storage

To be constructed on a red/brown earth near the south west corner of the ethanol plant. The Wrigley-Dillon investigations have emphasised that the B1 horizon of the red/brown earth is not considered suitable for water storages, but the deeper soil layers extending from 0.4m to 2.0m are suitable. Therefore particular care in the planning, designing, construction and operation of this storage will be required. Mitigation measures against adverse groundwater impacts shall be:

- The engagement of a geotechnical engineer with longstanding and peer respected experience with the design, construction and operation of such storages;
- To conduct detailed design level investigations prior to designing the storage and preparing detailed construction plans;
- To monitor construction of the facility and in particular to seek and respond to evidence of integrity compromising factors such as the presence of shoe-string sands, sandy lenses, changes in soil layers and changes in soil pedology;
- To install a compacted clay liner of no less than 600mm thickness which shall be subjected to replicated permeability tests based on an industry recognised minimum spatial grid distribution system affirming a deep percolation rate of no more than 1×10^{-9} m/sec;
- To install a membrane liner only if the project geotechnical engineer so determines;
- The embankment to include a compacted core which shall extend into a key reaching 3.0m below NSL;
- To install three (3) monitoring piezometers at locations and to depths required by the project geotechnical engineer. It is important to note that CICL have recorded some main channel seepage losses in the vicinity of the proposed Category 1 storage and have advisedly addressed that problem. The proposed monitoring piezometers will need to be carefully managed to ensure differentiation between CICL and project water;
- To maintain no less than 50ML of water in the storage to ensure no cracking and loss of integrity of the clay liner;
- To install monitoring equipment such as depth gauges and meters for measuring volumes in and out of the storage;



- To install and performance monitor a leakage detection and monitoring system; and
- To performance monitor the storage and regularly (no less than annually) undertake and record an accurate inventory of all water sources and sinks using the project meteorological station to calculate evaporation losses.

Being used for high quality water storage there should be minimal issues of concern with the facility assuming the design, construction and commissioning is undertaken by the appropriate geotechnical engineer. Operationally enhancing factors favouring minimal risk area:

- Build-up of biological slime and mono-saccharides under continuous anaerobic conditions in and below the compacted layer;
- Sedimentation of fine clay and silt particles on the surface and in the upper layer of the clay liner leading to some pore clogging; and
- Some beneficial soil dispersion within the compacted clay layer which will clog pore space.

Whilst the above benefits are expected to enhance operational performance and integrity and further reduce deep percolation losses to less than 1×10^{-9} m/sec, there will be no absolute dependence on such benefits and the need for best practice performance monitoring shall not be compromised.

5.5.2.5 Grain Storages

The proposed grain storage bunkers are located on largely grey transitional soils with some red/brown earth soils on the southern end. Mitigation against potential adverse groundwater impacts shall be:

- The floor of each bunker shall be bitumen sealed on top an engineered, compacted layer and surrounded by a 1m wall;
- The bunker floors shall be convex to shed any run-off water towards or surrounding, and integrated drainage line lasered to a constant slope and leading to a dedicated capture point for pumping into either of the Category 1 or 2 water storages as appropriate for the particular event;
- Access roads into and out of the grain storage area shall be bitumen sealed on an engineered foundation with run-off directed to the integrated drainage system;
- Chemicals for insect pests of stored grain shall be separately stored in the project chemical storage facility associated with the ethanol plant;
- All chemical usage will be undertaken by qualified staff to operationally strict and legally compliant standards including a documented record of all inventory changes and usage circumstances;
- Weather damaged grain will be immediately loaded onto a truck/s and taken to “Tubbo” where it will be evenly and thinly spread on agricultural lands where it may decompose to the benefit of that land;
- Landscaping with deep rooted trees and shrubs will be sufficiently removed from the roads and bunkers so as to not compromise their integrity;
- Native grasses and herbages will be established in between all the bunkers and along the integrated drainage lines to mitigate against erosion. These grasses and herbs may be occasionally slashed to comply with fire risk management needs;
- The use of deep rooted species and their non-irrigation (except for limited drip irrigation to ensure establishment) will ensure any rain water entering the soil profile is intercepted and transpired to the atmosphere. These species will also assist in the management of rising groundwater resulting from activities and events outside the project area; and
- Subject to geotechnical recommendations, a simple piezometer could be established near the southern end of the bunkers and the piezometers for the ethanol plant should suffice for the northern end of the bunkers.



The pump station/s to direct the captured water run-off to the Category 1 and/or 2 water storages will need sufficient capacity to have moved all water from a 50mm rainfall event within 24 hours.

5.5.2.6 *Workshop/Truck Wash-down*

This integrated facility will be constructed on an engineered and compacted earthen foundation and have either a concreted floor or bitumen seal. The area will also be levelled and/or graded to uniform slopes to direct all run-offs to dedicated and sealed capture points of designed capacity for subsequent run-off management. Relevant comments are:

- Biologically degradable truck wash-down will be pumped direct to the anaerobic ponds for management through the Category 3 water reclamation system;
- Other truck wash-down water will be managed through a series of traps to capture sediments and to skim oils/fuels. Thereafter, the remaining water will be directed as best deemed on a case by case basis to the Category 2 and/or 3 storages; and
- Oils and other materials from the engineering and service workshops will be captured and managed according to the nature of the segregated products. For example, oils and greases into drums/tanks for off-site re-cycling, scrap metal and other filings to dedicated regional solid waste facilities and/or scrap metal merchants, etc.

This component infrastructure will be totally sealed with the project design engineers determining the capacity and relationship of each of the sub-components. The guiding principle for the engineers will be that the run-off management works should have the capacity to hold the water from a 100mm event for pumping out over a 24 hour period.

The only landscaping shall be some perimeter plantings of deep rooted native trees, shrubs and perennial understorey. The trees and shrubs will need to be sufficiently removed from the engineered surfaces to ensure their integrity is not compromised. Sufficient slashing of understorey will be needed to reduce fire risk.

5.5.2.7 *Office/Administration/Visitor Areas*

All buildings, landscaping, carpark areas and access roads are situated on red/brown earths.

The visitor centre is initially a simple and relatively small building dedicated as a rest room area from which people may walk further into limited interpretive and environmental areas around the northern sections of the shallow Category 2 water storage. Eventually this area will be expanded into an additional value-adding business at which time it will be subjected to a separate environmental and commercial assessment.

The following mitigation measures will be undertaken to prevent adverse impacts on local and regional groundwaters.

- Each of the buildings will be designed by an architect with the footings and structures affirmed by the project geotechnical and civil engineers;
- The access road/s, carparks and walkways will be bitumen sealed on engineered foundations. These areas will be convex in shape to ensure drainage is directed to dedicated capture points for presumably pumping to the Category 2 and/or 1 water storages as is appropriate for the quality of the water being received;
- Grey water and sewerage will be directed to dedicated and “off the shelf” treatment plants for full reclamation. Once reclaimed to acceptable standards the water will then be used for buried drip irrigation of the surrounding landscaped areas, eg: lawns, shade trees, garden beds, etc;



- The landscaping located further from the facility, consisting of native trees, shrubs and grasses/herbs will have a separate dedicated drip irrigation system, of most likely Category 1 or 2 water with a lower nutrient load;
- Separate drip irrigation systems will enable the differing water demands of the various species to be catered for. In times of extreme water shortage, the option also remains for not watering some areas and restrictive watering of other areas;
- The drip irrigation of the inner and outer landscaped areas will be based on providing only that amount of water which will not allow actual RAW to exceed more than 50% of maximum RAW. Soil moisture changes will be closely monitored with receptors, the data from which will be downloaded and cross compared with the data from the project meteorological station;
- Not fully irrigating deep rooted species will enable such species to intercept water moving both up and down through the soil profile and transpiring some to the atmosphere; and
- All landscaped areas will be set on continuously falling land (laser leveled) to ensure no prolonged wetness.

As is planned for the remainder of the project site, trees and shrubs which have root systems that could interfere with the integrity of building, road, carpark or other foundations will be kept away from such situations.

Slashing for fire risk management will be undertaken where and when required.

5.5.2.8 Category 2 Water Storage

This storage is situated over a mix of red/brown earth and black self-mulching clay soils. The boundaries will be modified slightly during the design and construction phases to avoid conflict with the sandy soils in the centre of the project site.

It is proposed that this storage will have the dual functions of managing the Category 2 water and providing habitat for aquatic flora and fauna which integrates with the proposed terrestrial habitat/corridor and the intent of the CIA LWMP. The storage will have a series of different level berms for littoral, intermediate and deeper zones. On average the storage will be relatively shallow and with a larger surface area.

Mitigation measures against adverse impacts on groundwater are:

- The floor is expected to be within the B2 and B5 horizons of the red/brown earth soil;
- To investigate the site in detail for the design and construction phases;
- The floor will be lined with a compacted clay layer of 600mm;
- The berms and banks will be topsoiled to encourage plant growth;
- To affirm the site integrity with infiltration testing prior to commissioning;
- Two (2) piezometers will be installed to monitor any potential risks of accession; and
- To install and performance monitor a leakage detection and monitoring system.

Being used for high quality water storage there should be minimal issues of concern with the facility assuming the design, construction and commissioning is undertaken by the appropriate geotechnical engineer. Operationally enhancing factors favouring minimal risk area:



- Build-up of biological slime and monosaccharides under continuous anaerobic conditions in and below the compacted layer;
- Sedimentation of fine clay and silt particles on the surface and in the upper layer of the clay liner leading to some pore clogging; and
- Some beneficial soil dispersion within the compacted clay layer which will clog pore space.

Whilst the above benefits are expected to enhance operational performance and integrity and further reduce deep percolation losses to less than 1×10^{-9} m/sec, there will be no dependence on such benefits and the need for best practice performance monitoring shall not be compromised.

5.5.2.9 *Commodity Shed, Milking Barn and Milk Storage*

Each of these facilities will be fully engineered and set on footings to standards set by specialist geotechnical and civil engineers following detailed design level investigations. Other comments of relevance are:

- The commodity shed is located on a mix of red/brown earths and grey transitional soils and will also include a small feedmill for daily mixing of cattle rations. The entire area will have concrete flooring designed to carry heavy duty feed trucks, large articulated loaders, tipping semi-trailers and B-Doubles. A large concrete apron will be located across the front of the shed/mill and tall concrete walls will separate the feed components;
- The milk storage area will be set in a fully sealed (concrete or bitumen) area with the temperature controlled storage vats set on engineered concrete footings. The area will be sloped to direct all run-offs to dedicated collection points for appropriate management;
- The milking bar also includes the cow pre-milking wash-down area. The entire facility will be concrete floored to full engineering standards. Subject to final design and commercial/technical considerations the milking system may be rotary or modern quick fill and empty herringbone system. The whole area will drain to the west with all waste water moving by gravity in an open clay lined drain to the sedimentation basins;
- There will be additional bitumen area for the entry and turning of trucks delivering the ration components for supplementing the distillers grain. Similar entry/turning areas will be required and built for milk tankers taking daily delivery of the milk. Each of these areas will be sloped to ensure run-off is directed to a dedicated, sealed and substantial capture point for pumping direct to the anaerobic ponds; and
- It is expected that there will be no landscaping in this area. Should it be found that some limited areas of landscaping is possible, then the combination of deep rooted native trees, shrubs and under-storey will be chosen and located so as to not compromise the integrity of footings of structures nor foundations of roads, concreted and other bitumen areas. Other than for establishment (drip irrigation) there would be no irrigation of such landscaped areas.

In summary, there should be no opportunity for any water and/or waste water to reach the groundwater through the sealed areas.

The only remaining concern would be from rising groundwaters driven by off-site accessions. This is most unlikely given the trend of declining groundwater levels driven by the implementation of the CIA LWMP.



5.5.2.10 Free-stall, Maternity and Hospital Sheds

The layout of the free-stall sheds have been presented in Annexure 4.11.1 and the maternity and hospital sheds will be similar with associated intensive veterinary care facilities. Relevant comments with respect to potential adverse groundwater impacts are as follows:

- Whilst the majority of this facility (4 x 40m x 600m sheds) is on a mix of suitable grey transitional soils and red/brown earths, there is a small area of sandy soil in the far south east corner of the most southern sheds which may be encountered. Should the detailed design level geotechnical investigations conclude that potentially adverse impacts cannot be alleviated through engineered solutions, such as extra deep compacted clay blankets and/or use of membranes and/or other appropriate technique then the following options arise:
 - o Shorten Shed 1 slightly and compensate with increased lengths of sheds 2, 3 and 4;
 - o Shorten Shed 1 and slightly reduce cattle numbers; and
 - o Move all sheds slightly westwards.
- The sheds and associated loading pens will be fully engineered viz;
 - o Will be sloped from east to west;
 - o The central feed laneway will either be fully bitumen or concrete;
 - o The flushing lanes will be fully concrete;
 - o The free-stalls will be concrete but filled with a mix of sand and rice hulls;
 - o Walls of the flush lanes will contain all water and direct same;
 - o All foundations will be compacted clay to full engineering standards;
 - o Loafing pens will slope away from the sheds at a 3% grade, be of compacted clay and have a documented and replicated series of permeability tests to prove the infiltration rate is less than 1×10^{-9} m/sec. If this compaction is not achievable, a non-porous liner or base material will be utilised; and
 - o In between each loafing pen for each successive shed will be a 3m laneway uniformly sloped and concreted to ensure all run-offs is directed westward to the main lined drain leading to the sedimentation basins.

The cattle sheds and associated loafing pens are sized so that 33% of the available cattle area is fully concreted and the remainder is a fully engineered pad to gazetted feedlot standards. The cattle spend the majority of their time inside the sheds and most manure and urine is passed in this area to be washed away at each of three (3) milkings. Therefore, the nutrient load on the compacted clay loafing pens is substantially less than that which would be normally found in a beef feedlot.

Based on the geotechnical assessment of the soils and the conclusion that the project soils are suited for the intended purpose, the risk of accessions to groundwater is low to very low.



5.5.2.11 Heifer Dry Lot Pens

Based on a mix of red/brown earth and grey transitional soils the heifer dry lot pens will be constructed to gazetted beef feedlot standards with a compacted clay blanket. Relevant comments on the measures proposed to mitigate against adverse impacts to groundwater are as follows:

- Additional detailed design level geotechnical investigations will be required by a suitably experienced geotechnical engineer to ensure best practice standards are ensured;
- A minimum thickness compacted clay foundation of 600mm will be constructed on a uniform pen slope of 3% and have a measured and replicated permeability test based on an industry recognized minimum spatial grid distribution system, affirming an infiltration rate less than 1×10^{-9} m/sec prior to commissioning;
- Livestock laneways to be of uniform slope and established on a compacted clay foundation of a proven permeability of less than 1×10^{-9} m/sec prior to commissioning. If this compaction is not achievable, a non-porous liner or base material will be utilised;
- Feed lanes and feed pads will also be established on a compacted clay foundation which shall be continuous with the cattle pen and cattle laneway foundations. The feed lane will be bitumen surface and of uniform slope to ensure drainage. The feed troughs will be concrete on a 4m wide concrete pad;
- Heifer pens will be regularly cleaned by uniform scraping to ensure on-going integrity of the pen's clay foundation and uniformity of slope;
- The whole dry lot area will drain to a compacted clay lined drain which will direct all run-offs to the sedimentation basins for reclamation through the anaerobic and aerobic pondages; and
- By best practice use of the dry lot watering and cattle cooling system, the optimum moisture content of the compacted clay layer will ensure the retention of the integrity of that pen foundation.

Best practice standards for the designing, construction, operation and maintenance of dry lot pens are well documented and will be strictly complied with as a minimum standard. Every effort will be made to achieve maximum infiltration rates of 1×10^{-10} m/sec to 1×10^{-11} m/sec, factors of 10 to 100 lesser deep percolation than the minimum standard. If the project geotechnical engineer recommends a compacted clay layer >600mm as an added margin of safety then that increased thickness shall be adopted.

5.5.2.12 Cattle Yards

The cattle yards will have a concrete or bitumen floor on top of a 600mm compacted clay layer subjected to replicated permeability tests, based on an industry recognised minimum spatial grid distribution system, affirming a deep percolation rate of no greater than 1×10^{-9} m/sec.

The access road and turning/parking areas for livestock transports shall be bitumen sealed on engineered foundations.

Cattle transfer laneways from the free-stall sheds and the heifer dry lot pens will be based on a bitumen surface over the standard compacted clay foundation.

The yards access roads and cattle lanes will be on a uniform grade to direct all run-offs from rain and/or wash-down events to a clay lined drain which leads directly to the sedimentation basins.



5.5.2.13 Manure and Other Solids Management

Heavily manure and nutrient loaded run-off and flush wash water from the free-stall sheds, dairy barn, maternity/hospital shed, dry lot pens, cattle yards, laneways and access roads will be delivered to the sedimentation basins in compacted clay lined drains.

Adjacent to the sedimentation basins will be a concrete based and bunded area for the wet manure to drain off the majority of surplus water before being freighted to “Tubbo” irrigation (2,200ha flood and 800ha drip) and spread thereon. The bunded drainage basin will have a uniform slope to a dedicated point for running excess water back to the sedimentation basins and on to the buffer storage.

The sedimentation basins and manure drainage areas will be concrete lined with the underlying foundations to full engineering standards. The access road will have the same foundation but be bitumen rather than concrete.

The buffer storage is situated downstream of the sedimentation basins on a mix of red/brown earths and grey transitional soils. The primary aim of this pond/storage is to accumulate all waste water originating within the Category 3 containment area before it may be pumped direct to the anaerobic ponds. The project geotechnical engineer will undertake detailed design level investigations and is expected to recommend a compacted clay liner of 600mm to 750mm thickness and achieve an infiltration rate no greater than 1×10^{-9} m/sec and preferably $<1 \times 10^{-10}$ m/sec. Ongoing performance monitoring will be required and at least one (1) adjacent piezometer will be installed.

The pump station to deliver the water from the surge storage to the anaerobic pond will need a maximum capacity of 45ML/day which will transfer all water within 24 hours following a 150mm rain storm on top of normal operations.

5.5.2.14 Anaerobic Ponds

There are two (2) proposed anaerobic ponds of 175ML capacity each. The minimum combined capacity has been calculated at 262ML in Annexure 4.1.6. The proposed 33% increase in capacity over the minimum requirement and the splitting into two (2) ponds will enable optimal performance as anaerobic ponds as well as cleaning and maintenance on one whilst the other remains operational.

The proposed ponds have been moved further south than that originally proposed to avoid potential problems with a narrow seam of sandy soil. The eastern pond is now on an area of red/brown earth whilst the western pond is located over a mix of grey transitional soils and red/brown earths. The project geotechnical and geomorphic assessments have determined that these soil types and profiles in this section of the project site are suited to the construction of the anaerobic ponds. The limitation of the B1 horizon (12cm to 40cm) in the red/brown earths has been recognised as has the benefits of the B2, B3 and B4 horizons (generally 40cm to 200cm).

Subsequent disturbed core drilling in the area of the anaerobic ponds has identified significant depths of sandier layers below the depth of the original slot trench investigations. The presence of sandy layers, the extent of which will be assessed in the detailed design investigations, dictates the need for special attention and the potential need for geosynthetic membrane lining of these facilities.

To mitigate any risks of accessions to the local and regional groundwaters the following actions will be implemented:

- The engagement of an experienced and peer respected geotechnical engineer for the design, construction and operation of storages;
- To conduct detailed design level investigations prior to designing the storage and preparing detailed construction plans;



- To monitor construction of the facility and in particular to seek and respond to evidence of integrity compromising factors such as the presence of shoe-string sands, sandy lenses, changes in soil layers and changes in soil pedology;
- To install a compacted clay liner of no less than 600mm thickness which shall be subjected to replicated permeability tests based on an industry recognized minimum spatial grid distribution system affirming a replicated deep percolation rate of no more than 1×10^{-9} m/sec;
- To install a suitable system for leakage monitoring, coupled to a leakage capture system (eg tile drain) in an appropriately engineered porous substrate over the top of the compacted clay liner;
- To install a membrane liner of appropriate operational capability over the top of the leakage monitoring and capture system (see Section 5.5.3);
- The embankment to include a compacted core which shall extend into a key reaching 3.0m below NSL;
- To install three (3) monitoring piezometers at locations and to depths required by the project geotechnical engineer;
- To maintain no less than 155ML in each pond except during servicing;
- To install monitoring equipment such as depth gauges and meters for measuring volumes in and out of the storage; and
- To performance monitor the storage and regularly (no less than annually) undertake and record an accurate inventory of all water sources and sinks using the project meteorological station to calculate evaporation losses.

The anaerobic ponds are the first treatment stage in reducing the BOD loading in the waste water. It is paramount that the integrity of these ponds is assured from the outset and therefore it will be necessary to undertake replicated infiltration testing both, documented and accepted prior to commissioning the facilities.

As is the case with the Category 1 and 2 water storages, operationally enhancing factors favouring minimal risk to regional and local groundwaters are:

- Build-up of biological slime and monosaccharides under continuous anaerobic conditions in and below the compacted layer;
- Sedimentation of fine clay and silt particles on the surface and in the upper layer of the clay liner leading to some pore clogging; and
- Some beneficial soil dispersion within the compacted clay layer which will clog pore space.

Whilst the above benefits are expected to enhance operational performance and integrity and further reduce deep percolation losses to less than 1×10^{-9} m/sec, there will be no dependence on such benefits and the need for best practice performance monitoring shall not be compromised.



5.5.2.15 *Aerobic Ponds*

To enable operational maintenance, it is intended to split the aerobic pond into three (3) cells. In doing so, it is recognised that each cell will need to contain a free water surface at all times except during periods of maintenance. The presence of the free water will ensure the clay liner, or other liner, integrity is not compromised through drainage and/or physical impact.

The proposed aerobic ponds have a water surface area of 25ha against a minimum required area of 13.7ha. The proposed 80% increase in surface area has the merits of:

- Enabling all water with any quality concern to be fully managed on site in an as yet, not historically experienced extreme wet year;
- Maximising the opportunity for aeration of the water with or without aeration paddles/pumps;
- Optimising the ability to bring in fresh water in 90+ % of years for dilution purposes; and
- Reducing the depth of “borrow” for building the embankments and “surplus” borrow could be used to supplement both the anaerobic pond embankments.

The aeration ponds wrap around the anaerobic ponds with water flowing directly from the anaerobic ponds. Water flow rate and volume will be controlled, measured and directed to one or more of the aerobic pond cells by an engineered controller, most likely being a combination of over-topping devices and gate valves. The control structure will also ensure a relatively constant water level flow-through rate is maintained in the anaerobic ponds.

The proposed measures to mitigate against adverse impacts on groundwater are:

- The engagement of a geotechnical engineer for the design, construction and operation of storages;
- To conduct detailed design level investigations prior to designing the storage and preparing detailed construction plans;
- To monitor construction of the facility and in particular to seek and respond to evidence of integrity compromising factors such as the presence of shoe-string sands, sandy lenses, changes in soil layers and changes in soil pedology;
- To install a compacted clay liner of no less than 600mm thickness which shall be subjected to permeability tests based on an industry recognized minimum spatial distribution system, affirming a replicated deep percolation rate of no more than 1×10^{-9} m/sec;
- To install a suitable system for leakage monitoring, coupled to a leakage capture system (eg tile drain) in an appropriately engineered porous substrate over the top of the compacted clay liner;
- To install a membrane liner of appropriate operational capability over the top of the leakage monitoring and capture system;
- The embankment to include a compacted core which shall extend into a key reaching 3.0m below NSL;
- To install three (3) monitoring piezometers at locations and to depths required by the project geotechnical engineer;
- To maintain no less than 600ML to 700ML of water in the storages to ensure no cracking and loss of integrity of the clay, or other liner; and
- To mechanically aerate the storage in accordance with the storage operational plan to be developed prior to commissioning.



There will be a substantially reduced level of biosolids passing from the anaerobic ponds to the aerobic ponds which, when settled will facilitate liner integrity. Operationally enhancing factors favouring minimal risk to groundwater will include:

- Build-up of biological slime and monosaccharides under continuous anaerobic conditions in and below the compacted layer;
- Sedimentation of fine clay and silt particles on the surface and in the upper layer of the clay liner leading to some pore clogging; and
- Some beneficial soil dispersion within the compacted clay layer which will clog pore space.

There will be accumulation of salts within the storage/s. Elevated salt levels may potentially compromise the integrity of a compacted clay layer through electro-chemical processes. For this reason it is crucial that any infiltration and other testing be undertaken by a suitably experienced geotechnical engineer and with water of the expected qualities to be contained in the aerobic ponds. The planned on-going dilution with fresh water from CICL channels will assist in managing the issue.

Whilst the fore-going issues will provide enhanced net benefits to the operational performance and integrity of the aerobic pond/s there will not be a dependence on such benefits.

Best practice performance monitoring will ensure optimal performance, retain optimal performance, retain infiltration rates to no more than 1×10^{-9} m/sec and preferably to 1×10^{-10} m/sec and 1×10^{-11} m/sec.

5.5.2.16 *Remainder of Landscape*

All areas on the project site which are not allocated to dedicated project infrastructure shall be planted to an appropriate mix of deep rooted and local indigenous native trees, shrubs and understorey.

With the exception of the initial establishment period, the plantings will not be watered. To ensure establishment, a combination of drip and/or mini sprinkler irrigation will be used and water application will not exceed 50% of RAW. By not filling the soil profile there will be the capacity to absorb substantial rainfall events before any run-off occurs.

After establishment, the deep rooted native vegetation will:

- Retain a deep dry soil profile to absorb major rain events before run-off occurs;
- Take up and transpire to the atmosphere any available water which enters the soil profile; and
- Act as a site contributor to the management of any potential rising groundwater driven by off-site actions/events/circumstances.

The obvious benefit of well planned native vegetation planting will be the provision of habitat and corridor for native fauna.



5.5.2.17 *Carcass Disposal*

Carcass disposal will be undertaken at a relatively remote part of “Tubbo” station. There will be a number of sites used over time to spread risk.

The proposed strategy to mitigate against adverse groundwater impacts and also reduce the remote chance of odour risks is:

- To use the project geotechnical engineer and geomorphologist to inspect and affirm the proposed series of sites;
- To select elevated areas above sections of the landscape prone to prolonged flooding and which cannot be subjected to intermittent overland flooding;
- To provide a preference for the denser, deeper and more impervious soils such as grey transitional soils, self-mulching clays and red/brown earths;
- To avoid sandy soils;
- To excavate long narrow trenches approximately (2m wide) with an excavator to 2.5m deep and leaving a windrow of soil beside for back filling. To minimise a potential slump, the walls will be battered to 2:1 slope;
- During the excavation process to verify that no sandy layers are exposed and if so to obtain the opinion and recommendations of the project geotechnical engineer and geomorphologist before proceeding;
- Carcasses for disposal will be transported to the site and deposited into the liner trench after which they will be covered with the adjacent loose soil; and
- Being some 30,000ha in area, suitable and relatively remote locations for carcass disposal shall be found in the central sections of the property to the north-east, east and south-east of the existing irrigation.

5.5.2.18 *Manure Disposal*

The manure generated from the development will be carted to the “Tubbo” irrigation areas where it will be spread at 12t/ha/year. The “Tubbo” irrigation (2,200ha flood and 800ha drip on “Tubbo”, with a further 350ha of flood irrigation on other surrounding Four Arrows properties) is established on largely reddish to grey self-mulching clays with both flood and furrow surface water application systems. The irrigation drainage is fully re-cycled with large engineered buffer water storage and is a “contained” system except in extreme storm events when excess run-off is allowed to spill into a “surge” area. That surge area does not impact on water courses or other farms or public and private infrastructure. The intent existing practice is to recapture and reuse surge water wherever possible.

The existing irrigation soils are, like any Riverina soils, deficient in organic matter and will benefit from the organic matter and most nutrients in the manure. The low to very low basic infiltration rates through the soils and their high CEC will mitigate against adverse impacts on groundwater.



5.5.3 Effluent Storage Integrity

5.5.3.1 Groundwater Monitoring System

It is proposed that Category 1 (CICL purchase and rainwater capture), and Category 2 (rainfall and stormwater capture) water storages be lined with a compacted clay base. However given the risks to surrounding groundwater users, and integrity of groundwater quality through potential accession by effluent water, the buffer, anaerobic and aerobic storages will need more rigorous treatment to protect the groundwater resource.

The buffer, anaerobic and aerobic storages will be engineered to incorporate a three (3) stage protection from potential groundwater accession. These stages will comprise a membrane liner, laid over a leakage detection and capture system, further overlaying an engineered confining layer of compacted clay of 600mm thickness with a demonstrated permeability of no greater than 1×10^{-9} m/sec. The anaerobic storages can be decommissioned one at a time for inspection and or repair if required, and the aerobic storage will be separated into three (3) separate cells for maintenance and/or repair if required. This will allow for rapid mitigative action should leakage be detected, without compromising site production capacity or adequate storage volume.

5.5.3.2 Membrane Liner

The membrane liner will be a minimum of 1.5mm thickness High Density Polyethylene (HDPE) membrane, having a quoted life expectancy of 15 years. Annexure 5.5.1 provides both indication of membrane type, and a case study of such membranes used in Colorado, USA demonstrating continued performance above the gazetted requirements 20 years after installation.

These liners are formulated to exhibit excellent chemical resistance, UV resistance and stress cracking. The membranes are welded in-site by qualified installers, and are readily repairable should the membranes be breached.

Certain precautions would be put in place to protect against damage from animals and to meet OH&S requirements including the following:

- Fence surrounding ponds to a minimum height of 1.7m;
- 2.4m intermediate posts at 7m spacing – either galvanized star posts or treated pine;
- Boxed corner assemblies installed at each change of direction – (150 – 200mm x 2.7m pine strainer posts and 100 – 125mm x 3m stay rails);
- Box end assemblies at gate installations (150 – 200mm x 2.7m pine strainer posts and 100 – 125mm x 3m stay rails);
- 0.9m 6-90-30 hinge joint wire from top of fence to 0.8m from ground level;
- 1050mm high rabbit netting to be supported by 3 plain wires installed at the base of hinge joint and continue to ground level and folded a further 250mm out from base; and
- 1 x 3.6m gate installation to be a minimum of the fence height and to be vermin proof.



5.5.3.3 *Leakage Detection and Capture*

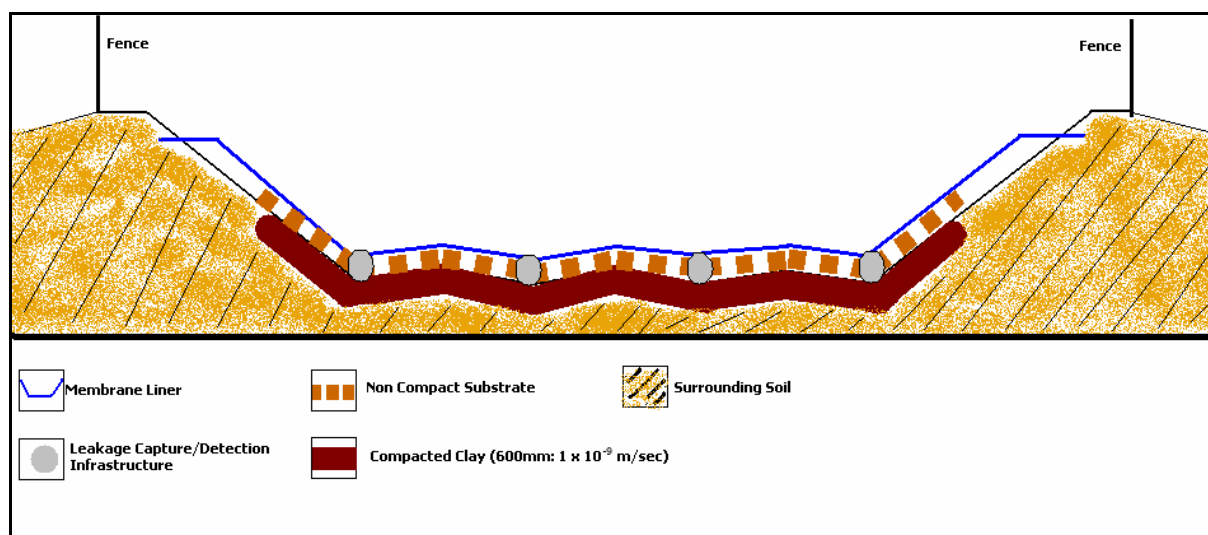
A system of sub-surface moisture sensors will be placed beneath the anaerobic and aerobic storages to ensure any leakage is detected, and the extent and rate of potential accession to groundwater can be established. This system will also allow for the location of leakage, enabling rapid decommissioning and repair of the appropriate storage cell.

This system will be complemented by a series of capture “pipes” or “tiles”, bedded into a porous or non-compacted substrate, and will intercept any leakage, directing it to small, separate sumps. This captured water is then able to be recirculated back into the appropriate storages. This system, whilst allowing for capture of effluent escape from leaking storages, also serves as a back-up for monitoring leakage should the moisture sensor system fail.

5.5.3.4 *Confining Layer*

This confining layer will be sited below the leakage detection and capture system to ensure that any potential leakage will be forced into capture systems as opposed to percolating through non-compacted porous substrates and entering the groundwater. Clay will be of 600mm thick, and compacted to a demonstrated permeability of no greater than 1×10^{-9} m/sec.

The illustration below provides some indication of the proposed effluent storage system as described above.



The specifics of detection system to be utilised and the installation of appropriate capture system will be determined by geotechnical experts during the design phase of the development, and approval would be sought from the DNR prior to installation. Section 5.5.4 following details the nature of a groundwater monitoring plan to be implemented on-site to further protect groundwater and the interests of groundwater users surrounding the proposed development site.



5.5.4 A Supportive Monitoring Program

The management of groundwater has been identified as a critical aspect of the development's success throughout the EA process. Concern over the potential to pollute the environment and affect the welfare of neighbouring enterprises has been expressed by various agencies. This has driven a comprehensive investigation and development of mitigating design at this early stage of the development process.

Innovative technologies as described in the previous sections are intended to be applied to stem groundwater issues. The types of technologies adopted for the management of water from various sources including run-off from the surrounding landscape, effluent derived from the dairy enterprise and buffer storages will be detailed within the upcoming Water Management Plan (WMP).

Part of this plan will include a water monitoring program. This describes how technologies are utilised in order to derive data that assists informed management decisions. A preliminary groundwater monitoring program had been included within this application to ensure a full understanding of the requirements of a monitoring program has been achieved.

This has become part of the proponent's Statement of Commitments (refer Section 7.4.2). This details the scope and extent of efforts to abate any accession to groundwater from sources associated with the development.

5.6 Soil Resource

The geotechnical investigations undertaken by Wrigley-Dillon and contained as Annexure 4.7.1 identifies that the soils on-site are suitable for the proposed development with the exception of the sand deposit running east-west to the western boundary of the site.

Detailed site design will be undertaken in such a manner as to ensure suitability of infrastructure location in relation to soils. Further detailed investigation on soil suitability would be undertaken if necessary at the design level investigation.

5.7 Visual Amenity

5.7.1 Landscape Values

Landscape amenity will be enhanced onsite through the establishment of 50 metre perimeter plantings, established with a mosaic of groundcover, understorey and over-storey species, and additional areas of habitat restoration and wetland creation onsite. In addition to these areas, sections of the site surrounding administrative infrastructure will be landscaped with grasses and other species as appropriate.

5.7.2 Lighting

As identified in Section 4.9.2, lighting on-site and the management of light spill off-site will be as per the specifications contained within *Australian Standard (AS4282-1977)*.

The detail of the installation and management of lighting issues will be prepared during the specific site design process post approval of this EA.



5.8 Animal Welfare

To ensure animal welfare and health are maintained, the following will be undertaken;

- Engage a project veterinarian who shall work to best practice protocols;
- Undertake regular training for staff working with the cattle and ensure they work to protocols;
- Constantly monitor the herd and isolate any animals of concern immediately; and
- Select cows with a genetic predisposition to not be prone to infections.

5.9 Flora and Fauna

5.9.1 Flora and Fauna

It is proposed the existing Acacia, Callitris and Eucalypt communities be excluded from site development and infrastructural design, and consequently the impacts of the proposed development, and these areas be enhanced, amended and protected by some form of conservation caveat. These communities represent areas of remnant vegetation which are relatively isolated though have the potential to provide substantial habitat corridor linkage between the Boona and Brett's State Forests, allowing for migration of avian and ground dwelling fauna.

The proponent does recognise these vegetation communities present an opportunity for enhancement of the local environment, and also represent an opportunity to go some way towards meeting the environmental targets set out in the Coleambally Land and Water Management Plan. These targets are:

- 50ha/annum of native vegetation protected, enhanced and managed primarily for conservation;
- 20ha/annum Black Box and River red gum (*E. camaldulensis*) depressions and streams protected and enhanced plus strategic watering; and
- 50ha/annum of strategic planting, reseeding and natural re-generation of locally native vegetation to enhance connectivity.

With these targets in mind, Four Arrows Ethanol Pty Ltd would propose that the following flora and fauna management strategies be put in place:

- A rabbit management plan to be put in place to remove rabbits from the *Callitris glaucophylla* woodland;
- 33 ha of Cypress (*C. glaucophylla*) woodland to be fenced to exclude grazing pressure from local rabbit populations;
- Protection of 8ha of Black Box (*E. largiflorens*) depression and continuance of implementation of rabbit management plan;
- Creation of a 400m wide habitat corridor between the Black box and Cypress woodland areas;
- Creation of a 200m wide habitat corridor between the Black Box and Cypress woodland areas and the western property boundary;
- These corridors to be incorporated into the rabbit management plan;
- Implementation of a weed management strategy to reduce competition for the recruitment of native species through natural process;
- Active habitat restoration to be undertaken to introduce native grass and shrubland species to the areas proposed for habitat corridor creation;



- Creation of perimeter plantings around the entire development site of not less than 50m width using locally sourced and local providence species further enhancing connectivity across the site between Boona and Brett's State Forests;
- The perimeter plantings to be established by a combination of random ripping, direct seeding and tube stock plantings to create a more natural mosaic effect of native vegetation;
- The creation of an artificial wetland capturing storm water run-off from sealed areas of the project site;
- The introduction of appropriate wetland species surrounding the area proposed as artificial wetland;
- Pursuant to climatic conditions, the maintenance of a minimum volume of water is maintained in the artificially created wetland, so as to allow permanent occupancy potential for wetland flora and fauna species; and
- Upon full establishment of habitat corridors and plantings, vermin proof fencing installed to enclose the entire area, removing grazing pressure from introduced herbivorous and predation by foxes, cats and other predatory species.

The habitat corridors, perimeter plantings and wetland can be seen in Figure 5.9.1: *Proposed Habitat Restoration*.

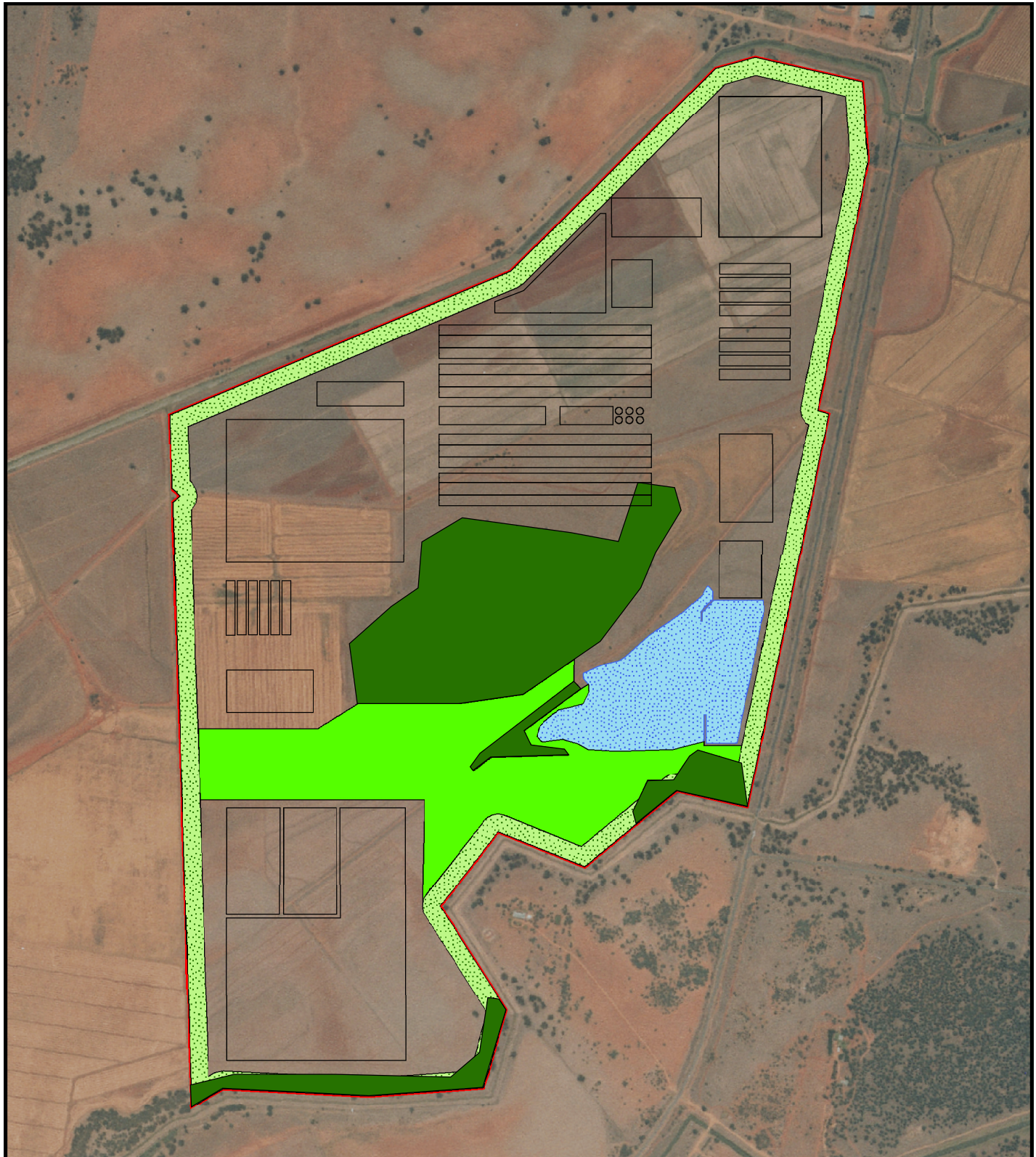
5.10 Heritage

5.10.1 Indigenous Heritage

Following the field survey undertaken by Steve Meredith (NPWS) a report was prepared outlining particular recommendations for the preservation of sites identified during the field survey. A copy of the Meredith report is contained in Annexure 4.13.1. Given three (3) probable modified trees are on fallen dead trunks within the Black Box Woodland, management strategies were not appropriate for recommendation at this time. A modified tree still standing within the Black Box Woodland will be preserved and maintained *in situ* as per the vegetation management strategy to retain all remnant vegetation in the area surrounding the modified tree. A further recommendation is the modified tree on the sand hill, previously identified as potentially bark damage from galah species, could be investigated in greater detail at a later date prior to design level investigations. The proposed development will in no way threaten the preservation of the areas identified in the report prepared by Steve Meredith as both landforms containing the sites identified are to be retained in a natural state and where possible enhanced and protected.

Further general recommendations have been identified in the report prepared by Meredith. These recommendations are:

- *"Total archaeological site avoidance. No consents will be given in accord with sections 87 and 90 of the NSW National Parks and Wildlife Act (1974) without further consultation.*
- *The employment of local Aboriginal people to act as monitors for the duration of ground disturbance works.*
- *All existing firebreaks and vehicle access tracks are to be maintained in their current positions with prior consultation required before the establishment of new tracks.*
- *All additional sites recorded, if any are found, are forwarded for entry and registration with the Department of Environmental Conservation/National Parks Service Aboriginal Heritage Information Management Systems (AHIMS).*



- | | | |
|---|--|--|
| Proposed Site V2 | Remnant Vegetation | Runoff wetland V2 |
| Skeleton of Proposed Infrastructure | Proposed Habitat Restoration | Proposed 50m Buffer Plantings |

0 0.1 0.2 0.4 0.6 0.8
 Kilometers





- *The community maintain that any cultural material or items uncovered or disturbed, all work must cease immediately and the Griffith LALC and NPWS Aboriginal Sites Officer contacted."*

In broad terms there are minimal constraints and mitigation needs for the establishment and operation of the proposed project.

5.10.2 Non Indigenous Heritage

All of the local area and regional sites identified in the database search of the Register of the National Estate are beyond the boundaries of the site. Consequently none of the sites identified on the register are at any threat of impact. Notwithstanding, three (3) of the listings on the database of the Register of the National Estate are specific to the homesteads and buildings of "Tubbo". "Tubbo" is owned by the Four Arrows Group presently and the management of "Tubbo" Station's farming operations are already previously advised of their obligations and responsibilities under the Register of the National Estate guidelines and national heritage legislation. It is therefore not perceived a change in the land use of the proposed site and development of the ethanol plant and dairy enterprise would hold any bearing or pose any threat of impact on the sites on "Tubbo".

5.11 Justification

5.11.1 Guiding Principles

The EP & A Regulations at Schedule 2 requires:

"that a project be justified in regard to the bio-physical, economic and social considerations".

In addition the principles of ecologically sustainable development (ESD) must be adhered to in the considerations for justification.

There are overriding issues in justifying a project such as proposed, being:

- As a baseline; and
- A development scenario with sub-sets of:
 - o Variations to the proposed development, and
 - o Alternative sites for the proposed development.

These issues along with the principles of ESD will be covered in the following sub-sections. The short and long term justification issues will also be considered.

5.11.2 Bio-Physical Justification

The bio-physical issues extend beyond the project site. The world is reliant upon non-renewable fuels such as oil, coal etc. As the reserves of non-renewable fuels diminish and prices increases, the search for new economically justifiable fuel sources begins to accelerate. Added to this are the increasing concerns nationally and internationally over global warming for which fossil fuels are claimed to be a major contributor and accelerant.



The Australian Government has developed a national Bio-fuels Action Plan (BAP) which targets a total production of 350ML by 2010. The aim is to accelerate the move away from the current dependency on fossil and non-renewable energy sources to renewable energy sources which are environmentally sound. Ethanol and bio-diesels are two (2) alternatives being actively promoted within the BAP.

The proposed project at 300ML of ethanol alone will generate approximately 85% of the production under the bio-fuels action plan.

At a local level the impacts on specific issues are succinctly covered. An impact on terrestrial ecology is covered in Section 4.12 of this EA. Specific comments are as follows:

- Native flora and fauna in a local and regional context will be enhanced over that currently found in and around the project site;
- Avifauna and ground fauna will have additional habitat, corridors and other foraging, nesting habitats for enhanced presence within the region;
- Archeological and heritage impacts are to be prevented within the project development. These heritage sites will receive less impact than if the project did not proceed. The archeological survey has not identified any area of particular interest which had been proposed for alteration or development, but has requested should a previously unidentified archeological site be disturbed in the construction process then construction cease until the matter is resolved to the satisfaction of all relevant stakeholders;
- Landscape issues. The project site contains a mix of soils, from sands through to heavy clays with significant variation in the general topography relative to similar landscapes regionally. The soil types, topography and geology have been independently assessed and deemed to be suited to the proposed project, including all integrated components;
- Water related issues. The topography of this site is such that the hydrology is able to be well managed and as part of an integrated water management package. The project site is located in a region which has had significant water table issues, but as part of the Coleambally Land and Water Management Plan Area (LWMPA), these issues of concern have been addressed and water tables are being appropriately managed and reduced. Project site management strategies have integrated all the various issues of concern and an integrated infrastructure and management system devised which will improve overall site management from a hydrological and hydrogeological perspective;
- Hydraulic loading will be reduced over what is currently found at the project site, as the increased volumes of water will be constrained within appropriately engineered and monitored water storages. The majority of the area within the project site is to be de-watered with the exception of targeted and limited areas of advanced landscape; and
- Waste management. Because the proponent has substantial irrigation and dryland farming operations close by, all waste from the dairy enterprise shall be initially managed on site, accumulated with the manure and then transported to the "Tubbo" irrigation and dryland farming areas for enhanced organic matter and nutrient management within those farming areas. The waste from the ethanol plant has been divided into two (2) streams. The first being, the distillers grain which will be used initially within the dairy enterprise on the project site with the surplus being sold to the established regional an intensive animal industry which there is a significant market, and substantial inquiry. The remaining major waste stream is carbon dioxide which is expected to be captured, pressurised and carted off-site for management in the carbonated beverage and appropriate industries.

Site management is always a major contributors to the success or otherwise of maintaining and enhancing bio-physical systems. The proponent has expressed a desire to be committed to best management practice for best bio-physical management. Not only best practice, but commercially the most appropriate direction to take. Hence, commercial drivers will enhance the net bio-physical elements of the project.



5.11.3 Economic Justification

Economic justification includes each justification in the commercial sense. Economic justification incorporates the wider community impacts of:

- Increased direct and indirect benefits to the local, regional and state economies;
- Direct and indirect economics benefits to national economy and its standing within the world economic structure; and
- An economic benefit in terms of a contribution to reduced impacts on global warming.

In the construction phase there will be increased employment as well as economic turnover within local and regional businesses. The full capital cost is not accurately known and will vary substantially in response to approval delays and dollar exchange rates. In total the fully commissioned cost of all works will be of the order of \$120M. Because of commercial in-confidence issues, the details of expenditure are not available nor where and who will provide the materials and services. Despite this the proponent has expressed keen interest in utilising local people, businesses and products. Whichever way the final construction process evolves, the local benefits will be very significant.

In the operational phase there will be further economic benefits to businesses and employment levels which will add stability to the local community, particularly Darlington Point and Coleambally. In the district context there will be substantial enhancements to the economies of rural communities from northern Victoria to central New South Wales as grain and other products are sourced for inputs to the ethanol plant with flow-ons into the dairy enterprise within the project. The benefit to the grain producers is already exemplified by the regional benefits already created by the existing animal industries. The addition of the ethanol plant as part of this project will further add demand pressures on grains which will be felt well beyond the regional community and tend to place a floor underneath grain prices.

Initially intensive animal industries have expressed concerns the increased competition for grain from the ethanol plant would increase the costs of products for their feeding operations. In more recent times and during the preparation of this EA, at least one feedlot has made a direct approach to seek mutuality through the purchase of distillers grain for use in their feedlot. Distillers grain has many benefits within intensive animal industries, with at least one major feedlot perceiving stable supply will enhance their operations rather than compete within the purchase of product for their operations.

The proponent is part of a wider group of companies known as the Four Arrows Group. This group has major rural holdings in Wagga Wagga, adjacent to the project site and also at Hay to the west. The proponent has made it clear that establishing the project at this particular location will not only benefit the local community but will add stability to the sources of people, skilled product and services for their existing and rapidly expanding operations.

The proposed project will also provide economic benefits to the state of New South Wales through royalties, taxes and other economic activity and also to the national economy by the same means.

Finally, the issue of import replacement of increasingly scarce fossil fuels is yet to be fully quantified in an economic and commercial sense and would be expected to grow to significant levels in the coming years and decades. The scale of the operation up to 300ML of ethanol per year being produced makes the project of such a scale to be assured of achieving the economies of scale. Furthermore, this scale makes it an attractive business for major fuel distributors and retailers to deal with and be assured of continuity of supply of quality products at a commercially sustainable price.



5.11.4 Social Justification

It is well documented and recognised that most regional, rural communities, with the exception of a limited number of large communities, are in economic and social decline. Many small communities are trending towards becoming satellite and dormitory towns for larger businesses which operate in the local area. With the increasing use of contractors and access to skill sets from outside local communities, the prospects for future employment are in continual decline. Machines replacing people are increasing in size, thereby requiring fewer people to operate them. The net effect is that there is a narrowing in social strata and in the ability to retain people who have special skills.

The proponent, by installing the proposed project at the intended location is enhancing prospects for the communities which the proponent is dependent for its existing substantial rural operations. By integrating the ethanol plant and dairy enterprise, the proponent is providing stability for their pre-existing businesses as well as the communities upon which they are reliant. Most particularly the project will add diversity to skills sets in the surrounding community which in turn widens the mix in social strata so necessary for strong and vibrant communities.

Despite providing social benefits such as employment and community enhancement, it is important to recognise community well-being in terms of their overall quality of life. The EA assessed issues such as:

- Noise;
- Odour;
- Traffic;
- Transportation;
- Visual amenity; and
- Heritage, diversity in people.

The last point is of particular interest. The proposed project will require a range of expertise within the people being employed. For example the dairy enterprise will require a full time veterinarian and also veterinarian assistants and livestock management specialists including nutritionists. Secondly, there will be management personnel associated with the overall project as well as engineers and chemists. Finally, there will be a range of expertise in the personnel required to manage the various components of the business through to the workers required to keep the business operating on a day to day basis. With the advent of the processing of the milk on site in a future project, food technological personnel will also be required. This diversity in personnel is crucial in an overall facility and in sustaining rural communities into the future.

The issues of odour, traffic, transport, noise, amenity, etc. are all initial potential issues however, when managed correctly and monitored appropriately become a solution rather than a problem. These solutions have been identified within the EA as being appropriately addressed in the construction and operational phases of the project. The project is justifiable on social grounds.



5.11.5 Environmentally Sustainable Development (ESD) – Precautionary Principles

There are four (4) guiding principles to assist and achieve ESD, these being clearly defined at Schedule 2 of the EP & A Regulations. The first of these is the precautionary principle which requires that:

“if there are threats of serious or irreversible environmental damage, lack of full scientific certainty should not be used as a reason for postponing measures to prevent environmental degradation”.

The inter-governmental agreement on the environment (IGAE) was signed in 1992 by the Federal and State Governments, Territories and the Australian Local Government Association. The IGAE requires a precautionary principle should undertake the following:

- Careful evaluation to avoid, wherever practicable, serious or irreversible damage to the environment; and
- An assessment of the risk weighted consequences of various options.

The proponent has been conscious of the precautionary principle in, not only developing the concept for the integrated ethanol plant and dairy enterprise project, but also in the design and construction phases.

The proponent instructions for this project incorporated the following:

- A preferred proposed project site which has available all the required infrastructure components of access, energy, land, water, etc;
- Conceptually designing the detail of the project around the findings of the investigations for the EA; and
- Ensuring the design of the conceptual layout of the project and associated on-site infrastructure and all the constraints of the site are addressed and no adverse impact shall occur.

The investigations for the EA have influenced the design and inter-relationships of all the component parts of the project and the site in which it occupies and the site itself within the total landscape.

The project team is comprised of such diversity of consultants who have long standing peer respect for their particular skills. They have thus influenced the overall project concept design and recommendations for the best outcomes of the EA.

The end result is all conceivable issues have been addressed and the proposed design, construction, operation, performance monitoring and review processes will ensure the site will be sustainably designed, constructed and operated. Furthermore, should there be any emerging issue of concern, the performance monitoring processes will identify issues at an early stage and the procedures will allow the issues of concern to be appropriately addressed in a short time. Therefore the precautionary principle has been addressed. There are to be no foreseeable issues of concern which could defer commencement of construction or operation of the project and there is as a complete level of scientific certainty as may be reasonably expected.



5.11.5.1 *Justification – Inter-Generational Equity*

The second principle of ecologically sustainable development is of Inter-Generational Equity (IGE). The principle of IGE requires decisions made by the present generation should not result in a degradation of the environment for future generations. The principles of IGE are also encapsulated in the principles of Responsible Resource Stewardship (RRS).

The Federal Government policy of increasing bio-fuel production and usage to replace the declining non-renewable resource of fossil fuels is a reflection of the declining environmental circumstances resulting from the use fossil fuels. The Federal Government perceives bio-fuels as enhancing environmental outcomes rather than degrading environmental outcomes. Thus the project is consistent with enhancing environmental outcomes for future generations.

Overall the project will benefit future generations. It is paramount in undertaking the EA and ultimately the detailed design level investigations the components of the environment surrounding the project should not undermine the overall concept of moving towards bio-fuels.

The investigations leading to this EA and the ultimate design level investigations that follow once approval is obtained, has ensured the project site is optimised against adverse environmental impact.

The construction phase will be bound by an Environmental Management Plan, which in turn will be driven by more detailed design level investigations which are site and situation specific for this project.

Finally, within the operations phase the ongoing performance monitoring, periodic review and detailed environmental management systems (EMS's) will ensure that, should any unforeseeable adverse impact begins to arise, it is immediately addressed and reversed.

Given the foregoing, the IGE for this project shall be enhanced rather than diminished as a result of the project at a local level as well as a regional, state and national level.

5.11.5.2 *Justification – Biological Diversity and Ecology Integrity*

The third principle of ecologically sustainable development is biological diversity and ecology integrity. This will be addressed by maintaining a full and diverse range of plant and animal species within the site. Extending beyond the site, the site itself must integrate with the local area and the regional natural resource landscape by providing continuity of natural habitat as well as enhancing areas for breeding, nesting, forage, protection from adverse influences, etc.

Full consideration of all the likely impacts of the proposed project on terrestrial ecology has been undertaken and the site has been appropriately designed in the conceptual sense and in detail in the future design phase, to optimise the ecological and biological diversity outcomes.

Supporting the planning of the site is the environmental enhancement, particularly in the central parts of the project site. This ensures the linkages of the sit within the local area with the region's areas of environmentally sensitive landscapes being maintained.

Finally the proposed project has been conceptually designed and the EA has been prepared with the outcomes of Coleambally Land and Water Management Plan in mind.



5.11.5.3 *Justification – NRM Valuation and Pricing*

Both the IGAE and Protection of Environmental Operations Act (POEO) require improved valuation, pricing and incentive mechanisms to be included for policy making processes and again during project implementation. The issue of environmental evaluation and pricing of environmental resources is the fourth component of the principles of ecologically sustainable development. Integration of environmental and economic goals is a key principle of ESD and the concept of the triple bottom line (TBL) incorporates the issues of economic, social and environmental impacts.

5.11.5.4 *Justification – Performance Monitoring*

The integrated outcomes of the investigative processes and conclusions reached when preparing this EA have identified the guiding principles for the design level investigations, namely:

- The EA itself;
- Parameters in broad principles for the design level investigations;
- Construction issues to be addressed;
- Performance monitoring requirements; and
- Periodic review procedures.

Upon project approval the subsequent construction environmental management procedures will ensure all performance monitoring, decision making and review processors will lead to best management of the project and the early identification of issues of concern for addressing and reversal.

Business management structures include appropriate environmental management systems which must be integrated with operational management systems for best commercial, social and environmental outcomes. Each of these outcomes cannot survive and be sustainable without the remaining outcomes being sustainable.

Prior to operation a more detailed operational environmental management system would be prepared and documented as will the same for the construction processors.

5.11.6 *Justification - Climate Change*

It is generally accepted that significant climate change is underway, globally and a significant proportion of this climate change is being generated by certain gases known collectively as greenhouse gases (GHG's). The GHG's capture heat radiated from the earth and re-radiates the heat back to the earth. The net outcome with increasing greenhouse gases in the atmosphere ultimately lead to global warming and climate change.

The main GHG's are documented as methane, nitrous oxide and carbon dioxide and a high proportion originate from agricultural activities. There are other gases such as chlorofluorocarbons which are generated from other sources. In an agricultural context the main gases of methane, nitrous oxide and carbon dioxide are reduced to CO₂ equivalents, with varying multipliers for methane and nitrous oxide to equate the output in CO₂.



The following issues have been considered in the preparation of this EA:

- Methane is emitted from the cattle when digesting their food;
- High quality and well considered nutrition of the cattle minimises the amount of methane generated;
- Each tonne of methane generated equates to 310 tonnes of carbon dioxide equivalents;
- Nitrous oxide is generated from anaerobic processes. The addition of manure to agricultural lands will add nitrogen which can be potentially contributing to nitrous oxide emissions. However, the addition of the manure source of nitrogen will reduce the need for mineral nitrogen imported in artificial fertilisers at “Tubbo”. The manure will not totally replace the mineral fertiliser but will reduce the amount required for organic matter breakdown and crop nutrition. Each tonne of nitrous oxide equates to 21 tonnes of carbon dioxide equivalents;
- Carbon dioxide is generated from agricultural activity as well as the ethanol plant. Rather than allow the carbon dioxide from the ethanol plant to be released to the atmosphere, it is proposed to capture the CO₂, compress it, and market it off site for incorporation in carbonated beverages and other potential usages. The export of CO₂ from the ethanol plant will be a substitute for carbon dioxide which would be required such that the capture of this gas will result in a “no net change” scenario; and
- The use of ethanol blended fuel will act as an off-set against GHG emissions currently being generated by fossil fuels in motor vehicles and other forms of energy. (See Annexures 4.14.1 and 4.14.2).

It is expected to be a “net reduction” in the level of GHG emissions with an ultimate “net reduction” in the impact on climate change.

5.11.7 Justification – No Project Scenario

Should this project not proceed, it will be an issue of “where will a similar and matching project be developed rather than there is no project at all”. Whether Four Arrows Ethanol Pty Ltd wishes to continue at another site if this project is not approved is not relevant, since another developer may still continue with their investigations into a substitute project.

The end result is bio-fuel production will accelerate in accordance with the Federal Government’s Bio-Fuels Action Plan.

Thus it is a matter of where a project continues rather than if.

The subject site is considered an excellent site on the balance of all the environmental, social, economic and commercial issues and perspectives.

5.11.8 Summary

Given the merging of the project conceptual design and operational plan in response to the EA investigations the outcomes are the principles of the ESD are sustained and it is a justifiable decision to approve the project provided it maintains the intended outcomes.



6.0 APPROVALS AND LICENCES

6.1 Development Consent

It is recognised from inclusions within Sections 75D through to 75F of the EP&A Act 1979 that a development is not to be carried out under part 3A of the Act unless the Minister has given his approval. This approval is to be granted by way of an Environmental Assessment prepared in conjunction with the Director General of the DOP requirements and submitted by the proponent to the Director General for comment and subsequent submission to the Minister being the sole consent authority for this Environmental Assessment with regard to the pursuing project.

6.2 Environment Protection Licence

The amended Protection of Environmental Operations Act 1997 stipulates that certain activities which may produce harmful wastes and pollutants passing a risk to the environment and human health must be licensed.

The combined ethanol and dairy enterprises fall into two (2) of the listed areas:

- Agricultural produce industries that process agricultural produce (including dairy products, seeds, fruits, vegetables or other plant material) and that crush, juice, grind, gin, mill or separate more than 30,000 tonnes of produce per years; and
- Breweries or distilleries that produce alcohol or alcoholic products and that have an intended production capacity of more than 30 tonnes per day or 10,000 tonnes per year.

The licence will be issued as a combined licence including agricultural production and brewery or distillers' activities post approval of the Development Application.



7.0 STATEMENT OF COMMITMENTS

7.1 General Overview

A Statement of Commitments has been included as part of this EA as per requirements of Part 3A of the EP & A Act 1997 [Division 2, 75F (6)]. The following sections detail the proponent's intent to address those issues identified throughout the development of this Environmental Assessment (EA) including those proposed by relevant agencies and stakeholders. The process has been comprehensive to ensure that all potential issues have been identified and addressed however not restricted to those included within the Director General's (DG) specifications.

Upon approval the proponent will commission the formulation of an Environmental Management Plan (EMP) that will include a Construction Environmental Management Plan (CEMP) and an Operational Environmental Management Plan (OEMP), to achieve a state of maintained and/or improved environmental integrity initiated by the EA process. The detailed commitments described within the following sections will form the basis of these plans.

In general the proponent will pursue:

- The mitigation of identified and predicted impacts during construction and operational stages of the development;
- The identification and mitigation of on-going impacts during subsequent design and planning phases;
- The identification and mitigation of additional impacts as a result of project implementation;
- The inclusion of strategies and activities within established management plans to alleviate and where appropriate, ameliorate impacts during all project phases;
- The precautionary and expeditious implementation of measures to achieve predicted environmental responses;
- The design and implementation of monitoring programs applied to appropriate aspects of the project;
- The regular auditing of actual outcomes and planning methodology to achieve environmental goals; and
- Maintaining a dynamic continuum associated with an adaptive management framework.

Four Arrows Ethanol Pty Ltd commits to abide by and adhere to all legislation, regulations, licensing requirements, policy and guidelines identified within this EA and those appropriate to the construction and operation of the ethanol production facility and intensive dairy enterprise.

The proponent intends that all environmental management system designs and quality assurance programs and procedures will achieve current standards and would also be consistent with industry benchmarks.



7.2 The Development of Environmental Management Plan (EMP)

7.2.1 Why an Environmental Management Plan?

Four Arrows upon approval of the Environmental Assessment (EA) will develop an Environmental Management Plan (EMP) as part of its commitment to ensuring that correct and appropriate procedures are followed and quality assurance benchmarks are achieved. The plan will be a site and situation specific document that in essence acknowledges that the proponent (or the nominated staff and contractor/s) understands and intends to comply with the conditions of approval as stipulated by the Department of Planning (DOP) and collaborative agencies. The plan will address, but not be limited to, those environmental aspects that have been identified during the collation of this report. It will be developed in conjunction with commitments made by the proponent that demonstrates preparedness to attend to each identified aspect and gives assurance to maintaining the prosperity of the environment and social welfare during construction and operation of the proposed enterprises.

The plans will include management strategies and actions to be implemented during each phase of the development. Details will be given as to staging, monitoring, accountability and review. The EMP will be comprised of two (2) main sections. One part being a Construction Environmental Management Plan (CEMP), which will identify all aspects of construction that may be required to be addressed and managed during earthworks, assemblage of plant, and the development of infrastructure. The other being an Operational Environmental Management Plan (OEMP) that will detail those actions involved with the commissioning and running of the plant as well as those ongoing strategies implemented during the execution of the CEMP.

The resultant EMP will be the culmination of sub-plans contained both within the CEMP and the OEMP detailing management activities addressing specific environmental aspects that will include but not be limited to the following:

- Surface runoff and soil management;
- Erosion and sedimentation control;
- Flora and fauna conservation and management;
- Waste stream management;
- Air quality management;
- Groundwater management;
- Traffic management and control; and
- Cultural and heritage management.



7.2.2 Contents of an Environmental Management Plan

The NSW CPSC (1998) guidelines suggest a framework to develop an Environmental Management Plan (EMP). It is intended that the EMP for the proposed ethanol and dairy development will be modelled upon these guidelines, the detail of which will include the following points.

Commitment

1. *Stating the objectives of the EMP*

Planning

2. *A listing of the environmental aspects and impacts associated with the work, including:*
 - *specific undertakings arising from the environmental assessment;*
 - *consent conditions;*
 - *any conditions attached to the approvals;*
 - *statutory obligations; and*
 - *environmental risks.*
3. *Documentation of the measures to be taken to manage the identified aspects and impacts.*
4. *A clear indication of the respective environmental responsibilities of the proponent.*

Implementation

5. *Assignment of corporate responsibilities for implementing, maintaining or monitoring each environmental requirement.*
6. *Assignment of individual responsibilities for implementing, maintaining or monitoring each environmental requirement.*
7. *Procedures and instructions for implementing, maintaining or monitoring each environmental requirement.*
8. *Administrative and supervisory arrangements, responsibilities and accountabilities (eg. supervisory protocols; provision of a site environmental manager; management of subcontractors, training of site staff; submission of regular reports on the implementation of the EMP).*
9. *Cross-references to other environmental management documents (eg. landscape plans, soil and water management plans, statements of heritage significance, incident management plans).*
10. *Emergency response procedures.*

Measurement, evaluation and review

11. *Monitoring and audit procedures including provisions for corrective action.*



7.2.3 Auditing

A schedule of audits will be developed and integrated into the EMP. These will be conducted by independent third parties representing appropriate authorities. These audits will ensure that existing conditions correlate with the objectives and procedures outlined within the plan. Failure to comply will result in the requirement to adjust aspects of the plan so that the future conformity can be achieved.

7.3 Summary of Specific Commitments

This Environmental Assessment (EA) process has resulted in a number of identified and predicted issues in relation to the Four Arrows' development and all have been examined in detail through expert consultation. Where appropriate, mitigation strategies have been developed, the results of which are included within the following table. All issues will be revisited and further revised in the detailed planning and design phases with continued monitoring, adjustment and application during the construction and operational stages. The identified issues and recommended mitigation measures will constitute the foundation and direction of management plans to ensure the maintenance of and social welfare.

Table 7.3.1 Specific Commitments

Air Quality					
Issue	Section No.	Annexure No.	Commitment	Ref No.	Project Phase
General	4.2 5.1.1 5.1.2 5.2	4.1.1 4.2.1	Four Arrows commits to the development of a Construction Environmental Management Plan (CEMP) and an Operational Environmental Management Plan (OEMP) that addresses recommendations made by the Department of Planning (DOP) and other relevant agencies, and the grievances of stakeholders through the consultation process, that contains air quality monitoring and management strategies that will address the sources of air quality impacts and detail mitigation measures that will achieve air quality goals.	1	Post approval
Dairy Sheds	3.3.2 3.4.2 5.2.1		Four Arrows commits to the design and the placement of dairy cattle sheds in order to minimise the drift of particulate and odours from the development site.	2	Design Construction
Distillers grain	3.3.2 3.4.1 5.2.1		Four Arrows commits to the design of holding and storage facilities that minimises the drift of odours from wet distillers grain awaiting transport.	3	Design Construction
	4.1.2 5.2.1	4.1.1	Four Arrows commits to an ethanol production volume that will ensure that all by-product, which includes wet distillers grain, will not be over and above that which results in the unnecessary storage of derivatives on site.	4	Operation
	4.1.2 5.2.1	4.1.1	Four Arrows commits to secure contracts that will ensure the expeditious movement of unrequired wet distillers grain offsite and develop strategies that make provision for unexpected dropouts or terminations of agreements.	5	Ongoing
	4.1.2 5.2.1	4.1.1	Four Arrows commits to the suspension of ethanol production in the event that mechanisms for the collection of wet distillers grain are interrupted or negatively affected until other disposal arrangements can be implemented.	6	Operation
Dust	5.2.2		Four Arrows commits to conducting construction activities that minimises the affects of dust on surrounding areas particularly towards the Kidman Way.	7	Construction



Air Quality					
Issue	Section No.	Annexure No.	Commitment	Ref No.	Project Phase
	5.2.2		Four Arrows commits to the operation of water trucks, and various sedimentation and dust capture systems, to ensure that the generation of dust is kept to a minimum as ot to affect surrounding areas particularly towards the Kidman Way.	8	Construction
	4.11.1 5.2.2		Four Arrows commits to the installation of misting and sprinkler type systems within cattle yards, dry pens and exercise yards etc. to minimise the drift of dust to surrounding areas.	9	Operation
	5.2.2		Four Arrows commits to the installation of hooded augers and screened areas at grain transfer sites to capture and minimise the amount of dust drifting from the project site.	10	Operation
	4.11.1 5.2.2 5.5.1.10		Four Arrows commits to the sealing of all appropriate surfaces including roads, paths, yards and pens that may be the potential sources of dust.	12	Design Construction
Ethanol Plant	4.1.2 4.2.3.1 4.2.3.2 5.2.1	4.2.1	Four Arrows commits to the design and placement of the ethanol plant and associated infrastructure in order to minimise the drift of gaseous and particulate emissions from the project site.	13	Design Construction
Manure	4.1.4 4.8.4 5.5.2.13	4.1.4	Four Arrows commits to the design and construction of a manure collection system involving flood wash-down channels and sedimentation basins that minimises the production and drift of odours from the development site.	14	Design Construction
	4.1.5 4.1.6 5.5.2.14 5.5.2.15	4.1.6 4.1.7	Four Arrows commits to the design and construction of anaerobic and aerobic ponds to facilitate the rapid breakdown of effluent produced by the dairy enterprise and to minimise the amount of odours that drift from the development site.	15	Design Construction
	4.1.4 4.8.4 4.14 5.5.2.18	4.1.4	Four Arrows commits to the regular removal of manures from sedimentation basins, and the dry down and cleaning of anaerobic ponds when required, in order to minimise the drift of odours from the development site.	16	Operation
	4.1.4 4.1.8 4.8.4 5.5.1.8	4.1.4	Four Arrows commits to the regular removal of manures from open penned areas to reduce the drift of odours from the development site.	17	Operation
	4.1.4 4.1.8 4.8.1 5.5.1.8 5.5.2.18	4.1.4	Four Arrows commits to the acceptance of all manures onto its neighbouring Tubbo Station property and the expeditious incorporation of these manures into the soil profile to minimise the drift of odours from this source.	18	Operation
Monitoring and Review	4.2.2, 5.2.1 5.2.2	4.2.1	Four Arrows commits to the installation of sensors and additional equipment including anemometers etc. to allow for the monitoring and modelling of particulate and odour movements to ensure that air quality goals are being achieved	19	Construction Operation
	4.2.2, 5.2.1 5.2.2	4.2.1	Four Arrows commits to appointing designated officers/consultants to monitor air quality and to implement improvements necessary to ensure ongoing compliance to air quality standards.	20	Construction Operation
	4.2.2 5.1.2 5.2.2	4.2.1	Four Arrows commits to providing a process where grievances regarding air quality can be registered and addressed in an effective and expeditious manner.	21	Operation
Reporting	4.2 5.1.2	4.2.1	Four Arrows commits to environmental performance reporting that will be forwarded as required to relevant agencies and allow for the updating of CEMP's and OEMP's	22	Construction Operation



Air Quality					
Issue	Section No.	Annexure No.	Commitment	Ref No.	Project Phase
Auditing	4.2.2 5.1.2	4.2.1	Four Arrows commits to allowing third parties to audit air quality records and review management strategies in order to ensure compliance to air quality standards	23	Construction Operation
	5.1.1	4.2.1	Four Arrows commits to the upgrading of structures to mitigate odours and if necessary the relocation of affected residents currently inhabiting the company's neighbouring property; Farm 641	24	Construction Pre-operation
Mitigation	4.2.6 5.2.1 5.2.2	4.2.1	Four Arrows commits to implementing all mitigation measures in relation to the management air quality identified throughout the EA process.	25	Design Construction Operation

Nutrients					
Issue	Section No.	Annexure No.	Commitment	Ref No.	Project Phase
General	4.1.8 5.1.1 5.1.2 5.5	4.1.9	Four Arrows commits to the development of a CEMP and an OEMP that addresses recommendations made by the Department of Planning (DOP) and other relevant agencies, and the grievances of stakeholders through the consultation process, that contains nutrient monitoring and management strategies that will address the sources of nutrient impacts and detail mitigation measures that will achieve minimal movement of nutrients produced by the development into the environment.	26	Post approval
	4.1.8 5.5		Four Arrows commits to a site design and management strategy that will result in minimal net loss of nutrients into the environment from sources including runoff which will contaminate the environment and in particular groundwater systems.	27	Operation
	4.1.5 4.1.8		Four Arrows commits to a management strategy that ensures that all liquid waste is collected and contained in ponds with the removal of residue solids once alternate ponds are dried out.	28	Operation
	4.1.8		Four Arrows commits to a management strategy that ensures that no high nutrient laden water will be used for the purposes of irrigation unless prior concurrence of the relevant agency is obtained in writing.	29	Operation
	4.1.8 4.8.1 4.14 5.5.1.8 5.5.2.18		Four Arrows commits to maintaining ownership of farms throughout the CIA; the land area and suitability of which can accommodate volumes of manure produced by the dairy enterprise and damaged grain unable to be utilised in ethanol production.	30	Ongoing
	4.1.8		Four Arrows commits to promoting the use of manures on affiliate company owned irrigation enterprises throughout the CIA in order to create a demand for manure from other producers.	31	Operation
Monitoring & Review	4.1.8		Four Arrows commits to regularly conduct soil nutrient status testing, and modelling comparisons to nutrient export data, to ascertain soils potential to continue to bind nutrients for further crop exploitation at Tubbo Station.	32	Operation
	4.1.8		Four Arrows commits to appointing designated officers/consultants to monitor nutrient movements throughout the system, and to assist with implementation of any improvements necessary in order to ensure minimal nutrient movement into the environment.	33	Operation
	4.1.8		Four Arrows commits to working closely with relevant agencies to design and implement monitoring programmes that will assist with the detection of the leaching of nutrient into the environment.	34	Design Operation



Nutrients					
Issue	Section No.	Annexure No.	Commitment	Ref No.	Project Phase
Reporting	5.1.1		Four Arrows commits to environmental performance reporting that will be forwarded as required to the relevant agencies and allow for the updating of CEMP's and OEMP's .	35	Construction Operation
Auditing	5.1.1		Four Arrows commits to allowing third parties to audit nutrient monitoring records and review management strategies in order to ensure minimal nutrient movement into the environment.	36	Operation
Mitigation	5.1.1		Four Arrows commits to implementing all mitigation measures in relation to the management of nutrient movements identified throughout the EA process.	37	Construction Operation

Noise/Vibration					
Issue	Section No.	Annexure No.	Commitment	Ref No.	Project Phase
General	4.3 5.1.1 5.1.2 5.3	4.3.1	Four Arrows commits to the development of a CEMP and an OEMP that addresses recommendations made by the Department of Planning (DOP) and other relevant agencies, and the grievances of stakeholders through the consultation process, that contains noise and vibration monitoring and management strategies that will address the sources of noise impacts and detail mitigation measures and will achieve noise and vibration goals.	38	Post approval
	4.3.2.4		Four Arrows commits to construction periods that will result in the least possible noise impact on surrounding receptors.	39	Construction
	4.3.2.4 5.3.1		Four Arrows commits to taking all possible steps towards mitigating construction noise that will impact on surrounding receptors.	40	Construction
	4.3.3.1 4.3.3.2 5.3.2		Four Arrows commits to taking all possible steps to mitigate the noise produced by plant and equipment associated with the development through acoustic dampening.	41	Design Operation
	4.3.3.1 5.4		Four Arrows commits to reducing noise impacts created by increased vehicle movements on access and egress roadways servicing the development, by encouraging car pooling, maximizing the back loading of heavy vehicles, and supplying group transportation if assessed to be a viable option and/or encouraging local bus companies to provide a transportation service.	42	Operation
	4.4.4 5.4	4.4.8	Four Arrows commits to reducing noise impacts created by increased vehicle movements on access and egress roadways servicing the development by limiting heavy transport movement to daylight hours (7.00am – 10.00pm).	43	Operation
	4.3.1 5.3.1		Four Arrows commits to the design and construction of a sound proofing barrier to mitigate the affect of noise on the companies neighbouring property Farm 641.	44	Design Construction
	4.3.1 5.3.1		Four Arrows commits to the upgrading of structures to mitigate noise and if necessary the relocation of affected residents currently inhabiting the companies neighbouring property Farm 641.	45	Design Construction
Monitoring & Review	4.3.2 5.3.2		Four Arrows commits to the installation of sensors and additional equipment, to allow for the monitoring and modelling of noise levels and types, to ensure that noise goals are being achieved.	46	Construction Operation
	4.3.2		Four Arrows commits to appointing designated officers/consultants to monitor noise and vibration levels, and to implement any improvements necessary to ensure ongoing compliance to noise and vibration standards.	47	Construction Operation



Noise/Vibration					
Issue	Section No.	Annexure No.	Commitment	Ref No.	Project Phase
	4.3.2.2 5.4		Four Arrows commits to working closely with relevant agencies to monitor variations in noise levels in neighbouring townships, particularly Darlington Point, from increased vehicle movements.	48	Design Construction Operation
	4.3.2 5.1.2		Four Arrows commits to providing a process where grievances regarding noise and vibration levels can be registered and addressed in an effective and expeditious manner.	49	Operation
Reporting	5.1.2		Four Arrows commits to environmental performance reporting that will be forwarded as required to the relevant agencies and allow for the updating of CEMP's and OEMP's.	50	Construction Operation
Auditing	4.3.2 5.4.2		Four Arrows commits to allowing third parties to audit noise and vibration level records and review management strategies in order to ensure compliance to noise and vibration level standards.	51	Construction Operation
Mitigation	5.1.1		Four Arrows commits to implementing all mitigation measures in relation to the management of noise and vibration identified throughout the EA process.	52	Design Construction Operation

Traffic/Transport					
Issue	Section	Annexure No.	Commitment	Ref No.	Project Phase
General	4.4 5.1.1 5.1.2 5.4	4.4	Four Arrows commits to the development of a CEMP and an OEMP that addresses recommendations made by the Department of Planning (DOP) and other relevant agencies, and the grievances of stakeholders through the consultation process, that contains traffic monitoring and management strategies that will address the sources of traffic impacts and detail mitigation measures and which will achieve traffic management goals.	53	Post approval
	4.4.3.4 5.4	4.4.8	Four Arrows commits to operational periods that will result in the least possible traffic impact to achieve a high level of safety and reduce traffic delays (7.00am – 10.00pm).	54	Operation
	4.4.3.4 4.4.3.5	4.4.4 4.4.8	Four Arrows commits to encouraging safety and alleviating delays created by increased vehicle movements, by supporting car pooling, maximising the back loading of heavy vehicles, and supplying group transportation if assessed to be a viable option and/or encouraging local bus companies to provide a transportation service.	55	Operation
	4.4.5 5.4	4.4.11a 4.4.11b 4.4.11c 5.4	Four Arrows commits to contributing towards a road upgrade, adjacent to the development site on the Kidman Way that will provide safe and efficient access and egress for heavy transport, staff and support vehicles.	56	Design Construction
	4.4.5 5.4		Four Arrows commits to the design and construction of an internal road structure that will allow for the safe and efficient movement of all vehicles onto, around and off of the development site.	57	Design Construction
	4.4.5 5.4		Four Arrows commits to a site design and construction standard that will be sufficient to allow off street parking for trucks waiting to unload and pick-up and to cater for high volume periods.	58	Design Construction
	4.4.5 5.4		Four Arrows commits to a site design and construction that will accommodate the parking of all staff vehicles and any ancillary vehicles that may be present during normal operations of the development.	59	Design Construction
	4.4.5 5.4		Four Arrows commits to incorporating into the internal roadway system, road crossings and pathways, that will allow for safe pedestrian movement.	60	Design Construction



Traffic/Transport					
Issue	Section No.	Annexure No.	Commitment	Ref No.	Project Phase
	4.4.4 5.4		Four Arrows commits to continuing its support for the upgrading and re-opening of the Willbriggie railhead to reduce the need for long distance transportation of resources and the potential transportation of product.	61	Ongoing
Monitoring & Review	4.3.2 5.4		Four Arrows commits to the installation and maintenance of sensors to maintain accurate records of vehicle movements and class.	62	Construction Operation
	5.4		Four Arrows commits to appointing designated traffic officers/consultants to monitor vehicle movements onto, around and off of the development site, and to implement any improvements necessary to ensure the effective and efficient movement of vehicles and the safety of personnel and livestock.	63	Construction Operation
	4.4.4 5.4		Four Arrows commits to working closely with relevant agencies to monitor traffic impacts in neighbouring townships, particularly Darlington Point and at the Willbriggie rail crossing, from increased vehicle movements.	64	Design Construction Operation
	5.1.2		Four Arrows commits to providing a process where grievances regarding traffic and vehicle movements can be registered and addressed in an effective and expeditious manner.	65	Operation
Reporting	5.1.2		Four Arrows commits to environmental performance reporting that will be forwarded as required to the relevant agencies and allow for the updating of CEMP's and OEMP's.	66	Construction Operation
Auditing	4.3.2 5.1.2		Four Arrows commits to allowing third parties to audit traffic records and vehicle movement records, and review management strategies in order to ensure efficiencies, safety and amenity.	67	Construction Operation
Mitigation	5.1.1		Four Arrows commits to implementing all mitigation measures in relation to the management of traffic/transport identified throughout the EA process	68	Design Construction Operation

Water Dynamics					
Issue	Section No.	Annexure No.	Commitment	Ref No.	Project Phase
General	4.5 5.1.1 5.1.2 5.5	4.1.9	Four Arrows commits to the development of a CEMP and an OEMP that addresses recommendations made by the Department of Planning (DOP) and other relevant agencies, and the grievances of stakeholders through the consultation process, that contains water monitoring and management strategies that will address the sources of water impacts and detail mitigation measures and will achieve water management goals.	69	Post approval
	5.5.2.13		Four Arrows commits to a project land and water management plan that includes contingencies for surface and stored water management in the event of an unlikely extreme rainfall period, being of the order of 150mm in a 24 hour period that will endeavour to minimise the escape of contaminated water into the CICL drainage system.	70	
	4.5.1.1		Four Arrows commits to continue to secure water sources beyond existing entitlements to ensure adequate and consistent supplies.	71	Ongoing.



Water Dynamics					
Issue	Section No.	Annexure No.	Commitment	Ref No.	Project Phase
Ground Water	4.1.5 to 4.1.7. 4.5.3.1 to 4.5.3.6. 5.5.2.4 5.5.2.8 5.5.2.13 5.5.2.14 5.5.2.15 5.6	4.1.5 4.1.6 4.1.7 4.1.8	Four Arrows commits to the design, placement and construction of water collection and storage systems to be consistent with the objectives of the Coleambally Land & Water Management Plan and as not to affect groundwater levels and/or quality, including the use of a 3 tier storage treatment (geosynthetic membrane liner, leakage, monitoring and capture system and compacted clay liner) for Category 3 storage areas.	72	Design Construction
	4.5.3.6 5.5.2.2 5.6		Four Arrows commits to conducting further field testing prior to construction to ensure that the design and placement of water collection and storage systems will prevent water from across the development site, both from natural and manipulated flows, from accessing the local and regional groundwater sinks.	73	Design Pre-construction
	5.5.2.2 5.5.2.17 5.6		Four Arrows commits to the design and placement of water storages to be upon the most appropriate soil types available at the proposed site, or where not possible, to provide engineered solutions to mitigate potential risks.	74	Design Construction
	5.5.2.2 to 5.5.2.15.		Four Arrows commits to applying engineering methods and other technologies upon areas that are to be utilised for infrastructure including water storages, dairy free-stall sheds and heifer drylot pens, to mitigate accessions to groundwater.	75	Design Construction
	5.5.2.2 to 5.5.2.16. 5.5.2.18		Four Arrows commits to the bunding of all Category 2 and 3 areas so as to contain spillages and contaminated runoff escaping into the environment and accession to groundwater.	76	Design Construction
	5.5.2.3		Four Arrows commits to the design and construction of the ethanol plant that will capture, isolate and categorise water from rainfall events, mitigating accessions to groundwater.	77	Design Construction
	5.5.2.5		Four Arrows commits to the design and construction of grain bunkers that will capture, isolate and categorise water from rainfall events mitigating accessions to groundwater	78	Design Construction
	5.5.1.6 5.5.2.6		Four Arrows commits to the design and construction of truck wash down bays that will capture, isolate and categorise water from rainfall events, mitigating accessions to groundwater.	79	Design Construction
	5.5.2.7		Four Arrows commits to the design and construction of administration buildings that will capture, isolate and categorise water from rainfall events, mitigating accessions to groundwater.	80	Design Construction
	5.5.2.9		Four Arrows commits to the design and construction of the commodity shed, milking barn and milk storage that will capture, isolate and categorise water from rainfall events, mitigating accessions to groundwater.	81	Design Construction
	5.5.2.10		Four Arrows commits to the design and construction of free stall sheds, maternity, and hospital sheds that will capture, isolate and categorise water from rainfall events, mitigating accessions to groundwater.	82	Design Construction
	5.5.2.11		Four Arrows commits to the design and construction of heifer dry lot pens that will capture, isolate and categorise water from rainfall events, mitigating accessions to groundwater.	83	Design Construction
	5.5.2.12		Four Arrows commits to the design and construction of cattle yards that will capture, isolate and categorise water from rainfall events, mitigating accessions to groundwater.	84	Design Construction



Water Dynamics					
Issue	Section No.	Annexure No.	Commitment	Ref No.	Project Phase
	5.5.2.4 5.5.2.8 5.5.2.14 5.5.2.15 5.5.2.17		Four Arrows commits to the engagement of an experienced geotechnical engineer for the design, construction and operation of storages, and other activities, which requires expert knowledge for the abatement of negative groundwater effects.	85	Design Construction Operation
	5.5.2.6 5.5.2.7 5.5.2.16 5.7.1 5.9.1		Four Arrows commits to landscaping and the planting of deep rooted, indigenous native flora, to assist with evapotranspiration of groundwater, and excess water which would otherwise percolate into aquifers.	86	Design Construction
Surface Water	4.5.1.1 4.5.2.1 5.5.1.1 5.5.1.7		Four Arrows commits to the inclusion of buffer storages within its development design to ensure constant supply in the event that CICL closes delivery channels for maintenance or in periods of emergency repairs to the delivery system.	87	Design Construction
	4.5.2.2 4.5.2.3 4.5.2.4 5.5.1.11		Four Arrows commits to the design and construction of drainage systems that will collect the maximum possible volumes of surface water runoff to be utilised by the production and support processes so as to not overburden or contaminate exit drainage channels.	88	Design Construction
	4.5.2.4 5.5.1.1 to 5.5.1.11		Four Arrows commits to the design and construction of water capture systems that collect the maximum possible volumes of precipitation from roofs and hard surfaces to be reused onsite.	89	Design Construction
	4.5.2.4 5.5.1		Four Arrows commits to maximizing the recycling of water from all processes including ethanol and dairy production and the associated support infrastructure.	90	Design Construction Operation
	5.5.1.2		Four Arrows commits to the appropriate design and construction of structures and infrastructure to accommodate the storage and handling of chemicals and hazardous materials as not to contaminate or affect the quality of surface water runoff.	91	Design Construction
	5.5.1.2		Four Arrows commits to the design of procedures and protocols, and the training of staff, in the handling of chemicals and hazardous materials particularly spillage management to alleviate the risk of affecting the quality of surface water runoff.	92	Operation
	5.5.1.3		Four Arrows commits to the design and construction of workshop areas that will contain any fuel spillages, which excludes inflows from other site sources allowing for the appropriate isolation, collection and categorisation of runoff from these areas.	93	Design Construction
	5.5.1.6 5.5.2.6		Four Arrows commits to the appropriate design and construction of truck wash down bays to collect contaminants and exclude inflows from other site sources allowing for the appropriate isolation, collection and categorisation of runoff from these areas.	94	Design Construction
	5.5.1.4		Four Arrows commits to the dewatering of distillers grain and the recycling of the water back through the ethanol system as not to create unnecessary burdens on the integrated water collection systems.	95	Operation
	5.5.1.5 5.5.2.5		Four Arrows commits to the design and construction of grain storages that limits the contamination of runoff and excludes inflows from other site sources allowing for the appropriate isolation, collection and categorisation of runoff from these areas.	96	Design Construction
	5.5.1.4		Four Arrows commits to the design and construction of appropriate facilities to store wet distillers grain awaiting transport from the development site, which contains and captures gravitational water losses.	97	Design Construction
	5.5.1.1 5.5.1.7		Four Arrows commits to the design and construction of a substantial bund or containment bank, which could be used as a site access road, encompassing the entire dairy enterprise area and its associated waste treatment facilities, which excludes inflows from other site sources allowing for the appropriate isolation, collection and categorisation of runoff from these areas.	98	Design Construction



Water Dynamics					
Issue	Section No.	Annexure No.	Commitment	Ref No.	Project Phase
	5.5.1.8 5.5.2.13		Four Arrows commits to the design and construction of bunded areas that are collection points for manure scrapings, which excludes inflows from other site sources allowing for the appropriate isolation, collection and categorisation of runoff from these areas.	99	Design Construction
	4.8.4 5.5.1.8 5.5.2.18		Four Arrows commits to the application of manures on its Tubbo Station at a rate that will result in minimal nutrient losses to the environment from the action of surface water.	100	Operation
	5.5.1.9 5.7.1 5.9.1		Four Arrows commits to landscaping that will assist with the flow of drainage water, that will minimise contamination due to erosion, and that will not allow free water to remain within the project site.	101	Design Construction
	5.5.1.10 5.5.2.3 5.5.2.5 5.5.2.7 5.5.2.9 5.5.2.12		Four Arrows commits to the sealing of all possible surfaces including the internal roadway system to assist with the capture of surface water and to reduce contamination due to erosion.	102	Design Construction
	5.5.1.11 5.5.2.13 5.5.2.14 5.5.2.15		Four Arrows commits to the design and construction of water storages that will accommodate waste water from production processes and increased surface water runoff in the event of high rainfall periods or repetitive storm events.	103	Design Construction
	3.3.2 3.4.3 4.1.7		Four Arrows commits to the integration of a wetlands area within the development design as part of the integrated surface runoff collection system, the water of which can be reused for dairy operations or landscape irrigation.	104	Design Construction Operation
Monitoring and Review	4.5.3.6 5.5.1.1		Four Arrows commits to the installation of piezometers throughout the site prior to final design to assist with the design and placement of water collection and storage systems.	105	Pre-design
	4.5.3.6 5.5.1.1 5.5.2.4 5.5.2.8 5.5.2.14 5.5.2.15		Four Arrows commits to the installation of piezometers throughout the site to provide data to assess impacts on groundwater levels and quality.	106	Pre-construction
	4.5.3.6		Four Arrows commits to appointing designated officers/consultants to monitor surface water movements and quality, and groundwater levels and quality, and to implement any improvements necessary to ensure adverse effects on groundwater levels and/or quality are not occurring.	107	Construction Operation
	5.5.1.1		Four Arrows commits to working closely with CICL and other relevant agencies to maintain and/or improve groundwater levels and quality through performance based monitoring and best management practice.	108	Construction Operation
	5.1.2		Four Arrows commits to providing a process where grievances regarding surface water runoff and quality, and groundwater levels and/or quality, can be registered and addressed in an effective and expeditious manner.	109	Construction Operation
Reporting	5.1.2		Four Arrows commits to environmental performance reporting that will be forwarded as required to the relevant agencies and allow for the updating of CEMP's and OEMP's .	110	Construction Operation
Auditing	5.1.2		Four Arrows commits to allowing third parties to audit groundwater records and review management strategies, in order to ensure that the development is not contributing adversely to surface runoff, and groundwater levels and quality.	111	Construction Operation
Mitigation	5.1.1		Four Arrows commits to implementing all mitigation measures in relation to the management of water dynamics identified throughout the EA process.	112	Design Construction Operation



Hazards and Risks					
Issue	Section No.	Annexure No.	Commitment	Ref No.	Project Phase
General	4.6 5.1.1 5.1.2	4.6.1	Four Arrows commits to the development of a CEMP and an OEMP that addresses recommendations made by the Department of Planning (DOP) and other relevant agencies, and the grievances of stakeholders through the consultation process, that contains hazard and risk monitoring, and risk analysis and management strategies, which will address the sources of hazards and risks and detail mitigation measures that will achieve the highest levels of abatement.	113	Post approval
	4.6.1 4.6.2 5.5.1.2 5.5.1.3 5.5.1.5 5.5.1.6 5.5.2.5		Four Arrows commits to the design of buildings, structures and infrastructure, which will mitigate the hazards and risks associated with ethanol production and the dairy enterprise.	114	Design Construction
	4.6.1 5.5.1.2 5.5.1.3 5.5.1.5 5.5.1.6 5.5.2.5		Four Arrows commits to management and procedural practices that will mitigate the hazards and risks associated with ethanol production and the dairy enterprise.	115	Operation
	4.6.1 4.6.2		Four Arrows commits to ensuring that potentially hazardous events are contained within the development site and do not result in injury or harm to off-site individuals and/or the environment.	116	Design Construction Operation
	4.6.2 4.6.3 4.8.6 5.5.1.2		Four Arrows commits to a quality assurance program that ensures the responsible and safe storage, application, and disposal of chemicals used throughout the ethanol and dairy enterprises.	117	Construction Operation
	4.6.2 4.6.3		Four Arrows commits to the training of relevant staff in the use of chemicals and safety procedures.	118	Construction Operation
	4.6.3		Four Arrows commits to adherence to OH&S and other legislative requirements to ensure the safety of employees, support staff and contractors.	119	Construction Operation
Monitoring & Review	4.6.2		Four Arrows commits to the installation of sensors and early warning systems throughout the site to detect undesirable levels of dust, vapour and toxins that may give rise to and/or present as a hazardous event.	120	Design Construction
	4.6.3		Four Arrows commits to appointing designated officers/consultants to monitor hazard reports, safety reports, processes, procedures etc. and to implement any improvements necessary to ensure the welfare of visitors and staff, the health of the environment, and continued economic security.	121	Construction Operation
	4.6.2		Four Arrows commits to working closely with relevant agencies to ensure best management practice is being implemented and benchmarks are being achieved.	123	Construction Operation
	5.1.2		Four Arrows commits to providing a process where grievances regarding hazards and risks can be registered and addressed in an effective and expeditious manner.	124	Operation
Reporting	4.6.2 5.1.2		Four Arrows commits to environmental performance reporting that will be forwarded as required to the relevant agencies and allow for the updating of CEMP's and OEMP's .	125	Construction Operation
Auditing	4.6.2 5.1.2		Four Arrows commits to allowing third parties to audit hazard and safety reports and to review processes, procedures and management strategies.	126	Construction Operation
Mitigation	4.6.2 5.1.2		Four Arrows commits to implementing all mitigation measures in relation to the management of hazards and risk identified throughout the EA process.	127	Design Construction Operation



Soils					
Issue	Section No.	Annexure No.	Commitment	Ref No.	Project Phase
General	4.7 5.1.1 5.1.2 5.6		Four Arrows commits to the development of a CEMP and an OEMP that addresses recommendations made by the Department of Planning (DOP) and other relevant agencies, and the grievances of stakeholders through the consultation process, that contains soil monitoring and management strategies that will maintain and improve soil condition, and prevent erosion throughout the site.	128	Post approval
	4.7.1 5.5.2.2 5.6		Four Arrows commits to the design, placement and construction of buildings, structures and infrastructure only upon suitable soil types and topography, and to exclude areas deemed inappropriate for development.	129	Design Construction
	4.7.2 5.5.2.2 5.6		Four Arrows commits to conducting further soil testing including chemical analysis and geophysical assessment as part of a detailed design investigation following approval of the EA.	130	Post approval
Monitoring & Review	4.7.6 4.7.7 5.6		Four Arrows commits to the close monitoring of soils for variations to expected types, including chemical and physical features, which may require redesign or layout of buildings, structures and infrastructure.	131	Design Construction
	4.7.7 5.6		Four Arrows commits to appointing designated officers/consultants to monitor soils and to implement any improvements necessary to ensure the maintenance and/or enhancement of soil condition	132	Construction Operation
	5.6		Four Arrows commits to working closely with relevant agencies to ensure soils are being managed appropriately thus avoiding negative effects including erosion.	133	Construction Operation
	5.1.2		Four Arrows commits to providing a process where grievances regarding soils and erosion can be registered and addressed in an effective and expeditious manner.	134	Construction Operation
Reporting	5.1.2		Four Arrows commits to environmental performance reporting that will be forwarded as required to the relevant agencies and allow for the updating of CEMP's and OEMP's .	135	Construction Operation
Auditing	5.1.2		Four Arrows commits to engaging third parties to audit soil monitoring records and review management strategies in order to ensure that the development is designed, constructed and managed according to soil characteristics and capability.	136	Construction Operation
Mitigation	5.1.1		Four Arrows commits to implementing all mitigation measures in relation to soil health and erosion identified throughout the EA process.	137	Design Construction Operation

Waste Management					
Issue	Section No.	Annexure No.	Commitment	Ref No.	Project Phase
General	4.8 5.1.1 5.1.2		Four Arrows commits to the development of a CEMP and an OEMP that addresses recommendations made by the Department of Planning (DOP) and other relevant agencies, and the grievances of stakeholders through the consultation process, that contains waste production monitoring and management strategies that will ensure effective and efficient management of waste streams, resulting in negligible impact on society and the environment.	138	Post approval
	4.8.1 4.8.2		Four Arrows commits to attracting markets for wastes and derivatives created from production.	139	Ongoing
Chemical	4.6.2 4.8.6		Four Arrows commits to the use of returnable chemical containers to reduce the risk of environmental contamination.	140	Design Construction Operation



Waste Management					
Issue	Section No.	Annexure No.	Commitment	Ref No.	Project Phase
CO ₂	4.8.2		Four Arrows commits to the maximised capture and sale of CO ₂ from ethanol production and to secure long term and diverse contracts to purchase the by-product.	141	Operation
Damaged grain	4.8.3 5.5.1.5 5.5.2.5		Four Arrows commits to the design, construction and operation of effective grain storage facilities to ensure that damaged grain is kept to a minimum.	142	Design Construction
	4.8.3 5.5.1.5 5.5.2.5		Four Arrows commits to the responsible disposal and application of damaged grain onto dryland areas of surrounding company properties at a rate that will result in no nutrient losses into the environment or accession to groundwater sinks.	143	Operation
Distillers grain	4.8.2 5.5.1.4		Four Arrows commits to the expeditious removal of excess wet distillers grain to what already is a ready and keen market and to secure long term and diverse contracts to purchase the by-product.	144	Operation
	4.8.2 5.5.1.4		Four Arrows commits to the recycling of excess water collected from wet distillers grain back through the ethanol production process.	145	Operation
Effluent management	4.8.4 5.5.1.7 5.5.1.8 5.5.2.9 to 5.5.2.15.		Four Arrows commits to the design and construction of an effluent management system consisting of sediment basins and anaerobic and aerobic ponds that will be sufficient in volume to accommodate both the total effluent production and extreme rainfall events.	146	Design Construction
	4.8.8.1 5.5.1.7		Four Arrows commits to the recycling of wastewater for use in the flushing of effluent from free-stall dairy sheds.	147	Design Construction Operation
	4.8.5 5.5.1.9 5.5.2.7		Four Arrows commits to the installation of an effluent treatment system to accommodate grey water etc, produced from staff amenities and associated support sources, which can be recycled and used to irrigate gardens etc. which results in minimal losses into the environment or accession to groundwater.	148	Design Construction Operation
	4.1.8 4.8.1 4.8.4 4.14 5.5.2.18		Four Arrows commits to the incorporation of manure into the soils of its properties in the vicinity of the development particularly the adjoining Tubbo Station.	149	Operation
Truck wash-down	4.8.7 5.5.1.6 5.5.2.6		Four Arrows commits to the segregation of materials produced from the truck wash-down areas and their responsible disposal according to best practice ruling at the time.	150	Design Construction Operation
Monitoring & Review	5.1.2		Four Arrows commits to the monitoring of each waste management stream using whatever methods and technologies are considered appropriate and applicable.	151	Design Operation
	5.1.2		Four Arrows commits to appointing designated officers/consultants to monitor each waste management stream to achieve optimum efficiencies and minimise impacts on the environment and society.	152	Construction Operation
	5.1.2		Four Arrows commits to providing a process where grievances regarding wastes can be registered and addressed in an effective and expeditious manner.	153	Operation
	5.1.2		Four Arrows commits to working closely with relevant agencies including primarily the EPA to improve monitoring and review efficiencies and to minimise impacts of each identified waste management stream.	154	Design Operation
Reporting	5.1.2		Four Arrows commits to environmental performance reporting that will be forwarded as required to the relevant agencies and allow for the updating of CEMP's and OEMP's .	155	Construction Operation



Waste Management

Issue	Section No.	Annexure No.	Commitment	Ref No.	Project Phase
Auditing	5.1.2		Four Arrows commits to engaging third parties to audit waste production and management records and to review management strategies in order to ensure that the developments ongoing processes are not adversely affecting the environment or society.	156	Construction Operation
Mitigation	5.1.1		Four Arrows commits to implementing all mitigation measures in relation to the management of waste streams identified throughout the EA process	157	Design Construction Operation

Visual Impacts

Issue	Section No.	Annexure No.	Commitment	Ref No.	Project Phase
General	4.9 5.1.1 5.1.2 5.7	4.9.1	Four Arrows commits to the development of a CEMP and an OEMP that addresses recommendations made by the Department of Planning (DOP) and other relevant agencies, and the grievances of stakeholders through the consultation process, that contains specific details pertaining to the design and management that will maintain and improve visual impacts including amenity of the site.	158	Post approval
Landscape values	4.9.1 5.5.1.9 5.7.1 5.9.1		Four Arrows commits to the maintaining remnant vegetation and enhancement, through the establishment of a 50 metre wide perimeter planting, consisting of a mosaic groundcover with understorey and over-storey species, with additional areas of habitat restoration and wetland creation onsite.	159	Design Construction Operation
Lighting	4.9.2 5.7.2		Four Arrows commits to the design of an outdoor lighting system consistent with Australian Standard (AS4282-1977) and which considers the effects of the lighting on occupants of surrounding properties and on vehicles in the vicinity of the installation.	160	Design Construction Operation
Monitoring and Review	5.1.2		Four Arrows commits to monitoring of visual impacts to maintain and/or enhance amenity.	161	Design Construction Operation
	5.1.2		Four Arrows commits to appointing designated officers/consultants to monitor visual impacts and to implement any improvements necessary to maintain and/or enhance visual amenity.	162	Construction Operation
	5.1.2		Four Arrows commits to working closely with relevant agencies to improve the effects of visual impacts to offsite receptors.	163	Design Construction Operation
	5.1.2		Four Arrows commits to providing a process where grievances regarding visual impacts can be registered and addressed in an effective and expeditious manner.	164	Operation
Reporting	5.1.2		Four Arrows commits to performance reporting that will be forwarded as required to the relevant agencies and allow for the updating of CEMP's and OEMP's .	165	Construction Operation
Auditing	5.1.2		Four Arrows commits to allowing third parties to audit any identified visual impact issues resulting from the development and the mitigation actions and strategies applied to alleviate these.	166	Construction Operation
Mitigation	5.1.1		Four Arrows commits to implementing all mitigation measures in relation to managing visual impacts and amenity identified throughout the EA process.	167	Design Construction Operation



Security					
Issue	Section No.	Annexure No.	Commitment	Ref No.	Project Phase
General	4.10 5.1.1 5.1.2		Four Arrows commits to the development of a CEMP and an OEMP that addresses recommendations made by the Department of Planning (DOP) and other relevant agencies, and the grievances of stakeholders through the consultation process, that contains specific details pertaining to security and the management of the factors that affect security from a physical, site, environment, chemical/biological, economic and political perspective.	168	Post approval
Chemical-biological	4.6.2 4.6.3 4.8.6 4.10		Four Arrows commits to best management practice in relation to production, handling, storage and distribution of all chemical/biological products on site.	169	Construction Operation
	4.6.2 4.6.3 4.10		Four Arrows commits to the strict adherence of operating procedures, manuals and guidelines in reference to all chemical and biological process, procedures and operations.	170	Construction Operation
	4.6.2 4.6.3 4.10		Four Arrows commits to the constant inventory audits of chemical and biological material to ensure accidents have been reported, chemicals have not been misused, or theft has occurred.	171	Construction Operation
Economic	4.8.2 4.10 4.15 5.11.2		Four Arrows commits to continue to strengthen markets for all its products and derivatives particularly ethanol in light of the federal governments support to move away from the use of fossil fuels.	172	Ongoing
Environmental	4.10		These commitments are covered by Commitment Reference Nos 201 to 211.	173	Design Construction Operation
Political	4.6.1.6 4.10		Four Arrows commits to the development of operational and management strategies that will address the threat of terrorism and bio-hazard abuse, which may result in catastrophic events endangering staff, neighbouring communities and individuals, and the environment.	174	Construction Operation
	4.6.1.6 4.10		Four Arrows commits to the development of management strategies that address the security of intellectual property including production techniques etc that may be used in an adverse fashion to endanger society and the environment.	175	Operation
Site	4.10		Four Arrows commits to securely fencing necessary sections of the property as required to prevent access from unauthorized personnel.	176	Construction Operation
	4.10		Four Arrows commits to limiting access and egress to two main points that will be staffed 24 hours a day, supported by a monitoring system and secured by boom gates.	177	Construction Operation
Monitoring and Review	5.1.2		Four Arrows commits to the monitoring of security measures and procedures to ensure the safety of the facility, staff, neighbouring properties and individuals, and the environment.	178	Construction Operation
	5.1.2		Four Arrows commits to appointing designated officers/consultants to monitor security measures and procedures and to implement any improvements necessary to ensure the ongoing safety and welfare of the development, community and environment.	179	Design Construction Operation
	5.1.2		Four Arrows commits to working closely with state and federal agencies, including anti-terrorist organisations, to develop and implement the highest security measures and procedures, to ensure the ongoing safety and welfare of the development, community and environment.	180	Design Construction Operation
	5.1.2		Four Arrows commits to providing a process where grievances regarding security can be registered and addressed in an effective and expeditious manner.	181	Operation



Security					
Issue	Section No.	Annexure No.	Commitment	Ref No.	Project Phase
Reporting	5.1.2		Four Arrows commits to reporting security performance that will be forwarded as required to the relevant agencies and allow for the updating of CEMP's and OEMP's.	182	Construction Operation
Auditing	5.1.2		Four Arrows commits to engaging third parties to audit security breaches and/or abuse reports and to review management strategies in order to ensure that security measures and procedures are adequate to maintain the present and ongoing safety of the development, neighbouring properties and individuals, community and the environment.	183	Construction Operation
Mitigation	5.1.1		Four Arrows commits to implementing all mitigation measures in relation to security including site, environmental, chemical/biological, economic and political aspects identified throughout the EA process.	184	Design Construction Operation

Animal Welfare					
Issue	Section No.	Annexure No.	Commitment	Ref No.	Project Phase
General	4.11 5.1.1 5.1.2 5.8		Four Arrows commits to the development of a CEMP and an OEMP that addresses recommendations made by the Department of Planning (DOP) and other relevant agencies, and the grievances of stakeholders through the consultation process, that contains livestock monitoring and management strategies that will ensure the dairy herd's constant vitality and vigour.	185	Post approval
	3.4.2 4.11.1		Four Arrows commits to a state of the art dairy design that includes features and infrastructure that provides for the comfort of cattle.	186	Design Construction
	4.11.2.1	4.11.1	Four Arrows commits to the design of dairy and freestall facilities that will mitigate the occurrence of disease.	187	Design Construction
	4.11.2.1	4.11.2	Four Arrows commits to the use of operating procedures based upon HACCP methods targeting metabolic disease, acidosis, lameness, mastitis and respiratory disease, as well as the concurrent use of recognized and approved protocols.	188	Operation
	4.11.2.2 4.8.4 5.5.2.17		Four Arrows commits the expeditious removal of dead stock to adjacent Tubbo Station where burial/incineration will be carried out in a manner that results in no significant impact to neighbours or the surrounding environment.	189	Operation
	3.4.2 5.8		Four Arrows commits to engaging a project veterinarian who shall work to best dairy management practice protocols.	190	Operation
	5.8		Four Arrows commits to undertake the regular training of staff for strict adherence to procedures and protocols.	191	Operation
	4.11.2.1 5.8	4.11.2	Four Arrows commits to a management program which maintains a herd with a genetic predisposition for health and vigour.	192	Operation
	5.8		Four Arrows commits to a management program that continually monitors individual beasts for injury or disease and immediately isolates them from the herd.	193	Operation
Monitoring and Review	5.1.2		Four Arrows commits to the continual monitoring of individual beasts and the herd, through physical and technological means, to ensure health, vigour and vitality.	194	Operation
	5.8		Four Arrows commits to appointing designated officers/consultants to monitor plant, equipment and procedures, and to implement any improvements necessary to ensure the welfare of the dairy herd.	195	Construction Operation



Animal Welfare					
Issue	Section No.	Annexure No.	Commitment	Ref No.	Project Phase
	5.1.2		Four Arrows commits to working closely with relevant agencies including DPI to maintain and/or improve the welfare of the dairy herd.	196	Design Construction Operation
	5.1.2		Four Arrows commits to providing a process where grievances regarding animal welfare can be registered and addressed in an effective and expeditious manner.	197	Operation
Reporting	5.1.2		Four Arrows commits to herd performance reporting that will be forwarded as required to the relevant agencies and allow for the updating of CEMP's and OEMP's .	198	Operation
Auditing	5.1.2		Four Arrows commits to engaging third parties to audit herd performance records, including calving and mortality statistics and injury reports, to ensure that best management practices are being pursued.	199	Operation
Mitigation	5.1.1		Four Arrows commits to implementing all mitigation measures in relation to the management of animal welfare identified throughout the EA process.	200	Design Construction Operation

Flora and Fauna					
Issue	Section No.	Annexure No.	Commitment	Ref No.	Project Phase
General	4.12 5.1.1 5.1.2 5.9.1		Four Arrows commits to the development of a CEMP and an OEMP that addresses recommendations made by the Department of Planning (DOP) and other relevant agencies, and the grievances of stakeholders through the consultation process, that details monitoring and management strategies which include limiting foraging pressure, limiting weedy competition, increasing connectivity and ground cover, and potentially reintroducing a flooding regime to the Black Box depression areas; that protects and enhances the natural environment and that not only includes threatened species.	201	Post approval
	5.7.1 5.9.1		Four Arrows commits to the exclusion of the <i>Acacia</i> , <i>Callitris</i> and <i>Eucalypt</i> communities from the site development and the enhancement of these areas which will be maintained through a conservation caveat.	202	Design Construction Operation
	5.7.1 5.9.1		Four Arrows commits to the conservation and enhancement of flora and fauna on the project site by pursuing actions and management strategies that contribute toward the goals of the Coleambally Land and Water Management Plan (CICL – LWMP).	203	Design Construction Operation
	5.9.1		Four Arrows commits to the conservation of flora and fauna on the development site by implementing the actions detailed in sections 5.9.1 that include rabbit management plans, weed management strategies, the construction of exclusion zones and the enhancement of existing areas through extended plantings.	204	Design Construction
Monitoring and Review	5.1.2		Four Arrows commits to the monitoring of flora and fauna through a variety of methods including habitat hectare assessment and targeted species observation.	205	Operation
	5.1.2		Four Arrows commits to appointing designated officers/consultants to monitor ecology on the site with ongoing flora and fauna surveys and to implement any improvements necessary to ensure the conservation of vegetative communities and the habitat of avian species.	206	Construction Operation
	5.1.2		Four Arrows commits to working closely with relevant agencies including the DEC, to ensure protection of the habitat of threatened species and the enhancement of remnant environmental aspects, within and adjacent to the development.	207	Construction Operation
	5.1.2		Four Arrows commits to providing a process where grievances regarding flora and fauna conservation and management can be registered and addressed in an effective and expeditious manner.	208	Operation



Flora and Fauna					
Issue	Section No.	Annexure No.	Commitment	Ref No.	Project Phase
Reporting	5.1.2		Four Arrows commits to environmental performance reporting that will be forwarded as required to the relevant agencies and allow for the updating of CEMP's and OEMP's.	209	Construction Operation
Auditing	5.1.2		Four Arrows commits to allowing third parties to audit environmental performance reports, the data from flora and fauna studies, and to review management strategies in order to ensure that the developments ongoing processes are not adversely affecting species and communities that inhabit the site.	210	Construction Operation
Mitigation	5.1.1		Four Arrows commits to implementing all mitigation measures in relation to flora and fauna management identified throughout the EA process.	211	Design Construction Operation

Heritage					
Issue	Section No.	Annexure No.	Commitment	Ref No.	Project Phase
General	4.13 5.1.1 5.1.2 5.10	4.13.1	Four Arrows commits to the development of a CEMP and an OEMP that addresses recommendations made by the Department of Planning (DOP) and other relevant agencies, and the grievances of stakeholders through the consultation process, that contains cultural heritage monitoring and management strategies that will ensure the maintenance and preservation of those areas and artefacts identified during the EA, as well as potential areas and artefacts that may be identified during construction and operations.	212	Post approval
Indigenous Heritage	4.13.1 5.10.1	4.13.1	Four Arrows will commit to a more detailed indigenous heritage survey if deemed necessary during the pre-construction stage as all potential areas of previous occupation exist within zones that are not proposed to be developed.	213	Post approval
	4.13.1 5.10.1	4.13.1	Four Arrows commits to the preservation of indigenous heritage and will protect those areas that have been identified to-date, and areas that may be encountered in the future, during the construction and operation of the development.	214	Construction Operation
	5.10.1		Four Arrows commits to the preservation of indigenous heritage within the identified areas and will conduct no further disturbances including the construction of firebreaks and vehicle access tracks without prior permission from a consent authority.	215	Construction Operation
	4.13.1 5.10.1		Four Arrows commits to a procedure of best management practice should additional sites and artefacts be identified during construction and operations which would include cessation of works affecting the area and the immediate notification of NPWS and the Griffith LALC.	216	Construction Operation
	5.10.1		Four Arrows commits to the recording and reporting of any additional sites of aboriginal heritage that may be found, for entry and registration, with the Department of Environment and Conservation/National Parks and Wildlife Service, Aboriginal Heritage Information Management Systems (AHIMS).	217	Construction Operation
Non-Indigenous Heritage	4.13.2 5.10.2		Four Arrows commits to the preservation of areas, buildings and items of significant heritage value, which may be encountered during the construction and operation of the development.	218	Construction Operation
	5.10.2		Four Arrows commits to management practices and strategies that mitigate any threats to the conservation of sites and dwellings at Tubbo Station, which have been listed on the Register of the National Estate, from activities associated with the development.	219	Operation



Heritage					
Issue	Section No.	Annexure No.	Commitment	Ref No.	Project Phase
Monitoring and Review	5.1.2		Four Arrows commits to monitoring heritage sites to ensure continued maintenance under conservation agreements and that no deterioration occurs due to neglect or abuse caused by the proposed development.	220	Operation
	5.1.2 5.10.1		Four Arrows commits to appointing designated indigenous officers/consultants to monitor existing heritage sites and to identify and verify sites that may be uncovered in the future, and to implement any improvements necessary to secure, preserve and protect these sites.	221	Construction
	5.1.2		Four Arrows commits to working closely with relevant agencies including the Griffith LALC to assist with the identification and conservation of indigenous heritage sites.	222	Construction Operation
	5.1.2 5.10.2		Four Arrows commits to providing a process where grievances regarding the management and conservation of indigenous heritage can be registered and addressed in an effective and expeditious manner.	223	Operation
Reporting	5.1.2		Four Arrows commits to the reporting of management strategies and compliance to conservation agreements and caveats, to ensure that no infringements occur and the maintenance of these areas, buildings and items is ongoing, which will be forwarded as required to relevant agencies and allow for the updating of CEMP's and OEMP's.	224	Construction Operation
Auditing	5.1.2		Four Arrows commits to allowing third parties to audit compliance reviews and management strategies to ensure the ongoing conservation of heritage areas, buildings and items.	225	Construction Operation
Mitigation	5.1.1		Four Arrows commits to implementing all mitigation measures in relation to indigenous heritage identified throughout the EA process.	226	Design Construction Operation

Greenhouse Emissions					
Issue	Section No.	Annexure No.	Commitment	Ref No.	Project Phase
General	4.14 5.1.1 5.1.2	4.14.1 4.14.2	Four Arrows commits to the development of a CEMP and an OEMP that addresses recommendations made by the Department of Planning (DOP) and other relevant agencies, and the grievances of stakeholders through the consultation process, that contains methane gas emission monitoring and management strategies that will pursue efficiencies to mitigate the impact of greenhouse gas production to within desirable emission goals.	227	Post approval
	4.14 4.8.1 4.1.8 5.5.2.18		Four Arrows commits to the expeditious removal of manures from the development site and its spreading onto and incorporation into the agricultural soils of the company owned Tubbo Station.	228	Operation
	4.1.2 4.14 4.8.2		Four Arrows commits to the use of production processes that capture maximum amounts of CO ₂ gases thus reducing contributions to greenhouse loading.	229	Operation
Monitoring and Review	5.1.2		Four Arrows commits to an understanding of the factors that contribute towards greenhouse gas production and the establishment of achievable emission goals.	230	Operation
	5.1.2		Four Arrows commits to the ongoing monitoring of factors that contribute towards greenhouse gas production, the data of which can be utilised to create models and influence management strategies to achieve emission goals.	231	Operation



Greenhouse Emissions					
Issue	Section No.	Annexure No.	Commitment	Ref No.	Project Phase
	5.1.2		Four Arrows commits to appointing designated officers/consultants to monitor by-product and waste streams, which contribute towards the production of greenhouse gases and to implement any improvements necessary to create greater efficiencies and to ensure that emission goals are being achieved.	232	Operation
	5.1.2		Four Arrows commits to working closely with relevant agencies, including primarily the Australian Greenhouse Office, to improve efficiencies and the impact of each identified by-product and waste management stream upon greenhouse gas loading.	233	Operation

	5.1.2		Four Arrows commits to providing a process where grievances regarding greenhouse gas production and emissions can be registered and addressed in an effective and expeditious manner.	234	Operation
Reporting	5.1.2		Four Arrows commits to environmental performance reporting, which also includes submitting information and contributing towards such programs as the Greenhouse Challenge Plus, that will be forwarded as required to the relevant agencies and allow for the updating of CEMP's and OEMP's .	235	Construction Operation
Auditing	5.1.2		Four Arrows commits to allowing third parties to audit greenhouse gas production records and to review management strategies in order to ensure that the developments ongoing processes are being managed in such a way as to avoid excess greenhouse gas emissions.	236	Construction Operation
Mitigation	5.1.1		Four Arrows commits to implementing all mitigation measures in relation to greenhouse gas emission management identified throughout the EA process.	237	Design Construction Operation

Economic and Social Effects					
Issue	Section No.	Annexure No.	Commitment	Ref No.	Project Phase
General	4.15 5.1.1 5.1.2 5.11.3 5.11.4		Four Arrows commits to the development of a CEMP and an OEMP that addresses recommendations made by the Department of Planning (DOP) and other relevant agencies, and the grievances of stakeholders through the consultation process, that pursues economic and social benefits for the company and the greater community.	238	Post approval
	4.15 5.11.3		Four Arrows commits where possible to employ local contractors and staff in the daily operations and support of the ethanol and dairy enterprises.	239	Design Construction Operation
	4.15 5.11.3		Four Arrows commits where possible to purchase local grains from the Riverina district the demand for which will provide further commercial activity in the local economy.	240	Operation
	4.8.2 4.15 5.11.3		Four Arrows commits to supply localised intensive livestock industries with distillers grain derivative satisfying a large percentage of the current demand.	241	Operational phase
	4.15 5.11.4		Four Arrows commits to preferentially investing profits into the expansion of existing Riverina enterprises and the development of further areas providing a boost to the local economy.	242	Ongoing
	3.4.3		Four Arrows commits to the construction and operation of a visitors centre to provide information and education to the public and other interested parties as to the developments management, processes, and benefits to the community and environment.	243	Design Construction Operation



Economic and Social Effects					
Issue	Section No.	Annexure No.	Commitment	Ref No.	Project Phase
Monitoring and Review	5.1.2 5.11.3 5.11.4		Four Arrows commits to monitoring the social and economic costs and benefits of the development and its activities.	244	Design Construction Operation
	5.1.2		Four Arrows commits to integrating social and economic costs and benefits information into its ongoing analysis as to the future direction and management of the development's processes and procedures.	245	Design Construction Operation
	5.1.2		Four Arrows commits to working closely with relevant agencies including planning authorities and local councils, to improve the design and management of the development, so as to mitigate the social and economic costs and promote benefits.	246	Design Construction Operation
	5.1.2		Four Arrows commits to providing a process where grievances regarding economic and social costs can be registered and addressed in an effective and expeditious manner.	247	Operation
Reporting	5.1.2		Four Arrows commits to cost and benefit reporting that will be forwarded as required to the relevant agencies and allow for the updating of CEMP's and OEMP's .	248	Construction Operation
Auditing	5.1.2		Four Arrows commits to allowing third parties to audit cost and benefit analysis reports and management records, and to review management strategies, in order to ensure that the developments ongoing processes are not adversely affecting the economy or society.	249	Construction Operation
Mitigation	5.1.1		Four Arrows commits to implementing all mitigation measures in relation to economic and social effects created by the development that have been identified throughout the EA process.	250	Design Construction Operation

7.4 Preliminary Planning and Design Requirements

7.4.1 Summary of Actions

A number of issues/aspects concerning the impact that the proposed development will have upon the environment, community and the greater society have been explored throughout the Environmental Assessment (EA) process. All have been thoroughly investigated with detailed analysis being completed upon each.

Thus the EA process up to this point has investigated:

- The aspects that may be adversely affected by the development;
- The ramifications that may present themselves;
- The what/who may be affected and to what degree; and
- The mitigation measures that may be instigated to alleviate impacts.

The areas that have required attention and the need for mitigative strategies to be applied include:

- Air quality;
- Nutrient movement;
- Noise/vibration;
- Traffic and transport;



- Water dynamics;
- Hazards and risks;
- Waste management;
- Visual impact;
- Security;
- Animal welfare;
- Flora and fauna;
- Heritage;
- Greenhouse emissions; and
- Economic and social effects.

It has been found necessary to expand upon findings as part of this EA submission and to conduct some preliminary planning activities to demonstrate and exhibit particular measures that will be undertaken when the proposed development is approved. These will be included as part of the Environmental Management Plan (EMP) that will be developed upon approval and serve as a working document throughout the construction and operation of the proposed development.

This exercise bolsters the commitments (detailed within Table 7.2.1) that the proponent will undertake. This exercise also ensures that the requirements for effective and responsible management are addressed prior to planning and design.

7.4.2 Groundwater Monitoring Program

7.4.2.1 Overview

The following details the scope and actions that will be undertaken as part of a groundwater monitoring program. This monitoring program will become an integral part of the groundwater management plan once the process to develop an EMP for the proposed site has been undertaken. Monitoring will include elements associated with water quality and the detection of variations to groundwater levels. The program will drive on-going decisions and subsequent actions/strategies to ensure that groundwater values are maintained.

Waterwatch Australia (2005) suggests that a monitoring program will achieve a number of goals including:

- Determining the trends in groundwater levels;
- Determining the effects of management practices on groundwater levels;
- Determining the effect of climate on groundwater levels;
- Determining long term trends in groundwater salinity;
- Detecting suspect contamination; and
- Educating local community and encouraging involvement in groundwater issues.



7.4.2.2 *Justification for a Groundwater Monitoring Program*

The following findings justify the necessity to establish a groundwater monitoring program at this early stage of the development process. This need for monitoring is primarily due to the nature of the system and the necessity to store large volumes of both potable and contaminated water. All storages typically have the potential to allow percolation and eventual accession to groundwater sinks.

The conclusions of investigations for groundwater status within and around the site were presented in Section 4.5.3 and found to be:

- Groundwater is present at 10+m below NSL and levels are now consistently falling after a period of rising groundwater throughout the CIA;
- The falling water tables are due to the combined effects of more appropriate land usages within the CIA following the implementation of the LWMP and the concurrent extended period of lower rainfalls;
- There is evidence of movement of groundwater between the upper and lower Shepparton formations and the Calivil formation; and
- The flow of groundwater is trending to the north west where a number of irrigation production bores extract water from principally the Calivil formation.

The groundwater assessment in Section 4.5.3 concludes that in the absence of appropriate site management there is a potential for adverse impacts on local and regional groundwater. The available evidence is that the impacts may be in two (2) broad levels namely:

- Add more water to the existing groundwater; and/or
- Add contaminants to the existing groundwater.

7.4.2.3 *Parameters*

An array of parameters will be measured as part of the groundwater monitoring program to ensure any variations to water quality are detected. The identified parameters have been derived from consultation with the DoP, DNR and DEC. These elements will include, but not be limited to:

- Nutrients include NO₃, NO₂, NH₄;
- Organic nitrogen/TKN;
- Total nitrogen;
- Total coliform bacteria;
- Total organic carbon;
- TDS;
- EC;
- pH;
- Sulphate;
- Chlordie;



- Phosphorus and phosphate (orthophosphate);
- Calcium;
- Magnesium;
- Sodium; and
- Potassium.

Certain parameters may not be required to be tested after operations have been in place over the long term (3 – 5 years) and these elements have not been detected during that period. This decision will be made in conjunction with the appropriate agencies seeking their consent to exclude certain parameters from the monitoring regime. Conversely, additional parameters may be included within the monitoring program as deemed necessary as on-going site and operational assessments are carried out.

It is also recommended that annual testing for a range of relevant agricultural chemicals (eg herbicides and insecticides) be undertaken. Since the proposed project will not be using agricultural chemicals, the presence of such chemicals will be a worthy indicator of off-site practices influencing groundwater quality and levels under the project site.

Temperature will also be monitored as this can affect physical and chemical properties. Groundwater levels will also be regularly recorded.

The suggested parameters to be tested will be applied to varying degrees (this will be established during the development of an EMP and in consultation with the appropriate agencies) during construction with a full suite being implemented during the operational phases of the development.

7.4.2.4 *Frequency*

The amount of testing conducted within any period will be dependant on the level of nutrients detected. Variations may require closer scrutiny and the frequency of testing may be required to be increased until causation can be established and remedial actions can be developed and implemented.

At this point in time it is suggested that monitoring occurs:

- Monthly
 - o Depth to groundwater; and
 - o Sample temperature.
- Quarterly
 - o For all other parameters.

The suggested frequency of testing will apply to both construction and operational phases with variations only to the parameters being monitored.



7.4.2.5 *Techniques*

It is proposed that groundwater monitoring will be conducted using three (3) techniques, these being:

- The traditional piezometer method. This is where water levels are measured and samples are taken and sent for laboratory testing;
- A system of sub-surface soil moisture sensors will be placed beneath the buffer, anaerobic and aerobic ponds to ensure that any unintended percolation is detected early and the extent and rate of accession to groundwater can be established; and
- A combination of meters that measure water level and weather station/s that calculate evapotranspiration, and by deduction provide early warning of unintended losses.

7.4.2.6 *Location of Monitoring Equipment*

The following locations are proposed for the installation of monitoring equipment. Refer to map 3.3.2 for an indication of these areas.

- It is proposed that at least two (2) piezometers will be installed in the vicinity of the ethanol plant;
- It is proposed that one (1) piezometer may be installed near the southern end of the grain bunkers with the piezometers for the ethanol plant being sufficient to detect percolation for the northern end;
- The gardens/vegetation surrounding office and administration areas will be drip irrigated. Soil moisture sensors will be installed at various locations merging information with the on-site weather station/s;
- It is proposed that one (1) piezometer be installed adjacent to the buffer storage;
- It is proposed that three (3) piezometers be installed adjacent to the Category 1 storage;
- It is proposed that two (2) piezometers be installed adjacent to the Category 2 storage;
- It is proposed that three (3) piezometers be installed adjacent to the anaerobic ponds;
- It is proposed one (1) piezometer be installed adjacent to the buffer storage;
- It is proposed that three (3) piezometers be installed adjacent to the aerobic ponds; and
- Methods that include sub-surface seepage detection and capture, and water level determinations will be installed at anaerobic and aerobic pond locations.

7.4.2.7 *Responsibility*

The responsibility for the success of the water monitoring program will be reliant on firstly the positioning of equipment, and secondly upon adherence to a stringent sampling and recording regime.

The positioning of piezometers and other equipment will be the responsibility of the site geotechnical engineer who will be appointed during the design and construction stages, and into the operational phases if required.

An environmental officer/consultant will be appointed for the ongoing testing and reporting of water and contaminant levels. This will be a qualified and trained person/s in the techniques required for sampling and the dutiful handling and labelling liquids.



Reports will be analysed regularly by a hydrological expert that will advise Four Arrows Ethanol Pty Ltd and the appropriate agencies of any undesirable variations so that remedial action can be devised and implemented.



8.0 CONCLUDING STATEMENT

The preceding sections of this EA have identified potential issues arising from the proposed development, and where required, outlines mitigative strategies to be implemented to minimise identified impacts. The structure of this EA has been developed as per the Director General of the Department of Planning's specifications, and follows the requirements for preparation of a major project EA for which Part 3A of the EP&A Act applies.

As demonstrated throughout this EA, the proposed project is not expected to have significant impacts on the surrounding environment or communities, beyond those issues that can be adequately mitigated against. Where appropriate, specific mitigative strategies have been identified.

As the proposed development will have no significant impact on any matter of national environmental significance, as outlined by the EPBC Act, it is unnecessary to refer the matter to the Department of Environment and Heritage for comment. As such the Minister for the Department of Planning is the sole consent authority for this proposed development.

Upon approval of this project development application, Four Arrows Ethanol Pty Ltd will adhere to both the Statement of Commitments outlined in Section 7.0 and the Conditions of Consent as provided by the Department of Planning to ensure potential negative impacts arising from the proposed development are adequately managed, maintaining and where possible, improving the Triple Bottom Line.



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