final report

FEEDLOTS

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Ethanol byproducts and maize supply chain study tour to USA

Abstract

With the possible development of a grain-based ethanol industry in Australia, the byproducts of the ethanol production process have been touted as a potential feedstuff for intensive livestock feeding operations. As the Australian feedlot industry has little or no experience with the feeding of these products, it must draw on the information and experience gained from their use overseas.

The development of a new grain devitalisation technology has also progressed to the stage where the feedlot industry needs to have direct information about how to source maize through procedures that are consistent with the export capabilities of the USA, integrate these with the prospective CSIRO developed technologies, and develop a supply chain methodology that is commercially viable for end-users in Australia and meets Australian quarantine requirements.

This project reports the outcomes of a study tour to the USA to research both the use and feeding value of ethanol byproducts, which are extensively produced and utilised there, and the supply chain for the import of maize suitable for the devitalisation process.

Executive Summary

A study tour was undertaken to the United States of America (USA), to view first hand the development of the ethanol production industry, and to draw on their experience with the use of the byproducts of ethanol production as a feedstuff for intensive cattle feeding operations. The maize supply chain in the USA was also examined to assist with the development of a protocol that will allow Australian operators to import identity preserved maize shipments from the USA, treat them with a devitalisation technology currently being developed, and subsequently move the grain up-country for use, while ensuring that Australian quarantine requirements are met.

Overview of current ethanol investment in the USA

The ethanol industry is expanding at an extraordinary rate in the USA. In 2005, the industry produced just over 3.9 billion US gallons (14,800 ML) of ethanol, nearly twice the amount produced in 2002. This production is predominantly grain-based and consumed more than 35.6 million metric tonne (MMt) of corn, or around 13% of total corn production (NCGA 2006). A further increase in production of 25% to 4.9 billion US gallons (18,600 ML) was recorded for 2006 (RFA 2007).

Rapid growth is expected to continue well into the future. Currently 110 plants are in production with a capacity of 5.3 billion US gallons (20,000 ML), with an additional 6.0 billion US gallons (22,700 ML) of capacity to be added by the end of 2008 through the expansion of existing facilities and construction of around 60 new plants (RFA 2007).

The current investment in ethanol production reminds one of the frenzied activity seen when investment in technology based companies was all the go. This activity is being driven by the phenomenal returns on investment available, the consequence of a combination of factors including the current high price of crude oil and government policy, incorporating subsidies and incentives, directed at decreasing the reliance of the USA on imported oil and improving homeland security. As with the ‘Dotcom’ revolution, some of the current ethanol production investment is based on poor business principles, and while profitability is currently high, margins will be reduced as the price of crude oil falls and/or the price of corn rises. There will ultimately be some rationalisation of the industry as margins tighten and, if as predicted by many of the organisations visited, the government reduces or removes the current tax incentive.

Given the massive development currently underway, many of the traditional corn users are being significantly impacted and are questioning how supplies for food, domestic feed and export markets can be maintained at adequate levels and priced such that their operations will remain viable. They are becoming more vocal in their opposition to the subsidy being paid to ethanol production and starting to question whether there will ultimately be a flow-on effect to food prices to maintain enterprise viability.

The concerns being articulated by non-ethanol grain users in the USA are the same as those being expressed by some of their cohorts here in Australia. It is fortunate that the ethanol industry development is further advanced in the USA, as industry has an opportunity to learn from the experiences of their processor, cattle feeding and cow-calf sectors. Their experiences strongly support the case of the industry sectors opposing subsidies for ethanol production.

Ethanol plants production statistics

The ethanol plants visited during the study tour are approximately equivalent in capacity to the plants that are being proposed for construction in Australia (42 million US gallons per year or 160 ML per year). Consequently, the production and operational statistics associated with these plants are directly relevant to the developments proposed for Australia. Discussions with plant operators confirmed the production and operational statistics that have been promoted in Australia. Briefly they are:

- Ethanol production of 160 ML per year;
- Employment of 30-35 personnel;
- Grain usage of 380-400,000 t per year on an as-received basis (88-90% dry matter);
- CO_2 production of 120,000 t per year;
- Net water usage of 620-650 ML per year; and
- Wet distillers grain production of 330,000 t per year at 30% dry matter; or
- Dried distillers grain production of 110,000 t per year at 90% dry matter.

Feeding value of ethanol byproducts

Experience in the USA indicates that the byproducts of ethanol production do have potential as feedstuffs for use in the livestock feeding industries and, if suitably priced, provide a useful source of energy, protein and minerals for feedlot cattle. As the majority of grain-based ethanol production now employs the dry milling process, the principal byproducts that will be available in Australia are wet distillers grain with solubles and dried distillers grain with solubles.

The use of wet distillers grains with solubles and/or dry distillers grains with solubles will need to be evaluated on a feedlot by feedlot basis and individual operators will need to make this assessment based on the nutrient value of the products available, respective costs, optimum feeding levels and economic value to their business. This assessment should be based on sound nutritional practices and an analysis of their costs as a source of protein and energy on a delivered-to-bunk basis relative to the costs associated with alternative ingredients.

There is a substantial amount of research data and practical feeding experience available from the USA to suggest that distillers grains can be incorporated into feedlot rations at optimal inclusion levels of between 5 and 25% on a dry matter basis. Information from this study, together with that from other research currently underway to assess potential limitations to the use of ethanol byproducts under Australian conditions, will provide a solid resource that feedlot operators can use for decision making on the use of the ethanol byproducts within their enterprises.

Impact on grain availability and price

While the byproducts of ethanol production are a potential feedstuff for the intensive livestock feeding sectors, some simple mathematics on the figures presented above, namely grain usage (380,000 t) versus byproduct produced (110,000 t), confirms the net loss of high energy feedstuffs available to other industry sectors of around 270,000 t per 160 ML plant per year. This is the best case scenario as it assumes that these industry sectors will be able to fully capture and utilise the wet distillers grains with solubles and dried distillers grains with solubles produced.

From this assessment, and an analysis of the current situation in the USA it was concluded that the establishment of an ethanol industry in Australia, with associated demand for grains, will impact the intensive livestock industries. Grain shortages that are currently experienced in areas such as south-east Queensland will become more frequent and of larger scale if the development of proposed ethanol plants proceeds. This will result in higher production costs for the feedlot industry, as competition for the available grain supplies increases; and will have a flow-on effect to the entire Australian beef industry. This flow-on effect is currently impacting cow-calf operators in the USA as cattle feeders adjust (lower) their purchase prices to compensate for higher ration costs.

Additionally, the increased demand for grain will result in the establishment of a new higher baseline for grain prices. Again, this is currently happening in the USA where corn prices are being driven towards a level that equates to the breakeven position for corn as an input to ethanol production, effectively incorporating the competitive benefits the ethanol industry derives from the subsidy at the same time.

Maize import supply chain

One of the positives to come out of the study tour is that the import of maize from the USA appears to be technically feasible, though it will require the development of a new AQIS-approved protocol that incorporates a seed cleaning/screening operation as a means of addressing the weed seed contamination issue.

Areas of minimal risk from a disease perspective are readily identifiable and Biosecurity Australia has recently approved the sourcing of sorghum and maize from selected states in the USA, subject to current quarantine conditions, including processing at AQIS-approved facilities in metropolitan areas (Biosecurity Australia 2006).

The majority of companies visited during the study tour have maize export operations and are well versed in the identity preservation and certification requirements necessary for the export of maize. Consequently, the development of an import protocol incorporating the sourcing of maize from areas that are low risk from a pathogen contamination perspective and identity preservation of this grain through the entire supply chain should be achievable. This, combined with an effective devitalisation process will, in our view, reduce the risk of pathogen transfer to an acceptable level.

The major issue to be addressed is that of overcoming any potential weed seed contamination of the original maize supply. Sourcing supplies of maize that are certified as low risk from a weed seed contamination perspective is likely to be difficult. Generally, crop hygiene is very good and weeds are controlled. However, not all state departments of agriculture have reliable survey information on weed status and it is difficult to obtain the information needed to assess the risk status of a particular region.

The USDA Grain Inspection, Packers and Stockyards Administration (GIPSA) through the Federal Grain Inspection Service (FGIS) has responsibility for pre-shipment inspection and certification of export grain shipments. They advised that they would have difficulty providing certification to the standard required by the current AQIS protocol, due to the large number of weed seeds that are included in the non-permitted category and their inability to determine whether particular areas and/or consignments are free of these weeds.

One potential solution investigated during the study tour, is to develop an import protocol that permits the removal of potential weed seed contaminants utilising grain cleaning/screening methods. The majority of grain handling and storage facilities visited during the study tour did have grain cleaning equipment. However, in some situations it is not installed in the correct part of the supply chain to allow for efficient operation and is often only used on an as-required basis to ensure the shipment meets the grade specifications ordered. While the grain cleaning process can be performed on complete shipments, this reduces throughput and increases cost. Implementation of a grain cleaning step in the import protocol would require the development of depot specific relationships.

As a result of discussions and inspections conducted during site visits, it was concluded that it is feasible to address the weed seed contamination problem by incorporating a grain cleaning operation and further work is warranted to develop a protocol that would be acceptable to AQIS and Biosecurity Australia.

While technically feasible, it will not be either a quick or simple process to achieve acceptance of any developed protocol. It will take some time to collect the information necessary to demonstrate to Biosecurity Australia that a protocol can be developed that reduces the risk of weed seed transfer to an acceptable level. Notwithstanding this, a workable protocol for maize importation should be able to be achieved within a five year timeframe. Subsequent to this, there will undoubtedly be a need to address the industry politics that surround the whole imported grain issue.

From observations made during the tour, it was also clear that protocols for identity preservation and maintaining a high standard of hygiene and cleanliness at all facilities, essential elements of any import protocol, are now standard operating practice for the majority of supply chain participants in the USA. This, coupled with the industry's ability to overcome problems associated with the cleaning of barges, should allow the shipment of grain from ports in the Gulf of Mexico, an option not previously available.

Potential to import dried distillers grains

During the study tour, the view was extensively promoted that the supply of dried distillers grains in the USA was likely to outstrip the capacity of domestic users to make use of the product. This provides an opportunity for the Australian intensive livestock feeding industries, as new export markets need to be cultivated for this additional production. While it is unlikely that dried distillers grains imports will be economic on an ongoing basis, they may be viable under the current conditions of drought and associated high grain costs, particularly if lower freight rates can be achieved by utilising containers that need to be returned to south-east Asia. An additional benefit is that the Australian industry would obtain experience in feeding these products prior to them potentially becoming available through domestic ethanol production.

Recommendations

The following recommendations are made to progress issues and capture benefits identified during the course of the study tour:

1. The Australian beef industry should draw on the knowledge and experience of the industry in the USA to assist in the debate on subsidised ethanol production.

The beef industry in the USA is currently trying to adapt to the reality of life with a subsidised ethanol production industry. As they make the structural and operational changes necessary to best position themselves into the future, the experiences of their processor, cattle feeding and cow-calf sectors highlight all the issues that have previously been raised in the debate here. The Australian beef industry can learn from these experiences, which strongly support the case opposing subsidised ethanol production.

2. The lotfeeding sector, through the MLA Feedlot R&D Program, further investigate the option of incorporating a grain cleaning process in the maize import protocol to address the risk associated with weed seed contamination of bulk maize imports from the USA.

   Given the lack of reliable information on areas assessed as being of low risk from a weed seed perspective, the inability of the USDA to provide the certification required by AQIS and the fact that the grain devitalisation technology currently being developed does not give complete control of all weed seeds likely to be contaminants of any imported maize shipment, a new approach is required to address the weed seed contamination problem.

   One potential solution to this issue is to develop an import protocol that permits the removal of potential weed seed contaminants utilising grain cleaning/screening methods. Further work should be undertaken to assist in evaluating the likely effectiveness of this process and the subsequent development of a protocol proposal for submission to Biosecurity Australia

3. AQIS and Biosecurity Australia should be advised that the conclusions drawn by Heinrich during his 1997 assessment of the maize supply chain, with respect to identity preservation protocols and the ability to clean barges, no longer apply and a re-evaluation of shipments through the ports in the Gulf of Mexico is warranted.

   Contrary to the experience of Heinrich during his 1997 assessment, identity preservation protocols from source to destination and maintenance of a high standard of hygiene and cleanliness for all facilities and transport vehicles, including barges, are now standard operating practice for the majority of grain supply chain participants in the USA.

   Practices and procedures have obviously improved and shipments through ports in the Gulf of Mexico are now considered a viable option. Acceptance of this position by AQIS and Biosecurity Australia will increase the range of supply chain options available for the potential import of both grain and ethanol byproducts.

4. The potential for importation of dried distillers grains should be further investigated in conjunction with the other intensive livestock industries.

   As the ethanol production industry increases its capacity, the supply of dried distillers grains is likely to outstrip the capacity of domestic users to utilise the product. This provides an opportunity for the Australian intensive livestock industries that is worth investigation. While it is unlikely that dried distillers grains imports will be economic on an ongoing basis, they may be viable under conditions of drought with associated high grain costs, particularly if lower freight rates can be achieved by utilising containers that need to be returned to south-east Asia.

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1 Background

Meat and Livestock Australia (MLA) and Australian Pork Limited (APL) are currently funding a major project being conducted by CSIRO Entomology that aims to develop new grain processing technologies that will enable grain to be imported, and, after receiving a devitalisation treatment to ensure it complies with Australian quarantine requirements, to be transported up-country where it can be utilised as whole grain by the livestock industries.

This project is progressing to the stage where the feedlot industry needs to have direct information about how to source maize through procedures that are consistent with the export capabilities of the United States of America (USA), integrate these with the prospective CSIRO developed technologies, and develop a supply chain methodology that is commercially viable for end-users in Australia and meets Australian quarantine requirements. Maize sourced from the USA was chosen for study as initial testing indicates that the devitalisation process is most efficacious on maize and the USA is the largest exporter of maize in the world.

With the possible development of a grain-based ethanol industry in Australia, the byproducts of the ethanol production process have been touted as a potential feedstuff for intensive livestock feeding operations. As the Australian feedlot industry has little or no experience with the feeding of these products, it must draw on the information and experience gained from their use overseas. The USA, where these byproducts are extensively produced and utilised, was identified as an appropriate source of the technical information required.

As both aspects of the project required investigation on the ground, a study tour to the USA with an appropriate itinerary was organised. The study tour was undertaken during the second half of August 2006.

2 Project Objectives

The B.FLT.0137 project will undertake a study tour to the United States of America to:

1. Research the supply chain for import of maize suitable for the devitalisation process, including aspects related to:
    a. sourcing – identify areas of minimal risk from disease and weed seed;
    b. maintaining segregation during transport and minimising risk of cross-contamination;
    c. storage and handling at port;
    d. grain cleaning – screening of weed seed contaminants;
    e. shipment requirements and conditions;
        i. pre-shipment inspection and certification – FSIS
        ii. arrival inspection and certification – AQIS

2. Research the use and feeding value of ethanol byproducts in the USA and their potential application under Australian conditions, including:
    a. supply of feedstock base material;
    b. distillation/processing;
    c. distribution channels;
    d. usage;
        i. contracts
        ii. pricing
        iii. inclusion % levels
        iv. performance
        v. relative value to different species – pigs v cattle
    e. limitations;
        i. environment
        ii. product variability
        iii. wet v dry product
        iv. transportation distances

3 Methodology

The project was undertaken by way of a fact-finding study tour to the USA. The trip itinerary was organised prior to departure with input from contacts both in Australia and the USA to ensure that visits were made to appropriate locations and meetings organised with appropriate contacts to address the project objectives. The study tour was undertaken during the second half of August 2006. A brief outline of the study tour itinerary, including details of site visits, companies visited, individuals contacted, observations and discussions is attached as appendix 1.

Wherever possible during the study tour, endeavours were made to verify information supplied by a particular contact against responses and information supplied by other contacts that were interviewed. On return from the study tour, additional efforts were directed towards collecting further information to fill identified knowledge gaps and a desktop assessment and collation of the collected information. Production statistics and industry figures supplied verbally during site visits have subsequently been validated by reference to appropriate source documents where possible. Where price conversion has been required, an exchange rate of US $0.75 to AUD $1.00 has been applied.

Additional information has been incorporated in some areas to provide a more complete picture of the maize supply chain and ethanol industry in the USA. This report contains the final collation and distillation of the information gathered both during and subsequent to the study tour.

4 Overview of ethanol production in the USA

This section of the report provides an overview of the ethanol production industry in the USA and is included to provide an understanding of current industry capacity and the fundamentals that are driving the continued development of the industry.

4.1 Current and future production levels

The ethanol industry is expanding at an extraordinary rate in the USA. In 2005, the industry produced just over 3.9 billion US gallons (14,800 ML) of ethanol, nearly twice the amount produced in 2002. This production is predominantly grain-based and consumed more than 35.6 million metric tonne (MMt) of corn, or around 13% of total corn production (NCGA 2006). A further increase in production of 25% to 4.9 billion US gallons (18,600 ML) was recorded for 2006 (RFA 2007).

Rapid growth is expected to continue well into the future. Currently 110 plants are in production with a capacity of 5.3 billion US gallons (20,000 ML), with an additional 6.0 billion US gallons (22,700 ML) of capacity to be added by the end of 2008 through the expansion of existing facilities and construction of around 60 new plants (RFA 2007).

4.2 Factors driving investment in ethanol production

Investment in ethanol production continues unabated at the moment with investment prospectuses being over-subscribed by four to five times as investors try to capitalise on the phenomenal returns currently available. There are four principal drivers of this investment:

1. The replacement of methyl tertiary butyl ether as a fuel oxygenate;
2. Introduction of the Renewable Fuels Standards;
3. Introduction of the Volumetric Ethanol Excise Tax Credit; and
4. Current high crude oil prices.

4.2.1 Replacement of methyl tertiary butyl ether (MTBE) as a fuel oxygenate

MTBE is a fuel oxygenate derived from petroleum, which has traditionally been added to fuel to improve the octane rating and reduce exhaust emissions, particularly since the removal of lead as an additive. However, it has been found to pollute groundwater and surface water resources, causing a foul taste or odour in contaminated drinking water. MTBE has also been listed as a possible carcinogen for humans. Resultant public concerns have led to 20 states passing legislation either banning the use of MTBE or phasing it out over a period of time.

In response, fuel refiners have announced that they will progressively eliminate MTBE from markets across the USA and this has created an increased demand for ethanol as a replacement oxygenate additive. Assuming all current markets for ethanol are maintained, and ethanol replaces all of the MTBE currently sold, it is estimated that the annual demand for ethanol will increase by around 13,600 ML (NCGA 2006). This requirement will be met once the production capacity of approximately 50% of plants currently proposed for construction by the end of 2008 come on line.

4.2.2 The Renewable Fuels Standards.

The Renewable Fuels Standard (RFS) became law as part of the Energy Policy Act of 2005. It defines the level of domestically produced renewable fuels, such as ethanol and biodiesel, which are to be incorporated into fuel supplies in an endeavour to reduce the reliance of the USA on imported crude oil and improve homeland security.

The RFS sets the minimum annual level of renewable fuel blended into the nation's fuel supply at 7.5 billion US gallons per year (28,400 ML per year) by 2012. The legislation guarantees a future market for corn, estimated at about 66 MMt by 2012, and allows for continued opportunities for investment in new ethanol plants. The RFS also contains a requirement for the incorporation of an additional 250 million gallons (950 ML) per year of cellulose-derived ethanol from 2013 onwards. Latest estimates suggest that the target inclusion level set for 2012 will be achieved by the end of 2008 (RFA 2007).

4.2.3 Volumetric Ethanol Excise Tax Credit

The Volumetric Ethanol Excise Tax Credit (VEETC) was introduced in 2004. Under this Federal legislation, every gallon of ethanol blended with gasoline is eligible for a US $0.51 tax credit (read this as a subsidy of around AUD $0.18 per litre). While this tax incentive is paid to the entity that blends the ethanol into fuel, there is a flow back to the ethanol producer. In addition, many of the state governments are also offering subsidies and incentives for ethanol production.

4.2.4 Current crude oil prices

Current high crude oil prices (around US $60 /barrel) and resultant fuel prices of around US $2.80-3.00 per US gallon (about AUD $1.00 per litre) are providing additional impetus for investment in ethanol production. Ethanol for blending with gasoline has achieved prices very close to those being achieved for the gasoline itself, and in some cases where the ethanol has been used to replace MTBE, a premium has been extracted. With production costs of around US $1.00 per gallon (about AUD $0.35 per litre) at corn prices of around US $3.00 per bushel (AUD $160.00 per tonne) and the flow back of the government's ethanol tax incentive, this situation has created windfall profits for ethanol producers and payback of the capital investment in ethanol plants is reportedly being achieved within 3 years. Understandably, this has created additional investor interest and promoted the current frenzied investment in production facilities.

4.3 Future prospects

Currently, the only limitation to ethanol production appears to be the availability of the necessary equipment and expertise to build the plants. The resultant supply/demand imbalance has resulted in increases in plant construction costs of around 50% over the last 12-18 months as investors compete with one another for resources, with a 42 million gallon (160 ML) plant reportedly costing around US $100 million (AUD $ 133 M) to construct.

There is evidence that some of this investment is ignoring good business practice with ethanol plants now being constructed in locations removed from grain and cattle production areas, which supply the base feedstock and a market for the byproducts respectively, and fuel blending facilities. An extensive network of pipelines is available for the movement of crude oil and fuel allowing them to be moved cost-effectively anywhere in the USA. No such network exists for ethanol and it has to be moved by either rail or road transport to the point where it is blended with other fuels, increasing costs.

While ethanol production profitability is currently high, most analysts are forecasting that crude oil prices of US $40-50/barrel are more likely in the longer term, and this will impact margins, as will rising corn prices. There is also speculation that, given the current level of profitability within the ethanol production sector, the government may look to reduce the level of subsidy being offered within a couple of years; and a general view, that if these circumstances become a reality, there will ultimately be some rationalisation of the industry.

4.4 Impact of increased ethanol production on intensive livestock feeding

The considerable increase in corn use for ethanol production has led many of the traditional corn users to question how supplies for food, feed and export markets can be maintained at adequate levels and priced such that their operations will not be impacted, when faced with competition from the subsidised ethanol industry. This section examines some of the underlying fundamentals and records the various perspectives promoted on this issue.

4.4.1 Future corn usage for ethanol production

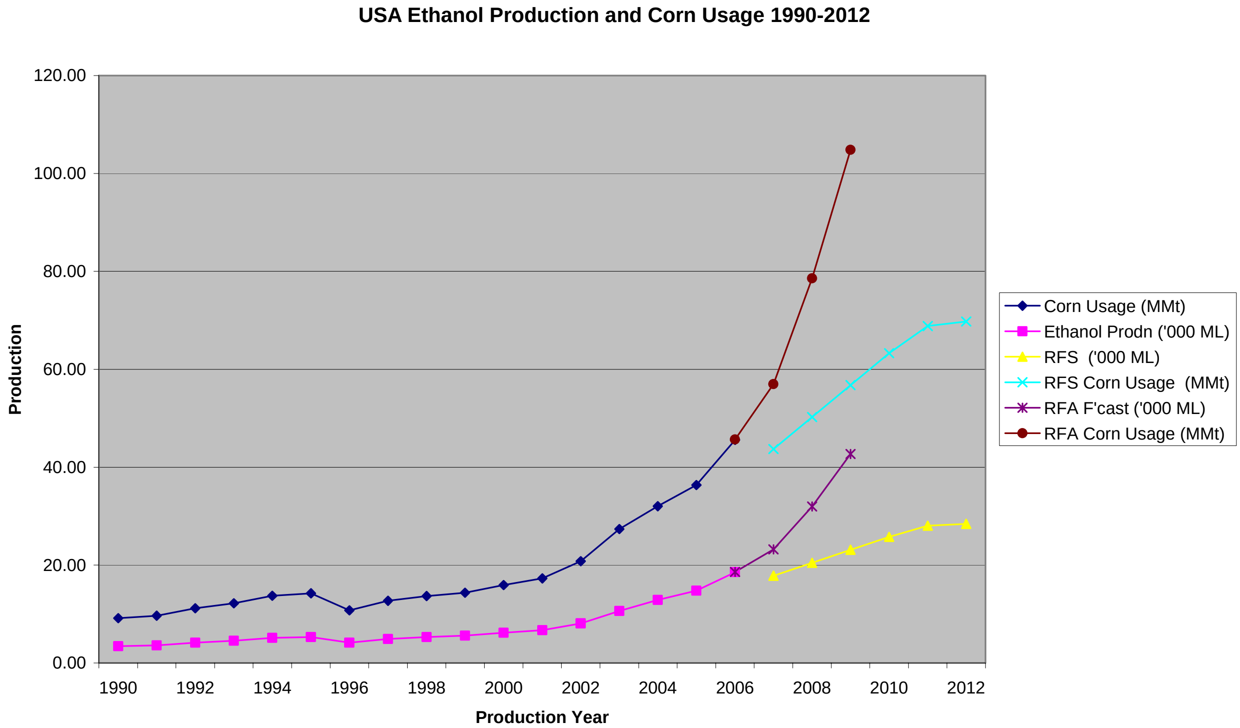

Figure 1 - Actual and forecast ethanol production and corn usage for the period 1990 to 2012.

Figure 1 shows actual USA ethanol production and associated corn usage for the period 1990 to 2006 and estimates out to 2012. Statistics supplied are historical actuals for ethanol production (thousand ML) and corn usage (MMt) for the period 1990 to 2006. Superimposed are the target production levels set under the Renewable Fuels Standards for the period 2007 to 2012, and an estimate of corn usage, calculated on the basis of the same corn usage ratio per ML of ethanol production as the 2005 and 2006 production years. Also shown are the latest Renewable Fuels Association (2007) estimates based on new ethanol production facilities to come on line between now and the end of 2008. Again corn usage is estimated on the basis of the same usage ratio as that recorded for 2005 and 2006. If all the ethanol plants proposed for construction by the end of 2008, do come on line, the requirement for corn will be doubled over the next three years.

4.4.2 Future grain availability – NCGA perspective

Industry bodies representing the interests of grain producers, the National Corn Growers Association (NCGA) in particular, have a view that there is sufficient grain available to meet all the current and future demand for the traditional market requirements as well as the increasing demand for ethanol. In support of this position the NCGA (2006) cites the following factors:

- Corn yields are increasing at a rate of 1.5 - 2.0% a year due to advances in biotechnology and improved cropping practices. Based on a 15-year trend line (1990-2004), average yields are projected to hit 162 bushels/acre (10.16 t/ha) by 2010 and 173 bushels/acre (10.86 t/ha) by 2015.
- Increasing demand for corn will see some acreage shifted to corn away from other crops such as soybean, wheat and cotton. Biotechnological advances have allowed the corn industry to overcome many of the problems that restricted growers to a corn/soybean cropping rotation and many now believe that corn/corn/soybean or corn/corn/corn/soybean rotations are possible and practical.
- In addition, it is likely that some portion of the 35 million acres (14.2 million hectares) currently allocated to the Conservation Reserve Program could also be brought back into production.
- Corn demand for livestock feed and export is not projected to grow significantly in the long term. Both independent economists and the USDA are projecting feed and export usage of corn to be relatively stable and flat-line at about 9.1 billion bushels (230 million tonnes) in the long-term.
- Increased availability of dried distillers grains associated with increased ethanol production will increasingly displace corn in beef and dairy rations, and eventually poultry and swine rations.
- New processing technologies, currently entering the market, will improve the efficiency of ethanol conversion from corn. These technologies will allow ethanol to be produced from the fibre portion of the corn kernel (currently not utilised) and increase yields of ethanol from corn hybrids that have been produced to contain higher levels of fermentable starch. Current production rates of 2.85 US gallons/bushel (425 l/tonne) are likely to shortly be improved to greater than 3.0 US gallons/bushel (448 l/tonne) (NCGA 2006).

Given these factors, the NCGA believes it is quite feasible that corn growers could harvest a crop of 14-15 billion bushels (350-380 MMt) by 2015-16, allowing them to supply approximately 16 billion gallons of ethanol (60,600 ML) or approximately 10% of the projected gasoline demand at that time, without impacting on corn availability for other users. This level of ethanol production would consume approximately 5.5 billion bushels (140 MMt) of corn or just over 35% of projected production (NCGA 2006).

4.4.3 Current grain production levels

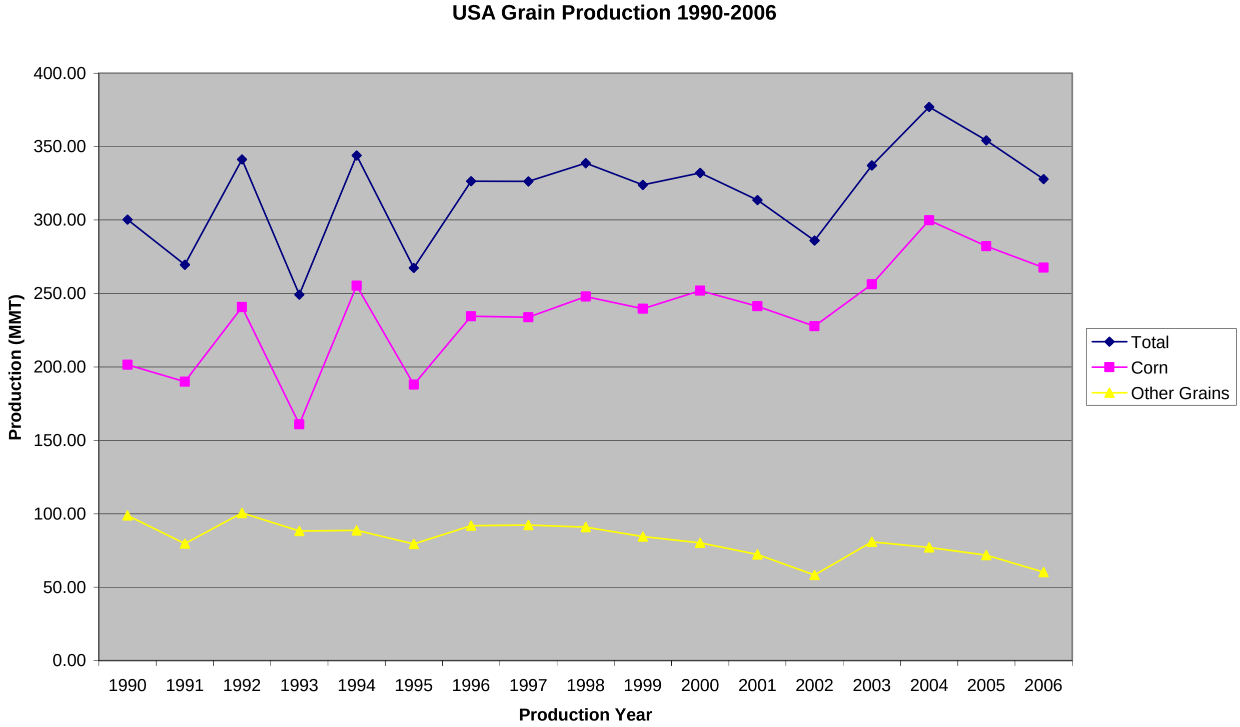

Figure 2 - USA Grain Production for the period 1990 to 2006 (USDA 2007b).

An examination of USDA (2007b) grain production figures for the USA (figure 2) shows that there is a way to go to achieve a consistent annual production of 350-380 MMt of corn, identified by the NCGA as being necessary to support their estimate of 60,000 ML of ethanol production by the year 2015. While corn production is increasing, production of other grains (barley, wheat and sorghum) has been on a long-term decline, reducing total grain production growth.

4.4.4 Non-ethanol grain users perspective

Other entities in the grain supply chain (including Bunge, Cargill, Cenex Harvest States and Archer Daniels Midland Company) are not convinced that the view held by the NCGA is going to prevail. There is a genuine concern that the move to use corn for ethanol production will result in less corn available for both the export market and livestock feeding activities, which will impact on their businesses. It is interesting to note that virtually all these organisations have developed a linkage with ethanol production as a means of ensuring they are not left out in the cold in the current changing landscape. The US Grains Council is also concerned, and is very keen to see export markets for corn retained to ensure the export customer base is preserved.

The National Cattlemen's Beef Association (NCBA), is concerned about grain availability for the cattle feeding industry and considers the most likely outcome will be an increase in the price of corn with potential flow-on effects to food prices. They have a particular concern about the impact of the US $0.51 per gallon tax credit on the ability of cattle feeders to compete for available corn supplies at these higher prices. The tax credit effectively provides a subsidy to the ethanol producer of US $1.45 per bushel of corn at current corn to ethanol conversion rates, assuming it is all passed back to the ethanol producer and applied to the purchase of grain.

This concern seems justified given the dramatic increase in corn prices that has taken place over the latter part of 2006, highlighted in figure 3, which shows the monthly average cash price for US No. 2 Grade[1] yellow corn in Central Illinois for the 2006 calendar year. Since that time, prices have continued to move towards US $4.00 per bushel (AUD $210 per tonne), which is considered by many analysts to be the ceiling price that ethanol distilleries can pay for corn based on crude oil prices of US $60 per barrel.

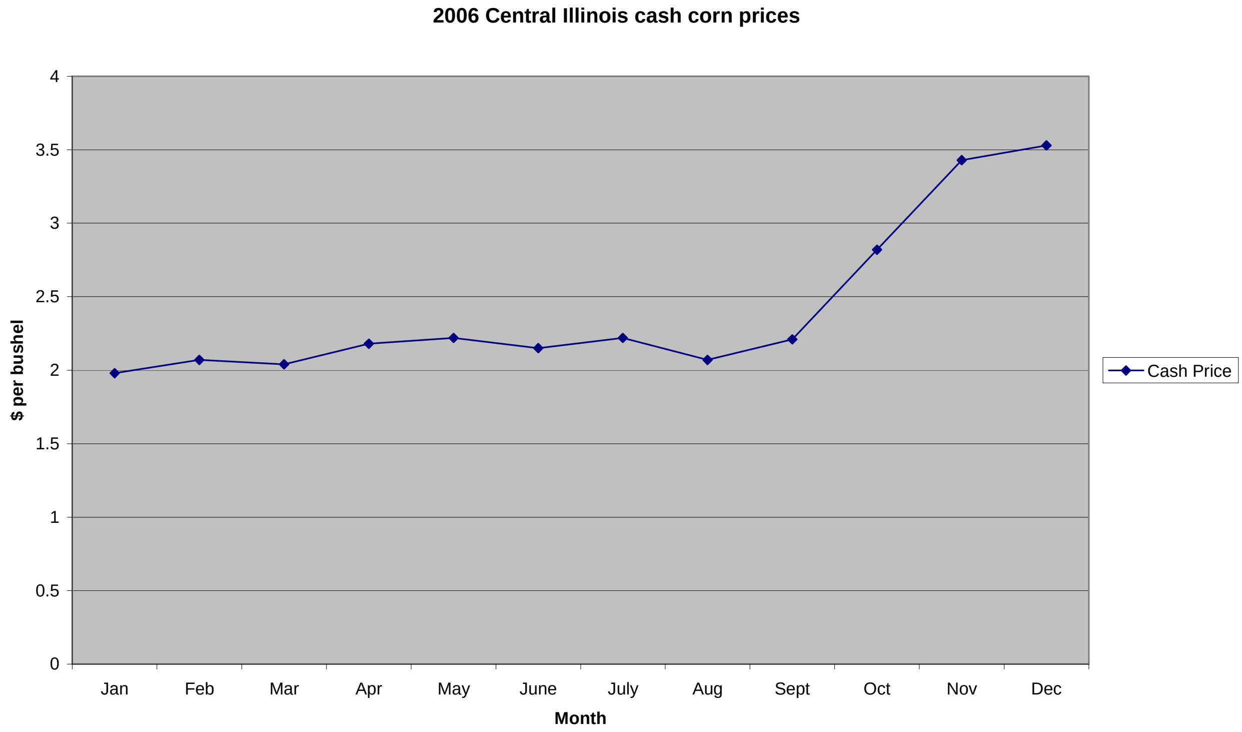

Figure 3 - Monthly average cash corn prices in Central Illinois during 2006 (USDA 2007c).

Recent media articles have highlighted the rising price of corn, its impact on margins for livestock feeding operations and its impact on cow-calf operators who are expected to bear the brunt of the adjustment as cattle feeders adjust their purchase price to offset increased feeding costs. Other media reports are predicting more radical structural change within the cattle feeding industry over the longer term, and see operations relocating to regions where they have ready access to the ethanol byproducts to ensure their survival. While there hasn't been an increase in food prices at this stage, there are plenty of market analysts predicting that this will come in the next year.

What is clear from all the information available is that the grain requirement estimate of 140,000 MMt put forward by the NCGA for 2015 will be required much earlier than predicted, with some analysts

[1] US No. 2 Grade is the major corn type available for animal feeding and by specification contains low levels of damaged kernels (< 5%) and foreign material (< 3%).

predicting requirements as high as 120 MMt by 2008. Current ethanol production levels and associated demand for corn are well ahead of both the levels required under the RFS and those predicted by the NCGA and most analysts. This additional demand for grain is outstripping the ability of the grain industry to respond. That's driving current price escalations, reducing grain supplies available for other users, and reducing corn carryover, which is expected to drop by 60% this year to a level of 19 MMt (USDA 2007a). While the final outcome of all of this is unknown at present, there appears to be only one certainty – change is in the air.

4.5 Lessons for Australia

Figure 4 shows Australian grain production for the period 1990 to 2006 (ABARE 2006). The coarse grains figure includes triticale, barley, maize and sorghum.

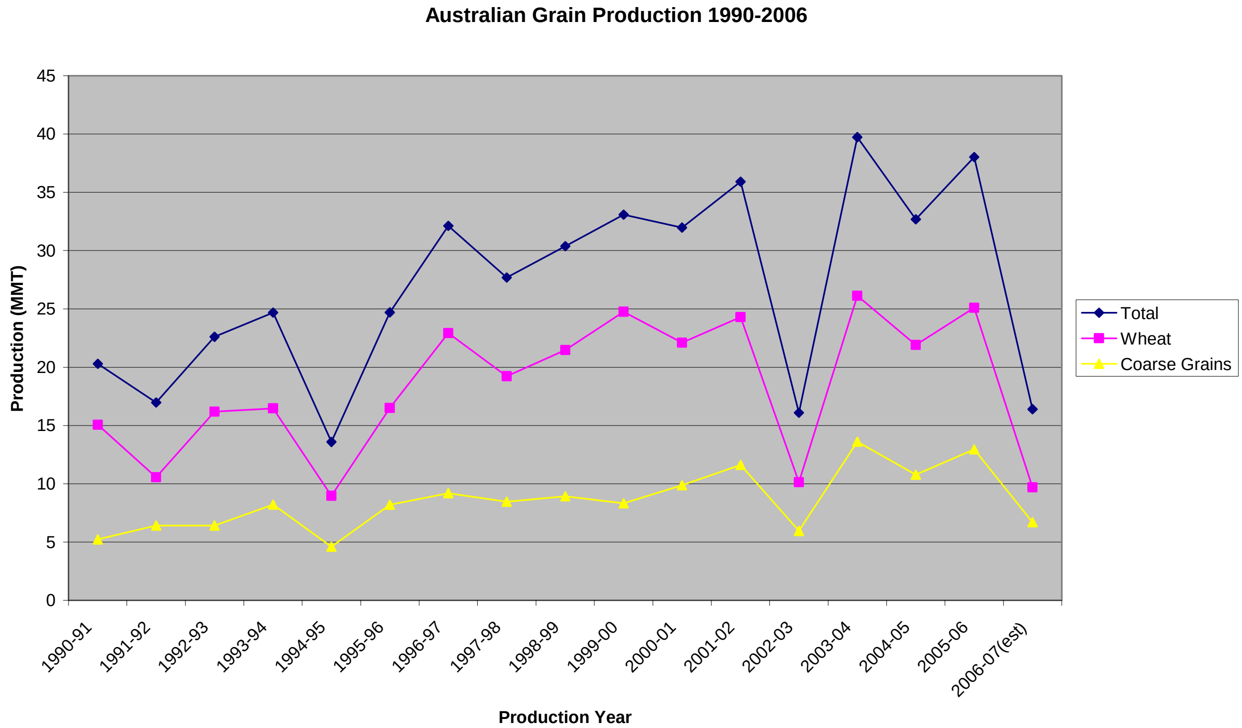

Figure 4 - Australian grain production for the period 1990 to 2006 (ABARE 2006).

A comparison of grain production for both the USA (figure 2) and Australia (figure 4) highlights the extra variability in grain production in Australia, due in a large part to the impact of drought. Production levels are more consistent in the USA, even during periods of drought, where a reduction in production of 20% seems to be the order of things. Australian production, however, is often impacted by as much as 50% during these same periods. This figure is likely to be even higher in many regions.

Based on the experience in the USA, the development of a grain-based ethanol industry in Australia will result in an increase in grain prices for all users of grain, ethanol producers and non-ethanol users alike, as a result of the increased demand for the available supplies. This additional demand, coupled with supply variability due to drought, will exacerbate the current regional shortages identified by Yates and Coombs (2003) in a previous study that examined options for reducing feedstuff supply variability in Australia. Shortages are likely to be more frequent and of greater extent.

This will result in higher production costs for the feedlot industry, as competition increases for available grain supplies; and will have a flow-on effect to the entire Australian beef industry. This flow-on effect is currently impacting cow-calf operators in the USA as cattle feeders adjust (lower) their purchase prices to compensate for higher ration costs. Additionally, the increased demand for grain will result in the establishment of a new higher baseline for grain prices. Again, this is currently happening in the USA where corn prices are being driven towards a level that equates to the breakeven position for corn as an input to ethanol production.

5 Ethanol production – the process

Corn is the primary grain used to produce ethanol in the USA, but sorghum, wheat and other sources of carbohydrates, such as whey or potato waste, are sometimes used. For corn, two primary types of milling processes currently exist, wet and dry, and the resultant feed byproducts are quite different and have different values for the animal feeding industries.

Given that all the grain-based ethanol plants proposed for construction in Australia will employ the dry milling process, it is unlikely that the byproducts of the wet milling process will become available to any extent. However, details on the wet milling process and its byproducts are included for completeness. Additionally, there is some potential for byproducts of both processes to be imported as animal feed during drought conditions.

5.1 Wet milling process

Wet milling of corn is the more traditional method employed and has been principally used in the past to produce products for human use. It requires the use of high quality corn (No. 2 Grade or better). During this process the corn is soaked in high temperature water containing sulphur dioxide, known as “steeping”, for 30 to 40 hours to begin the process of breaking the kernel down into its components.

During the steeping process, about 6% of the dry weight is dissolved, representing the soluble protein and carbohydrate components of the kernel. These dissolved components provide the nutritional value for the corn steep liquor, also known as steepwater solubles or condensed fermented corn extractives, which is separated off before the kernel proceeds to further processing. Most of the corn steep liquor is added back to the bran portion of the kernel, after it has been separated from the other kernel components, to produce corn gluten feed, but it does have the consistency of molasses and can be used in liquid supplements.

The kernels are then coarse milled to separate the germ from the other kernel components: bran (fibre), starch and gluten (protein). Oil is extracted from the germ and refined to produce corn oil. The remaining germ is dried to form corn germ meal, a very palatable protein meal containing 21-24% protein with high levels of digestible fibre. Because it has a good amino acid profile, it has a higher value and is more likely to be used in pig and poultry than ruminant rations.

The remaining portion of the kernel is pulverised in an impact mill and the bran is then screened from the starch and gluten protein portions. The bran portion is combined with the corn steep liquor to produce corn gluten feed, which is available as either a wet or dry product. The term corn gluten feed is a misnomer as it doesn’t actually contain any gluten. In addition to the bran and corn steep liquor, it may contain corn germ meal as well as other co-product streams from the plant. Its composition can vary due to the ratio of the ingredients added, which will vary from plant to plant depending on the markets available. Corn gluten feed that is higher in bran will be lower in protein, as well as phosphorus and sulphur. It is the highest volume coproduct of the wet milling industry.

The starch is then separated from the gluten using centrifugal separators. After the gluten protein is separated, it is concentrated and dried to form corn gluten meal, which has a protein content of around 60%.

The starch is separated a second time to ensure protein levels are low (less than 0.3%). A portion of the starch may be dried, or modified and dried, for sale into the paper, food or textile industries. The remaining portion is used for the production of ethanol or sweeteners.

When compared on an equivalent moisture basis (around 90% dry matter), the wet milling process of corn yields approximately 60-65% of the original grain weight as starch, which is then further processed to sweeteners or ethanol; 25% as corn gluten feed, which is the principal byproduct available for use in the animal feeding industries; 4% as corn gluten meal, which is principally used in the pig and poultry industries; and small percentages each of corn oil, corn germ meal and corn steep liquor.

The principal animal feeds of interest to the ruminant industry in the USA are the corn steep liquor and corn gluten feed (in either a wet or dry form). Figure 5 shows a schematic representation of the range of products available from the wet milling process.

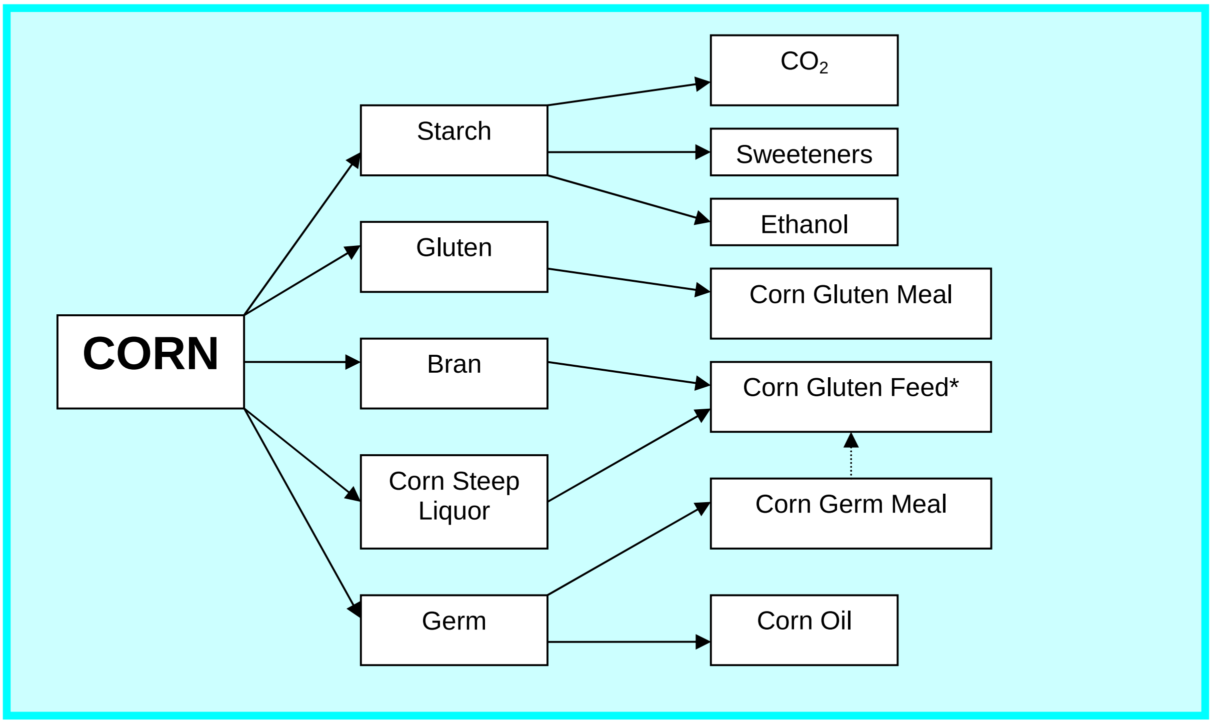

Figure 5 - Products of the corn wet milling process (Adapted from Loy and Miller 2002).
*Although it is the standard name used for the product, the term corn gluten feed is a misnomer as it doesn't actually contain any gluten.

5.2 Dry milling process

Dry milling of corn has been more extensively adopted by the newer plants dedicated to the production of ethanol. During this process the corn is initially ground to coarse flour using hammermills. This flour is combined with water to form a mash, which is then cooked and sterilised in the presence of enzymes to convert the starch to sugars. After cooling, yeast is added to the mash and it undergoes a fermentation process, which takes 40 to 50 hours to complete, where the sugars are converted to ethanol and carbon dioxide. The ethanol is then extracted by distillation.

Whole stillage, which is the liquid fraction remaining after distillation to remove the ethanol, is screened, pressed or centrifuged to separate the coarse solids (distillers grains) from the liquid which is then evaporated to produce thin stillage. The thin stillage is further concentrated by being passed back through the cooking system several times and/or partly dehydrated to form condensed distillers solubles, sometimes referred to as syrup. Condensed distillers solubles can be quite variable depending on the processes used in the plants and usually contain 25 to 50% dry matter, but sometimes are dried to 5% moisture.

The solids portion may be sold wet as wet distillers grains or combined with condensed distillers solubles and sold as wet distillers grains with solubles. The wet byproducts are usually around 30% dry matter and are used locally for livestock feed. Alternatively, the wet byproducts may be dried and sold as dried distillers grains or dried distillers grains with solubles. The dried byproducts are usually around 90% dry matter, which allows them to be transported longer distances.

Most ethanol plants produce a mixture of wet and dried byproducts, with the relative amounts being determined by the amount of wet byproduct that can be sold to animal feeding enterprises within close proximity to the plant. Figure 6 shows a schematic representation of the range of products available from the wet milling process.

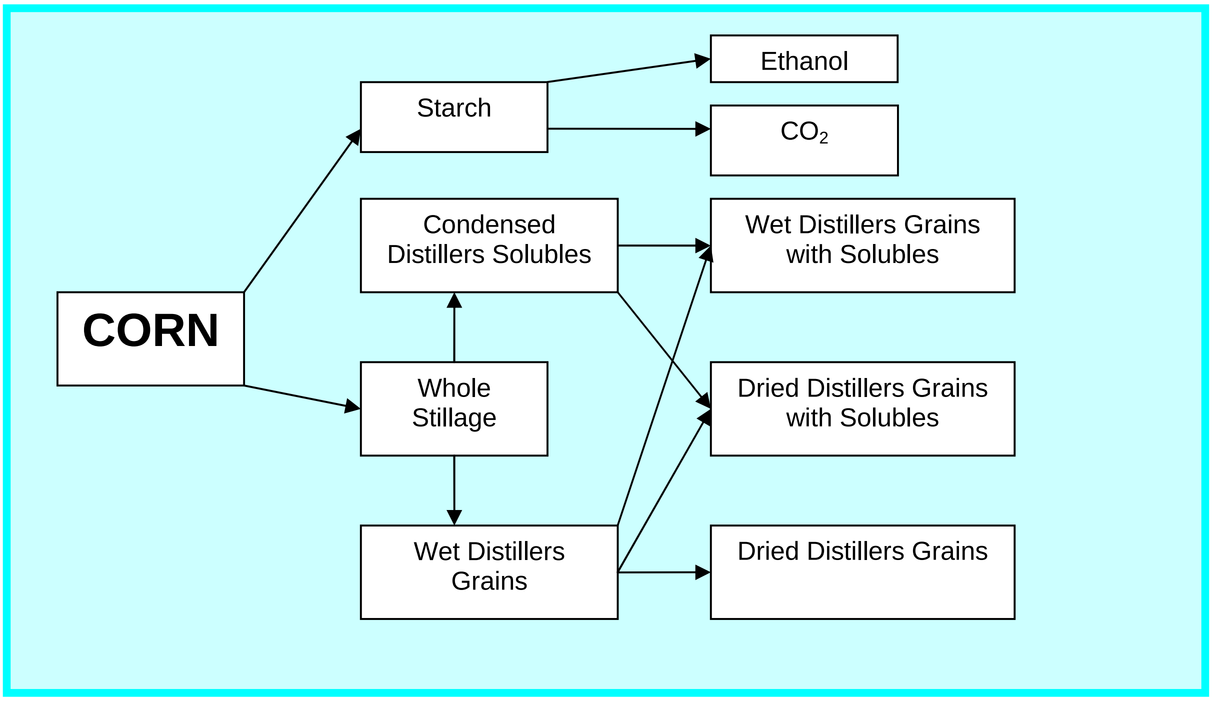

Figure 6 - Products of the corn dry milling process (Adapted from Loy and Miller 2002).

When compared on an equivalent moisture basis (around 90% dry matter), the dry milling process of corn yields approximately 60-65% of the original grain weight as starch, which is then further processed to ethanol, and the majority of the balance as distillers grains. Only small quantities of condensed distillers solubles are usually produced as a separate byproduct line.

Depending on the ethanol plant and whether it is producing wet or dry feed, the relative amount of distillers grains and condensed distillers solubles mixed together varies considerably. As there is no standard for the composition of distillers grains byproducts in the USA, their composition and nutrient profiles are very variable. As a result of this variability from plant to plant, there is mass confusion in the industry about what is in the byproducts. This confusion is reflected in the industry terminology; with the generic terms wet distillers grains and dried distillers grains often being used to denote both product that may or may not have condensed distillers solubles added (i.e. the percentage of addition is unknown and/or undeclared).

6 Site visits to ethanol plants

Given that virtually all the new grain-based ethanol production in the USA, as well as that proposed for Australia, is associated with dry mill plants, efforts were concentrated on understanding the operation of and byproducts produced from these mills.

During the course of the study, site visits were made to the three ethanol plants listed in table 1.

Table 1 - Ethanol plants visited during the study tour.

Company	Location	Production Capacity	Type	Feedstock
Cornhusker Energy Lexington	Lexington, Nebraska	42 million US gallons (160 ML) per year	Continuous flow, dry mill	Corn
Western Plains Energy	Oakley, Kansas	49 million US gallons (186 ML) per year	Batch plant, dry mill	Corn and sorghum
Archer Daniels Midlands (ADM)	Peoria, Illinois	45 million US gallons (170 ML) per year	Batch plant, wet and dry mill	Corn

Plants of this capacity are approximately equivalent to the plants that are being considered for construction in Australia (42 million US gallons per year equates to 160 ML per year). Consequently, the production and operational statistics associated with these plants are directly relevant to the proposed operations in Australia, although it should be noted that many of the plants proposed for Australia will initially operate at production levels of 80 million litres per year before expanding to full capacity. During this initial phase, the production statistics will be half of those recorded here. In addition to the different milling processes (dry versus wet), there are two different ways in which the ethanol production process is handled within the ethanol plant. As the name suggests, batch plants move the product through the various steps of the ethanol production process in batches while continuous flow plants are continuously moving product from one step to the next through the process. Plate 1 shows the Cornhusker Energy Lexington plant, a relatively new continuous flow dry milling operation that was commissioned in early 2006.

As a result of these visits the following statistics were obtained about the ethanol production process:

- Starch alone is removed from the grain during the dry milling process and converted to ethanol and CO_2. The yeast cells, enzymes and byproducts of the fermentation process are captured in the final byproducts. The average yield per bushel (56 lbs or 25.4 kgs) of corn is 2.8 US gallons (10.6 litres) of ethanol, 18 lbs (8.2 kgs) of CO_2 and 18 lbs (8.2 kgs) of dried distillers grains with solubles.

- Starch constitutes between 69 and 71% of the corn kernel and approximately one third of the DM remains as the feed byproduct following starch fermentation with a consequent three-fold concentration of the other nutrients. For example, if corn contains 4% oil (DM basis), the resultant distillers grains with solubles will contain approximately 12% oil on a dry matter basis.

- Given that sorghum and wheat are likely to be the major grains used for ethanol production in Australia, efforts were directed towards establishing a relative value for the starch in these base ingredients. The general consensus was that the same principle applies to these grains as they also contain around 65 to 70% starch.

- The Western Plains Energy facility reported that the ethanol yield per bushel of corn through their plant was 2.85 US gallons, while the yield from a bushel of sorghum was 2.65 US gallons, and they discounted the starch content of sorghum by 3 to 5% on that of corn.

Plate 1 - Cornhusker Energy Lexington ethanol plant at Lexington, Nebraska.

- The Western Plains Energy facility also provided an analysis of both the wet and dry distillers grains byproducts, indicating they contained residual starch levels of around 11% (DM Basis). This seems a very high figure and we were unable to substantiate it with any of the other plants. If true, it indicates that the fermentation process for both sorghum and corn must be inefficient at present with significant potential for improvements in conversion of starch to ethanol. It also has implications to the feeding value of the byproducts, depending on whether the starch is in a form that is readily available or not.

- Western Plains Energy was the only facility visited where they used sorghum. Interestingly, there was no separation of sorghum from corn. Both products were commingled in storage prior to milling and went through the system as a mixture, based on whatever grain happened to be delivered on a load by load basis. However, when sorghum formed part of the mix, a protease enzyme (Genecor GC106, produced by Novozyme) was added to improve the breakdown of the protein matrix surrounding the starch granules in the sorghum grain. Use of this product may have some application in Australian feedlots that are tempering sorghum and warrants further investigation.

- Approximately 1050 tonnes of grain are utilised every day in a plant of this size, necessitating delivery of around 45 truck loads using predominantly 'belly-dumper' trucks (plate 2). There are very few trucks of either the 'semi-tipper' or 'B-double' type in the USA and this has necessitated the use of specialised trucks for delivery of the wet product to livestock operations (plate 3).

Plate 2 - Corn being delivered to Western Plains Energy utilising 'belly-dumper' truck.

- CO_2 produced during the ethanol production process is not collected at many of the current ethanol plants. At the facilities visited, it was treated using thermal oxidisers and then scrubbed to remove any impurities and toxic compounds, which were subsequently added back to the distillers grains. The CO_2 was then vented to the atmosphere. The ADM facility did collect a small percentage of the CO_2 for use in soft drink manufacture, but generally there is not sufficient economic return to warrant collecting it.

- Net water usage for a plant of this capacity is 620-650 ML per year. Most of this loss occurs through the additional water that is incorporated into the ethanol and the distillers grains byproduct and evaporative losses associated with the operation of boilers and cooling towers and the drying of the wet distillers grains.

Plate 3 - Specialised truck for delivery of wet distillers grains with solubles product.

- Approximately 1,000 tonnes per day of wet distillers grains with solubles are produced at 30-35% DM. This product has to be either quickly utilised as stock feed or dried as it can be neither stacked nor stored.

- Because wet distillers grains will only stack to a height of around 1metre, large areas are required for storage and most plants have substantial bunded concrete areas dedicated to its storage. Plate 4 shows these and the specialised loading equipment employed at Western Plains Energy for loading the wet product onto trucks for delivery to feedlots in the surrounding area. Other operations utilise wheeled loaders for this loading operation.

- In the case of Cornhuskers Energy Lexington virtually all the distillers grains byproduct is sold as wet product. In their situation, there are 1,000,000 head of cattle on feed within a radius of 80 km of the ethanol plant. Very little product is currently dried, although drying will become an important part of the operation as it expands from 42 to 200 million gallons capacity.

Plate 4 - Wet distillers grains loading facility at Western Plains Energy, Oakley, Kansas.
(Note that the water in the foreground is from overnight rain, not from the product, which appears to have very little seepage.)

- Western Plains Energy does dry more of the product, principally because they have access to less feeding operations in close proximity, while ADM have made a conscious decision to dry virtually all the product they produce. This provides them with the versatility to market it anywhere in the country and overseas.

- Storage life of the wet distillers grains is around 3-4 days during the summer and up to 7 days during the winter.

- The drying process is similar across plants, is very energy intensive, and hence very expensive. Wet distillers grains at 65-70% moisture enters rotary driers, where it is subjected to temperatures of 800 - 850^{O}F (425-455^{O}C) for 20 to 30 minutes to drive off the excess moisture. The dried distillers grains leaves the drier at 200^{O}F (95^{O}C) and around 8-10% moisture. It must then be allowed to cool to 100^{O}F (38^{O}C) before being trucked or stacked. If it is packed at higher temperatures than this, it tends to consolidate into a solid mass, which then becomes difficult to handle and has to be broken up before use.

- All plants advised that they were selling the wet distillers grains product for around the US $20-25 per ton (AUD $29-37 per tonne) FOB basis, with costs of drying in the vicinity of US $60-65 per ton (AUD $88-96 per tonne), and a sale price of the dried distillers grains product of around US $90 per ton (AUD $130 per tonne). All US product is sold and priced on the basis of a US short ton (2000 lbs or 907 kgs).

- Freight rates are much lower in the USA than they are in Australia. In general, they are able to move product up to 80 km for a cost of around US $3.00 per ton (AUD $4.40 per tonne). This is less than the flag fall cost in Australia, without the additional costs incurred on a per km basis.

- Antibiotics, principally penicillin and virginiamycin, and sulphur dioxide are routinely utilised in both batch and continuous flow plants to control bacterial growth that competes with the yeast for substrate. There is little evidence on whether the antibiotics are denatured by the temperatures associated with the ethanol distillation process. The general view is that they are destroyed although no evidence is available to demonstrate this.

- Anhydrous ammonia is commonly added to the fermentation process to both regulate the pH and to supply an additional source of readily utilisable nitrogen (N) for the yeast. This additional nitrogen has to be accounted for when determining supplemental N requirements for rations.

- There is also speculation that the addition of anhydrous ammonia may have a positive impact by contributing to aflatoxin denaturation, although this has not been demonstrated. This needs to be further investigated, because if the denaturation does not occur, then it is likely that the aflatoxins are also concentrated three-fold in the byproduct. Under Australian conditions, the fate of the alkaloids associated with sorghum ergot during the fermentation process also needs to be established.

- Both the wet and dry distillers grains products contain high levels of sulphur (S), which have been linked with an increased level of polioencephalomalacia (PEM) in animals fed on the product. The higher levels of sulphur may also cause problems for those operations that utilise ammonium sulphate to manage urolithiasis (waterbelly) in feedlot cattle.

7 Site visits to feedlot operations

During this part of the study we were accompanied by Gary Holcomb, a consulting nutritionist with Nutrition Service Associates based out of Amarillo, Texas. Holcomb spent several years working in Australia in the early 1990s and is very familiar with the types of ration ingredients and formulations used here. Site visits were made to the three feedlot operations listed in table 2.

Table 2 - Feedlots visited during the study tour.

Company	Location	Capacity	Byproduct use
North Platte Feeders	North Platte, Nebraska	40,000 head	Condensed distillers solubles
Roberts Cattle Company	Lexington, Nebraska	11,000 head	Wet distillers grains with solubles
Hoxie Feedyard Inc.	Hoxie, Kansas	40,000 head	Wet distillers grains with solubles

Plate 5 - Finisher ration containing 55% (as fed) wet distillers grains with solubles.

As a result of these visits, and discussions with Gary Holcomb and Todd Milton, consulting nutritionist to Hoxie Feedyard, the following observations were made on the feeding of the byproducts.

- North Platte Feeders were using condensed distillers solubles at an inclusion rate of 8% (as fed basis) as an alternative to molasses as an energy source. They are currently researching the potential for use of wet distillers grains. As they are almost 100 km from the closest ethanol plant, they have to weigh up the value versus the cost of the wet distillers grains, particularly the cost of transport, compared to other commodities.

- Roberts Cattle Company were utilising wet distillers grains with solubles at 55% of the ration as fed, with a resultant ration dry matter of 60-62%. Plate 5 shows the finisher ration as it is presented to the cattle in the feedbunk. Note that there is some uneven mixing and clumping of the wet distillers grains with solubles.

- The Roberts Cattle Company feedlot is located in close proximity (10 km) to the Cornhusker Energy Lexington plant, with obvious cost benefits from reduced transport distance. Due to the dry matter levels of the ration, cattle performance was reduced and an additional 20-30 days on feed has been added to the normal feeding period of 150 days to achieve market specifications. Extra feed trucks are also required to deliver the higher moisture ration, increasing feeding costs.

- Deterioration of the wet distillers grains with solubles, with mould growth, was also evident where it had not been utilised within the appropriate time, highlighting the need for good control and management of wet byproducts inventory (plate 6). While the mould itself was not considered a problem, any aflatoxins it produced were of concern.

Plate 6 - Mould growth on wet distillers grains with solubles.

- Hoxie Feedyard has been feeding wet distillers grains with solubles for about 4 years, and at the time of the visit, was utilising a finisher ration that contained 29% of wet distillers grains with solubles on an as fed basis. Todd Milton, their consulting nutritionist, was onsite when we visited and supported the need for additional feeding capacity when feeding wet distillers grains, by confirming that the use of wet distillers grains with solubles at these levels required more horsepower and an increased mixing time to achieve an acceptable ration, and an increase in total feed output of around 25%.

- Milton believes that maximum inclusion rate of wet distillers grains should be restricted to 20% on an as fed basis. This view was at odds with the previous feedlot; and the owner of Hoxie Feedyard, who incidentally was also a shareholder in the local ethanol plant.

- While the fibre levels of the wet distillers grains appear quite high when you look at the compositional analysis, they do not have a high level of effective fibre, due to the fine grinding of the corn in the ethanol production process. To maintain effective fibre levels in rations containing wet distillers grains requires the retention of the usual levels of roughage employed in the rations containing higher levels of grain that they replace. This can result in rations that, on paper at least, appear to have higher levels of fibre than might seem to be required. Plate 7 shows the finisher ration used at Hoxie Feedyard, comprised of 29% wet distillers grains with solubles on an as fed basis, with cottonseed hulls and straw making up the effective fibre portion of the ration. Inclusion of wet distillers grains in the ration does allow the use of straws for the effective fibre component of the ration in place of better quality hays.

Plate 7 - Finisher ration containing 29% (as fed) wet distillers grains with solubles.

- Milton was also of the view that the high levels of fat in wet distillers grains (around 10%) also impact on the maximum inclusion levels, with total ration fat levels being restricted to levels below those that reduce dry matter intakes.

- There was general agreement that the wet distillers grains are highly palatable. While highly desirable most of the time, this can cause some problems with reduced dry matter intakes if supply of the product is interrupted for any reason and the wet distillers grains are suddenly removed from the ration. Most feedlots hold a supply of dried distillers grains for use in this situation, but their use is not effective in offsetting the decline in dry matter intake. Cornhusker Energy Lexington has developed a process for re-hydrating dried distillers grains which they claim is effective in arresting this decline. However, we were unable to view the process or establish its effectiveness in overcoming the problem.

- It was also generally agreed that use of distillers grains reduces the incidence of acidosis, due to the reduced starch levels in the ration.

- Increased incidence of bloat was raised by Cornhusker Energy Lexington as one of the problems associated with feeding higher levels of wet distillers grains. This view was not supported by the nutritionists, who held the opposite view, that the inclusion of wet distillers grains had a positive effect on the incidence of bloat.

- For inventory control, a shrink of 5% should be allowed for the wet distillers grains and a shelf life of 3-4 days during the summer and up to 7 days during the winter.

- There is a growing concern about the impact of feeding distillers grains on carcase specifications and yield grades. Most of the scientific evidence suggests that there is no reduction in yield grades unless the distillers grains are fed at very high levels (greater than 40% of ration dry matter). However, processors and cattle feeders are concerned about a drop-off in the percentage of carcasses that are achieving ‘Prime’ and ‘Choice’ grading. There were no hard data available on this that we were able to discover in the public arena.

As a result of the site visits to both ethanol plants and feedyards and discussions with Holcomb and Milton it was evident that opinions on the feeding value and optimum inclusion rates for ethanol byproducts are extremely diverse and often influenced more by association than science.

Discussions with Milton were very enlightening, particularly with respect to his evaluation of the research work that was undertaken at the University of Nebraska. This work, which compares the relative feeding value of wet distillers grains to corn at a range of inclusion rates, is commonly quoted in the available scientific literature and extensively used by ethanol proponents to expound the virtues of the byproduct as an animal feed. Milton was highly critical of this work, even though he had been involved, and in fact, was co-author of many of the scientific papers produced. The criticism was principally directed at the selection of diets chosen as controls for the experimental program, which in his view were neither appropriate for the purpose nor representative of those commonly in use at commercial operations. In his view, conclusions drawn on the relative feeding value of the ethanol byproducts were consequently flawed.

8 Feeding ethanol byproducts in Australia

Subsequent to the Milton revelations, Holcomb was requested to provide an independent evaluation of the feeding value of the wet distillers grains, based on his assessment of the scientific literature and practical feeding experience with the product, and also to develop rations that would demonstrate the use of wet distillers grains under Australian conditions. His report is attached as appendix 2.

This section is an attempt to collate and crystallise all the information gathered during the study tour into a succinct reference for any Australian operator that is looking at feeding ethanol byproducts.

8.1 Ethanol production byproducts

8.1.1 Principal byproducts

The initial byproducts of the grain-based dry milling ethanol production process are condensed distillers solubles and wet distillers grains. Wet distillers grains may in turn be dried to produce dried distillers grains. The condensed distillers solubles may also be added to the wet distillers grains to produce wet distillers grains with solubles, which in turn may be dried to produce dried distillers grains with solubles.

It is unlikely that ethanol production plants in Australia will produce a separate supply of condensed distillers solubles for sale, so the most likely byproducts that will be available are wet distillers grains with solubles and dried distillers grains with solubles.

The decision to use either wet or dried distillers grains with solubles in feedlot rations should be principally based on sound nutritional practices and an analysis of their costs as a source of protein and energy on a delivered-to-bunk basis relative to the costs associated with alternative ingredients. The following sections provide detail on the factors that need to be considered when making that decision.

8.2 Composition and nutrient values

Clearly, it is difficult to assess the composition and nutrient value of products that are not yet available in Australia and the values presented here are a guide only, based on overseas information sourced either during the tour or from the scientific literature. Further analysis of the final products will be essential when a plant is established in Australia.

As a general rule, compared to the levels in the original feedstock, nutrients have a three-fold concentration in the byproduct as two thirds of the dry matter is lost when the starch is utilised for ethanol production. For example, if maize contains 4% oil (DM basis), the resultant distillers grains with solubles will contain approximately 12% oil on a dry matter basis.

Experience in the USA highlights the significant variance in product quality and composition associated with differences in plant engineering and processes within plants. Composition is also influenced by variables such as type of feedstock and seasonal conditions. A lack of commodity standards for ethanol byproducts in the USA also contributes to product variability.

Moisture levels are extremely variable and need to be monitored on a load by load basis. Specialised analytical equipment is required for the determination of nutrient composition of ethanol byproducts as it is very easy to evaporate volatile compounds and burn off fat, especially if drying ovens of the type normally found at feedlots are used. Ethanol plants have extensive laboratory capabilities for monitoring their own processes and feedlots are advised to request an analysis on each load of byproduct received to verify nutrient content and moisture levels.

As sorghum and wheat are likely to be the major grains used for ethanol production in Australia, efforts have been directed to ascertaining composition and nutrient values for their byproducts. Table 3 provides comparative data that has been adapted from Preston (2006). There are numerous other sources of analytical data available, but these have been chosen for inclusion as they appear to contain the most comprehensive range of analyses.

Table 3 – Nutrient profiles for a range of ethanol byproducts (Adapted from Preston 2006).

	Barley	Maize			Sorghum		
	DDG	DDG	WDG	DDGS	DDG	WDG	DDGS
DM (% as fed)	90	91	36	90	91	35	92
ME (MJ/kg DM)	11.7	15.0	15.3	15.0	12.9	13.5	12.9
NE_m (MJ/kg DM)	6.75	9.3	9.5	9.3	7.7	7.9	7.7
NE_g (MJ/kg DM)	4.36	6.2	6.4	6.2	5.1	5.3	5.1
CP (% DM)	30	31	30	30	32	32	31
UIP (% CP)	56	58	54	52	62	55	53
CF (% DM)	18	8	8	8	13	13	13
ADF (% DM)	22	16	16	15	22	22	19
NDF (% DM)	45	40	40	39	44	44	47
eNDF (% NDF)	4	4	4	4	4	4	4
Fat (% DM)	3.7	10.0	10.0	11.0	10.0	10.0	10.0
Ca (% DM)	0.15	0.09	0.09	0.20	0.22	0.22	0.25
P (% DM)	0.67	0.66	0.66	0.80	0.63	0.63	0.65
K (% DM)	1.0	0.9	0.9	1.0	0.3	0.3	0.5
S (% DM)	0.43	0.45	0.45	0.50	0.45	0.45	0.40

There is very limited data available on the composition and nutrient values of wheat and barley based distillers grains byproducts. Wheat based byproducts are likely to have lower energy values than either sorghum or maize based byproducts as a result of lower fat levels. Barley based byproducts are likely to have less energy again as a result of higher fibre levels. Barley and especially wheat based byproducts will have higher protein levels than sorghum or maize based byproducts. Based on the 3 times base product concentration rule, wheat byproducts are likely to have protein levels of up to 40% (DM basis), particularly for our 'Prime Hard' varieties.

Wet distillers grains have a moisture content of 65-70% (i.e. they have a dry matter of 30-35%) while dried distillers grains have a moisture content of around 10% (i.e. a dry matter of 90%). The drying process is expensive and does drive off some of the volatile nutrients and burns some of the fat, resulting in a loss of nutrient energy of around 3%. Protein levels remain relatively unchanged, although the proportion of undegradable intake protein (UIP) or bypass protein may be slightly higher in the dried byproducts.

8.3 Transport, storage and handling considerations

Wet distillers grains have all the limitations normally associated with a high moisture byproduct. They are expensive to transport and their value reduces quickly with increased distance between the ethanol plant and feedlot. Experience in the USA indicates that they can be cost-effectively transported up to a distance of 80 km. Freight rates are much lower in the USA than they are in Australia, and the viability of transporting a high moisture product that distance in Australia is questionable. Handling and transport are routinely achieved using wheeled loaders and ‘tipper’ type trailers. Plate 8 shows the loading of wet distillers grains into a feed truck at one of the feedlots visited, exactly the same process we use here. Note the consistency of the wet distillers grains, very much like plasticine, which increases energy requirements for mixing and requires additional effort to ensure ration addition levels are accurate.

Plate 8 - Loading wet distillers grains with solubles.

Wet distillers grains are also difficult to store as they will not stack to a height of greater than one metre because of their moisture content; they exhibit all the characteristics of a sloppy concrete mix. Access to considerable areas of bunded storage is required for storage. Additional feeding capacity is required and additional costs are incurred when wet distillers grains are fed, as a result of higher horsepower requirements, increased feed mixing time to achieve an acceptable ration and an increase in total feed output.

Shelf life of the wet byproducts is limited to about 4 days during the warmer part of the year and may stretch to 7 days during the cooler periods. Growth of mould occurs after this period. While the mould itself may not be a problem, unless it affects the palatability of the ration, any aflatoxins that the mould might produce are a concern. Additionally, because it is a high moisture product, it must be stored out of the rain and has a high level of shrink; it is recommended that a shrink of 5% be allowed for.

Dry distillers grains on the other hand are relatively easy to transport, store and handle, with properties very similar to the protein meals currently utilised in the industry. They do, however, have a lower bulk density than most of the traditional protein meals, which does increase transport costs. The benefits achieved at the user end incur a cost at the production end, as drying is very energy intensive, hence very expensive. The experience in the USA would indicate that many plants are unable to recoup these additional costs from the marketplace and prefer to supply wet distillers grains wherever possible.

8.4 Distillers grains in feedlot diets

There is a substantial amount of research data available from the USA to suggest that distillers grains can be incorporated into feedlot diets at optimal inclusion levels of between 5 and 25% on a dry matter basis. This position is supported by Holcomb in the evaluation he provided (appendix 2).

In summary, Holcomb makes the following points:

- The value of distillers grains will be highly variable from operation to operation and is best evaluated in conjunction with a consulting nutritionist and must be based on sound ration management principles and a complete evaluation of the costs of the range of ingredients available.

- Distillers grains may be fed at levels of 5 to 15% of the ration dry matter in feedlot finisher diets as a source of supplemental protein, replacing protein meals and whole cottonseed, with their value being determined by the cost of other protein sources. When fed at these levels, feed intake, average daily gain and conversions are optimised and may actually improve, as protein levels become non-limiting, and their value may be superior to grain.

- When fed at higher levels, around 20-25% of ration dry matter, distillers grains replace a portion of the ration energy as well as continuing to supply the protein requirements. Performance is maintained and their value is roughly equivalent to grain.

- When fed at higher levels, the energy density of the ration is reduced, which results in reduced performance (lower average daily gains and higher conversions) and an extended period on feed to meet carcase specifications. The decision to feed at these levels will be based entirely on cost of production. Depending on the cost of the distillers grains, cost of gain can actually be lower even given the higher conversion rates.

The importance of evaluating the value of the distillers grains byproducts against the range of ingredients available is demonstrated very effectively in the sample rations that Holcomb developed. At the time, whole cottonseed was trading at a price premium of 20% to sorghum on the Darling Downs in Queensland. At these prices, whole cottonseed was a better buy than wet distillers grains, which had been theoretically priced as being equivalent to grain, hence whole cottonseed had to be excluded from the list of available ingredients to allow the demonstration rations to be formulated.

8.5 Other considerations and cautions

Use of distillers grains results in a reduction in acidosis problems. It is likely that the reduction in starch levels is responsible, and the control of sub-clinical acidosis is responsible for the improvements in performance that are seen when distillers grains are fed at levels of 5-15% of ration dry matter. This is viewed as one of the major advantages of using distillers grains in feedlot diets. Rations containing distillers grains are also highly palatable and are readily consumed by cattle, while the moisture from wet distillers grains may assist to condition dry rations.

Fibre levels in distillers grains do not meet the animals requirement for effective fibre. As shown in Table 2, NDF levels appear high but effective NDF (eNDF) levels are quite low. This is due to the small particle size that results from the fine grinding of the grain required for the ethanol production process. Roughage levels similar to those that are traditionally used in finisher rations are normally included to supply the effective fibre requirement, although lesser quality straws can be substituted for the better quality hay normally used. On paper at least, these rations may appear to be over-formulated for fibre.

High levels of fat in distillers grains (around 10%) also impact on the maximum inclusion levels, with total ration fat levels being restricted to levels below those that reduce dry matter intakes, and somewhere around 6-7% is about the limit. For those operations that have access to whole cottonseed, it is going to be easy to exceed these levels if both ingredients are included.

Both wet and dry distillers grains have high levels of undegraded intake protein (bypass protein) which provides a valuable source of protein for young, growing cattle. However, if protein levels are too high in feedlot rations, the excess nitrogen is excreted as urea, which is an energy expense for the animal. This energy expenditure may result in elevated body temperatures which is a concern during periods of hot weather conditions. Excess urea is also converted to ammonia on the manure pad and this may potentially cause problems with odour.

Levels of phosphorus and sulphur are also high in distillers grains necessitating adjustments to supplement formulations. High levels of sulphur (S) have been linked with an increased level of polioencephalomalacia (PEM) in animals fed on these products. The higher levels of sulphur may also cause problems for those operations that utilise ammonium sulphate to manage urolithiasis (waterbelly) in feedlot cattle. Levels of phosphorus in manure must be monitored and managed to ensure they are applied to manure utilisation areas at appropriate rates.

The potential for inclusion of antibiotics (penicillin and Virginiamycin) and concentrated levels of aflatoxins as a result of the ethanol production process all require further investigation before a definitive statement can be made. Likewise, the potential for the concentration of the sorghum ergot alkaloids will need to be assessed once product becomes available in Australia.

9 Supply chain for imported maize

This section of the report records the information gathered from the study tour relevant to the supply chain for importing maize suitable for the devitalisation process.

9.1 Site visits to maize supply chain participants

During the study tour, visits were made to a number of supply chain participants and other contacts that have roles in management of various aspects of the maize export process. Table 4 details the major maize supply chain site visits and contacts made. Other contacts were also visited and details of these contacts and information sourced is shown in the trip itinerary attached as appendix 1.

Table 4 - Maize supply chain participants visited during study tour.

Company	Location	Discussion Points/Operations Viewed
United States Department of Agriculture	Washington, D.C.	AQIS Import protocol for maize Certification procedures Identity Preservation Program
Cargill	Savage, Minnesota	Grain receival depot and elevator complex Barge loading facility
Cargill	Fairmont, Minnesota	Grain receival depot and elevator complex Identity Preservation Program Grain cleaning Rail loading facility
Cargill	Marna, Minnesota	Grain receival depot and elevator complex Identity Preservation Program Grain cleaning Rail loading facility
Archer Daniels Midland	Decatur, Illinois New Orleans, Louisiana	Identity Preservation Program Barge unloading facility Ship loading facility
AG Processing Inc	Seattle, Washington	Rail unloading facility Ship loading facility

As a result of these site visits and discussions with all the parties visited, the following observations were made on the maize supply chain:

- The disease status of the various regions where maize is grown is well known and there are no problems identifying regions of minimal risk from a disease perspective. Most state departments of agriculture undertake annual surveys of disease status and the results of these surveys are readily available.

- The importance that AQIS and Biosecurity Australia place on Karnal Bunt (*Tilletia indica*) as a contaminant of export maize shipments appears to be largely overstated. Since it was first identified in 1996, Karnal Bunt has been subject to active quarantine and control procedures and is now considered to be under control. Incidence of the disease was only ever recorded in small localised areas of durum wheat crops in Arizona, California, New Mexico and Texas and grain movement from these areas has been controlled so that it does not enter the export supply chain.

- Sourcing supplies of maize that are certified free of weed seeds is likely to be more difficult without incorporating a seed cleaning process. Generally, crop hygiene is very good and weeds are controlled. However, not all state departments of agriculture have reliable survey information on weed status and it is more difficult to obtain this information.

- Additionally, due to the large number of weed seeds included in the Biosecurity Australia non-permitted weed seed list, the USDA Animal and Plant Health Inspection Service (APHIS) and Grain Inspection, Packers and Stockyards Administration (GIPSA) advised that they would find it very difficult to provide the required certification for any shipment, irrespective of where it was sourced.

- Grain cleaning equipment is present at most receival and storage depots. However, it is normally utilised only on an as-required basis to ensure that grain meets the required standards. Some operations are set up to clean grain as it is received, in which case cleaning is primarily used to remove foreign matter and insects, while others clean grain as it is outloaded. In this situation, cleaning is usually only undertaken on an intermittent basis to ensure that the sample being outloaded meets the required grade specifications.

- The grain cleaning process can be performed on complete shipments, but this reduces throughput and increases cost. Hence, the cleaning process is only used on an as-required basis to ensure the shipment meets the grade specifications ordered.

- Identity preservation programs are now well entrenched along the entire grain supply chain in the USA. Their implementation has been driven by the marketers acceptance of their customers requirements, in particular, the need to supply non-GMO products into the Asian markets.

- Procedures and processes were evident to ensure the identity of any particular consignment right through the entire supply chain. Programs addressed and provided certification for all the following areas:
    - source grain of known quality from specific origins;
    - segregation of product;
    - avoidance of cross-contamination;
    - cleanliness of storage and handling facilities;
    - cleanliness of transport vessels; and
    - ability to individually identify and seal transport vessels.

- ADM, for example, have written protocols for identity preservation of non-GMO grains and products right through the supply chain. Performance of the protocols is audited by the USDA. A range of tests are available, and are used at each stage of the process, to test for GMO contamination.

- Barges are now considered to be relatively easy to clean and are probably now preferred over rail wagons as a means of transporting identity preserved shipments of grain and other products.

- Cleaning has been facilitated by the use of special gantries that are capable of removing the entire cover in one piece (plate 9). This enables easy access for unloading equipment (plate 10) and thorough cleaning of all ledges to be easily undertaken. Skid-steer loaders are lowered into the barge to assist with the unloading and cleaning process. Once unloading is completed, any residual material is then removed by washing. Companies have now been established to service the requirement for specialist barge cleaning.

Plate 9 - Barge cover raised to permit unloading and thorough cleaning for identity preserved shipments of either grain or byproducts.

- All barges are capable of being sealed and are individually identified to assist the identity preservation process. However, the application of seals after loading is not usually a mandatory requirement as the addition of product after loading is highly improbable.

Plate 10 - Barge unloading at the Archer Daniels Midlands facility at New Orleans.

- Many of the older type elevator and storage systems are difficult to clean, and some companies have looked to find alternative methods of handling product without the need to go through these systems. ADM, for example, use a floating elevator leg to unload barges direct to vessel. This removes the potential for cross-contamination through the elevator and storage systems at port.

- AG Processing Inc. have developed a state of the art, dedicated rail unloading and ship loading facility at Port of Grays Harbour, near Seattle, Washington State. Identity preserved shipments are received in numbered rail cars that must be registered with and recognised by the computer system before unloading is permitted. This is undoubtedly the cleanest grain facility that we have ever seen. The whole facility is cleaned down using compressed air and vacuum suction between each shipment. Cleanliness of the facility is certified by an independent marine surveyor, licensed by the USDA. Plates 11 to 16 show the various features of the Ag Processing Inc facility including the rail unloading facility, inside of the conveyor belt housing that transfers the material being loaded from the rail unloading area to the ship loading facility, the automatic weighing facility, ship loading facility and dust extraction equipment. Currently utilised for the export of soybean meal, corn gluten feed and dried distillers grains, the facility does have the capacity to export identity preserved grain shipments.

Plate 11 - Rail unloading area at Ag Processing Inc facility at Port of Grays Harbour.

Plate 12 - Inside the conveyor belt housing between the rail unloading and automatic weighing facilities.

Plate 13 - Automatic weighing facility.

Plate 14 - Ship loading facility (rear view).

Plate 15 - Ship loading facility (side view).

Plate 16 - Dust extraction and collection equipment.

- Rail wagons are slightly more difficult to clean. Compressed air is used to remove grain and product residues from interior and exterior ledges prior to and after loading (plate 17).

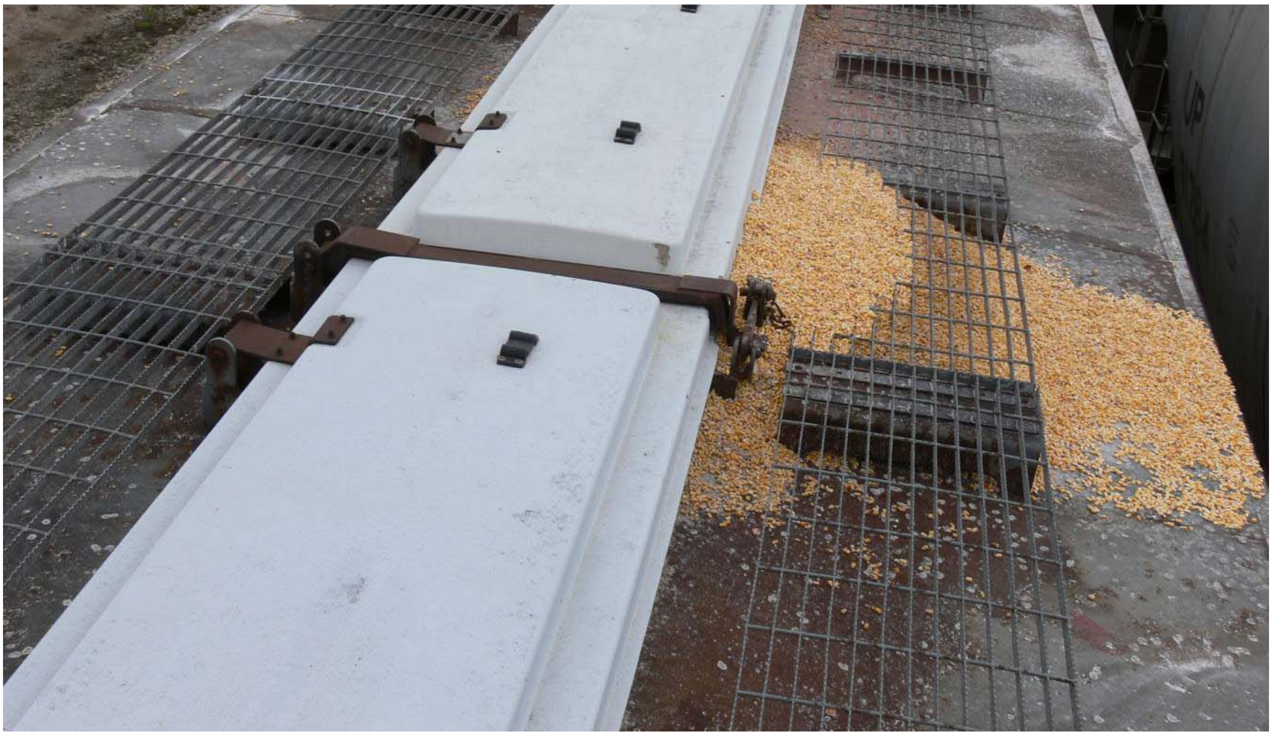

Plate 17 - Grain residues on rail wagon following loading.

- Rail wagons are able to be sealed (plate 18) and individually identified (plate 19).

Plate 18 - Seal on discharge chute of rail wagon.

Plate 19 - Unique identifying number on rail wagon.

- Ship holds are probably the most difficult to clean (plate 20). We were advised that many of the newer vessels have removed the ledges and concertina wall structures evident in this photograph and now have holds with reasonably smooth walls.

Plate 20 - Ship being loaded with corn gluten feed for export.
(Note the ledges in the background that make some of the older ships more difficult to clean.)

Overall, the impression gained was one of a professional industry, very commercially focussed, that is capable of meeting customer requirements in terms of supplying identity preserved parcels of grain that meet required specifications.

10 Potential for Australia to import dried distillers grains

While it was not a stated objective of the study tour to examine the potential for Australia to import dried distillers grains, the possibility for such imports was raised and promoted by almost all contacts we made during the course of the tour. The potential for import of dried distillers grains is the subject of a separate project being jointly funded by MLA and Australian Pork Limited, so the opportunity was taken to collect additional information that would assist in this evaluation. The following records the information collected:

10.1 Current and future production of dried distillers grains

Wherever possible, the production statistics quoted during meetings have been verified by reference to additional sources of information.

- In 2005, ethanol dry mills produced just over 9.0 MMt of distillers grains, approximately 20-25% of which was sold locally as a wet product, thereby reducing energy inputs for drying and transportation costs. The balance was sold as dried product, predominantly on the domestic market, with 1.08 MMt being exported, principally to South America, Mexico, Canada, SE Asia and Europe (NCGA 2006).

- At the same time, wet mills produced 0.43 MMt of corn gluten meal, 2.4 MMt of corn gluten feed and corn germ meal, and 0.26 MMt of corn oil (NCGA 2006).

- The majority of the distillers grains (75-80%) was fed to ruminant animals (beef and dairy cattle), with the balance being used by the pig (18-20%) and poultry (3-5%) industries (NCGA 2006).

- Industry sources estimated the production of dried distillers grains for 2006 to be the order of 10.0 MMt. More recent estimates suggest that 14.5 MMt were produced in 2006 (RFA 2007).

10.2 Potential assistance available to Australian users

There was a general acknowledgement that supply of the dried distillers grains was likely to outstrip the capacity of domestic users to use the product and new export markets would need to be cultivated for a portion of this additional production. The following were identified as possible opportunities for assistance to potential Australian users of the product:

- Substantial quantities of dried distillers grains are being exported by containerisation. Given the imbalance of trade between China and the USA, there are more containers to be returned to China than there is cargo. With the only option being to return these as empty containers, many are being backloaded with dried distillers grains to Asian destinations at very low freight costs.

- US Grains Council demonstrated an eagerness to work with the Australian industry to trial the use of dried distillers grains. Funding is available through the USDA Market Access Program to assist with product and freight costs associated with any feeding trials.

While the economics are unlikely to be favourable on an ongoing basis, the use of imported dried distillers grains may offer some opportunities for Australian lotfeeders during periods of drought. Plate 21 shows a sample of dried distillers grains. Note the very small particle size that reduces its value as a source of effective fibre.

Plate 21 - Sample of dried distillers grains.

10.3 Nutrient value of maize milling byproducts

Table 5 provides details of the nutrient value of the range of corn byproducts that are likely to be available for import into Australia as ruminant feeds. While there is some inconsistency between the values shown here and those shown in table 3, all values are within the normal range seen for these byproducts. This reference has been chosen because it provides comparative values for dried corn gluten feed, which is the most readily available byproduct from the wet milling process.

Table 5 - Typical nutrient profiles of the dried byproducts of the corn wet and dry milling process (Adapted from Loy and Miller 2002).

	Unit	Dried distillers grains	Dried distillers grains with solubles	Dried gluten feed
DM	% As Fed	90	90	90
Protein	% DM	30	29	20
Fat	% DM	8.5	10	2.8
Fibre	% DM	14.4	8.5	11.1
NDF	% DM	44	45	12
ADF	% DM	18	19	38
ME	MJ/kg	11.7	13.3	12.1
NE_m	MJ/kg	8.2	9.2	8.8
NE_g	MJ/kg	6.2	6.3	5.5
Ca	% DM	0.11	0.22	0.06
P	% DM	0.41	0.80	1.10
K	% DM	0.20	0.80	1.60
S	% DM	0.48	0.40	0.33

11 Conclusions and Recommendations

11.1 Conclusions

The study tour was very informative and provided the opportunity to gain first hand knowledge of the ethanol industry, the use of the ethanol byproducts as cattle feed and the maize supply chain in the USA. As a result of the observations made and discussions held during the course of the study tour the following conclusions have been drawn:

11.1.1 Lessons to be learned from the USA experience

The study tour provided an opportunity to view first hand the development of the ethanol production industry in the USA. The current investment in ethanol production reminds one of the frenzied activity seen when investment in technology based companies was all the go. As with the 'Dotcom' revolution, some of the current investment is based on poor business principles, and while profitability is currently high, margins will be reduced as the price of crude oil falls and/or the price of grain rises. There will ultimately be some rationalisation of the industry as margins tighten and, if as predicted by many of the organisations visited, the government reduces or removes the current tax incentive.

Proponents of ethanol production and industry bodies representing the interests of grain producers, the NCGA in particular, have a view that there is sufficient grain available to meet the current and future needs of existing users as well as the increasing demand for ethanol production. They quote near-record grain production levels and continuing productivity advances as evidence that these higher levels of usage can be supported.

However, the considerable increase in corn use for ethanol production has led many of the traditional corn users to question how supplies for food, domestic feed and export markets can be maintained at adequate levels and priced such that their operations will remain viable. They are becoming more vocal in their opposition to the subsidy being paid to ethanol production and starting to question whether there will ultimately be a flow-on effect to food prices to maintain enterprise viability.

The concerns being articulated by non-ethanol grain users in the USA are the same as those being expressed by some of their cohorts here in Australia and there is an opportunity for the Australian beef industry to gain knowledge and support from the processor, cattle feeding and cow-calf operators in the USA to assist in the debate on subsidised ethanol production. Their experiences strongly support the case of the industry sectors opposing subsidies for ethanol production.

11.1.2 Production statistics confirmed

The ethanol plants visited during the study tour are approximately equivalent in capacity to the plants that are being proposed for construction in Australia (42 million US gallons per year or 160 ML per year). Consequently, the production and operational statistics associated with these plants are directly relevant to the proposed operations in Australia, although it should be noted that many of the plants proposed for Australia will initially operate at production levels of 80 ML per year before expanding to full capacity. During this initial phase, the production statistics will be half of those shown here.

Discussions with plant operators in the USA confirmed that the production and operational statistics that the proponents of ethanol production have been promoting for 160 ML plants to be established in Australia are correct. In summary, these statistics are:

- Ethanol production of 160 ML per year;
- Employment of 30-35 personnel;
- Grain usage of around 380,000 t per year on an as-received basis (88-90% dry matter);
- CO_2 production of 120,000 t per year;
- Net water usage of 620-650 ML per year; and
- Wet distillers grains production of 330,000 t per year at 30% dry matter; or
- Dried distillers grains production of 110,000 t per year at 90% dry matter.

11.1.3 Ethanol byproducts have a value in feedlot rations

The byproducts of ethanol production do have potential as feedstuffs for use in the livestock feeding industries and, if suitably priced, provide a useful source of energy, protein and minerals for feedlot cattle. As the majority of grain-based ethanol production now employs the dry milling process, the principal byproducts that will be available for consideration in Australia are wet distillers grains with solubles and dried distillers grains with solubles.

The use of wet distillers grains with solubles and/or dried distillers grains with solubles will need to be evaluated on a feedlot by feedlot basis and individual operators will need to make this assessment based on the nutrient value of the products available, respective costs, optimum feeding levels and economic value to their business. This assessment should be based on sound nutritional practices and an analysis of their costs as a source of protein and energy on a delivered-to-bunk basis relative to the costs associated with alternative ingredients.

There is a substantial amount of research data and practical feeding experience available from the USA to suggest that distillers grains can be incorporated into feedlot rations at optimal inclusion levels of between 5 and 25% on a dry matter basis. A collation of this information has been included and will provide operators with a useful guide to the factors that they need to consider when evaluating the potential use of these byproducts.

Additional research is currently underway to examine the ability of the industry to make use of ethanol byproducts, given likely limitations to ration inclusion levels due to high protein levels, the potential environmental impacts, and the location of feedlots in relation to ethanol supplies.

The project will also evaluate the impact of ethanol production on grain availability for the three regions of Australia where the majority of feedlots are located – southern Queensland, central New South Wales and the Riverina. This information will be of value in the ongoing assessment of the impact of ethanol production.

11.1.4 Ethanol production will further exacerbate regional grain shortages

While the byproducts of ethanol production are a potential feedstuff for the intensive livestock feeding sectors, some simple mathematics on the figures presented above, namely grain usage (380,000 t) versus byproduct produced (110,000 t), confirms the net loss of high energy feedstuffs available to other industry sectors of 270,000 t per 160 ML plant per year. This is the best case scenario as it assumes that these industries will be able to fully capture and utilise the wet distillers grains and dried distillers grains produced.

From this, it is clear that the ethanol industry's demand for grains will impact the intensive livestock industries. Grain shortages that are currently experienced in areas such as south-east Queensland will become more frequent and of larger scale if the development of proposed ethanol plants proceeds. This will result in higher costs for the feedlot industry, as competition for the available grain increases, and will have a flow-on effect to the entire Australian beef industry.

11.1.5 Ethanol production will raise the cost of production for all grain users

Corn users in the USA have been exposed to recent significant increases in the price of corn. While there has been considerable conjecture about whether this increase is driven by domestic or export factors, it matters little, as the reality is that the establishment of ethanol production capacity has created an additional demand for corn. This increased demand for grain will result in the establishment of a new higher baseline for grain prices, which also factors in the subsidy available to ethanol producers. Again, this is currently happening in the USA where corn prices are being driven towards a level that equates to the breakeven position for corn as an input to ethanol production.

This effect will also be evidenced in Australia as the ethanol production sector grows and it will impact the cost of production through higher feeding costs.

11.1.6 Import of maize from the USA is technically feasible

One of the positives to come out of the study tour is that the import of maize from the USA appears to be technically feasible. While there is still a lot of work to be completed and a lot of hurdles, both technical and political, to be overcome; there is some reason for optimism that a workable protocol for maize importation may be available within a five year timeframe.

GIPSA through the Federal Grain Inspection Service (FGIS) has responsibility for pre-shipment inspection and certification of grain shipments. The companies visited have protocols in place to address the identity preservation and certification requirements necessary for the export of maize. These are regularly monitored by the FGIS.

The development of an import protocol incorporating the sourcing of maize from areas that are low risk from a pathogen contamination perspective and identity preservation of this grain through the entire supply chain is achievable. This, combined with an effective devitalisation process will, in our view, reduce the risk of pathogen transfer to an acceptable level.

Areas of minimal risk from a disease perspective are readily identifiable and Biosecurity Australia has recently approved the sourcing of sorghum and maize from selected states in the USA, subject to current quarantine conditions, including processing at AQIS-approved facilities in metropolitan areas (Biosecurity Australia 2006).

The major issue to be addressed is that of overcoming any potential weed seed contamination of the original maize supply. Sourcing supplies of maize that are certified free of weed seeds is likely to be difficult. Generally, crop hygiene is very good and weeds are controlled. However, not all state departments of agriculture have reliable survey information on weed status and it is difficult to obtain the information needed to assess a particular region as being of low risk.

In addition, USDA have advised that they are not able to certify to the standard required by the current AQIS protocol, due to the large number of weed seeds that are included in the non-permitted category and their inability to determine whether particular areas and/or consignments are free of these weeds.

Given these constraints, and the fact that the grain devitalisation technology being developed does not give complete control of all weed seeds likely to be contaminants of any maize shipment, one potential solution to this issue is to develop an import protocol that permits the removal of potential weed seed contaminants utilising grain cleaning/screening methods. This is considered to be an option worth pursuing. The majority of grain handling and storage facilities visited during the study tour did have grain cleaning equipment. However, in some situations it is not installed in the correct part of the supply chain to allow for efficient operation and is often only used on an as-required basis to ensure the shipment meets the grade specifications ordered. While the grain cleaning process can be performed on complete shipments, this reduces throughput and increases cost.

Implementation of a grain cleaning step in the import protocol would require the development of depot specific relationships. Further work is required to be able to identify areas of low risk from a weed seed contamination perspective and develop a cleaning protocol that would be acceptable to AQIS and Biosecurity Australia. While technically feasible, it will not be either a quick or simple process to achieve acceptance of any developed protocol. It will take some time to collect the information necessary to demonstrate to Biosecurity Australia that a protocol can be developed that reduces the risk of weed seed transfer to an acceptable level. Subsequent to this, there will undoubtedly be a need to address the industry politics that surround the whole imported grain issue.

11.1.7 Shipments through the ports in the Gulf of Mexico are a viable option

From observations made during the tour, it was also clear that identity preservation protocols and maintaining a high standard of hygiene and cleanliness at all facilities, which are essential components of any developed protocol, are now standard operating practice for the majority of supply chain participants in the USA.

This is contrary to the views expressed by Heinrich as a result of his investigation of the maize supply chain during a previous MLA project in 1997 (FLOT.104 – Corn sourcing evaluation report for the Australian feedlot industry). Heinrich had concerns about the ability of the supply chain to guarantee identity preservation, was critical of general facility hygiene and cleanliness, and deemed the use of barges to be non-viable as they were unable to be properly cleaned.

Barges are now considered to be relatively easy to clean and are preferred over rail wagons as a means of transporting identity preserved shipments of grain and other products. Cleaning has been facilitated by the use of special gantries that are capable of removing the entire cover in one piece, enabling easy access for unloading equipment and thorough cleaning of all ledges to be easily undertaken.

Many of the older type elevator and storage systems are difficult to clean, and some companies have looked to find alternative methods of handling product without the need to go through these systems. ADM, for example, use a floating elevator leg to unload barges direct to vessel. This removes the potential for cross-contamination through the elevator and storage systems at port.

Practices and procedures have obviously improved and shipments through ports in the Gulf of Mexico are now considered a viable option. Acceptance of this position by AQIS and Biosecurity Australia will increase the range of supply chain options available for the potential import of both grain and ethanol byproducts.

11.1.8 Potential for importation of dried distillers grains worth pursuing

Investigation of the potential for importation of dried distillers grains is considered worthwhile. While it is unlikely that dried distillers grains imports will be economic on an ongoing basis, they may be viable under conditions of drought and associated high grain costs, particularly if lower freight rates can be achieved by utilising containers that need to be returned to south-east Asia. An additional benefit is that the Australian industry would obtain experience in feeding these products prior to them potentially becoming available through domestic ethanol production. If appropriate, funding could be sought through the US Grains Council to assist with initial shipments and feeding trials.

11.2 Recommendations

The following recommendations are made as a means of addressing the issues and capturing the benefits from the opportunities identified during the study tour:

Recommendation 1:

The Australian beef industry should draw on the knowledge and experience of the industry in the USA to assist in the debate on subsidised ethanol production.

The beef industry in the USA is currently trying to adapt to the reality of life with a subsidised ethanol production industry. As they make the structural and operational changes necessary to best position themselves into the future, the experiences of their processor, cattle feeding and cow-calf sectors highlight all the issues that have previously been raised in the debate here. The Australian beef industry can learn from these experiences, which strongly support the case opposing subsidised ethanol production.

Recommendation 2:

The lotfeeding sector, through the MLA Feedlot R&D Program, further investigate the option of incorporating a grain cleaning process in the maize import protocol to address the risk associated with weed seed contamination of bulk maize imports from the USA.

Given the lack of reliable information on areas assessed as being of low risk from a weed seed perspective, the inability of the USDA to provide the certification required by AQIS and the fact that the grain devitalisation technology currently being developed does not give complete control of all weed seeds likely to be contaminants of any imported maize shipment, a new approach is required to address the weed seed contamination problem.

One potential solution to this issue is to develop an import protocol that permits the removal of potential weed seed contaminants utilising grain cleaning/screening methods. To assist in evaluating the likely effectiveness of this process, and as a basis for the development of a protocol proposal for submission to Biosecurity Australia, the following information should be collected, collated and assessed:

- An updated list of the weed seeds associated with the import of bulk maize from the USA that Biosecurity Australia ranks as of quarantine concern to Australia. Biosecurity Australia is currently reviewing this list and it should be finalised early in 2007.
- Survey data on the incidence of the weeds identified in this list throughout the major maize growing regions of the USA, which together with information on the season during which these weeds are actively growing, could be used to identify those weed seeds likely to be present in bulk maize supplies. This will require contact with, and the cooperation of, individual State Departments of Agriculture as the information is likely to have limited availability, and where available, is likely to be difficult to access.
- Data on the incidence and composition of weed seed contamination of bulk maize. Potential sources of this data, whether they are scientific papers, survey data or data collected at receival depots, need to be investigated and information collected where available.
- Data on the effectiveness of the various grain cleaning processes that are routinely employed in the maize supply chain. Potential sources of this data (scientific papers, cleaning equipment manufacturers, receival depots) need to be investigated and information collected where available.

Once this information has been collected and analysed, an assessment of the likely effectiveness of a grain cleaning/screening process can be made. If the outcome looks positive, a submission can be prepared for Biosecurity Australia to assess.

Recommendation 3:

AQIS and Biosecurity Australia should be advised that the conclusions drawn by Heinrich during his 1997 assessment of the maize supply chain, with respect to identity preservation protocols and the ability to clean barges, no longer apply and a re-evaluation of shipments through the ports in the Gulf of Mexico is warranted.

Contrary to the experience of Heinrich during his 1997 assessment, identity preservation protocols from source to destination and maintenance of a high standard of hygiene and cleanliness for all facilities and transport vehicles, including barges, are now standard operating practice for the majority of grain supply chain participants in the USA.

Practices and procedures have obviously improved and shipments through ports in the Gulf of Mexico are now considered a viable option. Acceptance of this position by AQIS and Biosecurity Australia will increase the range of supply chain options available for the potential import of both grain and ethanol byproducts.

Recommendation 4:

The potential for importation of dried distillers grains should be further investigated in conjunction with the other intensive livestock industries.

During the study tour, there was a view put forward by nearly all companies we visited that supply of the dried distillers grains was likely to outstrip the capacity of domestic users to use the product and new export markets would need to be cultivated for a portion of this additional production. While it is unlikely that dried distillers grains imports will be economic on an ongoing basis, they may be viable under conditions of drought with associated high grain costs, particularly if lower freight rates can be achieved by utilising containers that need to be returned to south-east Asia.

Areas that need further assessment include the availability and cost of both bulk and containerised product and clarification from AQIS and Biosecurity Australia that the drying methods currently employed for dried distillers grains in the USA meet the heat treatment requirements specified under the imported stockfeed protocols. ADM have knowledge of these requirements, having shipped 35,000 tonne of corn gluten feed to Australia in 2003, and their assistance should be sought in preparing the required information set for Biosecurity Australia to consider.

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13 Appendices

13.1 Appendix 1 – Study tour itinerary report

ITINERARY – USA Study Tour
Des Rinehart & Kevin Roberts
16 – 31 August 2006

<table>
<tr><th>Date</th><th colspan="2">Details</th></tr>
<tr><td>Wed 16 Aug
AUS</td><td>13.25 pm</td><td>Depart Sydney for Los Angeles</td></tr>
<tr><td>Wed 16 Aug
US</td><td>10.00 am</td><td>Arrive Los Angeles
Travel to North Platte, Nebraska
Met by Gary Holcomb, Nutrition Services</td></tr>
<tr><td rowspan="3">Thu 17 Aug
US</td><td colspan="2">Visited North Platte Feeders feedyard, 40,000 head. Owned by Dean McCaffery.

Observations:
Using condensed distillers liquid at 8%, as fed, in lieu of molasses as an energy source.
They are researching the use of wet distillers grains (WDGS) distance restriction versus cost as they are some sixty miles from the nearest ethanol plant.</td></tr>
<tr><td colspan="2">Visit to Cornhusker Energy LLC at Lexington, Nebraska ethanol plant. Owners Johnny Rohrborough and Tydd Rohrborough. Capacity 40,000,000 US gallons.

Observations:
Employs 33 people.
Has 1,000,000 head of cattle within fifty miles of the plant.
Produces 1,000 US tons per day of WDGS. The WDGS has a shelf life of three days. Moisture content is 65-70% when emptied from the truck, spreads out to a maximum height of one metre (requires a concreted, bunkered area for use at the feedyard. Vulnerable to wet weather if stored in the open). Indicated cost of the WDGS is US$25 to $28 per ton.
Antibiotics (Virginiamycin and Penicillin) used to decontaminate digesters when bacteria invade the digesters.
Sulphur identified as a potential cause of polioencephalomalacia (PEM).
Bloat was raised as a concern but not verified by the nutritionists.
Good laboratory facilities are required by ethanol plants for continuous inplant testing. End users would require written analysis of every load delivered to verify nutrient value and moisture content.</td></tr>
<tr><td colspan="2">Visit Roberts Feedyard, Nebraska – 11,000 capacity.

Observations:</td></tr>
</table>

	• WDGS at 55% as fed of ration, making the ration a 60-62% dry matter. • Due to dry matter and ultimately reduced performance, cattle required an extra 20-30 days feeding period to gain market specifications (if this was extrapolated to Australian conditions, with heavier cattle, feedyards would either need to be one-third larger or a reduced throughput of one-third on an annual basis). • Extra feed trucks required to deliver a higher moisture feed (less efficiency plus extra cost).
Fri 18 Aug US	Visit Hoxie Ethanol Plant, Kansas. Capacity 43,000,000 gallons. **Observations:** • Employed 33 people. • Some Distillers Dried Grain (DDG's) produced at a cost of US$65 per ton. • WGS distributed to feedyards within fifty miles at a delivered price of US$25-30 per ton. • Antibiotics (Virginiamycin and Penicillin) required to kill bacteria in batch tanks (these antibiotics are of concern to the animal feeding operations; Virginiamycin is not available for use in Australia).
	Visit Hoxie Feedlot, Kansas. Owner-Manager Scott Foote. 40,000 head capacity. **Observations:** • Nutritionist Todd Milton was at odds with the inclusion percentage to the previous day's feedlot and the owner-manager of Hoxie Feedlot. Hoxie Feedyard had an inclusion of 29% of WDG's. Todd's recommendation was a maximum 20% as fed inclusion. • Due to the fine grinding of the corn, fibre structure of the WDGS requires extra inclusion of effective fibre (straw and cotton hulls formed the basis of the roughage content). • The 10% fat in the WDGS impacted against the maximum inclusion affecting dry matter intakes (dry matter intakes effect animal performance and therefore time on feed and therefore affects market specification).
Sat 19 Aug US	Driving from Kansas to Amarillo, Texas.
Sun 20 Aug US	Flying Amarillo, Texas to Washington, DC.
Mon 21 Aug US	Visited with the US Grains Council – Kenneth Hobbie President and CEO, and Adel Usupov, Manager of International Operations and Ryan LeGrand, Manager of International Operations – DDGS. **Observations:** • US Grains Council want to maintain existing export markets of corn. • 10% of current DDG's which equals 1,000,000 metric tonnes is exported

	annually. • Production of DDG's for 2006 is expected to be 10,000,000 metric tonnes. • Substantial quantities of DDG's is being exported by containerisation (A glut of Chinese containers are being backloaded with DDG's returning to Asia at extremely low freight rates) - (investigations will need to be undertaken to determine if Australia could benefit from this anomaly). • US Grains Council demonstrated an eagerness to work with our industry to trial the use of DDG's. It is their belief as ethanol production increases, the placement of DDG's will cause market distortion.
	Visited Tom Erikson, Bunge. **Discussion:** • DDG's value versus corn. • Potential distortion of values because of quantity DDG's to be in the market place if 10 billion gallons per annum is achieved by the year 2010. This equates to 3 billion bushels of corn annually. • Investment in ethanol plants has reached abnormal investment strategies (when investment is called to develop a plant of US$100 million, it can be oversubscribed by five times).
Tue 22 Aug US	Visited the USDA (APHIS and GIPSA). In attendance – **Australia:** Kevin Roberts, Vice President, Australian Lot Feeders Association; Des Rinehart, Feedlot R&D Project Manager, Meat & Livestock, Australia; Michelle Gorman, Regional Manager – North America, Meat & Livestock Australia; Dean Merrilees, Minister-Counsellor of Agriculture, Australian Embassy, Washington; and Rob Williams, Veterinary Counsellor, Australian Embassy, Washington. **USDA:** Jim Link, Administrator Grain Inspection, Packers & Stockyards Administration; John B. Pitchford, Director of International Affairs, GIPSA; Edward C. Durgin, Office of International Affairs, GIPSA; Rebecca A. Riese, Field Management Division, GIPSA; Karen Ackerman, Trade Director for Europe/Africa/Australia/New Zealand/Middle East – Animal and Plant Health Inspection Service (APHIS), Plant Protection and Quarantine/Phytosanitary Issues Management; Thomas C. O'Connor, National Trade Director, Grains Programs,

<table>
<tr><td></td><td>APHIS/PPQ/PIM; and
Marcus McElvaine, Export Specialist, Australia APHIS/PPQ/PIM.

Points of Discussion:
Identity preservation programme.
Non-GMO IPP.
DDG's (Rob Williams AQIS explained protocol for heat treatment of stock feeds).
CSIRO project and its potential for importation of identity preserved grain from specific points from the United States.
The co-operation of USDA testing karnal bunt using EDN.</td></tr>
<tr><td rowspan="2"></td><td>Visited with Gary Webber, National Cattlemen's Beef Assn. Lobbyist.

Discussions:
Gary believed that the US Government would revisit the subsidy on ethanol within two to three years.
After ten years with National Cattlemen's Beef Association, he was leaving to take up a position as CEO with an ethanol based complex in a North-eastern state of USA. It would include a dairy feedlot, a beef feedlot, ethanol production and energy production completely integrated.
United States cattlemen/feedyard operators were still divided over the use and benefits of WDGS and DDG's.</td></tr>
<tr><td>Visit National Corn Growers Association. John Doggett, Vice-President, Public Policy (Lobbyist).

Discussions:
Very positive that the genetic improvements of 1.5% annually to take care of the ethanol demand for corn.
Reiterated the investment and the change in investment fundamentals regarding ethanol.</td></tr>
<tr><td rowspan="2">Wed 23 Aug
US</td><td>Visit with John Hixson, Cargill. Director Federal Government Relations (Lobbyist).

Discussions:
Difficulties of importing grain to Australia were well understood by Cargill.
Saw potential for bulk shipments of DDG's to Australia.
Reiterated quantities of DDG's to become available as ethanol production expands.</td></tr>
<tr><td>Depart Washington, D.C. to Minneapolis, Minnesota.</td></tr>
<tr><td>Thu 24 Aug
US</td><td>Visited with David Christofore, Cenex Harvest State Inc. They are a Farmers' Co-operative.

Discussions:</td></tr>
</table>

	• Cenex have a joint venture with US Bio-Energy for the production of ethanol. • Cenex have two fuel refineries (no new refineries have been built in recent years due to environmental impacts. Petrol is transferred around US by pipeline, cost effectively. Ethanol can only be transported by rail or road transport, increasing the cost against ethanol). • Iowa and Minnesota produce 75% of all ethanol currently produced in the United States. • There are some 79,000,000 acres of corn grown in 2006. • Due to GMO (Genetically Modified Organism) technology, there will be a shift in production from the standard 50% corn, 50% soy rotation to a 65% : 45% rotation to accommodate extra ethanol production from corn. • Wet Distillers Grains (WDG's) have been identified as a problem due to logistic challenges ie shelf life three to five days; high moisture – low density. • Reiterated containerisation of DDG's, cheap freight back to Asia. • Highlighted that within DDG's, there is a wide spectrum of value depending upon moisture and nutritive value. (Nutritive value changes according to inclusion of distiller's liquids, corn germ removal effecting fat concentration).
	Visited Cargill barge loading facility, Savage, Minneapolis. **Observations:** • 800,000 bushels of storage. • Daily intake possible 12,500 ton a day. • Barge loading 55,000 bushels an hour (barge 1500 metric tonnes capacity). • Not all grain cleaned prior to shipment. Grain delivered against market specifications. • Identity preservation of Non-GMO corn is common practice for export to Asian countries. Certification by USDA. (This is contrary to the Heinrich Report, 1996. It is due to an acceptance by the United States marketers to meet world demand) • Barges able to be cleaned by complete removal of hatches.
Fri 25 Aug US	Visited a Cargill elevator (FAIRMONT). Main purpose being loading of rail cars and identity preservation. **Observations:** • Trains of 100 wagons by 100 ton, loaded in twelve hours. • Grain out turned for the West coast shipments, screened into rail wagons. (For removal of weed seeds, husks etc). • Wagons can be sealed at the top and the bottom for identity preservation. • Wagons individually identified. • Rail wagons cleaned for shipment of Non-GMO products. • Identity preservations programmes are overseen by USDA.
	Visited Cargill elevator (MARNA). Main purpose being IPP and grain

	cleaning/wagon cleaning. **Observations:** • Grain cleaned into storage as required to remove insects and foreign material. • Highlights the need for depot specific and identity preservation for sourcing grain for importation into Australia.
Sat 26 Aug US	Driving Minneapolis, Milwaukee to Chicago, Minnesota.
Sun 27 Aug US	Driving Chicago to Decatur, Illinois.
Mon 28 Aug US	Visited Archer Daniels, Midlands. Lance Forster, Nutritionist with ADM. (ADM have nine ethanol plants). **Observations:** • ADM specialise in Non-GMO shipments to Asia and Europe. • Most of ADM's exports are via the Mississippi River through four facilities in New Orleans. • DDG's in preference to WDG's because their marketability has increased their export business to Asia and South America. • 90% of ADM's distiller's grain goes as DDG's (including solubles). • Drying of DDG's is achieved with 850 degrees Fahrenheit at entry with 200 degrees Fahrenheit at exit with an average treatment time of thirty minutes (Note: this would exceed the specifications under stockfeed protocols set down by AQIS and Bio-Security, Australia). • ADM have knowledge of Australia's protocols under IPP (35,000 ton of corn gluten feed to Australia in 2003, soybean meal to Australia). • Acceptance of cleaning procedures for rail cars, barges and handling equipment. (ADM have written protocols for Non-GMO grains and products audited by USDA). (September, October, November not ideal months for shipment from US due to harvest pressure). • DDG's being pelletised so as to increase the density weight. • A quick test for GMO products available.
	Drove from Decatur, Illinois to St. Louis, Missouri. With Lance Forster, flew from St. Louis, Missouri to New Orleans, Louisiana.
Tues 29 Aug US	Visit to ADM Barge Loading Facility – one of four facilities at New Orleans. **Observations:** • IPP audited and checked by FGIS. • Complete cover removal from barges, front loading, makes cleaning easy. • Unloading of barges direct to vessel by floating unloading equipment

	alleviates potential contamination through elevators etc. • Screening of grains capable of removing weed seeds and foreign material. • ADM barge loading facilities handle 27,000,000 metric tonnes annually. **NOTE:** Identity Preserved Shipments, rail wagon, barges and equipment able to be thoroughly cleaned as a matter of customer requirements.
	Flew from New Orleans, Louisiana to Seattle, Washington State.
Wed 30 Aug US	Visit to Port of Grays Harbour, a bulk handling facility, specialising in transferring product from rail wagons to ocean vessels. Owned by Ag Processing Inc. (AGP). Talked with Chris Schaffer, Director of Speciality Products. **Discussions:** • Identity Preserved Shipments of soyabean meal, DDG's and corn gluten feed. • Can load 45,000 ton vessels at 1100 tons an hour. A continuous unloading process (450 rail cars). • The cleanest grain handling complex we've ever visited (complete clean down between every shipment, checked by an independent marine surveyor, licensed by USDA). • Identity Preserved wagons, computer identified. • Whole corn could be shipped from this facility under IPP. **NOTE:** Identity Preservation was taken as a given requirement to meet customer specifications (cleaning of wagons, vessels and facilities inspected by independent marine surveyors, licensed by USDA).
	Flew from Seattle, Washington State to Los Angeles, California. Flew from Los Angeles to Sydney, Australia.
Fri 1 Sept AUS	Arrive Sydney and transfer to Brisbane

13.2 Appendix 2 – Ethanol byproducts evaluation report (G Holcomb)

Nutrition Service Associates

August 28, 2006

Des Rinehart
Meat and Livestock Australia

Dear Sir:

In reference to conversations concerning use of distillers grains in the feedlot industry, the following is respectfully submitted. After review of limited amount of data, coupled with many years of feeding distillers grains, the following comments are respectfully submitted.

Enclosures:
1. Graph. My interpretation of use of distillers grains graphed by value of sorghum distillers grains to flaked/reconstituted sorghum and the percent of finishing diet dry matter. Each value has an alphabetic label that will highlight my comments concerning the corresponding inclusion level.
2. Sample Queensland rations with flaked or reconstituted sorghum presented on an as fed basis.
3. Sample Queensland rations with flaked or reconstituted sorghum presented on a dry matter basis.

General Overview. Distillers grains is a high protein, high fat, non-starch by-product from the ethanol industry. Generally, distillers grains is 100 minus the starch plus added products used in manufacturing. Use of distillers grains nutrients are currently fed in most finishing feedlots worldwide (1/3 of all grain). Due to the cost of forages and extremely small particle size, distillers grains will not replace effective fiber levels.

Level of Distillers grains, enclosure 1.

Levels A through C. Meet diet protein requirements. Replaced ingredients include protein meals and cottonseed. Efficacious use of distillers grains as cost per unit of protein is advantageous. Value based on cost of natural protein. Average daily gain, conversion, and intake are optimized and may actually improve. Protein becomes non-limiting.

Levels D through E. Meet protein requirements plus reduction of starch in the diet. Performance is maintained as protein is converted to energy and small particle NDF supports optimum rumen function. Expect performance (gain, conversion and carcass quality) to be equal to current programs. Value is equal to grain.

Levels F through H. Dilution of diet starch levels resulting in higher conversions, reduced average daily gains and extended days to meet carcass specifications. Use of distillers at these inclusion levels will depend on cost of production. For example, if distillers grains is priced at a discount to grain (my example- 35 percent DM inclusion needs to be 80 percent of grain cost), cost of gains may actually be lower given a poorer conversion.

Levels above H. Restricted diet inclusion levels due to high protein (environment and animal performance), sulfates (animal health), phosphorous (environment) and moisture (animal performance). Assuming a producer is willing to accept these challenges, the cost of distillers in the diet must be well below 50 percent of grain price. I am not prepared to address use at these levels without clear acceptance of these challenges coupled with dramatic reduction in cost of production.

Sample As Fed Ration, enclosure 2.

It is important to realize that your on-site nutritionists are better prepared to design diets with distillers grains in Australia, however these rations will provide for general comments based on enclosure 1.

As previously stated, the fiber in distillers grains will not meet the ruminants requirement for effective NDF and will not replace current roughage levels unless they are dramatically higher than enclosed rations.

Fixed ingredients in these rations include roughage and percent supplement (will need modification with inclusion of distillers grains). Within each set of rations for flaked and reconstituted sorghum is a low and high inclusion of distillers grains. Low level highlights use at levels A through E (enclosure 1) while the high level represents use at levels D through F (enclosure 1). Input price for the distillers grains is equal to sorghum (equivalent dry matter) and is cost effective in low level rations. Cost per ton actually increases when inclusion level is increased to my high level. Although your nutritionists will provide you will a feedyard value, looks like it will need to be at least 20 percent below grain price to be efficacious. Our least cost programs use complicated linear math equations to calculate break even or trading dollar use. It is important that changes in our diets result in economic benefit for the feeder as well as animal owner.

Cottonseed at $255 compared to sorghum at $210 is good value and will fit in these diets. Although I restricted use of cottonseed in these rations, distillers grains would not be drawn into these rations to meet diet protein requirements (levels A through C enclosure 1). Value of cottonseed at 20 percent premium to sorghum is much greater value than distillers at grain price. Use of cottonseed in your rations will result in my levels A through H being shifted down by at least 20 points.

Fat price will also determine level of distillers grains in your diets. For example, if fat becomes a better buy (well less than 3X grain price), our programs will include more fat which will allow higher use of distillers grains. Depending upon your nutritionist, levels may approach maximum diet concentration for optimum rumen function and diet management.

Finishing diet dry matters that approach 55 percent may limit intake and subject the animal to performance variation. Although I will not formulate diets with dry matters below this value each nutritionist will design based on personal experience. Other feedyard issues (feed manufacturing, bunk management, etc.) must also be addressed due to the sheer amount of water.

Sample Dry Matter Ration, enclosure 3.

Enclosure 3 contains diet dry matter percentage for as fed rations presented in enclosure 2.

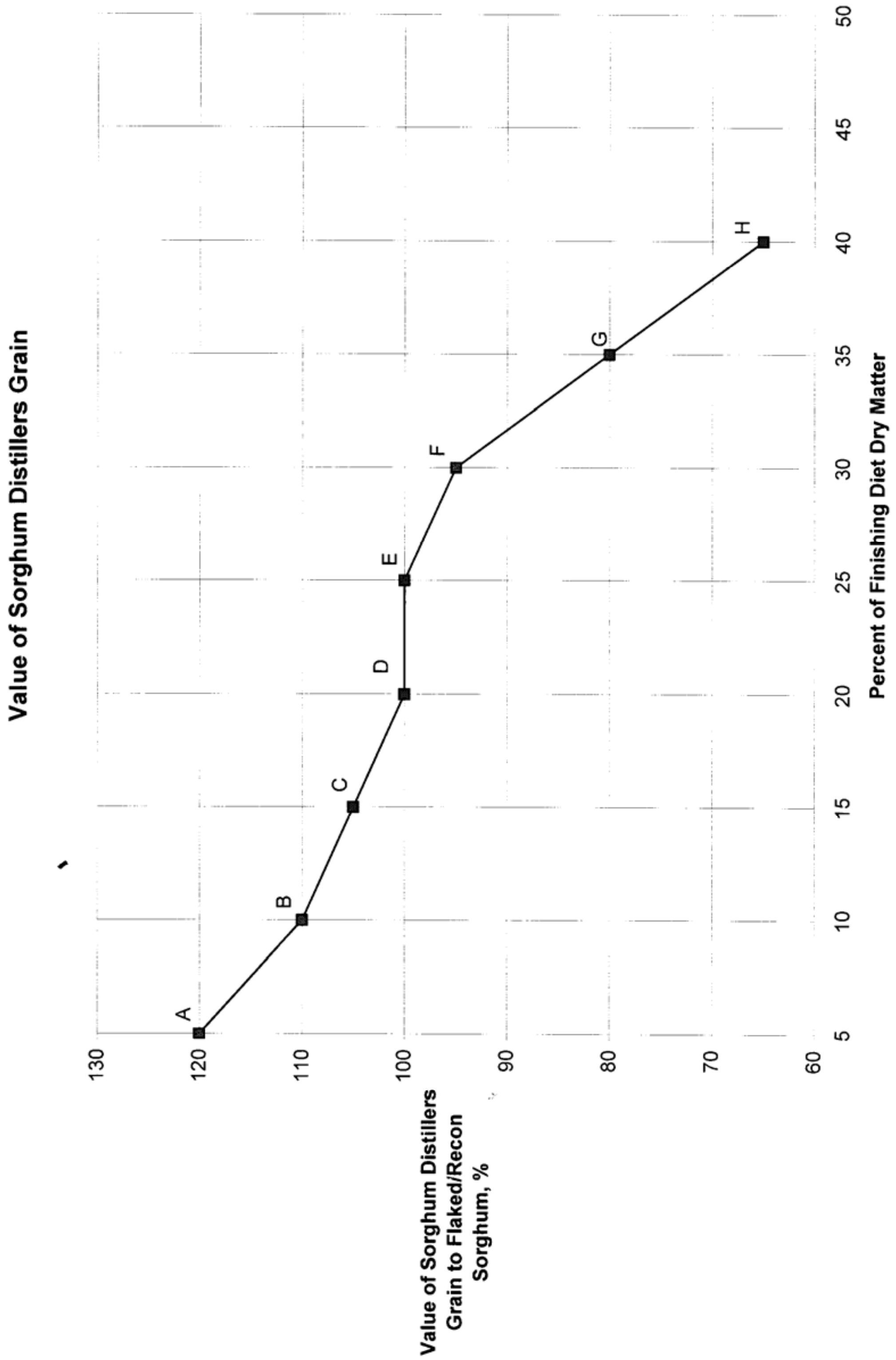
Although science, and practice, has demonstrated that distillers grains (wet or dry) can be a viable ingredient in beef production it is imperative that each operation clearly define use and value.

Hope this information helps. Please do not hesitate to contact my office with questions or comments.

Sincerely,

Gary Holcomb, M. Sc., P.A.S.
Nutrition Service Associates

Enclosure 1


Value of Sorghum Distillers Grain
Value of Sorghum Distillers Grain to Flaked/Recon Sorghum, %
130
120
110
100
90
80
70
60
5
10
15
20
25
30
35
40
45
50
Percent of Finishing Diet Dry Matter
A
B
C
D
E
F
G
H

Enclosure 2

Nutrition Service Associates
August 28, 2006
AUST DG EXAMPLE

PERCENT AS FED

ID	INGREDIENT	DM	CST/TON	RECON LOW	RECON HIGH	SF LOW	SF HIGH
112	SORG, RECON	71.00	172.36	61.05	41.62		
113	SORG, SF	80.00	210.00			58.28	36.72
40	CSILAGE	33.00	62.00	5.00	5.00	5.00	5.00
59	FAT-VEG	99.80	650.00	1.60	1.88	1.47	1.83
48	COTTONSEED HULLS	90.80	160.00	2.00	2.00	2.00	2.00
155	MIN-FY-CALC	94.87	260.00	4.75	4.75	4.75	4.75
111	SORG, DG	35.00	84.97	25.60	44.75	28.50	49.70
	TOTAL			100.00	100.00	100.00	100.00
	COST/TON-FEED			156.03	140.63	174.81	149.89
	DM CST/TON			252.17	255.41	264.71	264.96
	DRY MATTER, %			61.87	55.06	66.04	56.57
	C. PROTEIN, %			15.71	18.93	15.82	19.44
	NPN, %			1.66	1.87	1.56	1.82
	FAT, %			6.41	8.09	6.11	8.06
	NEM,MCAL/CWT			94.94	95.36	94.83	95.29
	NEG,MCAL/CWT			62.51	62.82	62.42	62.77
	NEL,MCAL/CWT			79.55	80.46	87.21	86.18
	C.FIBER, %			6.13	7.82	6.07	8.00
	ADF, %			9.88	11.93	9.84	12.18
	NDF, %			19.04	24.58	19.31	25.52
	ROUGHAGE, %			5.60	6.29	5.25	6.13
	CAB, MEQ			1.64	-1.53	-0.34	-3.40
	STARCH, %			53.65	45.18	54.05	44.37
	NEM,MCAL/KG			209.35	210.26	209.10	210.11
	NEG,MCAL/KG			137.83	138.52	137.64	138.41
	RUMENSIN,G/T						

nsa-gbh

Enclosure 3

AUST DG EXAMPLE
DRY MATTER PERCENT
August 28, 2006

		DM PERCENT			
		RECON	RECON	SF	SF
INGREDIENT	DM	LOW	HIGH	LOW	HIGH
SORG, RECON	71.00	70.01	53.63	0.00	0.00
SORG, SF	80.00	0.00	0.00	70.56	51.89
CSILAGE	33.00	2.66	2.99	2.50	2.91
FAT-VEG	99.80	2.58	3.40	2.22	3.23
COTTONSEED HULLS	90.80	2.93	3.30	2.75	3.21
MIN-FY-CALC	95.76	7.35	8.25	6.88	8.03
SORG, DG	35.00	14.47	28.42	15.10	30.73
TOTAL		100.00	100.00	100.00	100.00

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