Summary Input to Impact tracker

Name of proposed CRC	Cooperative Research Centre for Beef Genetic Technologies

CRC application number	

Brief description of proposed CRC	The Beef CRC is targeting an additional 1.5% p.a. increase in gross revenue of the Australian beef industry by using new genomic technologies to improve the profitability and productivity of beef businesses whilst also improving animal welfare and the environment.

Key Inputs	>	Key Activities	>	Key Outputs	>	Key Usages	>	Key Impacts
i.e. cash and in-kind resources for each research program		*e.g. Brief description of key activities for each research program*		*e.g. Key outputs intended from each research program*		*e.g. Identification of key intended users of outputs for each program and mechanisms by which use will occur*		*e.g. Identification and, where possible, approximate valuation of impacts from usage of outputs from each program*
Research Program 1 **High Quality Beef for Global**		**Research Program 1** **High Quality Beef for Global**		**Research Program 1** **High Quality Beef for Global**		**Research Program 1** **High Quality Beef for Global**		**Research Program 1** **High Quality Beef for Global**
$29,363,000 nominal $24,511,533 NPV		Design, execute and analyse experiments aimed at increased biological understanding of aspects of beef quality such as tenderness, retail yield, muscling and marbling, or of the mechanisms by which genes associated with these traits may be expressed or inhibited through environmental interventions. Develop, validate and field test accurate and commercially useful models and tools that will enable an increased rate of compliance with market specifications with associated improvements in profitability. Work in partnership with a number of value chains to create value by analysis of existing slaughter and production data and to test and verify the phenotypic prediction models in commercial situations.		A set of genetic parameters for meat tenderness, retail yield and marbling markers and their association with related measures such as shearforce, MQ4 score, flight time and meat colour. Different versions of the Beef Specs model, which predicts growth traits of cattle during finishing and carcase traits at slaughter to enable a 20% increased rate of compliance with market specifications with associated improvements in profitability. An enhanced palatability prediction model that underpins the Meat Standards Australia beef grading system and an enhanced information package that suggests ways to improve palatability scores against the cost of achieving compliance.		Genetic parameters for meat tenderness, retail yield and marbling markers and their association with related measures such as shearforce, MQ4 score, flight time and meat colour have been delivered directly to BREEDPLAN for use in calculating more reliable Estimated Breeding Values for these traits. Commercial producers purchase breeding stock from the seedstock sector on the basis of EBVs. The growth path prediction models are being used directly by commercial beef producers and feedlotters. The simple tools are freely on the web, the more complicated tools are being delivered through consultants. Updated palatability prediction models have been incorporated into the MSA model.		Genetic improvement in the cattle industry via traditional selection is a long, slow process. The impacts from R&D which delivers more accurate EBVs does not show in the commercial herd until at least 5 years after release. Thus only 4 years of benefits, with an **expected NPV of $16.2m** can be counted in the Impact Tool. The various versions of the BeefSpecs decision support tool will save substantial costs of non-compliance by commercial producers. Total **expected NPV is $74.8m**. The value of MSA is the increased willingness to pay by Australian consumers for tender beef. The contribution of the Beef CRC is assumed to be 5% of the ongoing benefits from year 1 to year 4 , then a 50% share of the increased benefits from year 5 onwards. **Expected NPV is $15.8m**.

Key Inputs	>	Key Activities	>	Key Outputs	>	Key Usages	>	Key Impacts
i.e. cash and in-kind resources for each research program		*e.g. Brief description of key activities for each research program*		*e.g. Key outputs intended from each research program*		*e.g. Identification of key intended users of outputs for each program and mechanisms by which use will occur*		*e.g. Identification and, where possible, approximate valuation of impacts from usage of outputs from each program*
Research Program 2 Feed Efficiency, Maternal		**Research Program 2 Feed Efficiency, Maternal**		**Research Program 2 Feed Efficiency, Maternal**		**Research Program 2 Feed Efficiency, Maternal**		**Research Program 2 Feed Efficiency, Maternal**
$32,163,000 nominal $26,661,751 NPV		Design, execute and analyse experiments aimed at increased biological understanding of the determinants of improved feed efficiency, of how feed efficiency is related to various aspects of beef quality and animal growth, and of the mechanisms by which genes associated with efficiency traits may be expressed or inhibited through environmental interventions. Design, execute and analyse experiments aimed at increased understanding of the relationships between selection for feed efficiency and end-product traits such as retail yield and fatness and breeder herd productivity. Develop strategies to increase dietary energy captured and reduce methane generated.		A set of genetic parameters for feed efficiency and reproductive traits in first and second calf heifers in Southern Australian herds and their association with measures of body composition and other economically important traits. A model of maternal productivity in Southern Australian herds. A set of microbial and bioactive candidates with the potential to deliver a commercial product to reduce methane emissions from Australian beef herds. Practical on-farm management strategies to reduce methane emissions from cattle.		Genetic parameters for feed efficiency and relationships with meat quality and growth have been delivered directly to BREEDPLAN for use in calculating more reliable Estimated Breeding Values. Commercial producers purchase breeding stock from the seedstock sector on the basis of EBVs. The maternal model would be used by managers of large breeding herds in Southern Australia. It will initially be validated and tested in cooperating large herds, but adoption should be high amongst seedstock breeders and large commercial herds. There are some promising early results in relation to the set of microbial and bioactive candidates but considerable further R&D is required. This information would be licensed to commercial animal health companies.		In Southern Australia weaning rates are already high and other parameters influence on farm profitability. A 2% increase in reproductive rate in the South is worth about $10/cow. Assume that half of this is attributable to more reliable EBVs for feed efficiency, meat quality and growth traits already delivered to BREEDPLAN. These impacts are counted in Impact 1.01. The other half is attributable to improved maternal management. **Expected NPV is $14.1m**. No economic benefits are estimated for the possible development of an additive to reduce methane emissions from Australian beef herds. But there is an **expected NPV of $4.8m** from savings in methane emissions due to breeding more feed efficient cattle.

Key Inputs	>	Key Activities	>	Key Outputs	>	Key Usages	>	Key Impacts
i.e. cash and in-kind resources for each research program		*e.g. Brief description of key activities for each research program*		*e.g. Key outputs intended from each research program*		*e.g. Identification of key intended users of outputs for each program and mechanisms by which use will occur*		*e.g. Identification and, where possible, approximate valuation of impacts from usage of outputs from each program*
Research Program 3 **Adaptation and Cattle Welfare**		**Research Program 3** **Adaptation and Cattle Welfare**		**Research Program 3** **Adaptation and Cattle Welfare**		**Research Program 3** **Adaptation and Cattle Welfare**		**Research Program 3** **Adaptation and Cattle Welfare**
$17,592,000 nominal $14,463,697 NPV		Design, execute and analyse experiments to better understand the host mechanisms associated with cattle tick resistance and susceptibility in divergent breeds of cattle; screening available tick gene sequences to identify immunogenic vaccine candidates; and conducting "proof of concept" cattle trials of the most promising candidates. Design, execute and analyse experiments to better understand the mechanisms by which genes associated with stress responses may be expressed or inhibited through environmental interventions and to assess whether there is any additional value in using gene expression to the traditional measures of animal welfare. Develop genetic marker tests for the polled gene in tropical cattle.		One is a test for acaracide resistance to identify ticks that are resistant to the synthetic pyrethroids used to control them. The other is a set of vaccine candidates with the potential to deliver a commercial product to control cattle ticks in Northern Australian beef herds. A set of objective measures of cattle welfare that have contributed to national animal welfare guidelines. A DNA marker test to differentiate polled animals (bulls or cows to be used for breeding) that carry one (heterozygous) or two (homozygous) copies of the favourable polled marker, in particular breeds of cattle. Homozygous polled bulls are expected to produce 100% polled calves when joined to horned, scurred or polled females.		A close-to-market cattle tick vaccine candidate antigens that provides 90% efficacy and 12 month duration of immunity in animal trials will be delivered to a commercial company who will be licenced to further develop the product for eventual market release as a single dose tick vaccine. The objective measures of cattle welfare have been included in the draft National Animal Welfare Guidelines. A DNA marker test for homozygous polled horn genes in particular breeds of cattle has been licenced to commercial genetics service providers to provide a polled gene test for Brahmans.		Cattle producers in tick prone regions internationally will be able to use a vaccine to reduce economic losses due to cattle ticks. The impact measured here is the royalty stream that the commercial company pays to the CRC based on a proportion of its wholesale sales revenue. **Expected NPV is $1.3m**. Use of the new animal welfare guidlines to better market Australian beef in high value export markets**. Expected NPV is $79.6m**. Use of better management practices around dehorning procedures on 600,000 calves pa. **Expected NPV is $2.1m.** Use of the poll gene marker test on 10,000 bulls five years after industry release would reduce the number of horned calves by some 300,000, saving $560,000 per year. **Expected NPV is $2.2m**.

Key Inputs	>	Key Activities	>	Key Outputs	>	Key Usages	>	Key Impacts
i.e. cash and in-kind resources for each research program		*e.g. Brief description of key activities for each research program*		*e.g. Key outputs intended from each research program*		*e.g. Identification of key intended users of outputs for each program and mechanisms by which use will occur*		*e.g. Identification and, where possible, approximate valuation of impacts from usage of outputs from each program*
Research Program 4 Female Reproductive		**Research Program 4 Female Reproductive**		**Research Program 4 Female Reproductive**		**Research Program 4 Female Reproductive**		**Research Program 4 Female Reproductive**
$26,946,000 nominal $22,610,292 NPV		Design, execute and analyse experiments aimed at increased biological understanding of the genes and gene networks associated with female reproduction, or of the mechanisms by which genes associated with lactating cows resuming reproductive activity may be expressed or inhibited through environmental interventions. Design, execute and analyse experiments aimed at identifying pre- or post-pubertal male traits that are early-life predictors of the males own fertility and the reproductive performance of the bull's progeny. Design, execute and analyse experiments aimed at identifying female traits that are early life predictors of lifetime reproductive performance of females in Northern Australian herds.		A set of genetic parameters for new male reproductive traits in Northern Australian herds. A set of genetic parameters for female reproductive traits in Northern Australian herds and their association with commercial steer (growth, feed efficiency, carcass and beef quality) traits.		The genetic parameters for new male reproductive traits in Northern Australian herds, and those for female reproductive traits in Northern Australian herds, and their association with steer traits, have been delivered directly to BREEDPLAN.		The financial impacts of more reliable EBV estimates from traditional selection for the various meat quality, growth, feed efficiency, carcase and beef quality traits are accounted for in Impact 1.01, while those from the genomic prediction equations are valued in Impact 7.01. The new post-partum reconception and age of puberty markers from Output 7.03 are not typically part of $ index valuations so they are valued differently. Use of these markers in association with Output 4.01 and Output 4.02 would lead to a 5% increase in pregnancy rate, except in herds where pregnancy rates are already high. The expected increase in average gross margins per cow AE was $7 in herds with weaning rates less than 70% , after 10 years. **Expected NPV is $20.3m.**

Key Inputs	>	Key Activities	>	Key Outputs	>	Key Usages	>	Key Impacts
i.e. cash and in-kind resources for each research program		*e.g. Brief description of key activities for each research program*		*e.g. Key outputs intended from each research program*		*e.g. Identification of key intended users of outputs for each program and mechanisms by which use will occur*		*e.g. Identification and, where possible, approximate valuation of impacts from usage of outputs from each program*
Research Program 5 Education and Training		**Research Program 5 Education and Training**		**Research Program 5 Education and Training**		**Research Program 5 Education and Training**		**Research Program 5 Education and Training**
$11,902,000 nominal $9,782,465 NPV		Produce a more skilled beef industry worksforce through postgraduate, undergraduate and vocational training in the sciences underpinning beef genetic improvement and effective innovation, commercialisation and adoption of outputs to generate beef industry outcomes. Produce a set of information packages about new research results, tools and technologies that facilitate implementation and make beef businesses aware of these packages, tools and technologies that lead to positive impacts on productivity and profitability in beef businesses. Design, execute and analyse a pilot of an accelerated adoption process to speed up implementation of new research results, tools and technologies by industry.		Provision of postgraduate training to produce a network of professionals with advanced training in the sciences underpinning beef genetic improvement and effective innovation, commercialisation and adoption of outputs. Information packages of new results, tools and technologies to achieve a balance between cow and foetal nutrition status and compliance with market specifications, about the best combination of cattle genetics and management inputs to achieve compliance with market specifications and to increase reproduction rates in Northern and Southern Australian herds. A network of Beef Profit Partnerships. Accredited sets of training materials and resources for courses to deliver these information packages.		The information packages of new results, tools and technologies are being delivered by extension agencies to seedstock producers and commercial cattle producers throughout Australia. They will use this information to make better breeding and management decisions leading to positive impacts on productivity and profitability in beef businesses.		No financial impacts for the more highly skilled beef industry R&D community have been estimated. The use of new genetic and management tools by seedstock and commercial cattle producers to make better breeding and management decisions has an **expected NPV of $46.2m**. Benefits from the BPP network are measured as differences in annual average changes in farm profit between BPP members and the wider beef industry in each State, times the number of cattle managed by each BPP. Newer BPP groups are assumed to generate half the benefits of existing groups. Spillovers are assumed to impact 5% of the cattle population in each state after 5 years, at half the benefit levels of existing groups. **Expected NPV is $63.5m**.

Key Inputs	>	Key Activities	>	Key Outputs	>	Key Usages	>	Key Impacts
i.e. cash and in-kind resources for each research program		*e.g. Brief description of key activities for each research program*		*e.g. Key outputs intended from each research program*		*e.g. Identification of key intended users of outputs for each program and mechanisms by which use will occur*		*e.g. Identification and, where possible, approximate valuation of impacts from usage of outputs from each program*
Research Program 6 Administration,		**Research Program 6 Administration,**		**Research Program 6 Administration,**		**Research Program 6 Administration,**		**Research Program 6 Administration,**
$17,128,000 nominal $14,089,697 NPV Includes IP commercialisation activities, all of the CRCs communications activities as well as activities involving managing and operayting facilities such as the Tullimba feedlot near Armidale.		Efficiently and effectively administer the resources at the disposal of the CRC to achieve the stated objectives. Establish an identified brand for the CRC, a set of strong internal and external networks through which the CRC can disseminate its messages, and a framework to deliver key messages to improve the productivity and profitability of the Australian beef industry and its stakeholders. Establish processes for the identification, protection and management of intellectual property generated by the CRC and its partners where necessary. Establish a framework or "path to adoption" for the commercialisation of new research results, tools and technologies.		The aggregate output is the efficient and effective administration of the resources at the disposal of the CRC; an identified brand for the CRC; a set of strong internal and external networks through which the CRC disseminates its messages; a framework to deliver key messages to stakeholders; processes to identify, protect and manage intellectual property generated by the CRC; and a framework or "path to adoption" for the commercialisation of new research results, tools and technologies.		The outputs from Program 6 are all for internal CRC use or for use by partner organisations. They facilitate usage of CRC products by others and contribute to the financial impacts achieved by those other users.		There are no financial impacts from Program 6 beyond those captured by usage of other CRC outputs.

Key Inputs	>	Key Activities	>	Key Outputs	>	Key Usages	>	Key Impacts
i.e. cash and in-kind resources for each research program		*e.g. Brief description of key activities for each research program*		*e.g. Key outputs intended from each research program*		*e.g. Identification of key intended users of outputs for each program and mechanisms by which use will occur*		*e.g. Identification and, where possible, approximate valuation of impacts from usage of outputs from each program*
Research Program 7 Underpinning Science		**Research Program 7 Underpinning Science**		**Research Program 7 Underpinning Science**		**Research Program 7 Underpinning Science**		**Research Program 7 Underpinning Science**
Resources for Program 7 are included in the budgets for Prorams 1-4.		Program 7 coordinated all gene discovery research activities across the CRC. The aim of the gene discovery research was to develop DNA based tests that predict the breeding values of cattle for economically important traits. Program 7 also provided services to support the R&D being conducted by other research programs, including maintaining the CRC's database of phenotypic animal records and the DNA collection, designing and analysing gene discovery and gene expression experiments, and coordinating bioinformatics support across all programs.		The output is a set of genomic prediction equations for various meat quality traits associated with Program 1, for growth, feed efficiency, carcase and beef quality traits associated with Program 2, for resistance to ticks and worms associated with Program 3 and for post-partum reconception and age of puberty associated with Program 4. The prediction equations account for at least 15% of the genetic variation for each of these economically important traits.		Genomic prediction equations for the various growth, feed efficiency, carcass and beef quality traits have been delivered directly to BREEDPLAN, in conjunction with other outputs from Programs 1 and 2. Genomic prediction equations for post-partum reconception and age of puberty have also been delivered directly to BREEDPLAN. The reseach on markers for resistance to ticks and worms was transferred to CSIRO under the terms of its CRC Supporting Participants' Agreement and results are being delivered to industry directly and exclusively by Pfizer Animal Genetics.		The financial impacts of more reliable EBV estimates for the various meat quality, growth, feed efficiency, carcase and beef quality traits, based on genomic prediction equations, are accounted for in Impact 7.01 as those traits are commonly part of the $ index valuations. **The expected NPV is $12.4m.** The financial impacts of genomic prediction equations for post-partum reconception and age of puberty are accounted for in Impact 4.02. No financial impacts were estimated for genomic prediction equations for resistance to ticks and worms as the CRC data provided background IP for CSIRO and Pfizer to deliver these results.

Inputs

Research Program 1 High Quality Beef for Global Consumers

Program resources

End FY 1	End FY 2	End FY 3	End FY 4	End FY 5	End FY 6	End FY 7	End FY 8	End FY 9	End FY 10	TOTAL	TOTAL NPV
$4,124,000	$4,679,000	$4,699,000	$4,813,000	$4,660,000	$3,659,000	$2,729,000	$0	$0	$0	$29,363,000	$24,511,533

Research Program 2 Feed Efficiency, Maternal Productivity and Responsible Resource Use

Program resources

End FY 1	End FY 2	End FY 3	End FY 4	End FY 5	End FY 6	End FY 7	End FY 8	End FY 9	End FY 10	TOTAL	TOTAL NPV
$4,404,000	$4,583,000	$4,797,000	$4,900,000	$5,114,000	$5,169,000	$3,196,000	$0	$0	$0	$32,163,000	$26,661,751

Research Program 3 Adaptation and Cattle Welfare

Program resources

End FY 1	End FY 2	End FY 3	End FY 4	End FY 5	End FY 6	End FY 7	End FY 8	End FY 9	End FY 10	TOTAL	TOTAL NPV
$1,623,000	$2,363,000	$3,312,000	$2,988,000	$2,522,000	$2,236,000	$2,548,000	$0	$0	$0	$17,592,000	$14,463,697

Research Program 4 Female Reproductive Performance

Program resources

End FY 1	End FY 2	End FY 3	End FY 4	End FY 5	End FY 6	End FY 7	End FY 8	End FY 9	End FY 10	TOTAL	TOTAL NPV
$4,160,000	$4,453,000	$4,810,000	$4,214,000	$3,682,000	$2,913,000	$2,714,000	$0	$0	$0	$26,946,000	$22,610,292

Research Program 5 Education and Training

Program resources

End FY 1	End FY 2	End FY 3	End FY 4	End FY 5	End FY 6	End FY 7	End FY 8	End FY 9	End FY 10	TOTAL	TOTAL NPV
$1,151,000	$1,575,000	$2,252,000	$1,957,500	$1,548,500	$1,674,500	$1,743,500	$0	$0	$0	$11,902,000	$9,782,465

Research Program 6 Administration, Commercialisation and Business Development

Program resources

End FY 1	End FY 2	End FY 3	End FY 4	End FY 5	End FY 6	End FY 7	End FY 8	End FY 9	End FY 10	TOTAL	TOTAL NPV
$2,184,000	$2,167,000	$2,522,000	$2,869,500	$2,244,500	$2,605,500	$2,535,500	$0	$0	$0	$17,128,000	$14,089,697

Research Program 7 Underpinning Science

Program resources

End FY 1	End FY 2	End FY 3	End FY 4	End FY 5	End FY 6	End FY 7	End FY 8	End FY 9	End FY 10	TOTAL	TOTAL NPV
$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0	$0

Total all program(s)

TOTAL	TOTAL NPV
$135,094,000	$112,119,435

Activities

Research Program 1 High Quality Beef for Global Consumers

Key activities:

The key activities undertaken in Program 1 related to three project areas.

Project 1.1 designed, executed and analysed experiments to complement the gene discovery activities related to meat quality now in Program 7. These experiments were aimed at increased biological understanding of aspects of beef quality such as tenderness, retail yield, muscling and marbling and the mechanisms by which genes associated with these traits are expressed or inhibited through environmental interventions.

Project 1.2 developed, validate dand field tested accurate and commercially useful models and tools to enable an increased rate of compliance with market specifications and associated improvements in profitability. These tools include *Beef Specs*, a model to predict growth traits of cattle during finishing and carcass traits at slaughter for groups of cattle; an on-farm drafting version allowing individual animals to be allocated to particular management groups based on individual predictions of fat depth; an optimisation model to predict production and economic parameters for the best operating procedures for beef finishing systems, in particular feedlots; and in conjunction with Program 2, a model to predict maternal productivity in cows in southern Australian herds.

Project 1.3 worked in partnership with a number of value chains in different environments to create value by : i) analyising slaughter and production dataa to test and verify the phenotypic prediction models in commercial situations and thus improve compliance to market specifications; and ii) to implement new research results and so improve the prediction of Meat Standards Australia palatability scores for the beef from those chains.

Research Program 2 Feed Efficiency, Maternal Productivity and Responsible Resource Use

Key activities:

The key activities undertaken in Program 2 related to three project areas.

Project 2.1 designed, executed and analysed experiments to complement the gene discovery activities related to feed efficiency now undertaken in Program 7. These experiments were aimed at increased biological understanding of the determinants of improved feed efficiency, of how feed efficiency was related to various aspects of beef quality and animal growth and of the mechanisms by which genes associated with efficiency traits are expressed or inhibited through environmental interventions.

Project 2.2 designed, executed and analysed experiments aimed at improved understanding of the relationships between feed efficiency and end-product traits such as retail yield and fatness, and cow breeder herd productivity. The experiments were undertaken in research and industry herds in different states across Southern Australia. Research results were used to develop and test a model to predict maternal productivity in cows in southern Australian herds, in conjunction with Program 1.

Project 2.3 developed strategies to increase dietary energy captured and reduce methane generated. Experiments were conducted to assess whether altering the ecology or the fermentation of rumen microbes could reduce methane emissions and improve feed efficiency in Australian cattle,and whether different types of rumen bacterial communities produced lower or higher amounts of methane. The project also evaluated the relationships between feed efficiency and on-farm productivity and methane emissions from cattle to develop on-farm management strategies to reduce methane emissions per kg of beef turned off.

Research Program 3 Adaptation and Cattle Welfare

Key activities:

The key activities undertaken in Program 3 related to three project areas.

Project 3.1 identified novel tick vaccine candidates to allow commercial development of a vaccine that controls cattle ticks. This involved a range of analyses and experiments to better understand the host mechanisms associated with tick resistance and susceptibility in divergent breeds of cattle; using the tick genome sequence to screen and identify immunogenic vaccine candidates; and conducting "proof of concept" cattle trials of she most promising candidates.

Project 3.2 designed, executed and analysed experiments to better understand the mechanisms by which genes associated with stress responses are expressed or inhibited through environmental interventions and to assess whether there is any additional value in using gene expression to the traditional objective measures of animal welfare such as stress hormones, blood composition and energy metabolites in blood.

Project 3.3 developed a DNA-based test for the polled gene in tropical cattle to allow beef producers to introduce the polled condition snd phase out the practice of dehorning. The project also investigated management options to reduce pain and suffering and improve welfare outcomes for calves being de-horned in the expectation it would take breeders several years to transition to a polled herd, during which time they would need to continue to dehorn using best-practice management strategies.

Research Program 4 Female Reproductive Performance

Key activities:

The key activities undertaken in Program 4 related to three project areas.

Project 4.1 designed, executed and analysed experiments to complement the gene discovery activities related to post-partum re-conception now undertaken in Program 7. These experiments were aimed at increased biological understanding of the genes and gene networks associated with female reproduction and of the mechanisms by which genes associated with lactating cows resuming reproductive activity are expressed or inhibited through environmental interventions.

Project 4.2 designed, executed and analysed experiments aimed at identifying pre- or post-pubertal male traits that are early life predictors of the males own fertility and the reproductive performance of the bull's progeny and so improve lifetime reproductive performance of females in Northern Australian herds.

Project 4.3 designed, executed and analysed experiments aimed at identifying female traits that are early life predictors of lifetime reproductive performance of females in Northern Australian herds.

Research Program 5 Education and Training

Key activities:

The key activities undertaken in Program 5 related to three project areas.
Project 5.1 delivered postgraduate, undergraduate and vocational training programs in the sciences underpinning beef genetic improvement and effective innovation, commercialisation and adoption of outputs to produce a more skilled beef industry worksforce. During the CRC's term, the undergraduate education and vocational training components were merged.
Project 5.2 delivered a set of resource materials about new research results, tools and technologies and made beef businesses aware of these packages, tools and technologies that would lead to positive impacts on productivity and profitability in beef businesses. Activities included a number of distillation workshops to develop the key messages from completed research, the production of a range of fact sheets, newsletters and information booklets, and presentations at national industry events and regional field days.
Project 5.3 designed, executed and analysed a pilot of an accelerated adoption process to speed up the processes by which beef businesses implemented new research results, tools and technologies leadingto positive impacts on productivity and profitability. The project was based on a formal Continuous Improvement and Innovation cycle and and involved establishing and supporting Beef Profit Partnership teams across Australia and New Zealand.

Research Program 6 Administration, Commercialisation and Business Development

Key activities:

The key activities undertaken in Program 6 related to three project areas.
Project 6.1 efficiently and effectively administered the resources at the disposal of the CRC to achieve the stated objectives.
Project 6.2 established a high-profile brand for the CRC, a set of strong internal and external networks through which the CRC could disseminate its messages and a framework to deliver key messages to improve the productivity and profitability of the Australian beef industry and its stakeholders. This included working with other CRC programs to summarise the key messages from completed research, to produce a range of fact sheets, newsletters and information booklets and to ensure effective presentations at national industry events and regional field days.
Project 6.3 established processes to identify, protect and manage intellectual property generated by the CRC and its partners where that was necessary, and established a framework or "path to adoption" for the commercialisation of new research results, tools and technologies leading to positive impacts on productivity and profitability. This second set of activities was undertaken in close collaboration with the research programs and the communications, awareness and adoption projects. In latter years the project was moved into Program 5 to better integrate with Program 5 activities.

Research Program 7 Underpinning Science

Key activities:

Program 7 coordinated all gene discovery and gene expression research activities across the CRC. The aim of this research was to develop DNA-based tests to predict the breeding values of cattle for economically important traits. Thus individual projects focussed on discovery of DNA markers . They were originally located in the other research Programs but in latter years were relocated into Program 7 to ensure better integration of genomic technologies. These included genomic prediction equations for various aspects of meat quality (from Program 1), feed efficiency (from Program 2), resistance to ticks and worms (from Program 3) and post-partum re-conception, and age at puberty in females and male and female reproductive predictions in bulls (from Program 4). One gene discovery project, a DNA marker for the polled gene in tropical cattle, was retained in Program 3.

Program 7 also provided services to support the R&D being conducted by all other research programs, including maintaining the CRC's database of phenotypic animal records and its DNA collection; designing and analysing gene discovery and gene expression experiments; and coordinating bioinformatics support.

Outputs

Research Program 1 High Quality Beef for Global Consumers

Output 1.01

Brief description

Output 1.01 results from Activity 1.1. The output is a set of genetic parameters for meat tenderness markers and their association with related measures such as shearforce, MQ4 score, flight time and meat colour that assist in increasing the accuracy of predictions of breeding value for profit to 40%.

Timeline of key milestones

End FY 1	End FY 2	End FY 3	End FY 4	End FY 5
Multiple markers discovered for marbling and retail beef yield. Provisional patents filed for associations with MQ4 palatability scores.	Markers discovered in Year 1 failed to validate in independent cattle populations. Planning commenced to integrate DNA marker results into BREEDPLAN EBVs.	International genomics collaborations with American and Canadian research groups formally approved by industry and CRC Board. New DNA marker commercialisation model approved.		Strong genetic links found between myostatin status, muscling and retail beef yield.
End FY 6	**End FY 7**	**End FY 8**	**End FY 9**	**End FY 10**
3600 young animals, mainly bulls, are now fully genotyped	Prediction equations for full range of carcase and beef quality attributes delivered to BREEDPLAN and to genomics companies (Neogen and Pfizer)			

Output 1.02

Brief description

Output 1.02 results from Activity 1.2. The output is the Beef Specs model, a model to predict growth traits of cattle during finishing and carcase traits at slaughter, for groups of cattle, that will enable a 20% increased rate of compliance with market specifications with associated improvements in profitability.

Timeline of key milestones

End FY 1	End FY 2	End FY 3	End FY 4	End FY 5
		Preliminary version of Beef Specs released for validation, well received.	Beef Specs released to industry.	Extensive media coverage of Beef Specs in CRC/MLA press releases.
End FY 6	**End FY 7**	**End FY 8**	**End FY 9**	**End FY 10**
More than 6,700 cumulative unique visits to Beef Specs free website to 2010/11.				

Output 1.03

Brief description

Output 1.03 results from Activity 1.2. The output is an on-farm drafting version of the Beef Specs model for individual animals, that will allow individual animals to be allocated to particular management groups based on individual predictions of fat depth, and so achieve a 20% increase in specification.

Timeline of key milestones

End FY 1	End FY 2	End FY 3	End FY 4	End FY 5
		Model development proceeding but waiting on laser beam measurement tool for hip height.		Drafting tool still being developed.
End FY 6	**End FY 7**	**End FY 8**	**End FY 9**	**End FY 10**
	Model tested	Model validated in industry herds	Model delivered to wider industry	

Output 1.04

Brief description

Output 1.04 results from Activity 1.2. The output is an optimisation model to predict production and economic parameters for the best operating procedures for beef finishing systems, in particular feedlots, to achieve a 20% increase in compliance.

Timeline of key milestones

End FY 1	End FY 2	End FY 3	End FY 4	End FY 5
		Model development proceeding.		Model validated using actual Cargill data. Options for commercialisation being explored.
End FY 6	**End FY 7**	**End FY 8**	**End FY 9**	**End FY 10**
	Model delivered to industry			

Output 1.05

Brief description

Output 1.05 results from Activity 1.3. The output is an enhanced palatability prediction model that underpins the Meat Standards Australia beef grading system, and an enhanced information package that suggests ways to improve palatability scores against the cost of achieving compliance, each routinely updated as new research results emerge and are assessed by end users. This makes the MSA system more reliable and therefore more valuable to end users.

Timeline of key milestones

End FY 1	End FY 2	End FY 3	End FY 4	End FY 5
MSA beef grading system has been in operation for 7 years and is routinely modified as new data and relationships become apparent.	Special edition of AJEA focussing on MSA was published.	Analysis of historical carcase data from 4 major processors showed how better selection and drafting of cattle could improve compliance with MSA specifications.	Proof of the concept that DNA markers for tenderness could be incorporated into the MSA prediction model.	MSA throughput grew substantially, in spite of a fall in aggregate slaughterings. Mostly due to higher number of accredited producers, up 2,500 to 19,000. At least 50% due to Beef CRC commercialisation focus on commercial producers.
End FY 6	**End FY 7**	**End FY 8**	**End FY 9**	**End FY 10**
Ongoing enhancements of the MSA model as new data and results become available that are shown to increase the prediction of palatability by beef consumers.				

Research Program 2 Feed Efficiency, Maternal Productivity and Responsible Resource Use

Output 2.01

Brief description

Output 2.01 results from Activity 2.1. The output is a set of genetic parameters for feed efficiency and reproductive traits in first and second calf heifers in Southern Australian herds and their association with measures of body composition and feed efficiency.

Timeline of key milestones

End FY 1	End FY 2	End FY 3	End FY 4	End FY 5
	Planning commenced to integrate DNA marker results for feed efficiency into BREEDPLAN EBVs.	New DNA marker commercialisation model approved.		
End FY 6	**End FY 7**	**End FY 8**	**End FY 9**	**End FY 10**
	Genomic prediction equations for feed efficiency released to industry.	A set of genetic parameters available for reproductive traits in first and second calf heifers in Southern Australian herds and their association with measures of body composition and feed efficiency.		

Output 2.02

Brief description

Output 2.02 results from Activity 1.2 and 2.2. The output is a model of maternal productivity in Southern Australian herds.

Timeline of key milestones

End FY 1	End FY 2	End FY 3	End FY 4	End FY 5
End FY 6	**End FY 7**	**End FY 8**	**End FY 9**	**End FY 10**
	Model developed and tested using CRC data.	Existing prototype maternal model validated with existing and new industry data	Maternal model refined and tested	Maternal model routinely refined and tested using data collected from cooperating large herds.

Output 2.03

Brief description

Output 2.03 results from Activity 2.3. The primary output is a set of microbial and bioactive candidates with the potential to deliver a commercial product to reduce methane emissions from Australian beef herds. A secondary output is better information on the relationships between feed efficiency and on-farm productivity and methane emissions from cattle that will allow the development of on-farm management strategies to reduce methane emissions per kg of beef turned off.

Timeline of key milestones

End FY 1	End FY 2	End FY 3	End FY 4	End FY 5
	Relationships between feed efficiency and methane outputs quantified.	Practical on-farm strategies to reduce methane emissions from cattle through associations with feed efficiency and productivity developed.		Some promising results found for a bacteria YE299 M b., but considerable further work required. Different bacterial communities in high and low methane producing animals can be distringuished.
End FY 6	**End FY 7**	**End FY 8**	**End FY 9**	**End FY 10**
	Candidates for non-genetic intervention (e.g. probiotic drench) identified but further basic research required before these candidates would be suitable for inclusion in a commercial product.			

Research Program 3 Adaptation and Cattle Welfare

Output 3.01

Brief description

Output 3.01 results from Activity 3.1. The output is is a set of vaccine candidates with the potential to deliver a commercial product to control cattle ticks in Northern Australian beef herds.

Timeline of key milestones

End FY 1	End FY 2	End FY 3	End FY 4	End FY 5
				1/6 polypeptide antigens and 1/4 single antigens achieved greather than 70% effectiveness in laboratory trials, while a cocktail mix of 6 peptides achieved greater than 90% effectiveness. Animal trials needed
End FY 6	**End FY 7**	**End FY 8**	**End FY 9**	**End FY 10**
New agreement with USDA and EMBRAPA to do animal trials in Brazil to test CRC's candidate antigens/peptides and then to collaborate to deliver candidates to commercial animal health company.	Test some antigens as singletons in Australian animal trials to identify candidate(s) that could potentially be combined with Bm86 (now off patent) in a commercial vaccine.	Complete testing of 14 individual candidate antigens for efficacy in reducing tick burdens. Ongoing testing of different combinations of the candidates to optimise efficacy and duration of immunity.	A tick vaccine “product” of antigen/s that provides 90% efficacy in animal trials and is licensed to a commercial company for further development for market release.	

Output 3.02

Brief description

Output 3.02 results from Activity 3.2. The primary output is a set of objective measures of cattle welfare that will contribute to national animal welfare guidelines. and improve the welfare reputation of Australian beef in overseas markets. Another output is a set of management strategies to improve animal welfare at dehorning.

Timeline of key milestones

End FY 1	End FY 2	End FY 3	End FY 4	End FY 5
		Significant effects found from fear experiments.		Results from the animal welfare project have now been incorporated into draft National Animal Welfare Guidelines

End FY 6	End FY 7	End FY 8	End FY 9	End FY 10
Northern Australian beef producers more aware of welfare impacts of dehorning, and Australian beef begins to be marketed overseas with increased welfare credibility.				

Output 3.03

Brief description

Output 3.03 results from Activity 3.3. The output is a DNA marker test to differentiate polled animals (bulls or cows to be used for breeding) that carry one (heterozygous) or two (homozygous) copies of the favourable polled marker, in particular breeds of cattle. Homozygous polled bulls are expected to produce 100% polled calves when joined to horned, scurred or polled females.

Timeline of key milestones

End FY 1	End FY 2	End FY 3	End FY 4	End FY 5
		New DNA marker commercialisation model approved. Marker discovered for polled gene that accurately identifies homozygous polled bulls in more than 90% of cases in tropical breeds.		University of Queensland licensed non-exclusively to validate and further test the poll gene marker in additional breeds of cattle.
End FY 6	**End FY 7**	**End FY 8**	**End FY 9**	**End FY 10**
Poll gene test received strong uptake from both Northern and Southern producers. Test licenced to Pfizer and Merial for use in Brahman and other tropically adapted cattle.	Further research underway to determine whether additional markers are associated with scurs and/or African horns to increase the accuracy of the existing diagnostic test.			

Research Program 4 Female Reproductive Performance

Output 4.01

Brief description

Output 4.01 results from Activity 4.1. The output is a set of genetic parameters for new male reproductive traits in Northern Australian herds.

Timeline of key milestones

End FY 1	End FY 2	End FY 3	End FY 4	End FY 5
	Planning commenced to integrate DNA marker results into BREEDPLAN EBVs.	International genomics collaborations with American and Canadian research groups formally approved by industry and CRC Board. New DNA marker commercialisation model approved.		
End FY 6	**End FY 7**	**End FY 8**	**End FY 9**	**End FY 10**
	Male indicator traits to predict female reproductive performance confirmed.			

Output 4.02

Brief description

Output 4.02 results from Activity 4.2. The output is a set of genetic parameters for female reproductive traits in Northern Australian herds, and their association with steer traits.

Timeline of key milestones

End FY 1	End FY 2	End FY 3	End FY 4	End FY 5
	Planning commenced to integrate DNA marker results into BREEDPLAN EBVs.	International genomics collaborations with American and Canadian research groups formally approved by industry and CRC Board. New DNA marker commercialisation model approved.		
End FY 6	**End FY 7**	**End FY 8**	**End FY 9**	**End FY 10**

Research Program 5 Education and Training

Output 5.01

Brief description

Output 5.01 results from Activity 5.01, the provision of postgraduate, undergraduate and vocational training in the sciences underpinning achievement of beef industry outcomes. During the course of the CRC the undergraduate education and vocational training components were integrated. The final output is a network of young scientists with advanced training in the sciences underpinning beef genetic improvement and effective innovation, commercialisation and adoption of outputs , so as to produce a more skilled beef industry worksforce.

Timeline of key milestones

End FY 1	End FY 2	End FY 3	End FY 4	End FY 5
End FY 6	**End FY 7**	**End FY 8**	**End FY 9**	**End FY 10**

Output 5.02

Brief description

Output 5.02 results from Activity 5.2. The output is an information package about new research results, tools and technologies to achieve a balance between cow and foetal nutrition status and compliance with market specifications to facilitate implementation and lead to positive impacts on productivity and profitability in beef businesses. It also featured practical solutions to overcome reproductive inefficiencies in northern herds without compromising carcass and beef quality attributes.

Timeline of key milestones

End FY 1	End FY 2	End FY 3	End FY 4	End FY 5
Scientific publications begin to appear, some local field days.	Further scientific publications appear, major economic report released.		Special edition of AJEA on the scientific results of all growth path experiments.	A major publication released which distilled the key messages from the growth path results.
End FY 6	**End FY 7**	**End FY 8**	**End FY 9**	**End FY 10**
Major efforts underway to distil and deliver key industry messages from current CRC	Major efforts underway to distil and deliver key industry messages from current CRC - arrangements put in place with partners to continue industry delivery activities beyond the CRC term through the Red Meat Coinvestment Committee			

Output 5.03

Brief description

Output 5.03 results from Activity 5.2. The output is an information package about new research results, tools and technologies to achieve the best combination of cattle genetics and management inputs and still comply with market specifications to facilitate implementation and lead to positive impacts on productivity and profitability in beef businesses. It also featured practical solutions to overcome reproductive inefficiencies in northern herds without compromising carcass and beef quality attributes.

Timeline of key milestones

End FY 1	End FY 2	End FY 3	End FY 4	End FY 5
Scientific publications begin to appear, some local field days.	Further scientific publications appear, MLA final report released. Distillation team commenced specifying and communicating key results and messages from the various projects reported in the Special Edition.		Special edition of AJEA on the scientific results of all growth path experiments. Set of economics publications released.	A major publication released which distilled the key messages from the various projects.
End FY 6	**End FY 7**	**End FY 8**	**End FY 9**	**End FY 10**
Major efforts underway to distil and deliver key industry messages from current CRC	Major efforts underway to distil and deliver key industry messages from current CRC - arrangements put in place with partners to continue industry delivery activities beyond the CRC term through the Red Meat Coinvestment Committee			

Output 5.04

Brief description

Output 5.04 results from Activity 5.2. The output is an information package about new research results, tools and technologies to increase reproduction rates in Northern Australian cattle herds to facilitate implementation and lead to positive impacts on productivity and profitability in beef businesses.

Timeline of key milestones

End FY 1	End FY 2	End FY 3	End FY 4	End FY 5
				The CRCs technology transfer activities were refocussed onto the better management of cattle breeding programs using CRC information. The distillation team attended Program 4 meetings and developed extension material and activities.
End FY 6	**End FY 7**	**End FY 8**	**End FY 9**	**End FY 10**
	Major efforts underway to distil and deliver key industry messages from current CRC - arrangements put in place with partners to continue industry delivery activities beyond the CRC term through the Red Meat Coinvestment Committee			

Output 5.05

Brief description

Output 5.05 results from Activity 5.2. The output is an information package about new research results, tools and technologies to increase reproduction rates in Southern Australian cattle herds to facilitate implementation and lead to positive impacts on productivity and profitability in beef businesses.

Timeline of key milestones

End FY 1	End FY 2	End FY 3	End FY 4	End FY 5
				The CRCs technology transfer activities were refocussed onto the better management of cattle breeding programs using CRC information. The distillation team attended Program 2 meetings and developed extension material and activities.
End FY 6	**End FY 7**	**End FY 8**	**End FY 9**	**End FY 10**
	Major efforts underway to distil and deliver key industry messages from current CRC - arrangements put in place with partners to continue industry delivery activities beyond the CRC term through the Red Meat Coinvestment Committee			

Output 5.06

Brief description

Output 5.06 results from Activity 5.3. The output is a network of Beef Profit Partnerships that use the Continuous Improvement and Innovation process in a structured way to routinely assess new research results, tools and technologies and implement those that are determined to be beneficial in the particular beef business.

Timeline of key milestones

End FY 1	End FY 2	End FY 3	End FY 4	End FY 5
End FY 6	**End FY 7**	**End FY 8**	**End FY 9**	**End FY 10**
	Beef Profit Partnerships incorporated into the National Beef RD&E strategy under the auspices of the Red Meat Coinvestment Committee to ensure the process of 'adoption' continues beyond the Beef CRC's term			

Output 5.07

Brief description

Output 5.07 results from Activity 5.2. The output is an accredited set of training materials and resources for a course called More Beef from Breeding aimed at Southern Australian cattle breeders. There have also been specific workshops for seedstock breeders, including a Genomics Master Class.

Timeline of key milestones

End FY 1	End FY 2	End FY 3	End FY 4	End FY 5
				The CRCs technology transfer activities were refocussed onto the better management of cattle breeding programs using CRC information. More Beef from Breeding workshops commenced.
End FY 6	**End FY 7**	**End FY 8**	**End FY 9**	**End FY 10**

Output 5.08

Brief description

Output 5.08 results from Activity 5.2. The output is an accredited set of training materials and resources for a course called Breeder Herd Management aimed at Northern Australian cattle breeders. There have also been specific workshops for seedstock breeders, including a Genomics Master Class.

Timeline of key milestones

End FY 1	End FY 2	End FY 3	End FY 4	End FY 5
			Breeder Herd Management workshops commenced under the old name of Breeding Edge.	The CRCs technology transfer activities were refocussed onto the better management of cattle breeding programs using CRC information. Breeder Herd Management workshops continued.
End FY 6	**End FY 7**	**End FY 8**	**End FY 9**	**End FY 10**

Output 5.09

Brief description

Output 5.09 results from Activity 5.3. The output is an accredited set of training materials and resources for a course called Continuous Improvement and Innovation.

Timeline of key milestones

End FY 1	End FY 2	End FY 3	End FY 4	End FY 5
End FY 6	**End FY 7**	**End FY 8**	**End FY 9**	**End FY 10**
	Course materials accredited through 'Farm Ready' and incorporated into National Training Curriculum			

Research Program 6 Administration, Commercialisation and Business Development

Output 6.01

Brief description

Output 6.01 results from Activity 6.1, 6.2 and 6.3. The aggregate output is the efficient and effective administration of the resources at the disposal of the CRC; an identified brand for the CRC, a set of strong internal and external networks through which the CRC could disseminate its messages, and a framework to deliver key messages to stakeholders; and processes for the identification, protection and management of intellectual property generated by the CRC, and a framework or "path to adoption" for the commercialisation of new research results, tools and technologies.

Timeline of key milestones

End FY 1	End FY 2	End FY 3	End FY 4	End FY 5

End FY 6	End FY 7	End FY 8	End FY 9	End FY 10

Research Program 7 Underpinning Science

Output 7.01

Brief description

Output 7.01 results from Activity 7.1. The output is a set of DNA-based genomic prediction equations accounting for at least 15% of the genetic variation for a range of carcass and meat quality traits.

Timeline of key milestones

End FY 1	End FY 2	End FY 3	End FY 4	End FY 5
Multiple markers discovered for marbling and retail beef yield. Provisional patents filed for associations with MQ4 palatability scores.	Markers discovered in Year 1 failed to validate in independent cattle populations. Planning commenced to integrate DNA marker results into BREEDPLAN EBVs.	International genomics collaborations with American and Canadian research groups formally approved by industry and CRC Board. New DNA marker commercialisation model approved.	Marker assisted EBVs for tenderness incorporated into BREEDPLAN using new method developed by the CRC.	Discovered new SNPs in tropically adapted breeds and contributed these to Illumina and Affymetrix to develop new high density SNP chips for use in across-breed genomic predictions
End FY 6	**End FY 7**	**End FY 8**	**End FY 9**	**End FY 10**
Methods developed and tested to impute 800K SNPs from 50K SNPs. Explains at least 15% of genetic variance within and across breeds for most traits except the fat-related carcass traits.	Prediction equations for full range of carcase and beef quality attributes delivered to BREEDPLAN and to genomics companies (Neogen and Pfizer)			

Output 7.02

Brief description

Output 7.02 results from Activity 7.1. The output is a set of DNA-based genomic prediction equations accounting for at least 15% of the genetic variation for a feed efficiency and related traits.

Timeline of key milestones

End FY 1	End FY 2	End FY 3	End FY 4	End FY 5
		New DNA marker commercialisation model approved. No confirmation of significant NFI genes in independent cattle populations.		Methods developed and tested for imputing 800K chip results from much cheaper 50K chip results. Will allow at least 15% explanation of genetic variance both within and across breeds. Many markers significant for NFI but few have consistency across breeds.
End FY 6	**End FY 7**	**End FY 8**	**End FY 9**	**End FY 10**
Discovered SNPs with a significant effect on NFI when all breeds combined.	Prediction equations for feed efficiency and related traits delivered to BREEDPLAN and to genomics companies (Neogen and Pfizer)			

Output 7.03

Brief description

Output 7.03 results from Activity 7.1. The output is a set of DNA-based genomic prediction equations accounting for at least 15% of the genetic variation for a range of female reproductive performance traits.

Timeline of key milestones

End FY 1	End FY 2	End FY 3	End FY 4	End FY 5
		New DNA marker commercialisation model approved. Internationation genomics collaborations commenced 15 markers found with significant additive effect on age of puberty in Brahmans and Tropical Composities		Methods developed and tested for imputing 800K chip results from much cheaper 50K chip results. Will allow at least 15% explanation of genetic variance both within and across breeds. New significant markers found for age of puberty.
End FY 6	**End FY 7**	**End FY 8**	**End FY 9**	**End FY 10**
	Prediction equations for full range of female reproductive and performance attributes delivered to BREEDPLAN and to genomics companies (Neogen and Pfizer)			

Output 7.04

Brief description

Output 7.04 results from Activity 7.1. The output is a set of DNA-based genomic prediction equations associated with genetic variation for resitstance to ticks and worms. The CRC's data were determined to provide Background IP in an agreement between CSIRO and Pfizer Animal Genetics, with the prediction equations to be delivered directly to industry by Pfizer.

Timeline of key milestones

End FY 1	End FY 2	End FY 3	End FY 4	End FY 5
		New DNA marker commercialisation model approved. 14 DNA markers identified for tick burden, need to be confirmed in independent populations.		CRC's knowledge deemed to be Background IP in agreement with CSIRO under terms of CRC-CSIRO Supporting Participant's Agreement. Output will be delivered directly to industry by Pfizer.

End FY 6	End FY 7	End FY 8	End FY 9	End FY 10

Output 7.05

Brief description

Output 7.05 results from Activity 7.1. The output is a full genome sequence for the Brahman, Africander and Tuli bulls.

Timeline of key milestones

End FY 1	End FY 2	End FY 3	End FY 4	End FY 5
		New DNA marker commercialisation model approved.		Formed new partnership with gene technology providers to fully sequence Brahman, Africander and Tuli bulls.
End FY 6	**End FY 7**	**End FY 8**	**End FY 9**	**End FY 10**
Full genome sequence for the Brahman, Africander and Tuli bulls made available commercially. New SNPs delivered to Illumina and Affymetrix for incorporation in new high density commercial SNP chips.	CRC uses new high density SNP chips to deliver across-breed genomic prediction equations based on 800,000 marker panels.			

Usage

Research Program 1 High Quality Beef for Global Consumers

	Description of different usage of outputs that is expected and quantification of scale of expected costs associated with usage of outputs and how these estimates were made	Probability that all required output(s) to enable this usage are produced	Rationale for enabling output(s) delivery probability selection	Probability of usage: given required outputs generated	Rationale for usage probability selections
Usage 1.01	Usage 1.01 flows from Output 1.01, a set of genetic parameters for meat tenderness markers and their association with related measures such as shearforce, MQ4 score, flight time and meat colour, that assists in predicting breeding values with higher accuracy. These new EBVs will be routinely utilised in BREEDPLAN, the Australian beef industry's genetic evaluation service, as well as to other service providers such as UQ-Animal Genetics Laboratory, Pfizer and Neogen. Beef seedstock producers will then access these more accurate EBVs to generate genetically superior bulls, which will be sold to commercial beef producers as yearlings (in 2 years time). It takes another 2-3 years from using a new BREEDPLAN recorded bull to when superior progeny become available for sale. The lag is 10 years for commercial producers who do not use BREEDPLAN recorded bulls. It is not envisaged that any costs will be incurred associated with Usage 1.01 additional to those already covered in Program 1 inputs.	**100%**	Theoretical papers and experience in the dairy industry in Australia and elsewhere suggests that an accuracy of 70% is possible for prediction of breeding value for profit, but we conservatively only targetted 40% accuracy from this CRC. The expected 40% level of accuracy has already been reached for many of the commercial traits of interest, although the average accuracy across all traits has been set at 35% from both genomic and phenotypic sources. BREEDPLAN has already accepted the new genetic information.	**95%**	Seedstock producers will access the new EBV data from BREEDPLAN in exactly the same way as they have done in the past. Commercial beef producers will access the new genetically superior bulls in exactly the same way as they have done in the past. They need to replace bulls about every 3 years. They do this by purchasing from a specialist seedstock producer, from other bull breeders or by using a bull they have bred themselves. Currently 30% of bulls used are BREEDPLAN registered and come from specialist seedstock producers. Given the increased accuracy of prediction of cow profitability through the use of the updated EBVs, commercial producers will be more likely to use BREEDPLAN registered bulls. It is estimated the proportion of commercial producers using BREEDPLAN registered bulls will rise to 35% over time. These variables and their various time lags are taken account of in the calculation of net impacts as detailed in an Appendix. There are some risks that seedstock producers will not make use of the new EBV data, although the higher levels of accuracy will mean higher profit per cow.

Usage 1.01

Timeline of key usage milestones

End FY 1	End FY 2	End FY 3	End FY 4	End FY 5
Northern Pastoral Group of companies, managing over 2 million breeders, begin receiving updated EBVs for steer and female reproductive traits. These are updated annually.				

End FY 6	End FY 7	End FY 8	End FY 9	End FY 10
		Seedstock producers begin using EBV data with average 35% accuracy in their breeding decisions.	35% of commercial beef producers start purchasing BREEDPLAN registered, superior bulls with 35% accuracy.	

End FY 11	End FY 12
	Commercial producers using BREEDPLAN registered bulls with average 35% accuracy have progeny for sale.

Estimate of $ costs associated with usage (including cost for further refinement and application) of output(s)

End FY 1	End FY 2	End FY 3	End FY 4	End FY 5	End FY 6	End FY 7	End FY 8	End FY 9	End FY 10
$0	$0	$0	$0	$0	$0	$0	$0	$0	$0

End FY 11	End FY 12
$0	$0

TOTAL	TOTAL NPV	EXPECTED NPV
$0	$0	$0

	Description of different usage of outputs that is expected and quantification of scale of expected costs associated with usage of outputs and how these estimates were made	Probability that all required output(s) to enable this usage are produced	Rationale for enabling output(s) delivery probability selection	Probability of usage: given required outputs generated	Rationale for usage probability selections
Usage 1.02	Usage 1.02 flows from Output 1.02, the Beef Specs model to predict growth traits of steers during finishing and carcase traits at slaughter, for groups of cattle, that will enable a 20% increased rate of compliance with market specifications with associated improvements in profitability. This model will be used directly by commercial beef producers. The potential long term use of this model is for 4 million commercial steers per annum. It is estimated that 1 million commercial steers slaughtered each year will have their performance predicted by the basic steer model 5 years after release. The implementation cost for BeefSpecs will be minimal as the tools will be available free on the web. Extra weighing and visual assessment is required but this will be done as part of normal operations. Suggested cost is an extra $1/animal/year. The cost of implementing interventions predicted by the models so as to meet specifications is included in the net impact .	**95%**	A simple version of the model is already developed and has been trialled and adopted. A risk is that by introducing ongoing enhancements to the model that there will be unforseen interactions which result in poor predictions. The strategy of sequential testing and validation should ensure that this risk is minimised.	**90%**	A wide range of producers have been and will be involved in testing and validation of the tool, and livestock agents are being targetted as end users of the tool. A risk is that by introducing ongoing enhancements to the model they will become more difficult to use and more difficult to interpret, and thus less adoptable. However, this suite of models will be aligned with the Livestock Data Link system being developed by MLA which proposes cost effective solutions to particular compliance problems.

Usage 1.02

Timeline of key usage milestones

End FY 1	End FY 2	End FY 3	End FY 4	End FY 5
		Assume 20,000 steers assessed by Beef Specs as part of validation trials.	Beef Specs formally released to industry. Assume 50,000 steers assessed by Beef Specs.	Assume 100,000 steers assessed by Beef Specs.
End FY 6	**End FY 7**	**End FY 8**	**End FY 9**	**End FY 10**
Assume 250,000 steers assessed by Beef Specs. More than 6,700 cumulative unique visits to Beef Specs free website to 2010/11	Assume 500,000 steers assessed by Beef Specs.	Assume 750,000 steers assessed by Beef Specs.	Assume 1,000,000 steers assessed by Beef Specs.	Assume 1,000,000 steers assessed by Beef Specs.
End FY 11	**End FY 12**			
Assume 1,000,000 steers assessed by Beef Specs.	Assume 1,000,000 steers assessed by Beef Specs.			

Estimate of $ costs associated with usage (including cost for further refinement and application) of output(s)

End FY 1	End FY 2	End FY 3	End FY 4	End FY 5	End FY 6	End FY 7	End FY 8	End FY 9	End FY 10
$0	$0	$20,000	$50,000	$100,000	$250,000	$500,000	$750,000	$1,000,000	$1,000,000

End FY 11	End FY 12
$1,000,000	$1,000,000

TOTAL	TOTAL NPV
$5,670,000	$3,586,327

EXPECTED NPV
$3,066,310

	Description of different usage of outputs that is expected and quantification of scale of expected costs associated with usage of outputs and how these estimates were made	Probability that all required output(s) to enable this usage are produced	Rationale for enabling output(s) delivery probability selection	Probability of usage: given required outputs generated	Rationale for usage probability selections
Usage 1.03	Usage 1.03 flows from Output 1.03, a model to predict growth traits of individual cattle during finishing and carcase traits at slaughter, that will enable an increased rate of compliance with market specifications with associated improvements in profitability, over and above use of Beef Specs alone. This version of the model will also be used directly by larger commercial beef producers. It is estimated that 500,000 commercial steers and heifers slaughtered each year will have their performance predicted by the enhanced steer model 5 years after release. Extra weighing and visual assessment is required but this will be as done as part of normal operations. Suggested cost is an extra $2/animal/year. The cost of implementing interventions predicted by the models is included in the net impact.	**85%**	A simple version of the model is already developed and has been trialled , although the individual animal model is much more complicated than the commercial steer model. The model does not require but would benefit from the concurrent delivery of an automated measuring system. The risk is that by introducing these enhancements to the models that there will be unforseen interactions which result in poor predictions. The strategy of sequential testing and validation should ensure that this risk is minimised.	**85%**	A wide range of producers have been and will be involved in testing and validation of the tool, and livestock agents are being targetted as end users of the tool. Initially 10 large producers (50,000 steers) would implement and test the models, and after industry release it is expected that usage would rise to 500,000 steers per year. A risk is that by introducing the enhancements to the models they will become more difficult to use and more difficult to interpret, and thus less adoptable. However, this suite of models will be aligned with the existing Livestock Data Link system which proposes cost effective solutions to particular compliance problems.

Usage 1.03

Timeline of key usage milestones

End FY 1	End FY 2	End FY 3	End FY 4	End FY 5

End FY 6	End FY 7	End FY 8	End FY 9	End FY 10
	Cooperating producers provide production and economic data to develop the on farm drafting tool. Number of steers and heifers assessed by the on-farm drafting tool reaches 20,000.	Cooperating producers test the new model. Number of steers and heifers assessed by the on-farm drafting tool reaches 50,000.	Model released to wider industry. Number of steers and heifers assessed by the on-farm drafting tool reaches 100,000.	Number of steers and heifers assessed by the on-farm drafting tool reaches 200,000.

End FY 11	End FY 12
Number of steers and heifers assessed by the on-farm drafting tool reaches 300,000.	Number of steers and heifers assessed by the on-farm drafting tool reaches 400,000.

Estimate of $ costs associated with usage (including cost for further refinement and application) of output(s)

End FY 1	End FY 2	End FY 3	End FY 4	End FY 5	End FY 6	End FY 7	End FY 8	End FY 9	End FY 10
$0	$0	$0	$0	$0	$0	$50,000	$100,000	$200,000	$400,000

End FY 11	End FY 12
$600,000	$800,000

TOTAL	TOTAL NPV
$2,150,000	$1,273,983

EXPECTED NPV
$920,452

	Description of different usage of outputs that is expected and quantification of scale of expected costs associated with usage of outputs and how these estimates were made	Probability that all required output(s) to enable this usage are produced	Rationale for enabling output(s) delivery probability selection	Probability of usage: given required outputs generated	Rationale for usage probability selections
Usage 1.04	Usage 1.04 flows from Output 1.04, an optimisation model to predict least cost growth paths of cattle during finishing that will enable an increased rate of compliance with market specifications with associated improvements in profitability. This model will be used directly by large commercial feedlot operators. The potential long term use of this system is for 6m young cattle (steers and heifers) per annum. Initially three mid size cooperating feedlots and processors(150,000 head pa) would implement and test the models, and it is estimated that 500,000 commercial steers and heifers fed each year will have their performance predicted by the feedlot model 5 years after release. The model will be delivered to feedlots by trained consultants. Costs are $20,000 for once off training of consultants, $5000/feedlot for installation of automated measuring system, $5000/business for model set up and testing, $2000/business pa for ongoing maintenance. The cost of implementing interventions predicted by the models is included in the net impact .	**80%**	Simple versions of the models are already developed and have been trialled , although the optimisation model is much more complicated than the commercial steer model. The optimisation model also requires the concurrent delivery of the automated measuring system for feedlots. The risk is that by introducing these enhancements to the models that there will be unforseen interactions which result in poor predictions. The strategy of sequential testing and validation should ensure that this risk is minimised.	**80%**	A risk is that by introducing the enhancements to the models they will become more difficult to use and more difficult to interpret, and thus less adoptable. However, this suite of models will be aligned with the existing Livestock Data Link system which proposes cost effective solutions to particular compliance problems.

Usage 1.04

Timeline of key usage milestones

End FY 1	End FY 2	End FY 3	End FY 4	End FY 5

End FY 6	End FY 7	End FY 8	End FY 9	End FY 10
	Cooperating feedlots provide production and economic data and advise on the development of the optimisation model.	Cooperating feedlots test the model. Cooperating feedlots test and validate new automated measuring system. 150,000 animals in feedlots assessed by the optimisation model.	150,000 animals in feedlots assessed by the optimisation model.	Model released to wider industry. 150,000 animals in feedlots assessed by the optimisation model.

End FY 11	End FY 12
300,000 animals in feedlots assessed by the optimisation model.	400,000 animals in feedlots assessed by the optimisation model.

Estimate of $ costs associated with usage (including cost for further refinement and application) of output(s)

End FY 1	End FY 2	End FY 3	End FY 4	End FY 5	End FY 6	End FY 7	End FY 8	End FY 9	End FY 10
$0	$0	$0	$0	$0	$0	$20,000	$21,000	$6,000	$27,000

End FY 11	End FY 12
$12,000	$33,000

TOTAL	TOTAL NPV
$119,000	$74,262

EXPECTED NPV
$47,528

	Description of different usage of outputs that is expected and quantification of scale of expected costs associated with usage of outputs and how these estimates were made	Probability that all required output(s) to enable this usage are produced	Rationale for enabling output(s) delivery probability selection	Probability of usage: given required outputs generated	Rationale for usage probability selections
Usage 1.05	Usage 1.05 results from Output 1.05, an enhanced palatability prediction model and an enhanced information package that suggests ways to improve palatability scores against the cost of achieving compliance. New research results are assessed by the Meat Standards Australia pathways team and if an improvement is forseen, the palatability prediction model is updated. This makes the MSA system more reliable and therefore more valuable to beef consumers, and therefore to commercial end users who supply MSA graded product (Thompson et al 2008). Current usage is 1.4 m carcases a year increasing by more than 15% per year over the past 5 years. Current compliance with MSA specification is over 94%. No usage costs are incorporated as the benefits listed in the impact tab are net benefits based only on the Beef CRC s contribution to the underpinning RD&E since 2005/06 (MLA 2012).	**100%**	Improvement in the palatability prediction model is incremental as more carcases are tested and as more relationships are discovered	**100%**	Meat Standards Australia is the sole supplier of palatability predictions in Australia and has been for 13 years. Well tested mechanisms are in place for the routine assessment and addition of new data into the prediction model as and when it becomes available.

Usage 1.05

Timeline of key usage milestones

End FY 1	End FY 2	End FY 3	End FY 4	End FY 5
MSA grading system commercialised in 1999/2000. 645,000 carcases graded in 2005/06.	716,000 carcases graded.	839,000 carcases graded.	979,000 carcases graded.	1,280,000 carcases graded.

End FY 6	End FY 7	End FY 8	End FY 9	End FY 10
1,420,000 carcases graded.	assumed 1,630,000 carcases graded, increase of 15%.	assumed 1,875,000 carcases graded, increase of 15%.	assumed 2,160,000 carcases graded, increase of 15%.	assumed 2,480,000 carcases graded, increase of 15%, to about half of all young cattle slaughtered per year.

End FY 11	End FY 12
assumed 2,500,000 carcases graded.	assumed 2,500,000 carcases graded.

Estimate of $ costs associated with usage (including cost for further refinement and application) of output(s)

End FY 1	End FY 2	End FY 3	End FY 4	End FY 5	End FY 6	End FY 7	End FY 8	End FY 9	End FY 10
$0	$0	$0	$0	$0	$0	$0	$0	$0	$0

End FY 11	End FY 12
$0	$0

TOTAL	TOTAL NPV	EXPECTED NPV
$0	$0	$0

Research Program 2 Feed Efficiency, Maternal Productivity and Responsible Resource Use

Usage 2.01

Description of different usage of outputs that is expected and quantification of scale of expected costs associated with usage of outputs and how these estimates were made	Probability that all required output(s) to enable this usage are produced	Rationale for enabling output(s) delivery probability selection	Probability of usage: given required outputs generated	Rationale for usage probability selections
Usage 2.01 flows from Output 2.01, a set of genetic parameters for reproductive traits in first and second calf heifers in Southern Australian herds and their association with measures of body composition and feed efficiency. This information will be delivered directly to BREEDPLAN. The new EBV information will be used by seedstock producers and commercial producers in conjuction with Output 2.02 to make better decisions about long term reproductive performance and herd productivity. No additional usage costs expected.	**90%**	Most of the components required to ensure delivery of this output are already in place. The BREEDPLAN system is in place and functioning efficiently, a prototype maternal model exists and pathways are in place to access the required data. The risks of non-delivery include lack of access to data from cooperating herds, and poor performance of the tool in trial situations.	**85%**	If the new EBV data is delivered as expected, with input and validation from cooperating breeders and well designed communication package, adoption should be high amongst the seedstock breeders and large commercial herds.

Usage 2.01

Timeline of key usage milestones

End FY 1	End FY 2	End FY 3	End FY 4	End FY 5

End FY 6	End FY 7	End FY 8	End FY 9	End FY 10
		A set of genetic parameters available for reproductive traits in first and second calf heifers in Southern Australian herds and their association with measures of body composition and feed efficiency.	New EBVs calculated and released. Cooperating producers test and validate the data. 20 cooperating herds	

End FY 11	End FY 12
30 cooperating herds	40 cooperating herds

Estimate of $ costs associated with usage (including cost for further refinement and application) of output(s)

End FY 1	End FY 2	End FY 3	End FY 4	End FY 5	End FY 6	End FY 7	End FY 8	End FY 9	End FY 10
$0	$0	$0	$0	$0	$0	$0	$0	$0	$0

End FY 11	End FY 12
$0	$0

TOTAL	TOTAL NPV	EXPECTED NPV
$0	$0	$0

	Description of different usage of outputs that is expected and quantification of scale of expected costs associated with usage of outputs and how these estimates were made	Probability that all required output(s) to enable this usage are produced	Rationale for enabling output(s) delivery probability selection	Probability of usage: given required outputs generated	Rationale for usage probability selections
Usage 2.02	Usage 2.02 flows from Output 2.02, a model of maternal productivity in Southern Australian herds. This model would be used by managers of large breeding herds in Southern Australia. The maternal model will initially be validated and tested in a group of cooperating large herds (assume 10,000 cows). The maternal model will make use of the new EBVs delivered from Output 2.01. It is assumed that the maternal model will be adopted by 30% of the Southern breeding herd five years after release. The implementation cost will be minimal. $500 for a computer program for each tool, the rest available free on the web. There will be extra visual assessment required but this will usually be done as part of normal operations. Suggested cost is an extra $2.50/animal/year.	**90%**	Most of the components required to ensure delivery of this output are already in place. A prototype maternal model exists and new EBVs will have been delivered. The risks of non-delivery include lack of access to data from cooperating herds, and poor performance of the tool in trial situations.	**85%**	If the tool is delivered as expected, with input and validation from cooperating breeders and well designed communication package, adoption should be high amongst the seedstock breeders and large commercial herds.

Usage 2.02

Timeline of key usage milestones

End FY 1	End FY 2	End FY 3	End FY 4	End FY 5

End FY 6	End FY 7	End FY 8	End FY 9	End FY 10
		Maternal model installed and tested in 20 cooperating cow herds.	Maternal model released to industry. 100,000 breeders.	600,000 breeders.

End FY 11	End FY 12
900,000 breeders.	1,200,000 breeders.

Estimate of $ costs associated with usage (including cost for further refinement and application) of output(s)

End FY 1	End FY 2	End FY 3	End FY 4	End FY 5	End FY 6	End FY 7	End FY 8	End FY 9	End FY 10
$0	$0	$0	$0	$0	$0	$0	$25,000	$250,000	$1,500,000

End FY 11	End FY 12
$2,250,000	$3,000,000

TOTAL	TOTAL NPV
$7,025,000	$4,084,984

EXPECTED NPV
$3,125,013

	Description of different usage of outputs that is expected and quantification of scale of expected costs associated with usage of outputs and how these estimates were made	Probability that all required output(s) to enable this usage are produced	Rationale for enabling output(s) delivery probability selection	Probability of usage: given required outputs generated	Rationale for usage probability selections
Usage 2.03	Usage 2.03 flows from Output 2.03, a set of microbial and bioactive candidates with the potential to deliver a commercial product to reduce methane emissions from Australian beef herds. There are some promising early results but considerable further R&D is required. This information would be delivered to commercial animal health companies. Usage costs are not known at this time. An associated usage is that methane emissions can also be reduced by breeding more feed efficient cattle. The R&D undertaken in this program has delivered impoved technologies to achieve better net feed intake in southern cattle. However uptake is likely to be quite low due to the low numbers of appropriate breeding animals, say 10% of the Southern breeding herd five years after release. No additional usage charges to achieve this impact.	**95%**	Considerable further R&D is required before a commercial additive product would be available for industry. However no economic value is claimed for this potential product. However, the R&d undertaken in this program has already delivered impoved technologies to achieve better net feed intake in southern cattle and so contribute to reduced methane emissions.	**90%**	If cost effective, commercial producers would use the product to reduce their emissions and potential costs under a future carbon pricing scheme which includes agriculture.

Usage 2.03

Timeline of key usage milestones

End FY 1	End FY 2	End FY 3	End FY 4	End FY 5
				Some promising results found for a bacteria YE299 M b., but considerable further work required. Different bacterial communities in high and low methane producing animals can be distringuished.

End FY 6	End FY 7	End FY 8	End FY 9	End FY 10
		20 cooperating herds reducing methane output by improving NFI	50,000 breeders	200,000 breeders

End FY 11	End FY 12
300,000 breeders	400,000 breeders

Estimate of $ costs associated with usage (including cost for further refinement and application) of output(s)

End FY 1	End FY 2	End FY 3	End FY 4	End FY 5	End FY 6	End FY 7	End FY 8	End FY 9	End FY 10
$0	$0	$0	$0	$0	$0	$0	$0	$0	$0

End FY 11	End FY 12
$0	$0

TOTAL	TOTAL NPV	EXPECTED NPV
$0	$0	$0

Research Program 3 Adaptation and Cattle Welfare

	Description of different usage of outputs that is expected and quantification of scale of expected costs associated with usage of outputs and how these estimates were made	Probability that all required output(s) to enable this usage are produced	Rationale for enabling output(s) delivery probability selection	Probability of usage: given required outputs generated	Rationale for usage probability selections
Usage 3.01	Usage 3.01 comes from Output 3.01, which has two parts. The main output is a close-to-market cattle tick vaccine product of candidate antigens that provides 90% efficacy and 12 month duration of immunity in animal trials . This output will be passed directly to a commercial company who will be licenced by the Beef CRC to further develop the optimal combination of candidate antigens for eventual market release as a single dose tick vaccine. On release (5-10 years) commercial beef cattle producers in tick prone regions in Australia and internationally will be able to use the vaccine to reduce economic losses due to cattle ticks. It is not envisaged that any costs will be incurred associated with Usage 3.01 additional to those already covered in Program 3 inputs or under the terms of the commercialisation agreement. The second output is a test to identify ticks resistant to synthetic pyrethroids. This has been delivered to Australian tick control agencies	**95%**	The probability that Output 3.01 will not be delivered is very low. Results to date indicate that 14 individual candidate antigens have achieved efficacy levels of at least 50%, and that some combinations of antigens have achieved efficacy levels of greater than 80%, all with acceptable duration of immunity. By June 2012 it is envisaged that provisional patents will be filed on all 14 candidates.	**100%**	The economic losses to Australia's beef industry due to cattle ticks is estimated to be at least $175m per year. There is no vaccine currently available, application of acaricides is the only protection available, and ticks are exhibiting increasing resistance to current acaracides. A new vaccine with 90% efficacy and 12 month immunity would greatly simplify farm operations, reduce current control costs and improve market access for cattle from within tick regions. Eight international animal health companies have confirmed their interest as potential commercialisation partners for the further development to market release.

Usage 3.01

Timeline of key usage milestones

End FY 1	End FY 2	End FY 3	End FY 4	End FY 5

End FY 6	End FY 7	End FY 8	End FY 9	End FY 10
		Negotiations with potential commercial partners as new trials are completed.	Licence agreement signed for delivery of a tick vaccine "product" of antigen/s that provides 90% efficacy and 12 month immunity to a commercial company for further development for market release.	Payment made for upfront access licence.

End FY 11	End FY 12
	Effective tick vaccine registered for use in Australia and offered to cattle producers in Northern Australia. Registered for use internationally 2 years later.

Estimate of $ costs associated with usage (including cost for further refinement and application) of output(s)

End FY 1	End FY 2	End FY 3	End FY 4	End FY 5	End FY 6	End FY 7	End FY 8	End FY 9	End FY 10
$0	$0	$0	$0	$0	$0	$0	$0	$0	$0

End FY 11	End FY 12
$0	$0

TOTAL	TOTAL NPV	EXPECTED NPV
$0	$0	$0

	Description of different usage of outputs that is expected and quantification of scale of expected costs associated with usage of outputs and how these estimates were made	Probability that all required output(s) to enable this usage are produced	Rationale for enabling output(s) delivery probability selection	Probability of usage: given required outputs generated	Rationale for usage probability selections
Usage 3.02	Usage 3.02 flows from Output 3.02, a set of objective measures of cattle welfare. Users are national cattle industry organisations, animal welfare organisations, and State and Australian goverment departments. Australian beef can now be marketed in high value domestic and overseas markets with higher welfare credentials. Another output is a set of management strategies to improve animal welfare at dehorning. Assume 20% of Northern Brahman and Brahman-derived producers adopt better management practices to save half of the cost of mortality due to dehorning. This means that 100,000 calves effected in year 6 rising to 600,000 calves in year 8 and thereafter. No additional usage costs are envisaged.	**90%**		**90%**	

Usage 3.02

Timeline of key usage milestones

End FY 1	End FY 2	End FY 3	End FY 4	End FY 5
				Results from the animal welfate project included in the draft National Animal Welfare Guidelines

End FY 6	End FY 7	End FY 8	End FY 9	End FY 10
Assume 20% of Northern Brahman and Brahman-derived producers adopt better management practices to save half of the cost of mortality due to dehorning. 100,000 calves effected.	300,000 calves effected	600,000 calves effected.	600,000 calves effected.	600,000 calves effected.

End FY 11	End FY 12
600,000 calves effected.	600,000 calves effected.

Estimate of $ costs associated with usage (including cost for further refinement and application) of output(s)

End FY 1	End FY 2	End FY 3	End FY 4	End FY 5	End FY 6	End FY 7	End FY 8	End FY 9	End FY 10
$0	$0	$0	$0	$0	$0	$0	$0	$0	$0

End FY 11	End FY 12
$0	$0

TOTAL	TOTAL NPV	EXPECTED NPV
$0	$0	$0

	Description of different usage of outputs that is expected and quantification of scale of expected costs associated with usage of outputs and how these estimates were made	Probability that all required output(s) to enable this usage are produced	Rationale for enabling output(s) delivery probability selection	Probability of usage: given required outputs generated	Rationale for usage probability selections
Usage 3.03	Usage 3.03 flows from Output 3.03, a DNA marker test for homozygous polled horn genes in particular breeds of cattle. This information has been licenced to commercial genetics service providers to provide a polled gene test for the Brahman breed. There are about 6m cows in Northern Australia of which 90% are Brahman or Brahman-derived. With a reproduction rate of around 70%, this means close to 3.75m calves a year are born with horns. Expect test to cover 10,000 bulls per year within five years of release to industry. Test cost around $25.	**100%**	The test has been released commercially following extensive validation trials in entirely new cattle populations.	**100%**	Tropical cattle breeds (Brahman and Brahman-derived) make up more than half of Australia's cattle population and the frequency of the polled gene is low. Most of these cattle are produced in the large, extensive cattle enterprises of Northern Australia, where it is impractical or very costly to dehorn cattle when young. Polled gene test is simple and cost-effective. Extensive consultation with industry upon release of the test and provision of fact sheets and information kits. More than 1200 industry animals were processed in the first few months of the release of the test.

Usage 3.03

Timeline of key usage milestones

End FY 1	End FY 2	End FY 3	End FY 4	End FY 5

End FY 6	End FY 7	End FY 8	End FY 9	End FY 10
Poll gene test for use in Brahman industry licensed to Pfizer and Merial . 1500 tests done	2,000 bulls tested.	4,000 bulls tested.	6,000 bulls tested.	8,000 bulls tested.

End FY 11	End FY 12
10,000 bulls tested.	10,000 bulls tested.

Estimate of $ costs associated with usage (including cost for further refinement and application) of output(s)

End FY 1	End FY 2	End FY 3	End FY 4	End FY 5	End FY 6	End FY 7	End FY 8	End FY 9	End FY 10
$0	$0	$0	$0	$0	$30,000	$50,000	$100,000	$150,000	$200,000

End FY 11	End FY 12
$250,000	$250,000

TOTAL	TOTAL NPV
$1,030,000	$630,458

EXPECTED NPV
$630,458

Research Program 4 Female Reproductive Performance

Usage 4.01

Description of different usage of outputs that is expected and quantification of scale of expected costs associated with usage of outputs and how these estimates were made	Probability that all required output(s) to enable this usage are produced	Rationale for enabling output(s) delivery probability selection	Probability of usage: given required outputs generated	Rationale for usage probability selections
Usage 4.01 flows from Output 4.01, a set of genetic parameters for new male reproductive traits in Northern Australian herds. This information will be delivered directly to BREEDPLAN and used in conjuction with Output 4.02 and Output 7.03.	**0%**		**0%**	

Usage 4.01

Timeline of key usage milestones

End FY 1	End FY 2	End FY 3	End FY 4	End FY 5

End FY 6	End FY 7	End FY 8	End FY 9	End FY 10

End FY 11	End FY 12

Estimate of $ costs associated with usage (including cost for further refinement and application) of output(s)

End FY 1	End FY 2	End FY 3	End FY 4	End FY 5	End FY 6	End FY 7	End FY 8	End FY 9	End FY 10
$0	$0	$0	$0	$0	$0	$0	$0	$0	$0

End FY 11	End FY 12
$0	$0

TOTAL	TOTAL NPV
$0	$0

EXPECTED NPV
$0

	Description of different usage of outputs that is expected and quantification of scale of expected costs associated with usage of outputs and how these estimates were made	Probability that all required output(s) to enable this usage are produced	Rationale for enabling output(s) delivery probability selection	Probability of usage: given required outputs generated	Rationale for usage probability selections
Usage 4.02	Usage 4.02 flows from Output 4.02, a set of genetic parameters for female reproductive traits in Northern Australian herds and their association with steer traits. This information, in conjunction with Output 4.01, a set of genetic parameters for new male reproductive traits in Northern Australian herds, will be delivered directly to BREEDPLAN for use by seedstock producers to breed females with higher reproductive performance. Assumed adoption is 30% of the Northern industry. Usage costs are acounted for in the estimation of net impacts.	**90%**		**90%**	Beef cattle seedstock producers will access the new gEBV data from BREEDPLAN in exactly the same way as they have done in the past. Commercial beef cattle producers will access the new genetically superior bulls in exactly the same way as they have done in the past. They need to replace bulls about every 3 years. They do this by purchasing from a specialist seedstock producer, from other bull breeders or by using a bull they have bred themselves. Currently about 1/3 of bulls used are BREEDPLAN registered and come from specialist seedstock producers. Given the increased accuracy of prediction of cow profitability through the use of gEBVs, commercial producers will be more likely to use BREEDPLAN registered bulls. It is estimated the proportion of commercial producers using BREEDPLAN registered bulls will rise to 50%.

Usage 4.02

Timeline of key usage milestones

End FY 1	End FY 2	End FY 3	End FY 4	End FY 5
Northern Pastoral Group of companies, managing over 2 million breeders, begin receiving updated EBVs for steer and female reproductive traits. These are updated annually.		15 markers found with significant additive effect on age of puberty in Brahmans and Tropical Composities		New imputation methods allow at least 15% explanation of genetic variance both within and across breeds. New significant markers found for age of puberty.

End FY 6	End FY 7	End FY 8	End FY 9	End FY 10
	100,000 cows mated	200,000 cows mated	600,000 cows mated	1,000,000 cows mated

End FY 11	End FY 12
1,500,000 cows mated	2,000,000 cows mated

Estimate of $ costs associated with usage (including cost for further refinement and application) of output(s)

End FY 1	End FY 2	End FY 3	End FY 4	End FY 5	End FY 6	End FY 7	End FY 8	End FY 9	End FY 10
$0	$0	$0	$0	$0	$0	$0	$0	$0	$0

End FY 11	End FY 12
$0	$0

TOTAL	TOTAL NPV	EXPECTED NPV
$0	$0	$0

Research Program 5 Education and Training

Usage 5.01

Description of different usage of outputs that is expected and quantification of scale of expected costs associated with usage of outputs and how these estimates were made	Probability that all required output(s) to enable this usage are produced	Rationale for enabling output(s) delivery probability selection	Probability of usage: given required outputs generated	Rationale for usage probability selections
Usage 5.01 flows from Output 5.01, a network of young scientists with advanced training in the sciences underpinning beef genetic improvement and effective innovation, commercialisation and adoption of outputs. This network of young scientists will bring new skills and knowledge to a range of scientific, extension and management positions within the Australian beef industry .	**0%**		**0%**	

Usage 5.01

Timeline of key usage milestones

End FY 1	End FY 2	End FY 3	End FY 4	End FY 5

End FY 6	End FY 7	End FY 8	End FY 9	End FY 10

End FY 11	End FY 12

Estimate of $ costs associated with usage (including cost for further refinement and application) of output(s)

End FY 1	End FY 2	End FY 3	End FY 4	End FY 5	End FY 6	End FY 7	End FY 8	End FY 9	End FY 10
$0	$0	$0	$0	$0	$0	$0	$0	$0	$0

End FY 11	End FY 12
$0	$0

TOTAL	TOTAL NPV
$0	$0

EXPECTED NPV
$0

	Description of different usage of outputs that is expected and quantification of scale of expected costs associated with usage of outputs and how these estimates were made	Probability that all required output(s) to enable this usage are produced	Rationale for enabling output(s) delivery probability selection	Probability of usage: given required outputs generated	Rationale for usage probability selections
Usage 5.02	Usage 5.02 flows from Output 5.02, an information package about new research results, tools and technologies to achieve a balance between cow and foetus nutrition status and compliance with market specifications. This package is delivered by extension agencies to commercial cattle producers who will use this information to make better management decisions that would lead to positive impacts on productivity and profitability in beef businesses. Target market are Southern Australian cattle breeders who tend to have feed constraints at some period of the year. These would be mostly the 17,000 small and very small herds who make up about 20% of the Southern breeding herd. To be conservative assume 250,000 breeding cows are subjected to revised nutritional decisions 5 years after release of major distillation messages. The cost of implementing interventions predicted by the models is included in the net impact.	**100%**	Outputs have been produced already.	**90%**	The technical and economic information already available provides guidelines for the profitable use of new cow nutritional strategies to improve compliance with market specifications.

Usage 5.02

Timeline of key usage milestones

End FY 1	End FY 2	End FY 3	End FY 4	End FY 5
Scientific publications begin to appear, some local field days. 10,000 breeding cows influenced by revised nutritional strategies.	Further scientific publications appear, major economic report released. Broader awareness through NSW DPI extension conferences. 20,000 breeding cows influenced by revised nutritional strategies.	20,000 breeding cows influenced by revised nutritional strategies.	Special edition of AJEA on the scientific results of all growth path experiments. Increasing awareness across Southern Australia. 30,000 breeding cows influenced by revised nutritional strategies.	A major publication released which distilled the key messages from the growth path results. Broader awareness across Southern Australia production systems. 50,000 breeding cows influenced by revised nutritional strategies.

End FY 6	End FY 7	End FY 8	End FY 9	End FY 10
100,000 breeding cows influenced by revised nutritional strategies.	150,000 breeding cows influenced by revised nutritional strategies.	200,000 breeding cows influenced by revised nutritional strategies.	250,000 breeding cows influenced by revised nutritional strategies.	250,000 breeding cows influenced by revised nutritional strategies.

End FY 11	End FY 12
250,000 breeding cows influenced by revised nutritional strategies.	250,000 breeding cows influenced by revised nutritional strategies.

Estimate of $ costs associated with usage (including cost for further refinement and application) of output(s)

End FY 1	End FY 2	End FY 3	End FY 4	End FY 5	End FY 6	End FY 7	End FY 8	End FY 9	End FY 10
$0	$0	$0	$0	$0	$0	$0	$0	$0	$0

End FY 11	End FY 12
$0	$0

TOTAL	TOTAL NPV	EXPECTED NPV
$0	$0	$0

	Description of different usage of outputs that is expected and quantification of scale of expected costs associated with usage of outputs and how these estimates were made	Probability that all required output(s) to enable this usage are produced	Rationale for enabling output(s) delivery probability selection	Probability of usage: given required outputs generated	Rationale for usage probability selections
Usage 5.03	Usage 5.02 flows from Output 5.02, an information package about new research results, tools and technologies to achieve the best combination of cattle genetics and management inputs and still comply with market specifications. This package is delivered by extension agencies to commercial cattle producers who will use this information to make better management decisions that would lead to positive impacts on productivity and profitability in beef businesses. Target market are 2 million Southern Australian commercial steer producers who mainly finish on grass. To be conservative assume 250,000 finished steers are subjected to revised nutritional decisions 5 years after release of major distillation messages. The cost of implementing interventions predicted by the models is included in the net impact . The package is also delivered to processors and buyers so that they are aware of the factors causing non compliance.	**100%**	Outputs already delivered in previous CRCs.	**90%**	The technical and economic information already available provides guidelines for the profitable combination of genetics and management inputs to improve compliance with market specifications.

Usage 5.03

Timeline of key usage milestones

End FY 1	End FY 2	End FY 3	End FY 4	End FY 5
Scientific publications begin to appear, some local field days. 10,000 finished steers influenced by revised nutritional strategies.	Scientific publications begin to appear, some local field days. 10,000 finished steers influenced by revised nutritional strategies.	20,000 finished steers influenced by revised nutritional strategies.	Special edition of AJEA on the scientific results of all growth path experiments. Set of economics publications released.Increasing awareness across Southern Australia. 30,000 finished steers influenced by revised nutritional strategies.	A major publication released which distilled the key messages from the growth path results. Broader awareness across Southern Australia production systems. 50,000 finished steers influenced by revised nutritional strategies.

End FY 6	End FY 7	End FY 8	End FY 9	End FY 10
100,000 finished steers influenced by revised nutritional strategies.	150,000 finished steers influenced by revised nutritional strategies.	200,000 finished steers influenced by revised nutritional strategies.	250,000 finished steers influenced by revised nutritional strategies.	250,000 finished steers influenced by revised nutritional strategies.

End FY 11	End FY 12
250,000 finished steers influenced by revised nutritional strategies.	250,000 finished steers influenced by revised nutritional strategies.

Estimate of $ costs associated with usage (including cost for further refinement and application) of output(s)

End FY 1	End FY 2	End FY 3	End FY 4	End FY 5	End FY 6	End FY 7	End FY 8	End FY 9	End FY 10
$0	$0	$0	$0	$0	$0	$0	$0	$0	$0

End FY 11	End FY 12
$0	$0

TOTAL	TOTAL NPV	EXPECTED NPV
$0	$0	$0

	Description of different usage of outputs that is expected and quantification of scale of expected costs associated with usage of outputs and how these estimates were made	Probability that all required output(s) to enable this usage are produced	Rationale for enabling output(s) delivery probability selection	Probability of usage: given required outputs generated	Rationale for usage probability selections
Usage 5.04	Usage 5.04 flows from Output 5.02, an information package about new research results, tools and technologies to increase reproduction rates in Northern Australian cattle herds. This package is delivered by extension agencies to commercial cattle producers who will use this information to make better management decisions that would lead to positive impacts on productivity and profitability in beef businesses.	**0%**		**0%**	

Usage 5.04

Timeline of key usage milestones

End FY 1	End FY 2	End FY 3	End FY 4	End FY 5

End FY 6	End FY 7	End FY 8	End FY 9	End FY 10

End FY 11	End FY 12

Estimate of $ costs associated with usage (including cost for further refinement and application) of output(s)

End FY 1	End FY 2	End FY 3	End FY 4	End FY 5	End FY 6	End FY 7	End FY 8	End FY 9	End FY 10
$0	$0	$0	$0	$0	$0	$0	$0	$0	$0

End FY 11	End FY 12
$0	$0

TOTAL	TOTAL NPV
$0	$0

EXPECTED NPV
$0

	Description of different usage of outputs that is expected and quantification of scale of expected costs associated with usage of outputs and how these estimates were made	Probability that all required output(s) to enable this usage are produced	Rationale for enabling output(s) delivery probability selection	Probability of usage: given required outputs generated	Rationale for usage probability selections
Usage 5.05	Usage 5.05 flows from Output 5.02, an information package about new research results, tools and technologies to increase reproduction rates in Southern Australian cattlke herds. This package is delivered by extension agencies to commercial cattle producers who will use this information to make better management decisions that would lead to positive impacts on productivity and profitability in beef businesses.	**0%**		**0%**	

Usage 5.05

Timeline of key usage milestones

End FY 1	End FY 2	End FY 3	End FY 4	End FY 5

End FY 6	End FY 7	End FY 8	End FY 9	End FY 10

End FY 11	End FY 12

Estimate of $ costs associated with usage (including cost for further refinement and application) of output(s)

End FY 1	End FY 2	End FY 3	End FY 4	End FY 5	End FY 6	End FY 7	End FY 8	End FY 9	End FY 10
$0	$0	$0	$0	$0	$0	$0	$0	$0	$0

End FY 11	End FY 12
$0	$0

TOTAL	TOTAL NPV
$0	$0

EXPECTED NPV
$0

	Description of different usage of outputs that is expected and quantification of scale of expected costs associated with usage of outputs and how these estimates were made	Probability that all required output(s) to enable this usage are produced	Rationale for enabling output(s) delivery probability selection	Probability of usage: given required outputs generated	Rationale for usage probability selections
Usage 5.06	Usage 5.06 flows from Output 5.06, a network of Beef Profit Partnerships that routinely assess new research results, tools and technologies and implement those that are beneficial. The BPP members are the direct users of the network. They make better management decisions that would lead to positive impacts on productivity and profitability in beef businesses. No extra usage costs are estimated as the net benefits include these costs.	**100%**	The network exists, facilitators are trained and key government extension agenies are supportive.	**100%**	Existing members are deriving significant profitability benefits and the network is growing

Usage 5.06

Timeline of key usage milestones

End FY 1	End FY 2	End FY 3	End FY 4	End FY 5

End FY 6	End FY 7	End FY 8	End FY 9	End FY 10
	BPP Forums to be held to communicate achievements to the wider beef industry.	Existing BPPs to continue, and benefits to reach another 5% of industry in QLD, NSW, Vic and WA within 5 years.		

End FY 11	End FY 12

Estimate of $ costs associated with usage (including cost for further refinement and application) of output(s)

End FY 1	End FY 2	End FY 3	End FY 4	End FY 5	End FY 6	End FY 7	End FY 8	End FY 9	End FY 10
$0	$0	$0	$0	$0	$0	$0	$0	$0	$0

End FY 11	End FY 12
$0	$0

TOTAL	TOTAL NPV
$0	$0

EXPECTED NPV
$0

	Description of different usage of outputs that is expected and quantification of scale of expected costs associated with usage of outputs and how these estimates were made	Probability that all required output(s) to enable this usage are produced	Rationale for enabling output(s) delivery probability selection	Probability of usage: given required outputs generated	Rationale for usage probability selections
Usage 5.07	Usage 5.07 flows from Output 5.07, an accreditied set of training materials and resources for a course called More Beef from Breeding. This package, in conjunction with Outputs 5.02 and 5.03 and other outputs across the CRC, is delivered by accredited extension officers to Southern Australia seedstock and commercial cattle producers who will use this information to make better finishing herd management decisions that would lead to positive impacts on productivity and profitability in beef businesses.	**0%**		**0%**	

Usage 5.07

Timeline of key usage milestones

End FY 1	End FY 2	End FY 3	End FY 4	End FY 5

End FY 6	End FY 7	End FY 8	End FY 9	End FY 10

End FY 11	End FY 12

Estimate of $ costs associated with usage (including cost for further refinement and application) of output(s)

End FY 1	End FY 2	End FY 3	End FY 4	End FY 5	End FY 6	End FY 7	End FY 8	End FY 9	End FY 10
$0	$0	$0	$0	$0	$0	$0	$0	$0	$0

End FY 11	End FY 12
$0	$0

TOTAL	TOTAL NPV
$0	$0

EXPECTED NPV
$0

	Description of different usage of outputs that is expected and quantification of scale of expected costs associated with usage of outputs and how these estimates were made	Probability that all required output(s) to enable this usage are produced	Rationale for enabling output(s) delivery probability selection	Probability of usage: given required outputs generated	Rationale for usage probability selections
Usage 5.08	Usage 5.08 flows from Output 5.08, an accredited set of training materials and resources for a course called Breeder Herd Management. This package, in conjunction with Outputs 5.04 and 5.05 and other outputs across the CRC, is delivered by accredited extension officers to Northern Australia seedstock producers and commercial cattle producers who will use this information to make better breeder herd management decisions that would lead to positive impacts on productivity and profitability in beef businesses.	**0%**		**0%**	

Usage 5.08

Timeline of key usage milestones

End FY 1	End FY 2	End FY 3	End FY 4	End FY 5

End FY 6	End FY 7	End FY 8	End FY 9	End FY 10

End FY 11	End FY 12

Estimate of $ costs associated with usage (including cost for further refinement and application) of output(s)

End FY 1	End FY 2	End FY 3	End FY 4	End FY 5	End FY 6	End FY 7	End FY 8	End FY 9	End FY 10
$0	$0	$0	$0	$0	$0	$0	$0	$0	$0

End FY 11	End FY 12
$0	$0

TOTAL	TOTAL NPV
$0	$0

EXPECTED NPV
$0

	Description of different usage of outputs that is expected and quantification of scale of expected costs associated with usage of outputs and how these estimates were made	Probability that all required output(s) to enable this usage are produced	Rationale for enabling output(s) delivery probability selection	Probability of usage: given required outputs generated	Rationale for usage probability selections
Usage 5.09	Usage 5.09 flows from Output 5.09, an accredited set of training materials and resources for a course called Continuous Improvement and Innovation. This package, in conjunction with Output 5.06 and other outputs across the CRC, is delivered by accredited trainers to extension agencies and commercial cattle producers who to make positive impacts on productivity and profitability in beef businesses.	**0%**		**0%**	

Usage 5.09

Timeline of key usage milestones

End FY 1	End FY 2	End FY 3	End FY 4	End FY 5

End FY 6	End FY 7	End FY 8	End FY 9	End FY 10

End FY 11	End FY 12

Estimate of $ costs associated with usage (including cost for further refinement and application) of output(s)

End FY 1	End FY 2	End FY 3	End FY 4	End FY 5	End FY 6	End FY 7	End FY 8	End FY 9	End FY 10
$0	$0	$0	$0	$0	$0	$0	$0	$0	$0

End FY 11	End FY 12
$0	$0

TOTAL	TOTAL NPV
$0	$0

EXPECTED NPV
$0

Research Program 6 Administration, Commercialisation and Business Development

	Description of different usage of outputs that is expected and quantification of scale of expected costs associated with usage of outputs and how these estimates were made	Probability that all required output(s) to enable this usage are produced	Rationale for enabling output(s) delivery probability selection	Probability of usage: given required outputs generated	Rationale for usage probability selections
Usage 6.01	Usage 6.01 flows from Output 6.01, which is efficient and effective administration; an identified brand for the CRC; a set of strong internal and external dissemination networks; an effective dissemination strategy; processes for the identification, protection and management of intellectual property; and a "path to market" for the commercialisation of new research results, tools and technologies. These outputs are all for internal CRC use or for use by partner organisations. They facilitate usage of CRC products by others and contribute to the financial impacts achieved by those other users. No separate usage costs are specified.	**0%**		**0%**	

Usage 6.01

Timeline of key usage milestones

End FY 1	End FY 2	End FY 3	End FY 4	End FY 5

End FY 6	End FY 7	End FY 8	End FY 9	End FY 10

End FY 11	End FY 12

Estimate of $ costs associated with usage (including cost for further refinement and application) of output(s)

End FY 1	End FY 2	End FY 3	End FY 4	End FY 5	End FY 6	End FY 7	End FY 8	End FY 9	End FY 10
$0	$0	$0	$0	$0	$0	$0	$0	$0	$0

End FY 11	End FY 12
$0	$0

TOTAL	TOTAL NPV
$0	$0

EXPECTED NPV
$0

Research Program 7 Underpinning Science

Usage 7.01

Description of different usage of outputs that is expected and quantification of scale of expected costs associated with usage of outputs and how these estimates were made	Probability that all required output(s) to enable this usage are produced	Rationale for enabling output(s) delivery probability selection	Probability of usage: given required outputs generated	Rationale for usage probability selections
Usage 7.01 flows from Output 7.01, a set of genomic prediction equations for meat tenderness. This information has been delivered directly to BREEDPLAN, and is therefore included in Usage 1.01, and to the MSA Pathways team, and is therefore included in Usage 1.05.	**100%**		**95%**	Beef cattle seedstock producers will access the new gEBV data from BREEDPLAN in exactly the same way as they have done in the past. Commercial beef cattle producers will access the new genetically superior bulls in exactly the same way as they have done in the past. They need to replace bulls about every 3 years. They do this by purchasing from a specialist seedstock producer, from other bull breeders or by using a bull they have bred themselves. Currently about 1/3 of bulls used are BREEDPLAN registered and come from specialist seedstock producers. Given the increased accuracy of prediction of cow profitability through the use of gEBVs, commercial producers will be more likely to use BREEDPLAN registered bulls. It is estimated the proportion of commercial producers using BREEDPLAN registered bulls will rise to 35%.

Usage 7.01

Timeline of key usage milestones

End FY 1	End FY 2	End FY 3	End FY 4	End FY 5
End FY 6	**End FY 7**	**End FY 8**	**End FY 9**	**End FY 10**
3600 young animals, mainly bulls, are now fully genotyped, data used in development of prediction equations	BREEDPLAN and other service providers accept CRC prediction equations and offer gEBVs with average 30% accuracy.	Seedstock producers begin using gEBV data with average 30% accuracy in their breeding decisions. 3600 young genotyped animals used in breeding, across approximately 100,000 cows	35% of commercial beef producers start purchasing BREEDPLAN registered, superior bulls with gEBVs of 30% accuracy.	Owners of 100,000 cows who used genotyped bulls have progeny for sale.
End FY 11	**End FY 12**			
	Commercial producers using BREEDPLAN registered bulls with average 30% accuracy in gEBVs have progeny for sale.			

Estimate of $ costs associated with usage (including cost for further refinement and application) of output(s)

End FY 1	End FY 2	End FY 3	End FY 4	End FY 5	End FY 6	End FY 7	End FY 8	End FY 9	End FY 10
$0	$0	$0	$0	$0	$0	$0	$0	$0	$0

End FY 11	End FY 12
$0	$0

TOTAL	TOTAL NPV	EXPECTED NPV
$0	$0	$0

	Description of different usage of outputs that is expected and quantification of scale of expected costs associated with usage of outputs and how these estimates were made	Probability that all required output(s) to enable this usage are produced	Rationale for enabling output(s) delivery probability selection	Probability of usage: given required outputs generated	Rationale for usage probability selections
Usage 7.02	Usage 7.02 flows from Output 7.02, a set of genomic prediction equations for for growth, feed efficiency, carcase and beef quality that account for at least 15% of the genetic variance for these traits. This information has been delivered directly to BREEDPLAN, and is therefore included in Usage 1.01.	**90%**		**90%**	

Usage 7.02

Timeline of key usage milestones

End FY 1	End FY 2	End FY 3	End FY 4	End FY 5

End FY 6	End FY 7	End FY 8	End FY 9	End FY 10

End FY 11	End FY 12

Estimate of $ costs associated with usage (including cost for further refinement and application) of output(s)

End FY 1	End FY 2	End FY 3	End FY 4	End FY 5	End FY 6	End FY 7	End FY 8	End FY 9	End FY 10
$0	$0	$0	$0	$0	$0	$0	$0	$0	$0

End FY 11	End FY 12
$0	$0

TOTAL	TOTAL NPV
$0	$0

EXPECTED NPV
$0

	Description of different usage of outputs that is expected and quantification of scale of expected costs associated with usage of outputs and how these estimates were made	Probability that all required output(s) to enable this usage are produced	Rationale for enabling output(s) delivery probability selection	Probability of usage: given required outputs generated	Rationale for usage probability selections
Usage 7.03	Usage 7.03 flows from Output 7.03, a set of DNA markers for post-partum reconception and age of puberty that account for at least 15% of the genetic variance for these traits. This information has been delivered directly to BREEDPLAN and will be used in conjuction with Output 4.01 and Output 4.02.	**95%**		**90%**	

Usage 7.03

Timeline of key usage milestones

End FY 1	End FY 2	End FY 3	End FY 4	End FY 5
		15 markers found with significant additive effect on age of puberty in Brahmans and Tropical Composities		New imputation methods allow explanation of at least 15% of genetic variance both within and across breeds. New significant markers found for age of puberty.

End FY 6	End FY 7	End FY 8	End FY 9	End FY 10
	New genomic prediction equations released and incorporated into BREEDPLAN EBVs. Seedstock breeders begin offering bulls with better age at puberty and post partum reconception EBVs			

End FY 11	End FY 12

Estimate of $ costs associated with usage (including cost for further refinement and application) of output(s)

End FY 1	End FY 2	End FY 3	End FY 4	End FY 5	End FY 6	End FY 7	End FY 8	End FY 9	End FY 10
$0	$0	$0	$0	$0	$0	$0	$0	$0	$0

End FY 11	End FY 12
$0	$0

TOTAL	TOTAL NPV
$0	$0

EXPECTED NPV
$0

	Description of different usage of outputs that is expected and quantification of scale of expected costs associated with usage of outputs and how these estimates were made	Probability that all required output(s) to enable this usage are produced	Rationale for enabling output(s) delivery probability selection	Probability of usage: given required outputs generated	Rationale for usage probability selections
Usage 7.04	Usage 7.04 flows from Output 7.04, a set of DNA markers for resistance to ticks and worms that account for at least 15% of the genetic variance for these traits. In 2009, the Beef CRC's gene discovery work in this area was agreed to become Background IP for an ongoing project directly between CSIRO and Pfizer and Animal Genetics under the terms of CSIRO's Supporting Participant's Agreement with Beef CRC. This was necessitated due to the need to develop very expensive additional phenotypes that will be funded by Pfizer. The Beef CRC has retained the right to evaluate the relationships between adaptive and productive traits for potential use in BREEDPLAN.	**0%**		**0%**	

Usage 7.04

Timeline of key usage milestones

End FY 1	End FY 2	End FY 3	End FY 4	End FY 5

End FY 6	End FY 7	End FY 8	End FY 9	End FY 10

End FY 11	End FY 12

Estimate of $ costs associated with usage (including cost for further refinement and application) of output(s)

End FY 1	End FY 2	End FY 3	End FY 4	End FY 5	End FY 6	End FY 7	End FY 8	End FY 9	End FY 10
$0	$0	$0	$0	$0	$0	$0	$0	$0	$0

End FY 11	End FY 12
$0	$0

TOTAL	TOTAL NPV
$0	$0

EXPECTED NPV
$0

	Description of different usage of outputs that is expected and quantification of scale of expected costs associated with usage of outputs and how these estimates were made	Probability that all required output(s) to enable this usage are produced	Rationale for enabling output(s) delivery probability selection	Probability of usage: given required outputs generated	Rationale for usage probability selections
Usage 7.05	Usage 7.05 flows from Output 7.05, a full genome sequence for the Brahman, Africander and Tuli breeds. This information has been delivered directly to SNP panel service providers. No further usage costs required.	**0%**		**0%**	

Usage 7.05

Timeline of key usage milestones

End FY 1	End FY 2	End FY 3	End FY 4	End FY 5

End FY 6	End FY 7	End FY 8	End FY 9	End FY 10
Full genome sequence for the Brahman, Africander and Tuli bulls made available commercially.				

End FY 11	End FY 12

Estimate of $ costs associated with usage (including cost for further refinement and application) of output(s)

End FY 1	End FY 2	End FY 3	End FY 4	End FY 5	End FY 6	End FY 7	End FY 8	End FY 9	End FY 10
$0	$0	$0	$0	$0	$0	$0	$0	$0	$0

End FY 11	End FY 12
$0	$0

TOTAL	TOTAL NPV
$0	$0

EXPECTED NPV
$0

Impacts

Research Program 1 High Quality Beef for Global Consumers

Impact 1.01

Description of type (express in terms such as increased profits for companies, earnings for individuals or cost savings to government), scale and recipients of expected monetary impacts associated with usage of outputs. Include description of how dollar values for impact were reached.	Probability of usage(s) required to enable impact occurring	Rationale for probability calculation *Note: The 'Probability of usage(s) required to enable impact occurring' must be claculated using the figures provided on the Usage tab (see Impact Tool - Applicant's User Guide)*	Probability of monetary impacts occurring (assuming usage(s) has occurred as expected)	Rationale for probability selection
Impact 1.01 comes from Usage 1.01, part of Usage 2.01, Usage 4.01 and Usage 4.02. This is the value of increased rates of genetic progress in the commercial herd, due to more trait measurement. It is measured by $index values, flowing from previous breeding decisions made by seedstock producers, due to more accurate EBVs delivered through BREEDPLAN and other commercial genetics companies, net of genetic progress already set in train from previous R&D. The raw data come from Banks (2012), and the specific assumptions are provided in an Appendix. The additional benefits for 4.5m cows commence in year 7 at $0.33/cow/year, while the additional benefits for the other 8.5m cows commence in year 12 at $0.23/cow/year. Genetic progress is cumulative (Griffith 2012b), so there are many benefits after year 15, approximately $102m undiscounted for the 10 additional years to year 25.	**95%**	There are some risks that seedstock producers will not make use of the new EBV data, although the higher levels of accuracy will mean higher profit per cow.	**95%**	There is little chance that the estimated monetary impacts will not accrue as predicted. Commercial cattle producers aim to meet specific target market specifications and they use genetic, nutrition and other inputs to try and minimse the cost of non-compliance. Thus they generally have a well specified breeding program underway. Once improved genetics are introduced into the herd, genetic improvement continues to occur at every mating, so the underlying rates of genetic gain will aggregate over time. Very little from the external environment can influence this. The $ index value simply values this underlying genetic improvement. The $ values tend to be both conservative for the value of individual traits and lagged, so they are probably underestimates at any point in time. With beef prices predicted to increase substantially in the next few decades, there is little chance that the $ index values will overestimate the value of the genetic improvement brought about by the more accuracy EBVs.

Impact 1.01

Timeline of key impact milestones

End FY 1	End FY 2	End FY 3	End FY 4	End FY 5
Northern Pastoral Group of companies, managing over 2 million breeders, begin receiving updated EBVs for steer and female reproductive traits. These are updated annually, but no explicit allowance is made for resulting improvements in genetic gain.				
End FY 6	**End FY 7**	**End FY 8**	**End FY 9**	**End FY 10**
		Seedstock producers begin using EBV data with average 35% accuracy in their breeding decisions.	35% of commercial beef producers start purchasing BREEDPLAN registered, superior bulls with average 35% accuracy.	
End FY 11	**End FY 12**	**End FY 13**	**End FY 14**	**End FY 15**
	Commercial producers using BREEDPLAN registered bulls with average 35% accuracy have progeny for sale with higher index values.		65% of commercial beef producers start purchasing non-BREEDPLAN registered, superior bulls with average 35% accuracy.	

Estimate of $ value associated with impact(s)

End FY 1	End FY 2	End FY 3	End FY 4	End FY 5	End FY 6	End FY 7	End FY 8	End FY 9	End FY 10
						$1,520,000	$1,600,000	$1,680,000	$2,640,000

End FY 11	End FY 12	End FY 13	End FY 14	End FY 15
$2,770,000	$4,890,000	$5,130,000	$5,390,000	$6,800,000

TOTAL	TOTAL NPV
$32,420,000	$17,923,130

EXPECTED NPV
$16,175,625

	Description of type (express in terms such as increased profits for companies, earnings for individuals or cost savings to government), scale and recipients of expected monetary impacts associated with usage of outputs. Include description of how dollar values for impact were reached.	Probability of usage(s) required to enable impact occurring	Rationale for probability calculation *Note: The 'Probability of usage(s) required to enable impact occurring' must be claculated using the figures provided on the Usage tab (see Impact Tool - Applicant's User Guide)*	Probability of monetary impacts occurring (assuming usage(s) has occurred as expected)	Rationale for probability selection
Impact 1.02	Impact 1.02 results from Usage 1.02, the use by commercial producers of a model to predict growth traits of steers during finishing and carcase traits at slaughter, for groups of cattle, that will enable an increased rate of compliance with market specifications with associated improvements in profitability. The average cost of non-compliance is $40/head (Slack-Smith et al 2009). Use of the BeefSpecs steer model reduces non-compliance by 50% ($20/head) (McKiernan 2011). Allowing for the costs of an intervention strategy gives a net return of $10/head.	**86%**	A simple version of the model is already developed and has been trialled and adopted and shown to be profitable. A risk is that by introducing ongoing enhancements to the model that there will be unforseen interactions which result in poor predictions.	**90%**	Non-compliance levels have not improved over time, so the costs of non-compliance will increase over time as the value of the carcase increases. Beef prices are expected to increase significantly over the next 20 years. In the grass finishing sector, competiton from alternative users of pasture such as the expanding prime lamb industry puts upward pressure on the opportunity cost of pasture and so savings in pasture costs will continue to be important.

Impact 1.02

Timeline of key impact milestones

End FY 1	End FY 2	End FY 3	End FY 4	End FY 5
		Assume 20,000 steers assessed by Beef Specs.	Assume 50,000 steers assessed by Beef Specs.	Assume 100,000 steers assessed by Beef Specs.
End FY 6	**End FY 7**	**End FY 8**	**End FY 9**	**End FY 10**
Assume 250,000 steers assessed by Beef Specs.	Assume 500,000 steers assessed by Beef Specs.	Assume 750,000 steers assessed by Beef Specs.	Assume 1,000,000 steers assessed by Beef Specs.	Assume 1,000,000 steers assessed by Beef Specs.
End FY 11	**End FY 12**	**End FY 13**	**End FY 14**	**End FY 15**
Assume 1,000,000 steers assessed by Beef Specs.	Assume 1,000,000 steers assessed by Beef Specs.	Assume 1,000,000 steers assessed by Beef Specs.	Assume 1,000,000 steers assessed by Beef Specs.	Assume 1,000,000 steers assessed by Beef Specs.

Estimate of $ value associated with impact(s)

End FY 1	End FY 2	End FY 3	End FY 4	End FY 5	End FY 6	End FY 7	End FY 8	End FY 9	End FY 10
$0	$0	$200,000	$500,000	$1,000,000	$2,500,000	$5,000,000	$7,500,000	$10,000,000	$10,000,000
End FY 11	**End FY 12**	**End FY 13**	**End FY 14**	**End FY 15**					
$10,000,000	$10,000,000	$10,000,000	$10,000,000	$10,000,000					

TOTAL	TOTAL NPV
$86,700,000	$51,027,338

EXPECTED NPV
$39,495,160

	Description of type (express in terms such as increased profits for companies, earnings for individuals or cost savings to government), scale and recipients of expected monetary impacts associated with usage of outputs. Include description of how dollar values for impact were reached.	Probability of usage(s) required to enable impact occurring	Rationale for probability calculation *Note: The 'Probability of usage(s) required to enable impact occurring' must be claculated using the figures provided on the Usage tab (see Impact Tool - Applicant's User Guide)*	Probability of monetary impacts occurring (assuming usage(s) has occurred as expected)	Rationale for probability selection
Impact 1.03	Impact 1.03 results from Usage 1.03, the use by larger commercial producers of an on-farm drafting tool for individual animals that will enable an increased rate of compliance with market specifications with associated improvements in profitability. The average cost of non-compliance is $40/head (Slack-Smith et al 2009). Use of the BeefSpecs steer model reduces non-compliance by 50% ($20/head) (McKiernan 2011). Allowing for the costs of an intervention strategy gives a net return of $10/head. Assume the onfarm drafting tool for individual animals, which better predicts growth traits during finishing and carcase traits at slaughter, allows another $5/head net improvement.	**72%**	A simple version of the model is already developed and has been trialled and adopted. The automated hip height measuring system is still not finalised. A risk is that by introducing ongoing enhancements to the model that there will be unforseen interactions which result in poor predictions. The strategy of sequential testing and validation should ensure that this risk is minimised.	**90%**	Non-compliance levels have not improved over time, so the costs of non-compliance will increase over time as the value of the carcase increases. Beef prices are expected to increase significantly over the next 20 years. In the grass finishing sector, competition from alternative users of pasture such as the expanding prime lamb industry puts upward pressure on the opportunity cost of pasture and so savings in pasture costs will continue to be important.

Impact 1.03

Timeline of key impact milestones

End FY 1	End FY 2	End FY 3	End FY 4	End FY 5
End FY 6	**End FY 7**	**End FY 8**	**End FY 9**	**End FY 10**
	Cooperating producers provide data to develop and test the on farm drafting tool. Compliance rates decrease for 20,000 commercial cattle.	Cooperating producers validate the on farm drafting tool to save costs. Compliance rates decrease for 50,000 commercial cattle.	Model released to wider industry, commercial producers begin using, Compliance rates decrease for 100,000 commercial cattle.	Compliance rates decrease for 200,000 commercial cattle.
End FY 11	**End FY 12**	**End FY 13**	**End FY 14**	**End FY 15**
Compliance rates decrease for 300,000 commercial steers and heifers.	Compliance rates decrease for 400,000 commercial steers and heifers.	Compliance rates decrease for 500,000 commercial steers and heifers.	Compliance rates decrease for 500,000 commercial steers and heifers.	Compliance rates decrease for 500,000 commercial steers and heifers.

Estimate of $ value associated with impact(s)

End FY 1	End FY 2	End FY 3	End FY 4	End FY 5	End FY 6	End FY 7	End FY 8	End FY 9	End FY 10
$0	$0	$0	$0	$0	$0	$100,000	$250,000	$500,000	$1,000,000
End FY 11	**End FY 12**	**End FY 13**	**End FY 14**	**End FY 15**					
$1,500,000	$2,000,000	$2,500,000	$2,500,000	$2,500,000					

TOTAL	TOTAL NPV	EXPECTED NPV
$12,850,000	$6,958,205	$4,508,917

Impact 1.04	Description of type (express in terms such as increased profits for companies, earnings for individuals or cost savings to government), scale and recipients of expected monetary impacts associated with usage of outputs. Include description of how dollar values for impact were reached.	Probability of usage(s) required to enable impact occurring	Rationale for probability calculation *Note: The 'Probability of usage(s) required to enable impact occurring' must be claculated using the figures provided on the Usage tab (see Impact Tool - Applicant's User Guide)*	Probability of monetary impacts occurring (assuming usage(s) has occurred as expected)	Rationale for probability selection
	Usage 1.04 flows from Output 1.04, an optimisation model to predict least cost growth paths of cattle during finishing that will enable an increased rate of compliance with market specifications with associated improvements in profitability. This model will be used directly by large commercial feedlot operators. The optimisation model generates savings in feed costs from better prediction of days on feed required to achieve specification. Using the model to just optimise days on feed for the existing pen allocations increased profitability by a minimum of 25% (McKiernan 2011). With a daily feed cost of $2/head, an extra 5% saving is $35/head/year.	**64%**	A simple version of the model is already developed and has been trialled and adopted. The automated hip height measuring system is still not finalised. A risk is that by introducing ongoing enhancements to the model that there will be unforseen interactions which result in poor predictions. The strategy of sequential testing and validation should ensure that this risk is minimised.	**95%**	Non-compliance levels have not improved over time, so the costs of non-compliance will increase over time as the value of the carcase increases. Beef prices are expected to increase significantly over the next 20 years. In the feedlots, grain prices are predicted to double in 20 years, so savings in feed costs will increase in importantance.

Impact 1.04

Timeline of key impact milestones

End FY 1	End FY 2	End FY 3	End FY 4	End FY 5
End FY 6	**End FY 7**	**End FY 8**	**End FY 9**	**End FY 10**
		150,000 animals in feedlots assessed by the optimisation model.	150,000 animals in feedlots assessed by the optimisation model.	150,000 animals in feedlots assessed by the optimisation model.
End FY 11	**End FY 12**	**End FY 13**	**End FY 14**	**End FY 15**
300,000 animals in feedlots assessed by the optimisation model.	400,000 animals in feedlots assessed by the optimisation model.	500,000 animals in feedlots assessed by the optimisation model.	500,000 animals in feedlots assessed by the optimisation model.	500,000 animals in feedlots assessed by the optimisation model.

Estimate of $ value associated with impact(s)

End FY 1	End FY 2	End FY 3	End FY 4	End FY 5	End FY 6	End FY 7	End FY 8	End FY 9	End FY 10
$0	$0	$0	$0	$0	$0	$0	$5,250,000	$5,250,000	$5,250,000
End FY 11	**End FY 12**	**End FY 13**	**End FY 14**	**End FY 15**					
$10,500,000	$14,000,000	$17,500,000	$17,500,000	$17,500,000					

TOTAL	TOTAL NPV
$92,750,000	$50,632,616

EXPECTED NPV
$30,784,631

	Description of type (express in terms such as increased profits for companies, earnings for individuals or cost savings to government), scale and recipients of expected monetary impacts associated with usage of outputs. Include description of how dollar values for impact were reached.	Probability of usage(s) required to enable impact occurring	Rationale for probability calculation *Note: The 'Probability of usage(s) required to enable impact occurring' must be claculated using the figures provided on the Usage tab (see Impact Tool - Applicant's User Guide)*	Probability of monetary impacts occurring (assuming usage(s) has occurred as expected)	Rationale for probability selection
Impact 1.05	Impact 1.05 results from Usage 1.05, the use by Meat Standards Australia of enhanced palatability prediction models based on new research results that make the MSA system more reliable and therefore more valuable to consumers and commercial suppliers of MSA graded beef. Gross impact was measured as increased willingness to pay by Australian beef consumers for tender beef as guaranteed by the MSA grade. Price premiums collected by Meat and Livestock Australia (2011) and analysed by Griffith and Thompson (2012). Beef CRC contribution assumed to be 5% of the ongoing benefits from year 1 to year 4 from routine enhancements and fine tuning of the prediction model, then a 50% share of the increased benefits from year 5 onwards due to Beef CRC extension programs focussing on compliance to MSA specifications.	**100%**	Meat Standards Australia is the sole supplier of palatability predictions in Australia and has been for 13 years. Well tested mechanisms are in place for the routine assessment and addition of new data into the prediction model as and when it becomes available. Improvement in the palatability prediction model is incremental as more carcases are tested and as more relationships are discovered.	**90%**	Premiums for MSA grade product may decline over time beyond that built in to the very conservative impact forecasts of $0.20/kg cwe and a relatively low carcase weight of 250kg. Off setting this is likelihood of commercial users further differentiating MSA product into 3 star, 4 star and 5 star instead of just 3 star plus as at present.

Impact 1.05

Timeline of key impact milestones

End FY 1	End FY 2	End FY 3	End FY 4	End FY 5
actual retail price premium for MSA graded beef over non graded beef is $0.39/kg carcase weight equivalent in 2005/06.	actual premium is $0.27/kg cwe.	actual premium is $0.30/kg cwe.	actual premium is $0.39/kg cwe.	actual premium is $0.24/kg cwe.
End FY 6	**End FY 7**	**End FY 8**	**End FY 9**	**End FY 10**
actual premium is $0.22/kg cwe.	assumed premium is $0.20/kg cwe.	assumed premium is $0.20/kg cwe.	assumed premium is $0.20/kg cwe.	assumed premium is $0.20/kg cwe.
End FY 11	**End FY 12**	**End FY 13**	**End FY 14**	**End FY 15**
assumed premium is $0.20/kg cwe.	assumed premium is $0.20/kg cwe.	assumed premium is $0.20/kg cwe.	assumed premium is $0.20/kg cwe.	assumed premium is $0.20/kg cwe.

Estimate of $ value associated with impact(s)

End FY 1	End FY 2	End FY 3	End FY 4	End FY 5	End FY 6	End FY 7	End FY 8	End FY 9	End FY 10
$635,000	$665,000	$851,000	$1,010,000	$1,115,000	$1,190,000	$1,750,000	$2,100,000	$2,350,000	$2,700,000
End FY 11	**End FY 12**	**End FY 13**	**End FY 14**	**End FY 15**					
$2,700,000	$2,700,000	$2,700,000	$2,700,000	$2,700,000					

TOTAL	TOTAL NPV
$27,866,000	$17,549,464

EXPECTED NPV
$15,794,518

Non monetary impact of Research Program 1	Description of type (express in terms of improved health, social, environmental outcomes), scale and recipients of expected non-monetary impacts associated with usage of outputs. Include description of how conclusions were reached. If this non monetary impact will involve usage costs not already noted in your submission please discuss them here.	Please note the percentage probability associated with each non monetary impact you have described occurring. Please provide a rationale for each of these percentage probabilities.
	The use of the Beef Specs suite of decision support tools should lead to a greater awareness by cattle producers of the balance between the energy requirements of various types of animals to meet market specifications and the energy available in pasture and supplementary feed. This should lead to a better matching of feed availability and demand, and so lead to a better long term use of pasture resources in particular, minimising overgrazing pressures as well as weed growth.	At least 50%. There are a anumber of feed balance tools available and some are free on the MLA web site.

Research Program 2 Feed Efficiency, Maternal Productivity and Responsible Resource Use

Impact 2.01

Description of type (express in terms such as increased profits for companies, earnings for individuals or cost savings to government), scale and recipients of expected monetary impacts associated with usage of outputs. Include description of how dollar values for impact were reached.	Probability of usage(s) required to enable impact occurring	Rationale for probability calculation *Note: The 'Probability of usage(s) required to enable impact occurring' must be claculated using the figures provided on the Usage tab (see Impact Tool - Applicant's User Guide)*	Probability of monetary impacts occurring (assuming usage(s) has occurred as expected)	Rationale for probability selection
Impact 2.01 results from Usage 2.01, the use by large commercial breeding herds in Southern Australia of a new set of genetic parameters for reproductive traits in first and second calf heifers and their association with measures of body composition and feed efficiency. In Southern Australia weaning rates are already high and other parameters have a more important influence on farm productivity and profitability. A 2% increase in reproductive rate in the South is worth about $10/cow. It is assumed that half of this benefit is delivered by improved EBVs, and this is valued as part of the general improvement in genetic merit estimated for Impact 1.01. The other half is valued by improved maternal management using the maternal model (Impact 2.02).	**77%**	McGowan and Holroyd (2008) concluded that a target weaning rate of 90% was realistic for the South. A target of only 2% improvement overall should be easily achievable in the South. Assume half the benefit will be delivered due to the better rate of genetic gain possible by using the new EBVs.	**90%**	The probability is high that these monetary impacts will be achieved. Beef prices are expected to increase significantly over the next 20 years, so the value of increased number of calves will increase. In the Southern grass finishing sector in particular, competiton from alternative users of pasture such as the expanding prime lamb industry puts upward pressure on the opportunity cost of pasture and so a more productive maternal herd will continue to be important.

Impact 2.01

Timeline of key impact milestones

End FY 1	End FY 2	End FY 3	End FY 4	End FY 5
End FY 6	**End FY 7**	**End FY 8**	**End FY 9**	**End FY 10**
			Better selection and management of cows and heifers in Southern Australian cow herds.	
End FY 11	**End FY 12**	**End FY 13**	**End FY 14**	**End FY 15**
			Heifers from superior bulls in South with 1% better reproduction rate.	

Estimate of $ value associated with impact(s)

End FY 1	End FY 2	End FY 3	End FY 4	End FY 5	End FY 6	End FY 7	End FY 8	End FY 9	End FY 10
$0	$0	$0	$0	$0	$0	$0	$0		
End FY 11	**End FY 12**	**End FY 13**	**End FY 14**	**End FY 15**					

TOTAL	TOTAL NPV	EXPECTED NPV
$0	$0	$0

	Description of type (express in terms such as increased profits for companies, earnings for individuals or cost savings to government), scale and recipients of expected monetary impacts associated with usage of outputs. Include description of how dollar values for impact were reached.	Probability of usage(s) required to enable impact occurring	Rationale for probability calculation *Note: The 'Probability of usage(s) required to enable impact occurring' must be claculated using the figures provided on the Usage tab (see Impact Tool - Applicant's User Guide)*	Probability of monetary impacts occurring (assuming usage(s) has occurred as expected)	Rationale for probability selection
Impact 2.02	Impact 2.02 results from Usage 2.02, the use by large commercial breeding herds in Southern Australia of a model of maternal productivity. The maternal model will initially be validated and tested in a separate group of 20 cooperating large herds (assume 10,000 cows). In Southern Australia weaning rates are already high and other parameters have a more important influence on farm productivity and profitability. A 2% increase in reproductive rate in the South is worth about $10/cow. It is assumed that half of this benefit is delivered by improved maternal management using the maternal model.	**80%**	McGowan and Holroyd (2008) concluded that a target weaning rate of 90% was realistic for the South. A target of only 2% improvement overall should be easily achievable in the South. Assume half of the benefit will be delivered by the genetic enhancements already counted in Impact 2.01. The other half will be directly due to the better management of females possible by using the maternal model.	**90%**	The probability is high that these monetary impacts will be achieved. Beef prices are expected to increase significantly over the next 20 years, so the value of increased number of calves will increase. In the Southern grass finishing sector in particular, competiton from alternative users of pasture such as the expanding prime lamb industry puts upward pressure on the opportunity cost of pasture and so a more productive maternal herd will continue to be important.

Impact 2.02

Timeline of key impact milestones

End FY 1	End FY 2	End FY 3	End FY 4	End FY 5
End FY 6	**End FY 7**	**End FY 8**	**End FY 9**	**End FY 10**
		Better selection and management of cows and heifers in 20 cooperating cow herds (10,000 breeders).	Maternal model released to industry. 100,000 breeders.	600,000 breeders.
End FY 11	**End FY 12**	**End FY 13**	**End FY 14**	**End FY 15**
900,000 breeders.	1,200,000 breeders.	1,500,000 breeders.	1,500,000 breeders.	1,500,000 breeders.

Estimate of $ value associated with impact(s)

End FY 1	End FY 2	End FY 3	End FY 4	End FY 5	End FY 6	End FY 7	End FY 8	End FY 9	End FY 10
$0	$0	$0	$0	$0	$0	$0	$50,000	$500,000	$3,000,000
End FY 11	**End FY 12**	**End FY 13**	**End FY 14**	**End FY 15**					
$4,500,000	$6,000,000	$7,500,000	$7,500,000	$7,500,000					

TOTAL	TOTAL NPV
$36,550,000	$19,543,016

EXPECTED NPV
$14,070,971

	Description of type (express in terms such as increased profits for companies, earnings for individuals or cost savings to government), scale and recipients of expected monetary impacts associated with usage of outputs. Include description of how dollar values for impact were reached.	Probability of usage(s) required to enable impact occurring	Rationale for probability calculation *Note: The 'Probability of usage(s) required to enable impact occurring' must be claculated using the figures provided on the Usage tab (see Impact Tool - Applicant's User Guide)*	Probability of monetary impacts occurring (assuming usage(s) has occurred as expected)	Rationale for probability selection
Impact 2.03	Impact 2.03 results from Usage 2.03, the eventual commercialisation by a commercial animal health companies of a set of microbial and bioactive candidates with the potential to deliver a commercial product to reduce methane emmissions from Australian beef herds. Some promising results found for a bacteria YE299 M b., but considerable further R&D required. Different bacterial communities in high and low methane producing animals can be distringuished. No financial impacts estimated at this stage. Alford et al (2006) estimated that a 100-cow southern Australian herd could save 20.6 tonnes CO2 annually through investing in more feed efficient cattle. At the current expected carbon price of $23/t, this is a saving of $4.75/cow/year.	**85%**		**90%**	

Impact 2.03

Timeline of key impact milestones

End FY 1	End FY 2	End FY 3	End FY 4	End FY 5
End FY 6	**End FY 7**	**End FY 8**	**End FY 9**	**End FY 10**
		10,000 breeders saving $4.75	50,000 breeders	200,000 breeders
End FY 11	**End FY 12**	**End FY 13**	**End FY 14**	**End FY 15**
300,000 breeders	400,000 breeders	500,000 breeders	500,000 breeders	500,000 breeders

Estimate of $ value associated with impact(s)

End FY 1	End FY 2	End FY 3	End FY 4	End FY 5	End FY 6	End FY 7	End FY 8	End FY 9	End FY 10
$0	$0	$0	$0	$0	$0	$0	$47,500	$237,500	$950,000
End FY 11	**End FY 12**	**End FY 13**	**End FY 14**	**End FY 15**					
$1,425,000	$1,900,000	$2,375,000	$2,375,000	$2,375,000					

TOTAL	TOTAL NPV
$11,685,000	$6,261,086

EXPECTED NPV
$4,789,731

Non monetary impact of Research Program 2

Description of type (express in terms of improved health, social, environmental outcomes), scale and recipients of expected non-monetary impacts associated with usage of outputs. Include description of how conclusions were reached. If this non monetary impact will involve usage costs not already noted in your submission please discuss them here.	Please note the percentage probability associated with each non monetary impact you have described occurring. Please provide a rationale for each of these percentage probabilities.

Research Program 3 Adaptation and Cattle Welfare

	Description of type (express in terms such as increased profits for companies, earnings for individuals or cost savings to government), scale and recipients of expected monetary impacts associated with usage of outputs. Include description of how dollar values for impact were reached.	Probability of usage(s) required to enable impact occurring	Rationale for probability calculation *Note: The 'Probability of usage(s) required to enable impact occurring' must be claculated using the figures provided on the Usage tab (see Impact Tool - Applicant's User Guide)*	Probability of monetary impacts occurring (assuming usage(s) has occurred as expected)	Rationale for probability selection
Impact 3.01	On release, some 5 years after commencing final registration trials, commercial beef cattle producers in tick prone regions in Australia (from 2020) and internationally (from 2022) will be able to use the vaccine to reduce economic losses due to cattle ticks. The cost to the cattle producers will be about $5/dose in Australia, and $4/dose internationally, at the farm level. They will use the vaccine if it is profitable for them to do so. The commercialisation company will sell the vaccine to retailers at a lower price than what farmers pay and at this price they would expect to also make profits. However the impact measured here is simply the royalty stream that the commercial company pays to the CRC based on a proportion of its wholesale sales revenue. Note that the revenue stream will continue for another 5 years beyond the year 15 limit set by the impact tool. This additional revenue is worth an undiscounted $35 m	**95%**	The vaccine is a one shot once a year treatment, and it can only be used in a particular way.	**90%**	The terms and conditions of the monetary impacts will be set by the licence agreement, and it is normal practice to have measuring and monitoring systems in place to keep track of the key variables (number of sales and price per sale).

Impact 3.01

an undiscounted $55m.

Timeline of key impact milestones

End FY 1	End FY 2	End FY 3	End FY 4	End FY 5
End FY 6	**End FY 7**	**End FY 8**	**End FY 9**	**End FY 10**
				Payment received for upfront access licence
End FY 11	**End FY 12**	**End FY 13**	**End FY 14**	**End FY 15**
	Cattle producers in Northern Australia begin purchasing the tick vaccine. Sales reach 3% of the northern herd at a wholesale price of $4/dose. Royalties of 5% of sales begin to flow to the CRC.	Sales increase to 5% of the Northern herd.	Sales increase to 10% of the Northern herd. Cattle producers in Central/South America begin purchasing the tick vaccine. Sales reach 3% of the herd at a wholesale price of $3/dose. Royalties of 3% of sales begin to flow to the CRC.	Sales increase to 15% of the Northern herd. Sales in Central/South America increase to 5% of the herd.

Estimate of $ value associated with impact(s)

End FY 1	End FY 2	End FY 3	End FY 4	End FY 5	End FY 6	End FY 7	End FY 8	End FY 9	End FY 10
$0	$0	$0	$0	$0	$0	$0	$0	$0	$500,000

End FY 11	End FY 12	End FY 13	End FY 14	End FY 15
$0	$54,000	$90,000	$882,000	$1,440,000

TOTAL	TOTAL NPV
$2,966,000	$1,522,889

EXPECTED NPV
$1,302,070

	Description of type (express in terms such as increased profits for companies, earnings for individuals or cost savings to government), scale and recipients of expected monetary impacts associated with usage of outputs. Include description of how dollar values for impact were reached.	Probability of usage(s) required to enable impact occurring	Rationale for probability calculation *Note: The 'Probability of usage(s) required to enable impact occurring' must be claculated using the figures provided on the Usage tab (see Impact Tool - Applicant's User Guide)*	Probability of monetary impacts occurring (assuming usage(s) has occurred as expected)	Rationale for probability selection
Impact 3.02	Impact 3.02 results from Usage 3.02. There are two parts. One results from marketing of Australian beef in overseas markets with higher animal welfare reputation. Australia sells 475Kt of beef into Japan, Korea and the US valued at $2.6b. An increased willingness to pay of just 1% due to enhanced animal welfare attributes would generate $26m pa. The second results from changes in dehorning management by commercial producers of Brahman and Brahman -derived cattle. The cost of labour for de-horning calves is estimated at between $0.17 and $0.33 per head. The cost of mortalities due to dehorning is estimated at $1.70 per head (Prayaga 2005). There are about 6m cows in Northern Australia of which 90% are Brahman or Brahman-derived. With a reproduction rate of around 70%, this means at least 3m calves a year are born with horns. If 20% of these producers save half the motality costs through improved management, the saving is ~~$500,000 per year~~.	**81%**		**90%**	The survey work of Umberger (2007) and others shows that animal welfare attributes rank highly with consumers of imported beef into japan and the US, and that an increased willingness to pay of 1% for higher welfare credentials is entirely feasible.

Impact 3.02

Timeline of key impact milestones

End FY 1	End FY 2	End FY 3	End FY 4	End FY 5
				Results from the animal welfate project have now been included in the draft National Animal Welfare Guidelines.

End FY 6	End FY 7	End FY 8	End FY 9	End FY 10
Northern producers begin adopting better management practices to save half the costs of mortalities from dehorning in 100,000 calves. Australian beef sold in overseas markets with enhanced animal welfare reputation.	300,000 calves 0.1% increase in export value due to enhanced animal welfare attributes of Australian beef in the US, Japanese and Korean markets.	600,000 calves 0.5% increase in export value due to enhanced animal welfare attributes of Australian beef in the US, Japanese and Korean markets.	600,000 calves 0.8% increase in export value due to enhanced animal welfare attributes of Australian beef in the US, Japanese and Korean markets.	600,000 calves 1%

End FY 11	End FY 12	End FY 13	End FY 14	End FY 15
600,000 calves 1%	600,000 calves 1	600,000 calves 1	600,000 calves 1	600,000 calves 1

Estimate of $ value associated with impact(s)

End FY 1	End FY 2	End FY 3	End FY 4	End FY 5	End FY 6	End FY 7	End FY 8	End FY 9	End FY 10
$0	$0	$0	$0	$0	$80,000	$2,850,000	$13,850,000	$21,500,000	$26,500,000

End FY 11	End FY 12	End FY 13	End FY 14	End FY 15
$26,500,000	$26,500,000	$26,500,000	$26,500,000	$26,500,000

TOTAL	TOTAL NPV	EXPECTED NPV
$197,280,000	$112,022,119	$81,664,125

	Description of type (express in terms such as increased profits for companies, earnings for individuals or cost savings to government), scale and recipients of expected monetary impacts associated with usage of outputs. Include description of how dollar values for impact were reached.	Probability of usage(s) required to enable impact occurring	Rationale for probability calculation *Note: The 'Probability of usage(s) required to enable impact occurring' must be claculated using the figures provided on the Usage tab (see Impact Tool - Applicant's User Guide)*	Probability of monetary impacts occurring (assuming usage(s) has occurred as expected)	Rationale for probability selection
Impact 3.03	Impact 3.03 results from Usage 3.03, the use by Braham seedstock breeders and large commercial producers of Brahman and Brahman -derived cattle of a DNA marker test for homozygous polled horn genes in Brahmans. The cost of labour for de-horning calves is estimated at between $0.17 and $0.33 per head. The cost of mortalities due to dehorning is estimated at $1.70 per head (Prayaga 2005). There are about 6m cows in Northern Australia of which 90% are Brahman or Brahman-derived. With a reproduction rate of around 70%, this means at least 3m calves a year are born with horns. If they are all dehorned, the cost is in excess of $5.6m per year. Use of the poll gene marker test on 10,000 bulls five years after industry release would reduce the number of horned calves by some 300,000, saving $560,000 per year. Additional animal welfare benefits are valued in Impact 3.02.	**100%**	The test has been released commercially following extensive validation trials in entirely new cattle populations, it is impractical or very costly to dehorn cattle in Northern Australia when young, and the polled gene test is simple and cost-effective.	**95%**	The pressure for improved animnal welfare practices will continue to build, the costs of dehorning will continue to rise, the value of cattle is expected to continue to increase, and the cost of the test will likely decrease as throughput rises and new technology comes into play.

Impact 3.03

Timeline of key impact milestones

End FY 1	End FY 2	End FY 3	End FY 4	End FY 5
End FY 6	**End FY 7**	**End FY 8**	**End FY 9**	**End FY 10**
Calves born from 1,500 tested polled bulls.	Calves born from 2,000 tested polled bulls.	Calves born from 4,000 tested polled bulls.	Calves born from 6,000 tested polled bulls.	Calves born from 8,000 tested polled bulls.
End FY 11	**End FY 12**	**End FY 13**	**End FY 14**	**End FY 15**
Calves born from 10,000 tested polled bulls.	Calves born from 10,000 tested polled bulls.	Calves born from 10,000 tested polled bulls.	Calves born from 10,000 tested polled bulls.	Calves born from 10,000 tested polled bulls.

Estimate of $ value associated with impact(s)

End FY 1	End FY 2	End FY 3	End FY 4	End FY 5	End FY 6	End FY 7	End FY 8	End FY 9	End FY 10
$0	$0	$0	$0	$0	$80,000	$120,000	$230,000	$340,000	$450,000
End FY 11	**End FY 12**	**End FY 13**	**End FY 14**	**End FY 15**					
$560,000	$560,000	$560,000	$560,000	$560,000					

TOTAL	TOTAL NPV
$4,020,000	$2,284,517

EXPECTED NPV
$2,170,291

Non monetary impact of Research Program 3	Description of type (express in terms of improved health, social, environmental outcomes), scale and recipients of expected non-monetary impacts associated with usage of outputs. Include description of how conclusions were reached. If this non monetary impact will involve usage costs not already noted in your submission please discuss them here.	Please note the percentage probability associated with each non monetary impact you have described occurring. Please provide a rationale for each of these percentage probabilities.
	There are significant animal welfare benefits from Program 3. One is the use of the results of R&D undertaken within the program to contribute to the revision and release of the draft National Animal Welfare Guidelines for beef cattle. This will ensure that the new welfare guidelines are science based. Another output from the cattle tick work is a test for acaracide resistance to identify ticks that are resistant to the synthetic pyrethroids that are used to control them. The use of this test prevents the unnecessary use of acaracides which would be ineffective. Tropical cattle breeds (Brahman and Braham-derived) make up more than half of Australia's cattle population and most have horns. That is, the frequency of the polled gene is low. Dehorning is a common practice to prevent injury and bruising in cattle herds. It is recommended to be done when the animals are young. However, most of these tropical breed cattle are produced in the large, extensive cattle enterprises of Northern Australia, where it is impractical or very costly to dehorn cattle when young. The polled gene test is simple and cost-effective and in the long run will greatly minise the animal welfare consequences of dehorning including mortalities.	

Research Program 4 Female Reproductive Performance

	Description of type (express in terms such as increased profits for companies, earnings for individuals or cost savings to government), scale and recipients of expected monetary impacts associated with usage of outputs. Include description of how dollar values for impact were reached.	Probability of usage(s) required to enable impact occurring	Rationale for probability calculation *Note: The 'Probability of usage(s) required to enable impact occurring' must be claculated using the figures provided on the Usage tab (see Impact Tool - Applicant's User Guide)*	Probability of monetary impacts occurring (assuming usage(s) has occurred as expected)	Rationale for probability selection
Impact 4.01		**0%**		**0%**	

Impact 4.01

Timeline of key impact milestones

End FY 1	End FY 2	End FY 3	End FY 4	End FY 5
End FY 6	**End FY 7**	**End FY 8**	**End FY 9**	**End FY 10**
End FY 11	**End FY 12**	**End FY 13**	**End FY 14**	**End FY 15**

Estimate of $ value associated with impact(s)

End FY 1	End FY 2	End FY 3	End FY 4	End FY 5	End FY 6	End FY 7	End FY 8	End FY 9	End FY 10
$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
End FY 11	End FY 12	End FY 13	End FY 14	End FY 15					
$0	$0	$0	$0	$0					

TOTAL	TOTAL NPV	EXPECTED NPV
$0	$0	$0

	Description of type (express in terms such as increased profits for companies, earnings for individuals or cost savings to government), scale and recipients of expected monetary impacts associated with usage of outputs. Include description of how dollar values for impact were reached.	Probability of usage(s) required to enable impact occurring	Rationale for probability calculation *Note: The 'Probability of usage(s) required to enable impact occurring' must be claculated using the figures provided on the Usage tab (see Impact Tool - Applicant's User Guide)*	Probability of monetary impacts occurring (assuming usage(s) has occurred as expected)	Rationale for probability selection
Impact 4.02	Fordyce et al (2012) have shown that using known variations in EBV for age at puberty and PPAI in both Brahmans and tropical composites, coupled with preliminary modelling of potential response rates to selection, could reduce both by approximately 30 days in continuously-mated Brahmans and 14 days in seasonally-mated composites over a 10-year period, and that this would lead to a 5% increase in pregnancy rate, except in herds where pregnancy rates are already high. Effects on mortality rates or individual animal values were unpredictable. Other assumptions were an increase in replacement bull values of $1,000 and a one-third reduction in bull to female mating ratios. The expected increase in average gross margins per cow AE was $7 in herds with weaning rates less than 70% , after 10 years. 11 million AE in these regions, the target market is 5.5 million with pregnancy rates less than 70%. Assume adoption of 60% in the target market, 30% over the Northern industry.	**81%**		**90%**	

Impact 4.02

Timeline of key impact milestones

End FY 1	End FY 2	End FY 3	End FY 4	End FY 5
End FY 6	**End FY 7**	**End FY 8**	**End FY 9**	**End FY 10**
	new EBVs released and seedstock breeders begin offering bulls with better age to puberty and post partum reconception EBVs 100,000 cows, increase in GM of $1	200,000 cows, increase in GM of $1	600,000 cows, increase in GM of $1	1,000,000 cows, increase in GM of $1
End FY 11	**End FY 12**	**End FY 13**	**End FY 14**	**End FY 15**
1,500,000 cows, increase in GM of $2	2,000,000 cows, increase in GM of $3	2,500,000 cows, increase in GM of $4	3,000,000 cows, increase in GM of $5	3,000,000 cows, increase in GM of $6

Estimate of $ value associated with impact(s)

End FY 1	End FY 2	End FY 3	End FY 4	End FY 5	End FY 6	End FY 7	End FY 8	End FY 9	End FY 10
$0	$0	$0	$0	$0	$0	$100,000	$200,000	$600,000	$1,000,000
End FY 11	**End FY 12**	**End FY 13**	**End FY 14**	**End FY 15**					
$3,000,000	$6,000,000	$10,000,000	$15,000,000	$18,000,000					

TOTAL	TOTAL NPV
$53,900,000	$27,839,718

EXPECTED NPV
$20,295,154

Non monetary impact of Research Program 4

Description of type (express in terms of improved health, social, environmental outcomes), scale and recipients of expected non-monetary impacts associated with usage of outputs. Include description of how conclusions were reached. If this non monetary impact will involve usage costs not already noted in your submission please discuss them here.	Please note the percentage probability associated with each non monetary impact you have described occurring. Please provide a rationale for each of these percentage probabilities.

Research Program 5 Education and Training

	Description of type (express in terms such as increased profits for companies, earnings for individuals or cost savings to government), scale and recipients of expected monetary impacts associated with usage of outputs. Include description of how dollar values for impact were reached.	Probability of usage(s) required to enable impact occurring	Rationale for probability calculation *Note: The 'Probability of usage(s) required to enable impact occurring' must be claculated using the figures provided on the Usage tab (see Impact Tool - Applicant's User Guide)*	Probability of monetary impacts occurring (assuming usage(s) has occurred as expected)	Rationale for probability selection
Impact 5.01	No monetary estimates are made of the impact of creating a network of young scientists in the Australian beef industry who have advanced training in the sciences underpinning beef genetic improvement and effective innovation, commercialisation and adoption of outputs.	**0%**		**0%**	

Impact 5.01

Timeline of key impact milestones

End FY 1	End FY 2	End FY 3	End FY 4	End FY 5
End FY 6	**End FY 7**	**End FY 8**	**End FY 9**	**End FY 10**
End FY 11	**End FY 12**	**End FY 13**	**End FY 14**	**End FY 15**

Estimate of $ value associated with impact(s)

End FY 1	End FY 2	End FY 3	End FY 4	End FY 5	End FY 6	End FY 7	End FY 8	End FY 9	End FY 10
$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
End FY 11	End FY 12	End FY 13	End FY 14	End FY 15					
$0	$0	$0	$0	$0					

TOTAL	TOTAL NPV	EXPECTED NPV
$0	$0	$0

	Description of type (express in terms such as increased profits for companies, earnings for individuals or cost savings to government), scale and recipients of expected monetary impacts associated with usage of outputs. Include description of how dollar values for impact were reached.	Probability of usage(s) required to enable impact occurring	Rationale for probability calculation *Note: The 'Probability of usage(s) required to enable impact occurring' must be claculated using the figures provided on the Usage tab (see Impact Tool - Applicant's User Guide)*	Probability of monetary impacts occurring (assuming usage(s) has occurred as expected)	Rationale for probability selection
Impact 5.02	Impact 5.02 flows from Usage 5.02, commercial cattle producers using an information package about new research results, tools and technologies to achieve a balance between cattle growth rates and compliance with market specifications. Alford et al. (2007) showed that in all cases, gross margins were higher for management groups with foetal growth based on a higher level of nutrition than groups with compromised nutrition. The difference in gross margin between the high/high group and the low/low group was $84/cow, with smaller differences between other groups. Higher costs have to come out of this, so we assume a net benefit of $20/cow across all types of nutrition systems.	**90%**	The outputs have been produced already. The technical and economic information already available provides guidelines for the profitable use of new cow nutritional strategies to improve compliance with market specifications.	**80%**	Non-compliance levels have not improved over time, so the costs of non-compliance will increase over time as the value of the carcase increases. Beef prices are expected to increase significantly over the next 20 years.

Impact 5.02

Timeline of key impact milestones

End FY 1	End FY 2	End FY 3	End FY 4	End FY 5
10,000 breeding cows influenced by revised nutritional strategies.	20,000 breeding cows influenced by revised nutritional strategies.	20,000 breeding cows influenced by revised nutritional strategies.	30,000 breeding cows influenced by revised nutritional strategies.	50,000 breeding cows influenced by revised nutritional strategies.
End FY 6	**End FY 7**	**End FY 8**	**End FY 9**	**End FY 10**
100,000 breeding cows influenced by revised nutritional strategies.	150,000 breeding cows influenced by revised nutritional strategies.	200,000 breeding cows influenced by revised nutritional strategies.	250,000 breeding cows influenced by revised nutritional strategies.	250,000 breeding cows influenced by revised nutritional strategies.
End FY 11	**End FY 12**	**End FY 13**	**End FY 14**	**End FY 15**
250,000 breeding cows influenced by revised nutritional strategies.	250,000 breeding cows influenced by revised nutritional strategies.	250,000 breeding cows influenced by revised nutritional strategies.	250,000 breeding cows influenced by revised nutritional strategies.	250,000 breeding cows influenced by revised nutritional strategies.

Estimate of $ value associated with impact(s)

End FY 1	End FY 2	End FY 3	End FY 4	End FY 5	End FY 6	End FY 7	End FY 8	End FY 9	End FY 10
$200,000	$400,000	$400,000	$600,000	$1,000,000	$2,000,000	$3,000,000	$4,000,000	$5,000,000	$5,000,000
End FY 11	**End FY 12**	**End FY 13**	**End FY 14**	**End FY 15**					
$5,000,000	$5,000,000	$5,000,000	$5,000,000	$5,000,000					

TOTAL	TOTAL NPV
$46,600,000	$28,090,029

EXPECTED NPV
$20,224,821

	Description of type (express in terms such as increased profits for companies, earnings for individuals or cost savings to government), scale and recipients of expected monetary impacts associated with usage of outputs. Include description of how dollar values for impact were reached.	Probability of usage(s) required to enable impact occurring	Rationale for probability calculation *Note: The 'Probability of usage(s) required to enable impact occurring' must be claculated using the figures provided on the Usage tab (see Impact Tool - Applicant's User Guide)*	Probability of monetary impacts occurring (assuming usage(s) has occurred as expected)	Rationale for probability selection
Impact 5.03	Impact 5.03 flows from Usage 5.03, commercial cattle producers using an information package about new research results, tools and technologies to achieve a balance between cattle growth rates and compliance with market specifications. Griffith (2009) reported results by State that showed that in all cases, gross margins were higher for management groups with fast growth rates than slow. The difference in gross margin between the fast and the slow groups was between $13 and $37/steer. Additional benefits of between $20 and $37/steer were generated in those states where it was possible to change time of calving. Higher costs have to come out of this, so we assume a net benefit of $20/steer across all types of nutrition systems. Deland (2011) has shown that working with a processor in SE south Australia, very high rates of non-complinace due to meat colour (high pH) could be reduced using this information package. Discounts of 60c/kg on 10,000 carcases a year were reduced to almost ~~zero in 2012~~.	**90%**	The outputs have been produced already. The technical and economic information already available provides guidelines for the profitable combination of genetics and management inputs to improve compliance with market specifications.	**80%**	Non-compliance levels have not improved over time, so the costs of non-compliance will increase over time as the value of the carcase increases. Beef prices are expected to increase significantly over the next 20 years.

Impact 5.03

Timeline of key impact milestones

End FY 1	End FY 2	End FY 3	End FY 4	End FY 5
10,000 finished steers influenced by revised nutritional strategies. Cost of $600,000 in non-compliance to meat colour specification in SE South Australia.	10,000 finished steers influenced by revised nutritional strategies. Cost of $600,000 in non-compliance to meat colour specification in SE South Australia.	20,000 finished steers influenced by revised nutritional strategies. Cost of $1.5m in non-compliance to meat colour specification in SE South Australia.	30,000 finished steers influenced by revised nutritional strategies. Cost of $1.5m in non-compliance to meat colour specification in SE South Australia.	50,000 finished steers influenced by revised nutritional strategies. Cost of $1.5m in non-compliance to meat colour specification in SE South Australia.
End FY 6	**End FY 7**	**End FY 8**	**End FY 9**	**End FY 10**
100,000 finished steers influenced by revised nutritional strategies. Cost of $600,000 in non-compliance to meat colour specification in SE South Australia.	150,000 finished steers influenced by revised nutritional strategies. Saving of $1.5m in non-compliance to meat colour specification in SE South Australia.	200,000 finished steers influenced by revised nutritional strategies. Saving of $1.5m in non-compliance to meat colour specification in SE South Australia.	250,000 finished steers influenced by revised nutritional strategies. Saving of $1.5m in non-compliance to meat colour specification in SE South Australia.	250,000 finished steers influenced by revised nutritional strategies. Saving of $1.5m in non-compliance to meat colour specification in SE South Australia.
End FY 11	**End FY 12**	**End FY 13**	**End FY 14**	**End FY 15**
250,000 finished steers influenced by revised nutritional strategies. Saving of $1.5m in non-compliance to meat colour specification in SE South Australia.	250,000 finished steers influenced by revised nutritional strategies. Saving of $1.5m in non-compliance to meat colour specification in SE South Australia.	250,000 finished steers influenced by revised nutritional strategies. Saving of $1.5m in non-compliance to meat colour specification in SE South Australia.	250,000 finished steers influenced by revised nutritional strategies. Saving of $1.5m in non-compliance to meat colour specification in SE South Australia.	250,000 finished steers influenced by revised nutritional strategies. Saving of $1.5m in non-compliance to meat colour specification in SE South Australia.

Estimate of $ value associated with impact(s)

End FY 1	End FY 2	End FY 3	End FY 4	End FY 5	End FY 6	End FY 7	End FY 8	End FY 9	End FY 10
$200,000	$400,000	$400,000	$600,000	$1,000,000	$2,000,000	$4,500,000	$5,500,000	$6,500,000	$6,500,000
End FY 11	**End FY 12**	**End FY 13**	**End FY 14**	**End FY 15**					
$6,500,000	$6,500,000	$6,500,000	$6,500,000	$6,500,000					

TOTAL	TOTAL NPV
$60,100,000	$36,045,978

EXPECTED NPV
$25,953,104

	Description of type (express in terms such as increased profits for companies, earnings for individuals or cost savings to government), scale and recipients of expected monetary impacts associated with usage of outputs. Include description of how dollar values for impact were reached.	Probability of usage(s) required to enable impact occurring	Rationale for probability calculation *Note: The 'Probability of usage(s) required to enable impact occurring' must be claculated using the figures provided on the Usage tab (see Impact Tool - Applicant's User Guide)*	Probability of monetary impacts occurring (assuming usage(s) has occurred as expected)	Rationale for probability selection
Impact 5.04	Impact 5.04 results from Usage 5.02, the use by commercial cattle producers of an information package about new research results, tools and technologies to increase reproduction rates in Northern Australian cattle herds. This package is delivered by extension agencies. Commercial cattle producers will use this information to make better management decisions that would lead to positive impacts on productivity and profitability in beef businesses.	**0%**		**0%**	

Impact 5.04

Timeline of key impact milestones

End FY 1	End FY 2	End FY 3	End FY 4	End FY 5
End FY 6	**End FY 7**	**End FY 8**	**End FY 9**	**End FY 10**
End FY 11	**End FY 12**	**End FY 13**	**End FY 14**	**End FY 15**

Estimate of $ value associated with impact(s)

End FY 1	End FY 2	End FY 3	End FY 4	End FY 5	End FY 6	End FY 7	End FY 8	End FY 9	End FY 10
$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
End FY 11	End FY 12	End FY 13	End FY 14	End FY 15					
$0	$0	$0	$0	$0					

TOTAL	TOTAL NPV	EXPECTED NPV
$0	$0	$0

Impact 5.05	Description of type (express in terms such as increased profits for companies, earnings for individuals or cost savings to government), scale and recipients of expected monetary impacts associated with usage of outputs. Include description of how dollar values for impact were reached.	Probability of usage(s) required to enable impact occurring	Rationale for probability calculation *Note: The 'Probability of usage(s) required to enable impact occurring' must be claculated using the figures provided on the Usage tab (see Impact Tool - Applicant's User Guide)*	Probability of monetary impacts occurring (assuming usage(s) has occurred as expected)	Rationale for probability selection
	Impact 5.04 results from Usage 5.02, the use by commercial cattle producers of an information package about new research results, tools and technologies to increase reproduction rates in Southern Australian cattle herds. This package is delivered by extension agencies. Commercial cattle producers will use this information to make better management decisions that would lead to positive impacts on productivity and profitability in beef businesses.	**0%**		**0%**	

Impact 5.05

Timeline of key impact milestones

End FY 1	End FY 2	End FY 3	End FY 4	End FY 5
End FY 6	**End FY 7**	**End FY 8**	**End FY 9**	**End FY 10**
End FY 11	**End FY 12**	**End FY 13**	**End FY 14**	**End FY 15**

Estimate of $ value associated with impact(s)

End FY 1	End FY 2	End FY 3	End FY 4	End FY 5	End FY 6	End FY 7	End FY 8	End FY 9	End FY 10
$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
End FY 11	End FY 12	End FY 13	End FY 14	End FY 15					
$0	$0	$0	$0	$0					

TOTAL	TOTAL NPV	EXPECTED NPV
$0	$0	$0

	Description of type (express in terms such as increased profits for companies, earnings for individuals or cost savings to government), scale and recipients of expected monetary impacts associated with usage of outputs. Include description of how dollar values for impact were reached.	Probability of usage(s) required to enable impact occurring	Rationale for probability calculation *Note: The 'Probability of usage(s) required to enable impact occurring' must be claculated using the figures provided on the Usage tab (see Impact Tool - Applicant's User Guide)*	Probability of monetary impacts occurring (assuming usage(s) has occurred as expected)	Rationale for probability selection
Impact 5.06	Impact 5.06 results from Usage 5.06 , the use by members of a network of Beef Profit Partnerships of specialised decision making tools and processes that routinely assess new research results, tools and technologies and implement those that are beneficial. The BPP members are the direct users of the network. They make better management decisions that would lead to positive impacts on productivity and profitability in beef businesses. The benefit calculations are outlined in Griffith (2012a). They are differences in annual average changes in farm profit per animal between BPP members and the wider beef industry in each State estimated by comparing trends over at least 5 year periods for the longer running BPP groups, times the number of cattle managed by each BPP. More recent BPP groups are assumed to generate half the benefits of existing groups. Spillovers are assumed to impact 5% of the cattle population in each state after 5 years, at half the benefit levels of existing groups.	**100%**	The network exists, facilitators are trained and key government extension agenies are supportive. Existing members are deriving significant profitability benefits and the network is growing.	**95%**	The members of BPP groups use the CI&I process (Output 5.09) which encourages producers to continually strive for further productivity enhancements or cost savings. Both input costs and beef prices are expected to increase significantly over the next 20 years, so base profitability measures should remain fairly constant so changes in profist should not decline over time.

Impact 5.06

Timeline of key impact milestones

End FY 1	End FY 2	End FY 3	End FY 4	End FY 5
End FY 6	**End FY 7**	**End FY 8**	**End FY 9**	**End FY 10**
	BPP Forums to be held to communicate achievements to the wider beef industry.	Existing BPPs continue, and benefits reach another 1% of industry in QLD, NSW, Vic and WA.	Existing BPPs continue, and benefits reach another 2% of industry in QLD, NSW, Vic and WA.	Existing BPPs continue, and benefits reach another 3% of industry in QLD, NSW, Vic and WA.
End FY 11	**End FY 12**	**End FY 13**	**End FY 14**	**End FY 15**
Existing BPPs continue, and benefits reach another 4% of industry in QLD, NSW, Vic and WA.	Existing BPPs continue, and benefits reach another 5% of industry in QLD, NSW, Vic and WA.	Existing BPPs continue, and benefits reach another 5% of industry in QLD, NSW, Vic and WA.	Existing BPPs continue, and benefits reach another 5% of industry in QLD, NSW, Vic and WA.	Existing BPPs continue, and benefits reach another 5% of industry in QLD, NSW, Vic and WA.

Estimate of $ value associated with impact(s)

End FY 1	End FY 2	End FY 3	End FY 4	End FY 5	End FY 6	End FY 7	End FY 8	End FY 9	End FY 10
$0	$3,753,800	$4,110,200	$4,110,200	$3,195,200	$3,411,928	$3,861,928	$3,861,928	$7,511,928	$9,136,928
End FY 11	**End FY 12**	**End FY 13**	**End FY 14**	**End FY 15**					
$10,861,928	$12,736,928	$14,611,928	$14,611,928	$14,611,928					

TOTAL	TOTAL NPV
$110,388,680	$66,797,186

EXPECTED NPV
$63,457,327

	Description of type (express in terms such as increased profits for companies, earnings for individuals or cost savings to government), scale and recipients of expected monetary impacts associated with usage of outputs. Include description of how dollar values for impact were reached.	Probability of usage(s) required to enable impact occurring	Rationale for probability calculation *Note: The 'Probability of usage(s) required to enable impact occurring' must be claculated using the figures provided on the Usage tab (see Impact Tool - Applicant's User Guide)*	Probability of monetary impacts occurring (assuming usage(s) has occurred as expected)	Rationale for probability selection
Impact 5.07	Impact 5.07 results from Usage 5.07 , the use by Southern Australia seedstock and commercial cattle producers of an accredited set of training materials and resources for a course called More Beef from Breeding. This course relies on Output 5.05 and makes use of information provided by Outputs 2.01, 2.02, and 7.02. It is delivered by accredited extension officers to seedstock producers and commercial cattle producers who will use this information to make better breeder herd management decisions that would lead to positive impacts on productivity and profitability in beef businesses. This impact is included in Impact 2.01.	**0%**		**0%**	

Impact 5.07

Timeline of key impact milestones

End FY 1	End FY 2	End FY 3	End FY 4	End FY 5
End FY 6	**End FY 7**	**End FY 8**	**End FY 9**	**End FY 10**
End FY 11	**End FY 12**	**End FY 13**	**End FY 14**	**End FY 15**

Estimate of $ value associated with impact(s)

End FY 1	End FY 2	End FY 3	End FY 4	End FY 5	End FY 6	End FY 7	End FY 8	End FY 9	End FY 10
$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
End FY 11	End FY 12	End FY 13	End FY 14	End FY 15					
$0	$0	$0	$0	$0					

TOTAL	TOTAL NPV	EXPECTED NPV
$0	$0	$0

Impact 5.08	Description of type (express in terms such as increased profits for companies, earnings for individuals or cost savings to government), scale and recipients of expected monetary impacts associated with usage of outputs. Include description of how dollar values for impact were reached.	Probability of usage(s) required to enable impact occurring	Rationale for probability calculation *Note: The 'Probability of usage(s) required to enable impact occurring' must be claculated using the figures provided on the Usage tab (see Impact Tool - Applicant's User Guide)*	Probability of monetary impacts occurring (assuming usage(s) has occurred as expected)	Rationale for probability selection
	Impact 5.08 results from Usage 5.08 , the use by Northern Australia seedstock producers and commercial cattle producers of an accredited set of training materials and resources for a course called Breeder Herd Management. This course relies on Output 5.04 and makes use of information provided by Outputs 4.01, 4.02, and 7.03. It is delivered by accredited extension officers to seedstock producers and commercial cattle producers who will use this information to make better breeder herd management decisions that would lead to positive impacts on productivity and profitability in beef businesses. This impact is included in Impact 7.03.	**0%**		**0%**	

Impact 5.08

Timeline of key impact milestones

End FY 1	End FY 2	End FY 3	End FY 4	End FY 5
End FY 6	**End FY 7**	**End FY 8**	**End FY 9**	**End FY 10**
End FY 11	**End FY 12**	**End FY 13**	**End FY 14**	**End FY 15**

Estimate of $ value associated with impact(s)

End FY 1	End FY 2	End FY 3	End FY 4	End FY 5	End FY 6	End FY 7	End FY 8	End FY 9	End FY 10
$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
End FY 11	End FY 12	End FY 13	End FY 14	End FY 15					
$0	$0	$0	$0	$0					

TOTAL	TOTAL NPV	EXPECTED NPV
$0	$0	$0

Impact 5.09	Description of type (express in terms such as increased profits for companies, earnings for individuals or cost savings to government), scale and recipients of expected monetary impacts associated with usage of outputs. Include description of how dollar values for impact were reached.	Probability of usage(s) required to enable impact occurring	Rationale for probability calculation *Note: The 'Probability of usage(s) required to enable impact occurring' must be claculated using the figures provided on the Usage tab (see Impact Tool - Applicant's User Guide)*	Probability of monetary impacts occurring (assuming usage(s) has occurred as expected)	Rationale for probability selection
	Impact 5.09 results from Usage 5.09, the delivery of an accredited set of training materials and resources for a course called Continuous Improvement and Innovation across existing and proposed new Beef Profit Partnerships. This package, in conjunction with Output 5.06 and other outputs across the CRC, is delivered by accredited trainers to extension agencies and commercial cattle producers who will join the BPP network to make positive impacts on productivity and profitability in beef businesses. This impact is valued in conjuction with Impact 5.06.	**0%**		**0%**	

Impact 5.09

Timeline of key impact milestones

End FY 1	End FY 2	End FY 3	End FY 4	End FY 5
End FY 6	**End FY 7**	**End FY 8**	**End FY 9**	**End FY 10**
End FY 11	**End FY 12**	**End FY 13**	**End FY 14**	**End FY 15**

Estimate of $ value associated with impact(s)

End FY 1	End FY 2	End FY 3	End FY 4	End FY 5	End FY 6	End FY 7	End FY 8	End FY 9	End FY 10
$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
End FY 11	**End FY 12**	**End FY 13**	**End FY 14**	**End FY 15**					
$0	$0	$0	$0	$0					

TOTAL	TOTAL NPV	EXPECTED NPV
$0	$0	$0

Non monetary impact of Research Program 5

Description of type (express in terms of improved health, social, environmental outcomes), scale and recipients of expected non-monetary impacts associated with usage of outputs. Include description of how conclusions were reached. If this non monetary impact will involve usage costs not already noted in your submission please discuss them here.	Please note the percentage probability associated with each non monetary impact you have described occurring. Please provide a rationale for each of these percentage probabilities.
Output 5.01 will create a network of young scientists with advanced training in the sciences underpinning beef genetic improvement and effective innovation, commercialisation and adoption of outputs. This network of young scientists will bring new skills and knowledge to a range of scientific, extension and management positions within the Australian beef industry and so lead to better R&D outcomes, faster and deeper adoption of effective tools and technologies, and better industry decision making.	There is a very high probability of these projected outcomes occurring because all Beef CRC students have graduated as anticipated and there is currently an unfilled demand for graduates in the agricultural sciencesl area.

Research Program 6 Administration, Commercialisation and Business Development

Impact 6.01

Description of type (express in terms such as increased profits for companies, earnings for individuals or cost savings to government), scale and recipients of expected monetary impacts associated with usage of outputs. Include description of how dollar values for impact were reached.	Probability of usage(s) required to enable impact occurring	Rationale for probability calculation *Note: The 'Probability of usage(s) required to enable impact occurring' must be claculated using the figures provided on the Usage tab (see Impact Tool - Applicant's User Guide)*	Probability of monetary impacts occurring (assuming usage(s) has occurred as expected)	Rationale for probability selection
Impact 6.01 results from Usage 6.01, the use within the CRC or within partner prganisations of the administration outputs from the CRC : efficient and effective administration; an identified brand for the CRC; a set of strong internal and external dissemination networks; an effective dissemination strategy; processes for the identification, protection and management of intellectual property; and a "path to market" for the commercialisation of new research results, tools and technologies. These outputs facilitate usage of CRC products by others and contribute to the financial impacts achieved by those other users. No separate usage costs are specified. There are no financial impacts from Usage 6.01 beyond those captured by usage of other CRC outputs.	**0%**		**0%**	

Impact 6.01

Timeline of key impact milestones

End FY 1	End FY 2	End FY 3	End FY 4	End FY 5
End FY 6	**End FY 7**	**End FY 8**	**End FY 9**	**End FY 10**
End FY 11	**End FY 12**	**End FY 13**	**End FY 14**	**End FY 15**

Estimate of $ value associated with impact(s)

End FY 1	End FY 2	End FY 3	End FY 4	End FY 5	End FY 6	End FY 7	End FY 8	End FY 9	End FY 10
$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
End FY 11	End FY 12	End FY 13	End FY 14	End FY 15					
$0	$0	$0	$0	$0					

TOTAL	TOTAL NPV	EXPECTED NPV
$0	$0	$0

Non monetary impact of Research Program 6

Description of type (express in terms of improved health, social, environmental outcomes), scale and recipients of expected non-monetary impacts associated with usage of outputs. Include description of how conclusions were reached. If this non monetary impact will involve usage costs not already noted in your submission please discuss them here.	Please note the percentage probability associated with each non monetary impact you have described occurring. Please provide a rationale for each of these percentage probabilities.

Research Program 7 Underpinning Science

Impact 7.01

Description of type (express in terms such as increased profits for companies, earnings for individuals or cost savings to government), scale and recipients of expected monetary impacts associated with usage of outputs. Include description of how dollar values for impact were reached.	Probability of usage(s) required to enable impact occurring	Rationale for probability calculation *Note: The 'Probability of usage(s) required to enable impact occurring' must be claculated using the figures provided on the Usage tab (see Impact Tool - Applicant's User Guide)*	Probability of monetary impacts occurring (assuming usage(s) has occurred as expected)	Rationale for probability selection
Impact 7.01 results from Usage 7.01, Usage 7.02, and Usage 7.03. This is the value of increased rates of genetic progress in the commercial herd, due to the CRCs genomic prediction equations. It is measured by $index values, flowing from previous breeding decisions made by seedstock producers, due to more accurate gEBVs delivered through BREEDPLAN and other commercial genetics companies, net of genetic progress already set in train from previous R&D. The raw data come from Banks (2012), and the specific assumptions are provided in an Appendix. The additional benefits for 5.2m cows commence in year 10 at $0.39/cow/year. Genetic progress is cumulative (Griffith 2012b), so there are many benefits after year 15, approximately $251m undiscounted for the 10 additional years to year 25. For example, the benefits for the remaining 7.8m cows do not commence until year 2019/20 ($0.58/cow/year) .	**90%**	There are some risks that seedstock producers will not make use of the new EBV data, although the higher levels of accuracy will mean higher profit per cow.	**90%**	There is little chance that the estimated monetary impacts will not accrue as predicted. Commercial cattle producers aim to meet specific target market specifications and they use genetic, nutrition and other inputs to try and minimse the cost of non-compliance. Thus they generally have a well specified breeding program underway. Once improved genetics are introduced into the herd, genetic improvement continues to occur at every mating, so the underlying rates of genetic gain will aggregate over time. Very little from the external environment can influence this. The $ index value simply values this underlying genetic improvement. The $ values tend to be both conservative for the value of individual traits and lagged, so they are probably underestimates at any point in time. With beef prices predicted to increase substantially in the next few decades, there is little chance that the $ index values will overestimate the value of the genetic improvement brought about by the more accuracy gEBVs.

Impact 7.01

Timeline of key impact milestones

End FY 1	End FY 2	End FY 3	End FY 4	End FY 5
End FY 6	**End FY 7**	**End FY 8**	**End FY 9**	**End FY 10**
End FY 11	**End FY 12**	**End FY 13**	**End FY 14**	**End FY 15**

Estimate of $ value associated with impact(s)

End FY 1	End FY 2	End FY 3	End FY 4	End FY 5	End FY 6	End FY 7	End FY 8	End FY 9	End FY 10
$0	$0	$0	$0	$0	$0	$0	$0	$0	$40,000
End FY 11	**End FY 12**	**End FY 13**	**End FY 14**	**End FY 15**					
$40,000	$6,100,000	$6,410,000	$6,730,000	$10,530,000					

TOTAL	TOTAL NPV
$29,850,000	$15,308,229

EXPECTED NPV
$12,399,666

	Description of type (express in terms such as increased profits for companies, earnings for individuals or cost savings to government), scale and recipients of expected monetary impacts associated with usage of outputs. Include description of how dollar values for impact were reached.	Probability of usage(s) required to enable impact occurring	Rationale for probability calculation *Note: The 'Probability of usage(s) required to enable impact occurring' must be claculated using the figures provided on the Usage tab (see Impact Tool - Applicant's User Guide)*	Probability of monetary impacts occurring (assuming usage(s) has occurred as expected)	Rationale for probability selection
Impact 7.02	Impact 7.02 results from Usage 7.02, the incorporation into BREEDPLAN of a set of DNA markers for for growth, feed efficiency, carcase and beef quality that account for at least 15% of the genetic variance for these traits. The impact of this information is included in Impact 7.01.	**0%**		**0%**	

Impact 7.02

Timeline of key impact milestones

End FY 1	End FY 2	End FY 3	End FY 4	End FY 5
End FY 6	**End FY 7**	**End FY 8**	**End FY 9**	**End FY 10**
End FY 11	**End FY 12**	**End FY 13**	**End FY 14**	**End FY 15**

Estimate of $ value associated with impact(s)

End FY 1	End FY 2	End FY 3	End FY 4	End FY 5	End FY 6	End FY 7	End FY 8	End FY 9	End FY 10
$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
End FY 11	End FY 12	End FY 13	End FY 14	End FY 15					
$0	$0	$0	$0	$0					

TOTAL	TOTAL NPV	EXPECTED NPV
$0	$0	$0

Impact 7.03	Description of type (express in terms such as increased profits for companies, earnings for individuals or cost savings to government), scale and recipients of expected monetary impacts associated with usage of outputs. Include description of how dollar values for impact were reached.	Probability of usage(s) required to enable impact occurring	Rationale for probability calculation *Note: The 'Probability of usage(s) required to enable impact occurring' must be claculated using the figures provided on the Usage tab (see Impact Tool - Applicant's User Guide)*	Probability of monetary impacts occurring (assuming usage(s) has occurred as expected)	Rationale for probability selection
	Impact 7.03 results from Usage 7.03 , incorporation into BREEDPLAN of a set of DNA markers for post-partum reconception and age of puberty that account for at least 15% of the genetic variance for these traits. This impact is included in Impact 4.02.	**0%**		**0%**	

Impact 7.03

Timeline of key impact milestones

End FY 1	End FY 2	End FY 3	End FY 4	End FY 5
End FY 6	**End FY 7**	**End FY 8**	**End FY 9**	**End FY 10**
End FY 11	**End FY 12**	**End FY 13**	**End FY 14**	**End FY 15**

Estimate of $ value associated with impact(s)

End FY 1	End FY 2	End FY 3	End FY 4	End FY 5	End FY 6	End FY 7	End FY 8	End FY 9	End FY 10
$0	$0	$0	$0	$0	$0				
End FY 11	**End FY 12**	**End FY 13**	**End FY 14**	**End FY 15**					

TOTAL	TOTAL NPV	EXPECTED NPV
$0	$0	$0

	Description of type (express in terms such as increased profits for companies, earnings for individuals or cost savings to government), scale and recipients of expected monetary impacts associated with usage of outputs. Include description of how dollar values for impact were reached.	Probability of usage(s) required to enable impact occurring	Rationale for probability calculation *Note: The 'Probability of usage(s) required to enable impact occurring' must be claculated using the figures provided on the Usage tab (see Impact Tool - Applicant's User Guide)*	Probability of monetary impacts occurring (assuming usage(s) has occurred as expected)	Rationale for probability selection
Impact 7.04	Impact 7.04 was expected to result from Output 7.04, a set of DNA markers for resistance to ticks and worms that account for at least 15% of the genetic variance for these traits. The Beef CRC gene discovery work in this area was terminated early due to lack of any significant findings. Scientists are re-examining past data to see if there are any useful relationships that can be captured for potential use in Breedplan. No financial impacts have been estimated from this output.	**81%**		**90%**	

Impact 7.04

Timeline of key impact milestones

End FY 1	End FY 2	End FY 3	End FY 4	End FY 5
End FY 6	**End FY 7**	**End FY 8**	**End FY 9**	**End FY 10**
End FY 11	**End FY 12**	**End FY 13**	**End FY 14**	**End FY 15**

Estimate of $ value associated with impact(s)

End FY 1	End FY 2	End FY 3	End FY 4	End FY 5	End FY 6	End FY 7	End FY 8	End FY 9	End FY 10
$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
End FY 11	End FY 12	End FY 13	End FY 14	End FY 15					
$0	$0	$0	$0	$0					

TOTAL	TOTAL NPV	EXPECTED NPV
$0	$0	$0

	Description of type (express in terms such as increased profits for companies, earnings for individuals or cost savings to government), scale and recipients of expected monetary impacts associated with usage of outputs. Include description of how dollar values for impact were reached.	Probability of usage(s) required to enable impact occurring	Rationale for probability calculation *Note: The 'Probability of usage(s) required to enable impact occurring' must be claculated using the figures provided on the Usage tab (see Impact Tool - Applicant's User Guide)*	Probability of monetary impacts occurring (assuming usage(s) has occurred as expected)	Rationale for probability selection
Impact 7.05	Impact 7.05 results from Usage 7.05, the use by commercial genomics companies of the full genome sequence for the Brahman, Africander and Tuli bulls. No financial impact to the CRC is estimated from this usage.	**0%**		**0%**	

Impact 7.05

Timeline of key impact milestones

End FY 1	End FY 2	End FY 3	End FY 4	End FY 5
End FY 6	**End FY 7**	**End FY 8**	**End FY 9**	**End FY 10**
Full genome sequence for the Brahman, Africander and Tuli bulls made available commercially.				
End FY 11	**End FY 12**	**End FY 13**	**End FY 14**	**End FY 15**

Estimate of $ value associated with impact(s)

End FY 1	End FY 2	End FY 3	End FY 4	End FY 5	End FY 6	End FY 7	End FY 8	End FY 9	End FY 10
$0	$0	$0	$0	$0	$0	$0	$0	$0	$0
End FY 11	End FY 12	End FY 13	End FY 14	End FY 15					
$0	$0	$0	$0	$0					

TOTAL	TOTAL NPV	EXPECTED NPV
$0	$0	$0

Non monetary impact of Research Program 7	Description of type (express in terms of improved health, social, environmental outcomes), scale and recipients of expected non-monetary impacts associated with usage of outputs. Include description of how conclusions were reached. If this non monetary impact will involve usage costs not already noted in your submission please discuss them here.	Please note the percentage probability associated with each non monetary impact you have described occurring. Please provide a rationale for each of these percentage probabilities.
	Full genome sequences for the Brahman, Africander and Tuli bulls were achieved and made available to the broader beef cattle genomics industry.	

Risk analysis

Research Program 1 High Quality Beef for Global Consumers

Key risks to generation of outputs, usage and impacts occurring	>	Risk management strategy
Impact 1.01. There are some risks that seedstock producers will not make use of the new EBV data, although the higher levels of accuracy will mean higher profit per cow.		Beef cattle seedstock producers will access the new EBV data from BREEDPLAN in exactly the same way as they have done in the past. Commercial beef cattle producers will access the new genetically superior bulls in exactly the same way as they have done in the past. Breed societies will emphasise increased accuracy and higher profits.
Impacts 1.02-1.04. A risk is that by introducing ongoing enhancements to the model that there will be unforseen interactions which result in poor predictions. The more complicated model salso require the concurrent delivery of an automated measuring system.		The strategy of sequential testing and validation should ensure that this risk is minimised. Very conservative estimates of usage and net benefit per head.
Impact 1.05. Very little risk of projected benefits not occuring. Well tested mechanisms are in place for the routine assessment and addition of new data into the prediction model as and when it becomes available. Premiums for MSA grade product may decline over time beyond that built in to the very conservative impact forecasts of $0.20/kg cwe and a relatively low carcase weight of 250kg. Off setting this is likelihood of commercial users further differentiating MSA product into 3 star, 4 star and 5 star instead of just 3 star plus as at present.		Very conservative impact forecasts of $0.20/kg cwe premium and a relatively low carcase weight of 250kg. Also the likelihood of commercial users further differentiating MSA product into 3 star, 4 star and 5 star instead of just 3 star plus as at present.

Research Program 2 Feed Efficiency, Maternal Productivity and Responsible Resource Use

Key risks to generation of outputs, usage and impacts occurring	>	Risk management strategy

Research Program 3 Adaptation and Cattle Welfare

Key risks to generation of outputs, usage and impacts occurring	>	Risk management strategy
There is a small risk that a tick vaccine candidate "product" cannot be found which delivers 90% efficacy and 12 months immunity. There is a small risk that producers will not adopt the new vaccine.		Testing 14 individual candidate antigens and various combinations, some of which already show efficacy levels of over 80%. The economic losses to Australia's beef industry due to cattle ticks is estimated to be at least $175m per year. There is no vaccine currently available, application of acaricides is the only protection available, and ticks are exhibiting increasing resistance to current acaracides. A new vaccine with 90% efficacy and 12 month immunity would greatly simplify farm operations, reduce current control costs and improve market access for cattle from within tick regions.

Research Program 4 Female Reproductive Performance

Key risks to generation of outputs, usage and impacts occurring	>	Risk management strategy

Research Program 5 Education and Training

Key risks to generation of outputs, usage and impacts occurring	>	Risk management strategy

Research Program 6 Administration, Commercialisation and Business Development

Key risks to generation of outputs, usage and impacts occurring	>	Risk management strategy

Research Program 7 Underpinning Science

Key risks to generation of outputs, usage and impacts occurring	>	Risk management strategy

Benefit:Cost ratio calculation

Research Program 1 — High Quality Beef for Global Consumers

Inputs into High Quality Beef for Global Consumers		Expected cost of all usage of outputs for High Quality Beef for		Expected costs associated with High Quality Beef for Global
$24,511,533	+	**$4,034,290**	=	**$28,545,824**

Expected benefits associated with High Quality Beef for Global		Expected costs associated with High Quality Beef for Global		Expected Benefit: Cost ratio of High Quality Beef for Global
$106,758,850	/	**$28,545,824**	=	**3.74**

Please briefly note any major non-monetary impacts expected for this research program

The use of the Beef Specs suite of decision support tools should lead to a greater awareness by cattle producers of the balance between the energy requirements of various types of animals to meet market specifications and the energy available in pasture and supplementary feed. This should lead to a better matching of feed availability and demand, and so lead to a better long term use of pasture resources in particular, minimising overgrazing pressures as well as weed growth.

Research Program 2 — Feed Efficiency, Maternal Productivity and Responsible Resource Use

Inputs into Feed Efficiency, Maternal Productivity and		Expected cost of all usage of outputs for Feed Efficiency,		Expected costs associated with Feed Efficiency, Maternal
$26,661,751	+	**$3,125,013**	=	**$29,786,763**

Expected benefits associated with Feed Efficiency, Maternal		Expected costs associated with Feed Efficiency, Maternal		Expected Benefit: Cost ratio of Feed Efficiency, Maternal
$18,860,702	/	**$29,786,763**	=	**0.63**

Please briefly note any major non-monetary impacts expected for this research program

Research Program 3 Adaptation and Cattle Welfare

Inputs into Adaptation and Cattle Welfare		Expected cost of all usage of outputs for Adaptation and Cattle		Expected costs associated with Adaptation and Cattle Welfare
$14,463,697	+	$630,458	=	$15,094,154

Expected benefits associated with Adaptation and Cattle Welfare		Expected costs associated with Adaptation and Cattle Welfare		Expected Benefit: Cost ratio of Adaptation and Cattle Welfare
$85,136,487	/	$15,094,154	=	5.64

Please briefly note any major non-monetary impacts expected for this research program

Research Program 4 — Female Reproductive Performance

Inputs into Female Reproductive Performance		Expected cost of all usage of outputs for Female Reproductive		Expected costs associated with Female Reproductive Performance
$22,610,292	+	$0	=	$22,610,292

Expected benefits associated with Female Reproductive Performance		Expected costs associated with Female Reproductive Performance		Expected Benefit: Cost ratio of Female Reproductive Performance
$20,295,154	/	$22,610,292	=	0.90

Please briefly note any major non-monetary impacts expected for this research program

Research Program 5 Education and Training

Inputs into Education and Training		Expected cost of all usage of outputs for Education and		Expected costs associated with Education and Training
$9,782,465	+	$0	=	$9,782,465

Expected benefits associated with Education and Training		Expected costs associated with Education and Training		Expected Benefit: Cost ratio of Education and Training
$109,635,252	/	$9,782,465	=	11.21

Please briefly note any major non-monetary impacts expected for this research program

Research Program 6 Administration, Commercialisation and Business Development

Inputs into Administration, Commercialisation and Business		Expected cost of all usage of outputs for Administration,		Expected costs associated with Administration, Commercialisation
$14,089,697	+	$0	=	$14,089,697

Expected benefits associated with Administration, Commercialisation		Expected costs associated with Administration, Commercialisation		Expected Benefit: Cost ratio of Administration, Commercialisation
$0	/	$14,089,697	=	0.00

Please briefly note any major non-monetary impacts expected for this research program

Research Program 7 Underpinning Science

Inputs into Underpinning Science		Expected cost of all usage of outputs for Underpinning Science		Expected costs associated with Underpinning Science
$0	+	$0	=	$0

Expected benefits associated with Underpinning Science		Expected costs associated with Underpinning Science		Expected Benefit: Cost ratio of Underpinning Science
$12,399,666	/	$0	=	0.00

Please briefly note any major non-monetary impacts expected for this research program
Full genome sequences for the Brahman, Africander and Tuli bulls were achieved and made available to the broader beef cattle genomics industry.

Overall cost:benefit ratio

Expected benefits associated with all Programs		Expected costs associated with all Programs		Expected Benefit: Cost ratio of CRC
$353,086,111	/	$119,909,196	=	2.94

Additional information

References Cited

Alford A, Cafe L, Greenwood P and Griffith GR (2007), The Economic Effects of Early-Life Nutritional Constraints in Crossbred Cattle Bred on the NSW North Coast*, Economic Research Report No. 33*, NSW Department of Primary Industries, Armidale, May. Available at: http://www.agric.nsw.gov.au/reader/economics-research-reports

Alford A, Hegarty R, Parnell P, Cacho O, Herd R and Griffith G (2006) The impact of breeding to reduce residual feed intake on enteric methane emissions from the Australian beef herd. *Australian Journal of Experimental Agriculture* 46, 1-9.

Banks R (2012) MLA spreadsheet of genetic gain by breed and market segment.

Deland M (2011) Graph of rates of non-compliance over time, South East South Australia.

Fordyce G, Barwick S, Corbet N, Burns B and Holmes WE (2011) Potential economic impact of Beef CRC Program 4 outputs when applied in north Australian cow herds. unpublished paper, Beef CRC, Charters Towers, December.

Griffith GR (2009) Economic effects of alternate growth path, time of calving and breed type combinations across southern Australian beef cattle environments: industry-wide effects. *Animal Production Science* 49 (5&6) (Beef CRC Special Issue on Growth Path Studies), 542-547.

Griffith GR (2012a) Have BPPs made a difference? unpublished paper, Beef CRC, Armidale, March.

Griffith GR (2012b) The value of genetic progress in Australian beef cattle due to Beef CRC R&D. unpublished paper, Beef CRC, Armidale, March.

Griffith GR and Thompson JM (2012) The aggregate economic benefits to the Australian beef industry from the adoption of Meat Standards Australia: updated to 2010/11. *Australasian Agribusiness Review,* under review.

McGowan MR and Holroyd RG (2008) Reproductive inefficiencies and opportunities in dairy and beef cattle in Australia. *Animal Production in Australia, 27, 1-9.*

McKiernan B (2011) Solutions to feedback: Livestock Data Link. *Meat and Livestock Australia Final Report, Project V.LDL.1004.*

Meat and Livestock Australia (2012) Red meat eating quality. Report to MLA by The Centre for International Economics, Sydney, January.

Meat and Livestock Australia (2011) Meat Standards Australia Annual Outcomes Report 2010-11. MLA, Sydney, November.

Prayaga K (2005) Replacing the practice of dehorning in tropical beef cattle through the development of genetic markers for polled, African horn and scurs genes. Innovative Projects Fund Application, National and International Research Alliances Program 2005/06, CSIRO, Rockhampton, October.

Slack-Smith A, Griffith G and Thompson J (2009) The cost of non-compliance to beef market specifications. *Australasian Agribusiness Review, 17, Paper 9, 178-190.*

Thompson JM, Polkinghorne R, Anderson CA and Webb LE (Editors, 2008) *'Meat Standards Australia', Australian Journal of Experimental Agriculture Special Edition, 48, 1351-1480.*

Umberger, W.J. (2007). Beef quality, beef demand and consumer preferences. In D.L. VanOverbeke (Ed.), The Handbook of Beef Quality and Safety. Binghamton, NY. The Haworth Press, Inc.