MLP Analysis & Reporting Plan - VERSION 2 FINAL March 18th, 2020 (MLP Executive Approved Mar 20)

Contents

Purpose and Summary

As yet the main R&D provider for the MLP project has not been decided. Negotiations continue with the OVIS owners and AGBU. If there is no agreement between all four parties (AWI, MLA, UNE and NSW DPI) AWI will conduct an Expression of Interest for the main body of the work.

Peer review of some of the key analysis outcomes (phenotypic, genetic and economic) will take place towards the end of the MLP project around 2022 to 2024.

The aim of this plan is to provide all stakeholders increased clarity regarding the key MLP project objectives, analysis questions, requirements, timelines and priorities and receive well informed feedback. It will also advise on how best to format and report the analysis outcomes.

An Analysis and Report Committee comprising 23 representatives from key stakeholders will provide advice and feedback to AWI

While the document will be work in progress until 2025; it will be updated annually (January) to reflect discussions and progress achieved in the previous year.

The main part of the plan is likely to remain fairly constant throughout the project. The main items for review, feedback and updating will be the Appendixes.

MLP Analysis and Reporting Committee

The membership of the Analysis and Reporting Committee will consist of the following permanent persons with the committee providing advice to AWI (AMSEA has a role but has the same level of influence as other parties):

- AWI Program Manager Genetics
- AMSEA Executive Officer
- MLP Project Manager
- Two AGBU representatives (Assuming AGBU are contracted for the analysis)
- A breeder from each Site Committee that are members of the ISC
- Five site managers
- Three 3 AASMB reps and the two classers on the ISC.
- Economist
- A representative from Sheep Genetics
- Independent Chair

Total 23. In addition;

  - Any ISC member that would like to contribute are welcome to attend meetings and equally advise AWI and vote if required.

- A person or persons, as agreed by the AWI Program Manager with special skills, can be invited to attend meetings as observers and contributors, where deemed relevant to special topics.

To improve efficiency and effectiveness sub-groups of the A&R committee will utilised for special interest topics reporting back to the A&R Committee.

The Committees will meet on an as needs basis, but likely to be once per year face to face and also by phone teleconference.

Roles and Responsibilities

- Receive suggestions from any interested party and make recommendations for updating the Analysis and Reporting Plan
- Receive suggestions from any interested party regarding key questions for analysis
- Review and make recommendations regarding MLP analysis methodology
- Review and make recommendations on analysis priorities and milestones
- Review and make recommendations on the format of the analysis reports for technical, ram breeder and ram buyer audiences
- Review and make recommendations on index assumptions for MLP
- Review and make recommendations on the outputs of the MLP analysis

The MLP project will work in close collaboration with the Sheep Genetics Technical Committee (SGTC) that continues to oversee the R&D for Sheep Genetics on behalf of MLA and OVIS owners. Analysis reports will be shared with the SGTC which will make recommendations regarding OVIS updates and changes to analysis methodology to OVIS owners and Sheep Genetics.

Key MLP Objectives (primarily based on AWI Board Papers)

The MLP project is collecting a wide range of data that can be analysed to;

a) Create a quality data set for genetic parameter estimates both phenotypic and genetic for all the current fleece, carcass, reproduction and welfare assessments currently available using the contemporary AI sires to improve current genetic benchmarking methodology, assess economic differences between sires, ewe types and progeny and compare both approaches. Are there differences in the parameter estimates between wool types, sheep types and micron?
b) Determine if the current Index (and other software like Grassgro) methodology and assumptions can be improved to better reflect lifetime productivity at young ages
c) Determine if some animals and sire progeny decline in relative fleece weight as they age, and is it more prevalent in low wrinkle Merinos
d) Determine is the current advice to collect A1 and A2 fleece, carcass and visual data and repeated adult reproduction data is correct; can recording repeat adult fleece traits improve genetic benchmarking accuracy
e) Raise the profile of A2 assessments and increase the collection of adult data
f) Determine if the Post Weaner or Yearling data that most ram breeders use to benchmark sale rams can be improved through use of genomics of other means to better reflective lifetime productivity

g) Determine what are the most effective ages and basket of measured and visual traits to select sheep for a range of breeding objectives and when and which traits are the most efficient and cost effective
h) Increase the number of animals with fleece, reproduction and health and welfare traits in the Genomics Resource Flock
i) Better define the impact of reproduction on fleece, carcass and welfare traits
j) Collect data for new traits; the 3 component traits of NLW, (Conception, Litter Size and Ewe Rearing Ability) Urine Stain, Faecal Consistency etc.
k) Compare link sire performance across sites and ewe types and compare sire performance across 2 main ewe type differences at Macquarie
l) Compare results using MLP data only (level playing field) with results using all data available (Dam pedigree of F1 ewe dams, Add On project data, MERINOSELECT data etc.)
m) Compare visual assessments and classing with FBV's, ASBVs and Indexes and economic outcomes

How much data and how much adult data should be collected and used by Ram Breeders?

The current broad technical advice from AGBU (and most other researchers), to Merino ram breeders is to collect in the Special Stud or Nucleus Ewe group;

- One set of younger age, likely Yearling and one set of Hogget/ pre lambing Adult 2 fleece data; (GFW, Yield, Curvature, Staple Strength, Staple Length) and
- Yearling or Hogget; Carcass, (Body weight, fat, muscle, scrotal circumference, worm egg count where appropriate, and visual traits data), and
- Annual lifetime reproduction data; (Conception, Litter Size and Ewe Rearing Ability)
- Use indexes as part of the selection process

This advice may vary slightly according to the breeding aims of the Merino breeder.

However, little Hogget or Adult pre lambing fleece carcass, or visual data is currently being collected by ram breeders in MERINOSELECT albeit increasing in recent years. There are large amounts of data at Post Weaner and barely Yearling ages in response to the demand to purchase rams at 14 to 16 months of age in 6 months wool. Some ram breeders both in MERINOSELECT and not in MERINOSELECT take older age measurements and visually class ewe and sires but little is formally recorded.

With the push to class and sell rams at younger ages since the 1980's, there has been keen interest to determine what data is required at what age to achieve good genetic evaluations of lifetime productivity for the benefit of ram breeders and their clients.

So there are lead questions for the MLP project to answer;

- Is the current advice to ram breeders on which data to collect supported by MLP outcomes?
- How many animals change in trait productivity and profitability after Yearling and A2 and does it justify modifying OVIS to analyse each age stage singularly for repeat adult fleece, carcase and visual traits?
- Can visual classing reduce some of the repeat measurement costs?

- How do the current Indexes compare to lifetime economic outcomes and can the indexes be improved in both the methodology and assumptions used, to better predict economic returns?

Comparisons can be made between;

I. Sires
II. Sire Types / Groups (Merino Type, Skin Type, Micron, Wrinkle, Fleece Weight, Fat, Muscle, Condition Score, Body weight)
III. Foundation Ewes Lines
IV. F1 ewes Types / Groups
V. Annual measures and index changes

These key questions will mostly have;

1. a technical answer; what maximises genetic gain, and

2. an economic answer; what optimises genetic gain (under a cost benefit analysis)

The Return on Investment from the MLP project will mostly hinge on these 4 key issues and the adoption of the outcomes by ram breeders.

A detailed list of the MLP Project questions can be found in Appendix A.

Key requirements for Analysis and Reporting

There are 9 key MLP analysis approaches and combination of them may be used to answer key MLP questions (these are additional to the current MLP Site Reports that AMSEA engage AGBU and OVIS to create).

1. Within drop, site raw data

2. Within drop, site adjusted sire means

3. Within site drop and across drop, flock breeding values FBVs

4. MLP Project (across site and drop) flock breeding values FBVs without genomics

5. MLP Project (across site and drop) flock breeding values FBVs with genomics

6. MLP Project alone and with all other relevant data, across flock MERINOSELECT Australian Sheep Breeding Values ASBVs with and without genomics

7. Genetic and phenotypic parameters for all MLP traits, additional traits and some Add-On Project data

8. Economic Evaluation of Lifetime Productivity and Profitability

9. Comparison of the Economic Evaluation (per head, per Ha, per DSE and other) with Indexes

10. Recommendations for ram breeders, ram buyers, service providers, consultants, OVIS and improvements to genetic benchmarking in general.

Items 3, 4, 5, 6 and 9 require access to OVIS

Items 1, 2, and 3 are used for the standard AMSEA type site reports that are produced for each MLP Site Field Days or annual update. These can be accessed via the AMSEA and MLP websites.

All other items will be part on milestone reports to AWI which will be disseminate as appropriate via the publication outlets below.

Analysis Providers

The OVIS owners will only licence AGBU to use OVIS for third party access and to update OVIS methodology and assumptions. Access to OVIS is required for 5, 6 and 9 and highly preferred for 3 and 4.

A range of other statistical analysis software can be used by a range of analysis providers for Items 7, 8, and 9. These then inform the methodology and assumptions used in OVIS.

A range of economists are available for option 8.

If the outcomes of any analysis by non AGBU analysis providers suggest potential improvements to OVIS, they would need to be approved by AGBU and then the OVIS owners.

MLP IP and Licenses

AWI owns all MLP IP. This includes the raw phenotypic and genomic data, analysed data and all reports.

The Sheep CRC has assigned their Genomic IP to MLA and MLA has agreed to AWI owning the MLP genomic IP.

AWI has provided a licence to MLA, (and plans to provide similar licences to UNE, NSW DPI and AGBU) to use MLP IP for sheep genetics benchmarking purposes.

The OVIS owners are likely to licence AGBU to use OVIS for the purposes on MLP analysis and AWI will share all analysis milestone reports with the OVIS owners.

AWI will also provide access to MLP IP for contracted organisations conducting MLP Add On projects and to other researchers and students when requested and approved by AWI. Approval is on the basis that sires will not be identified unless entrants otherwise agree. Licensees will be required to fill in an application form with confidentiality, data security and licence conditions.

The NSW Stud Merino Breeders Trust Fund have allocated money to assist with the analysis of MLP project outcomes and some Stud breeder relevant MLP Add-On projects

The MLP data is stored in the AMSEA data base at AGBU, there is a backup process at AGBU, along with separate backups held by AMSEA and AWI.

For a project which could impact on the conduct of the MLP project a potential project needs the MLP Executive approval. AWI then has a MLP project application form, similar to any on-farm application to AWI, once approved, a Data Sharing Agreement template for students and one for

researchers is available. Where a researcher is seeking data the does not impact operations at one of the MLP sites the original approval of the MLP Executive is not required.

Key Reports

- On-going Field Day reports as has occurred and evolved since 2016
- AWI will circulate analysis milestone reports to MLP Stakeholders
- AWI will circulate analysis milestone reports to Sheep Genetics Technical Committee (Includes MLA, AGBU, UNE, NSW DPI and others)
- Communications and Extension publications
- Scientific publications

Publication Outlets

To be determined by the Communication and Extension Plan but generally;

A) AWI, MLP and AMSEA websites
B) MLP Site reports and MLP e-newsletter
C) Woolgrower representative organisations; presentations and publication via conferences, seminars, meetings etc. (WPA, SFO, AWGA, Stud Merino Breeder Assn, MerinoLink)
D) Beyond The Bale
E) AWI e-newsletters
F) AAABG
G) National and International Genetics Journals

Site Calendar of Events

Each sites calendar of events differs owing to climate and enterprise mix which then impacts on the timing of data collection, and on the date of field days.

Timing of Husbandry Events

	Balmoral	Pingelly	MerinoLink	Macquarie	New England
Sires In	Mid March	Early Feb	Late Dec	Early Dec	Early April
Sires Out	Late April	Mid March	Early Feb	Mid Jan	Mid May
Preg Scanning	Mid June	Late April	Early March	March	June
Lambing Starts	Mid Aug	Early July	Early June	Early May	Early Sept
Lambing Finishes	End Sept	Early Aug	Early July	Mid June	Mid Oct
Lamb Marking	Early Oct	Mid Aug	Mid July	Late June	Mid Oct
Weaning	End Nov	Early Oct	Late Sept	Late August	Mid Dec
Field Day	March	Late Oct	Oct	March	June
Classing	Jan	Late Nov	Sept	Sept	June
Shearing	Feb	Dec	Oct	Oct	July
Crutching	Jan	May	March	August	Jan

Analysis Timelines

The five MLP sites started in four different years commencing with the 2015 drop at Balmoral and finishing with the 2018 drops at Macquarie and the New England. Thus, there is a time lag between

when all the 1, 2, 3, 4, 5, 6 and 7 year old data is collected. There are small nuances between sites such as differences in shearing times (pre or post joining) and some sites have changed time of shearing part way through the project. Note that items in red in the following table are not yet budgeted.

Year	Balmoral		Pingelly		MerinoLink		Macquarie		New England		
	15 Drop	16 Drop	16 Drop	17 Drop	16 Drop	17 Drop	17 Drop	18 Drop	17 Drop	18 Drop	Data Collection
2015											
2016	PW	PW	PW		PW						
2017	A2	Y	Y	PW	Y	PW	PW		PW		
2018	A3	A2	A2	Y	A2	Y	Y	PW	Y	PW	All PW
2019	A4	A3	A3	A2	A3	A2	A2	Y	A2	Y	All Y
2020	A5	A4	A4	A3	A4	A3	A3	A2	A3	A2	All A2
2021	A6	A5	A5	A4	A5	A4	A4	A3	A4	A3	All A3
2022	A7	A6	A6	A5	A6	A5	A5	A4	A5	A4	All A4
2023			A7	A6	A7	A6	A6	A5	A6	A5	All A5 & A6
2024							A7	A6	A7	A6	All A6 & A7
2025	**Major Publications Due**										

There may be the option of taking the ewes out for an additional year, hence A6 and A7 in red. The current age distribution of Merino Ewes in the Australian Flock 2017 is outlined later in the plan.

Even though there are different ages for fleece traits the number of lambing events are 5 events for the older age drop at each site and 4 events for the younger age ewes. Fleece age traits will need to be correlated to the lambing event.

The specific ages of shearing for each site is

Balmoral 2015 – P, A2, A3, A4, A5, A6, A7

Balmoral 2016 – P, A2, A3, A4, A5, A6

Pingelly 2016 - P, A2, A2, A3, A4, A5, A6

Pingelly 2017 - P, H, A2, A3, A4, A5

MerinoLink 2016 – Y, A2, A3, A3, A4, A5, A6

MerinoLink 2017 – Y, A2, A2, A3, A4, A5

Macquarie 2017 – P, H, A2, A3, A4, A5, A6

Macquarie 2018 – P, H, A2, A3, A4, A5

New England 2017 – Y, A2, A3, A4, A5, A6, A7

New England 2018 – Y, A2, A3, A4, A5, A6

The full list of analysis questions is outlined in Appendix A. R&D outcomes must be relevant to the data collected at any point in time. We need to ensure that outcomes will not change with the addition of future data and minimise the cost of duplicated analysis over time.

See Appendix B for the Analysis timelines and priorities. All sites will have collected Hogget or Adult pre lambing data by August 2020

Current Age Distribution of Merino ewes in commercial Flocks

Age of Cast for Age Ewes Sold	%	Accumulative %
<4 old	3%	3%
5 years	16%	19%
6 years	42%	61%
7 years	20%	81%
8 years	12%	93%
>9 years	4%	97%
Don't know	3%	100%

AWI 2017 Merino Husbandry Survey (1,200 growers)

MLP Trait Definition

Fleece traits; greasy fleece weight (GFW), yield (YLD), clean fleece weight (CFW), curvature (CURV), staple length (SL), staple strength (SS), coefficient of variation of fibre diameter (FDCV)

Carcass traits; body weight (WT), condition score (CS), fat (FAT), muscle (EMD)

Visual traits; traits in the visual score guide including AMSEA classing, Professional classing and Grades

Reproduction traits; conception, litter size, ewe rearing ability (ERA), number of lambs weaned (NLW), number of lambs born (NLB, assumed from pregnancy scanning), ram mating success of sires to produce F2 lambs, (Scrotal circumference of the sire if collected)

Resistance/Welfare traits; worm egg count (WEC), ewe survival, lamb survival, breech wrinkle (EBWR), breech cover (BCOV), dag (DAG), urine stain (URINE), face cover (FACE), horn/poll

Indexes; An overall productivity assessment, where traits receive an economic weighting depending on a set breeding objective relevant to four main production systems; Dual Purpose (DP), Merino Production (MP), fine Fibre Production (FP) and high Wool Production (WP).

Issues that the MLP project is not designed to investigate

There are limits on any R&D trial as to how much information can be collected without impacting on the core purpose and the cost of a trial.

The MLP project is not involved in;

- One year old ewe lambing
- Collecting joining day data on the F1 ewes
- Lambing Rounds. (Birth date, birth lamb type, birth weight, lambing ease, temperament) Thus we are unable to determine embryo loss from pregnancy scanning to lambing, date of lambing, lamb survival in first week, days to lambing,
- Ram Mating Success data on the sires used over the F1 ewes to breed the F2 progeny
- Autopsy on every death
- Assessing skin depth, wool follicle density, primary secondary fibre ratios, lock structure

- Resilience (an MLP Add on project has been funded with CSIRO)
- Better ways to determine profit per Ha (an MLP Add on project has been funded with Murdoch)
- Meat Eating Quality (MLA have funded 3 projects using F1 wether progeny)
- Ewe longevity for a 6th ,7th, or 8th lambing event (normally 7, 8 or 9 year old ewe)

Age Definitions

B Birth; within 24 hours of birth

M Marking; 14 to 42 days (2 to 7 weeks)

W Weaning; 42 days to 120 days (7 weeks to 4 months)

EP Early Post Weaning; 120 to 210 days (4 to 7 months)

P Post Weaning; 210 days to 300 days (7 months to 10 months)

Y Yearling; 300 days to 400 days (10 months to 13 months)

H Hogget; 400 days to 540 days (13 months to 18 months)

A2 Adult 2 year old; 18 months to 30 months (1.5 year old to 2.5 yo)

A3 Adult 3 year old; 30 months to 42 months (2.5 year old to 3.5 yo)

A4 Adult 4 year old; 42 months to 54 months (3.5 year old to 4.5 yo)

A5 Adult 5 year old; 54 months to 66 months (4.5 year old to 5.5 yo)

A6 Adult 6 year old; 66 months to 78 months (5.5 year old to 6.5 yo)

A7 Adult 7 year old; 78 months to 90 months (6.5 year old to 7.5 yo)

LT Lifetime; 0 months to 78 months (Birth to 6.5 yo)

Due to different lambing and shearing dates, some sites shear pre joining, others shear pre lambing and there is potential to review and improve the age definitions so that an A2 fleece relates to the fleece that is grown at the same time as it maiden 2yo lambing. etc

Classing Splits

Professional Classing

Within drop; Tops 1%, Stud 9%, Seconds 60%, Sales 20% and Culls 10%

AMSEA Classing

Within drop; Tops 25% Flocks 50% and Culls 25%

Wells Classing

Within each sire's progeny groups; Tops 10% Firsts 25% Seconds 30% and Culls 35%

List of Traits

List of Age and Traits Recorded on MLP Sheep															
	AI	Foundation Ewes		MLP F1 Ewes											F2 Lambs
	Sires	AI	S	T	W	P	Y	H	A2	A3	A4	A5	A6	A7#	W
		Joining	Scanning	Tagging or Marking	Weaning	Post Weaning	Yearl ing	Hogget	Adult 2yo	Adult 3yo	Adult 4yo	Adult 5yo	Adult 6yo	Adult 6yo	Marking/ Weaning
SEX				x											x
NLW Join Dates		x							x	x	x	x	x	x	
NLW Preg Scanning			x						x	x	x	x	x	x	
NLW Lambs Reared to Tagging				x					x	x	x	x	x	x	
NLW Reared to Weaning					x				x	x	x	x	x	x	
UDDER Wet/Dry									x	x	x	x	x	x	
GFW						x			x	x	x	x	x	x	
CFW						x			x	x	x	x	x	x	
FD						x			x	x	x	x	x	x	
FDCV						x			x	x	x	x	x	x	
FDSD						x			x	x	x	x	x	x	
Yield						x			x	x	x	x	x	x	
SL						x			x	x	x	x	x	x	
SS						x			x	x	x	x	x	x	
POB - T						x			x	x	x	x	x	x	
POB - M						x			x	x	x	x	x	x	
POB - B						x			x	x	x	x	x	x	
Spinning Fineness						x			x	x	x	x	x	x	
Comfort Factor						x			x	x	x	x	x	x	
Curv						x			x	x	x	x	x	x	
WT		x			x	x	x	x	x (4)	x (4)	x (4)	x (4)	x (4)	x (4)	x (2)
EMD - Scan						(x)	(x)	(x)	x	x	x	x	x	x	
FAT - Scan						(x)	(x)	(x)	x	x	x	x	x	x	
Condition Score		x	x				x	x	x (4)	x (4)	x (4)	x (4)	x (4)	x (4)	
WEC						(x)	(x)		(x)	(x)	(x)	(x)	(x)	(x)	
Faecal Consistency						(x)	(x)		(x)	(x)	(x)	(x)	(x)	(x)	
FLROT						x			x	x	x	x	x	x	
COL						x			x	x	x	x	x	x	
CHAR						x			x	x	x	x	x	x	
DUST						x			x	x	x	x	x	x	
WEATH						x			x	x	x	x	x	x	
SSTRC						x			x	x	x	x	x	x	
FPIG				x^u		x^u			x^u	x^u	x^u	x^u	x^u	x^u	
SPIG				x^u		x^u			x^u	x^u	x^u	x^u	x^u	x^u	
BLK				x^u		x^u			x^u	x^u	x^u	x^u	x^u	x^u	
SPOT				x^u		x^u			x^u	x^u	x^u	x^u	x^u	x^u	
FACE						x			x	x	x	x	x	x	
JAW						x			x	x	x	x	x	x	
LEGS						x			x	x	x	x	x	x	
BACK						x			x	x	x	x	x	x	
BDWR				x		x			x	x	x	x	x	x	
BCOV^				x		x			x	x	x	x	x	x	
CCOV^						x			x	x	x	x	x	x	
BRWR^						x			x	x	x	x	x	x	
DAG						(x)	(x)		(x)	(x)	(x)	(x)	(x)	(x)	
URINE						(x)	(x)		(x)	(x)	(x)	(x)	(x)	(x)	
GRADE						x			x	x	x	x	x	x	
SGRADE						x			x	x	x	x	x	x	
Professional Classing						x			x	x	x	x	x	x	
FUNCTIONALITY - teeth incisor count, alighment, length									x	x	x	x	x	x	
FUNCTIONALITY - Number of functional teats, teat shape									x	x	x	x	x	x	
PEDIGREE DNA			x	x											x
POLL / HORN	x			x											
PEDIGREE Other			x (1)												
DNA 15K SNP	x			x											
DNA 50K SNP	x			x											

(x)	When available or has hit a threshhold
x^u	Trait can be updated at subsequent assessments if identified after tagging.
^	Unmulesed sites only (Balmoral, Pingelly, New England)
#	The first drop of ewes at the Balmoral and New England site are assessed out to A7
Notes	The NE site has full lambing records on foundation ewes, and plan to have this data collected on all F1 natural lambings
	Some sites have two fleece assessments within the same age stage
	Sites either have their first assessment at post weaning or yearling age stage
	The Macquarie site has their first assessment at post weaning, second at hogget and then each adult through to A6
	Sires with 15KSNP will be imputed to the new 50K SNP

APPENDIX A

The lead questions for the MLP project to answer are;

- Is the current advice to ram breeders on which data to collect, supported by MLP outcomes?
- How many animals change in trait productivity and profitability after Yearling and A2 and does it justify modifying OVIS to analyse each age stage singularly for repeat adult fleece, carcase and visual traits?
- Can visual classing reduce some of the repeat measurement costs?
- How do the current Indexes compare to lifetime economic outcomes and can the indexes be improved in both the methodology and assumptions used, to better predict economic returns?

These key questions will mostly have;

1. a technical answer; what maximises genetic gain, and

2. an economic answer; what optimises genetic gain (under a cost benefit analysis)

The Return on Investment from the MLP project will mostly hinge on these 4 key issues and the adoption of the outcomes by ram breeders.

Key MLP Objectives

The MLP project is collecting a wide range of data that can be analysed to;

a) Create a quality data set for genetic parameter estimates both phenotypic and genetic for all the current fleece, carcass, reproduction and welfare assessments currently available using the contemporary AI sires to improve current genetic benchmarking methodology, assess economic differences between sires, ewe types and progeny and compare both approaches. Are there differences in the parameter estimates between wool types, sheep types and micron?
b) Determine if the current Index (and other software like Grassgro) methodology and assumptions can be improved to better reflect lifetime productivity at young ages
c) Determine if some animals and sire progeny decline in relative fleece weight as they age, is it more prevalent in low wrinkle Merinos
d) Determine if the current advice to collect A1 and A2 fleece, carcass and visual data and repeated adult reproduction data is correct; can recording repeat adult fleece traits improve genetic benchmarking accuracy?
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g) Determine what are the most effective ages and “basket” of measured and visual traits to select sheep for a range of breeding objectives and when and which traits are the most efficient and cost effective

h) Increase the number of animals with fleece, reproduction and health and welfare traits in the Genomics Resource Flock
i) Better define the impact of reproduction on fleece, carcass and welfare traits
j) Collect data for new traits; the 3 component traits of NLW, (Conception, Litter Size and Ewe Rearing Ability) Urine Stain, Faecal Consistency etc.
k) Compare link sire performance across sites and ewe types and compare sire performance across 2 main ewe type differences at Macquarie
l) Compare results using MLP data only (level playing field) with results using all data available (Dam pedigree of F1 ewe dams, Add On project data, MERINOSELECT data etc.)
m) Compare visual assessments and classing with FBV's, ASBVs and Indexes and economic outcomes

Alignment of research questions to key messages

Below each specific research question in the table below you will find in **bold** further information that further draws out each question.

Simplified key message	**1) MLP will determine what are the most important Merino ewe traits and how these interact with each other throughout a ewe's lifetime.**
Detailed message	MLP will seek to discover the key interdependencies between measured and visual traits throughout a ewe's lifetime. This will facilitate more effective selection of lifetime productive sheep to suit particular breeding objectives.
Specific research questions to be addressed	• Do ewes that fall in fleece weight as they age, tend to be lower wrinkle, with long staples and have more lifetime lambs? **Non Mulesed (NM) types** **Impact on early maturing v later maturing sheep** **Does age or the number of lambs they rear have the most impact** • Do sires and or ewe progeny that have lower mortality cut less wool, have lower wrinkle and produce less lambs? **NM type** **Is survival linked to lower productivity / lower stress – partitioning of nutrients?** **Should we include survival and welfare traits in indexes?** • Do ewes that increase in fleece weight as they age have higher wrinkle, mature later and have fewer lifetime lambs? **Are there differences between wool types, sheep types and micron?** **Existing R&D data has some limitations, suggests that A2 fleece traits are the same as A3, A4, A5 and A6** **As 2 age groups are further away in year terms the correlations fall, what are the correlations between each age groups and Adult Lifetime (AL)** **Are there productivity changes in other traits? (reproduction, carcass, visual scores, welfare traits)?** **Need to look at whole productivity, soundness, 'doability', not just fleece weight** • What are the trade-offs between reproduction traits and fleece traits and wool income between years, between sites and over a lifetime? **How much does NLW impact on fleece value; is the lower fleece weight balanced by lower micron** **Currently indexes don't account for reproduction impacts on production**

	• How long does the impact of being dry, raising a single or twin at A2 impact on later year performance? Is there a discernible difference at A3, A4, A5? **Management groups increase exponentially with age can we cut corners** **If not, it could be a real limitation for collecting on farm multiple age data** • How long does the impact of being dry, single and twin at A3 impact on later year performance? Is there a discernible difference at A4, A5, A6? **Management groups increase exponentially with age, can we simplify these in any way** • Is yearling fat and muscle a good predictor of lifetime reproduction, or its 3 component traits? **MLP provides a good dataset to evaluate the benefits of fat and muscle at phenotypic and genetic level. Do they change with varying ewe phenotypic condition scores at joining or lambing (i.e. 2.5, 2.75, 3.0, 3.25, 3.5 CS)** • Are there sire and or ewe progeny that can cut wool, have high reproduction and have low mortality through their lifetime? **Finding elite animals (high selection differential) and getting progeny from them has large impact on rate of genetic gain.** **How do we define an elite animal in this context and how many are there?** • Do sires or ewe progeny with lower wrinkle have more lambs? **Old data says yes, we don't have good data on current genotypes** **Currently correlations between wrinkle and reproduction are not used or fully used in MERINOSELECT but could be if it improves predictability of lifetime productivity and profitability** • Do ewe progeny from heavy cutting sires have fewer lambs? **Old data says yes, we don't have good data on current genotypes** **Does it increase as ewe condition score decreases?** • Do lower condition ewes at previous weaning, joining, pre lambing and at weaning have lower conception rates, litter size and ewe rearing ability at the following joining? **Validation across Merino types of Lifetime Ewe Management (LTEM) protocols** • Is poor conformation correlated to lower early, mid, late life productivity **Does conformation impact on productivity of the sheep (not including restocker price). It may later in life when teeth start breaking, condition score decreases and stress on the ewe increases?** • What are the attributes of ewes that cut wool and rear lambs? **Does this alter between environments of sheep type?** • Should lamb survival, weaner survival or longevity be added as important MERINOSELECT traits?

	What was the survival from foetus scanning to tagging, is it correlated with any measures? **How do the scanning results and tagging results at New England site correlated with the lambing round results?** **What existing traits are best correlated with survival (lamb, weaner and adult)?** **Is high or low CV and or high and low SS correlated with fleece weight or survival?** • Can the MLP F1 ewe growth rates offer any information with likely results from a 8-12 month ewe lamb joining? **The ability to join as a ewe lamb is not being assessed by MLP project. Can it offer any insights into this trait Y NLW?** • What are the traits most correlated to fleece rot? **Body strike has reduced with the fall in micron but could again become a more important trait with chemical resistance growing** • What can be gained by looking at the spread of progeny results around the mean? **Do some sires or traits have lower variation around the mean, are more consistent in their progeny than other for both measured and visual traits?** **Is there more variability and culls with outcrosses compared to within type progeny?** • Is mature age body weight an important trait? **Mature cow weight is measured in cattle, should it be measured in Merinos?** • Does MLP data support other new traits, i.e.; Urine Stain, Faecal Consistency, Survival, Longevity, Visual Trait ASBVs, Welfare, Resilience, Efficiency, Mature Ewe Weight? **Will they be cost effective for some breeders, can they be added to indexes?** • What is the repeatability of a visual classers scores? **How reliable are visual classers?** • Do structural or breech traits change over time? **If they don't change then classing is likely to have more impact now and future generations?** • Should the age trait definitions be adjusted so that an A2 fleece is associated with the fleece grown during the birth and lactation of the first lamb born to a maiden 2 year old ewe. Likewise for each additional age trait? **This could make it clearer when communicating value of repeat adult traits?**

Simplified key message	**2) MLP will determine the best way to apply current and future <u>selection techniques.</u>**
Detailed message	MLP will seek to validate and improve the application of and interaction between current selection techniques. This will allow existing selection techniques to be applied and leveraged to optimise future selection efficiencies and optimise/ maximise genetic gain.

Research questions addressed	• What is the preferred ewe selection strategy for lifetime fleece and lamb production?
	  ○ Class out light weight ewes prior to joining only?
	  ○ Class out ewes based on Post Weaning or Yearling classing?
	  ○ Class out ewes on Hogget classing
	  ○ Class out ewes based on A2 classing post scanning and prior to lambing?
	  ○ Class retained ewes on maiden lambing productivity?
	  ○ Minor classing (bottom 5% on body weight) and cull ewes when they fail to rear a lamb?
	  ○ Minor classing (bottom 5% on body weight) and cull ewes that fail to rear a second time?
	  ○ Is there a preferred mix of visual assessments and objective measurements?
	  ○ Are high body weight animals more productive?
	Use of sheep classers is falling particularly in WA, and classing via a drafter on body weight is increasing. Is this trend justified by MLP data?
	Do the recommendations to commercial growers, change between sheep type and region?
	How do we stop pushing body weight higher, or where is the limit? Can moderate frame ewes compete?
	
	• Does annual visual classing of mixed aged ewes assist in selecting for lifetime productivity, if adult fleece and or objective carcase traits are not collected each year?
	Is repeat adult fleece data too compromised by higher numbers of management groups that are difficult and complex to keep?
	Visual classing is low cost compared to measurement but will it achieve the same production gains?
	How important is annual stud sheep classing, which has reduced in recent years?
	How careful does a classer need to be classing adult ewes, what should the % be, without culling twin bearing ongoing fertile ewes. Should the dries or lambed and lost (L&L) be identified? Should the dries and L&L be culled at weaning so there are not present at classing?
	
	• Does the analysis of MLP data support the collection of detailed reproduction records every year (A2 to A6); submitting mating, scanning, lambing and weaning records?
	Very few ram breeders are collecting this data and submitting it, should they be?
	It is expensive, what are the returns? Should infrequently measured traits (NLW, SS) have such a large impact on indexes, how should we best manage this?
	
	• Is culling ewes when they fail to rear at the second event a good tool to improve flock reproductive performance, compared to culling ewes that fail to rear at any age, i.e. as a maiden or at any subsequent lambing event?
	This is a cheaper approach compared to full NLW data collection, how much progress is lost?
	Current advice is to cull when they fail for a second time, is this still correct and right for all ewe types?

	• Is culling ewes when they fail to rear at the second event a good tool to improve flock profitability, compared to lighter hogget classing and culling ewes that fail to rear at any age, i.e. as a maiden or at any subsequent lambing event? **What is the optimum culling strategy, does it apply across sheep types?** • Are current sheep classing techniques good predictors of lifetime productivity at PW/Y or H age? Which method of classing (AMSEA Grading, Professional Classing or Wells Classing) better reflected actual lifetime productivity; fleece, carcass, reproduction, visual, resistance and index traits. Does classing by sire progeny groups lead to improved selection of the top animals according to their chosen breeding objective? Can genomics assist a classer classing at 6 months of age or at 12 months of age using any of the 3 classing approaches? **Within sire progeny classing was about getting a transparent view on how the sire was performing, but then all boxed in a mob for actual classing to reduce bias. (Geoff Lindon experience) Wells Classing results are within site and drop and cannot be aggregated (The classing protocol requires each sire gets the same proportion of animals in each grade)** **AMSEA grading; are there differences between the site classers?** **Are there issues with older age grading that is with or without data?** **Professional Classing; 5 grades; top 1% is the key to genetic gain for Merino breed. Difficulty is the low number in the top 1 % grade and data will need to be aggregated across years, within a site and at project level.** **How do the 3 classing protocols compare to current Indexes and any new ones?** • How does visual classing at each (PW, A2, A3, A4, A5, A6, LT) age compare to the measurements collected at that age (fleece, carcass, reproduction, resistance and index)? **Is visual classing more accurate the older the ewe?** • Are dam and sire pedigree required to obtain sufficiently accurate records when only collecting PW/Y records of sire progeny, or ram and ewe progeny? Do genotypes (50K SNP Oct 2019) add benefit when measuring Merinos at PW/Y ages and joining at 17 months or when joining at seven months with mid-parent pedigree and EPW records? Do grandsire and granddam records further improve early age ASBVs? **Using with-in project FBVs, what is the impact of removing the sires dam and sire pedigree?** **Does genomics assist more when there is no pedigree, PW ages up?** **How much does genomics assist when there is full pedigree, PW ages up?** • What improvements to ASBVs at PW/Y and A2 is there from using actual early life adjustments compared to the default adjustments used by MERINOSELECT? **MS uses default early life adjustments for all flocks across all years** **How do the early life adjustments in MLP compare with the default adjustments?** **What improvements are gained from having the actual adjustments for each management group?**

	Does the size of the adjustments vary across sites (ewe type, country etc)? Note that MLP F1 ewes were born via AI and have limited variation in date of birth compared to ram breeders who will have variation in date of birth over 2-3 cycles. **Also need comparison of early raw data, sire adjusted means and ASBVs?** **Regarding adjustments for twins, what if one is female and one male, does the male get over promoted?** • How do the sire FBVs rank within site and within project (MLP data only) compared to their relative performance in MERINOSELECT? (All available data is used)? **How robust is on farm data?** **How robust is the ASBV system using all data? Prior work says ASBVs work well for most traits, less so for the problem traits (NLW, SS, WEC).** **What happens when only 50% or 70% of males are measured at 10 mths. (only measure animals "classed in" animals? What then happens if 90% of ewe drop are measured at 18mths?** • How have the MLP sire ASBVs and FBV changed over the duration of the MLP project? What about changes in the F1 ewe progeny and progeny types? **How much data is need before they become stable?** • How do the sires MERNOSELECT Index rankings (those used by Industry throughout the decade of the MLP project) compare with their lifetime economic performance? **MS has 4 data bases (NLW, WEC, Visual and all other data), some key correlations are not being used** **What if actual rather than the default adjustments are used?** **Not measuring the whole drop, what is impact in only testing 50% or 70%** **Survival is currently not in the index or are the key breech traits. How much does survival impact on the comparison between actual return and the index prediction?** **What is impact of low precision "problem" traits have on index (NLW, SS, WEC) if they are and are not directly measured?** **How do any new indexes compare to actual $ returns?** • How do $ per head, $ per Ha and $per DSE compare to indexes and GRASSGRO results? **Comparison with GRASSGRO** **Comparison with per DSE** **Wether trials** **Other measures from ON521 GEPEP Murdoch Uni** • Is lamb kg weaned per ewe kg joined a good KPI? **Another measure to assess** • How much does progeny survival impact on indexes? **What traits impact on survival and how should survival be economically assessed?**

	• What is the impact of foetal loss post scanning to lambing and lambing to marking? How important is birth weight to survival in Merinos and lifetime productivity? **Birth weight is not a standard site protocol but New England may collect this data as part of an "add on" project.** • Is survival correlated to ewe or sire visual assessments or objective measurements? **Can we better predict survival and include in indexes?** • Does poor conformation impact on survival and lifetime productivity or profitability? **Is it different between a ram breeder and ram buyer flock?** • How do the genetic parameters between traits in the MLP project compare with the genetic parameters used in MERINOSELECT? **Genetic and phenotypic parameters on today's Merinos are an important MLP outcome** **Between all age groups for each trait** **They may suggest updates to OVIS parameters are warranted.** • Is kg of lamb weaned as a percentage of ewe mating weight an important trait or selection strategy for dual purpose Merinos? **Can this work as a proxy for high lambing results on a lighter weight ewe, is it correlated with feed efficiency and how can fleece weight be recorded. Or do we just need greater downward pressure on mature age body weight?** **Does it vary between drops and sites?** • Will the MLP data improve genomic predictions? **If the MLP data is added to the Genomic resources flock what are the benefits?** **Can the MLP data improve "DNA Flock Profile" accuracies and increase the number of traits offered?** • Can MLP assist with the creation of a Data Quality Index? **By using MLP data and steadily removing parts of the data could it show what impact it is having on the FBVs and could this assist with the creation of a ram breeders' level of Data Quality?**

Simplified key message	**3) MLP will determine what <u>age of data</u> should be collected and when to assist selection.**
Detailed message	MLP will seek to determine the value of collecting adult data and when this should be collected. This will help ram breeders determine which yearling and adult measurements can help them select the most productive Merinos.
Research questions addressed	• Is there value in collecting ewe A2 fleece, carcass, visual, resistance and index data compared to Yearling or Hogget data only? **Cost benefit of A2 data** **Can we better predict A2 performance from Yearling data?**

	• Is there value in collecting ewe A2, A3 and A4 fleece, carcass, visual, reproduction, resistance and index data compared to A2 alone? **Cost benefit of A3 and A4 data** • Is there is value in collecting ewe A2, A3, A4, A5 and A6 fleece, carcass, visual, reproduction, resistance and index data compared to A2 alone? **Cost benefit of A5 A6 AL data** • What proportion of ewes change significantly in fleece weight as the animal age from PW/Y to A2? **A reasonable number appear to change (and why Yearling and Adult Fleece weights are treated as different traits) but we can we better predict A2 fleece weight from a Yearling assessment. It appears as though the A2 correlated fleece weight is more likely to be overstated at Yearling for low wrinkle, high fat, high muscle types.** • What proportion of ewes change significantly in fleece weight as the animals age from PW/Y to A6, and PW to LT? **Do ewe types change post A2?** **Currently in MS all A2 and older are averaged** • What proportion of sires change significantly in fleece weight as their ewe progeny age from PW/Y to A2? **A reasonable number appear to change (and why Yearling and Adult Fleece weights are treated as different traits) but we can we better predict A2 fleece weight from a Yearling assessment. It appears as though the A2 correlated fleece weight is more likely to be overstated at Yearling for low wrinkle, high fat, high muscle types.** • What proportion of sires change significantly in fleece weight as their ewe progeny age from PW/Y to A6 and PW/Y to LT? **Do ewe types change post A2?** **Currently in MERINOSELECT all A2 and older are averaged** • What proportion of sires change significantly in any other traits as their ewe progeny age from PW/Y to A2? **Do other traits change over time?** • How well do A2 ewe and A2 wether objective and subjective assessments compare to the ewe LT **Are wether trials a good indicator of the Merino ewe enterprise?**

Simplified key message	**4) MLP will show <u>how different types of Merino sheep perform in different years, and different sites</u> (Genotype by Environment interactions).**
Detailed message	MLP will show how different types of Merinos perform in different environments. This will provide a comparison of the lifetime productivity of Merinos of diverse types, managed in a range of environments and illustrate the important of linkages for across flock ASBVs.
Research questions addressed	• How variable is the raw data between sites. **The link sires will show the variability or raw data between years and across sites** • What is the variance between drops and between sites for the early lifetime adjustments (fixed effects) for the F1 ewes? **How important is ewe type and Genotype by E environment interactions?** • What is the variance between drops and between sites for the early lifetime adjustments for the F1 ewes? **How important is ewe type and G by E** • Do the link sires rank similarly for the key production traits between sites (do they rank differently due to the differing ewe types at sites and between years)? **How important is ewe type and G by E?** **G by E** • Do the sires at Macquarie rank similarly for traits for both core ewe types? • **How important is ewe type and G by E?** **G by E**

APPENDIX B

Analysis Priorities for 2020

By mid-March 2020;

- Update AMSEA database, develop and test format for transfer to MERINOSELECT (MS)
- Transfer repeat fleece, reproduction and visual trait data to MERINOSELECT
- Restructure and update visual score data in AMSEA database
- Balmoral and Macquarie Field Day Reports
- DNA genotypes made available to MERINOSELECT and AGBU

- Produce MLP Sire Site report (FBVs across 2 drops)
- Produce MLP Sire Project report (FBVs across drops and sites) with comparisons between Merino types, Wrinkle Score, Micron, Fleece Weight, MS and Non-MS.
- Update MLP Sire ASBV list and comparison with FBVs, Merino types, Wrinkle Score, Micron, Fleece Weight, MS and non-MS.

By December 2020, or earlier where possible; (What could be achieved by June 2020?)

- A scientific paper detailing the MLP project
- Update the report for the Yield Comparison of Wool Sample Site Project ON 643
- Provide ongoing advice on F1 ewe management groups
- Updated MLP Sire Site Report (FBVs across 2 drops)
- Updated MLP Sire Project Report (FBVs across drops and sites)
- Update MLP Sire ASBV list and grouping of sires based on Merino type, Wrinkle Score, Micron, Fleece Weight, MS and non-MS.
- Commence the creation of Visual trait ASBVs
- Preliminary review of SHEEP OBJECT and ASBV methodology require fine tuning
- MLP Field day Reports New England, MerinoLink and Pingelly

- Comparison of ASBVs when sire was chosen to enter MLP to 2020 ASBVs. Where have large changes occurred and what are the leading causes?
- Comparison of the F1 ewes fixed effects (dam type, dam age, scan type, rear type) adjustments between years and between sites at PW/Y and A2 ages.
- Comparison of 3 classing methods at PW/Y and A2 with objective data.
- Comparison of 3 classing methods between PW/Y and A2.
- Comparison of PW/Y and A2 objective data with and without genomics.
- How much do the results differ in the Site and Project FBV reports when depth of pedigree on the foundation dams, the 134 MLP sires or the F1 ewes themselves is excluded?
- First whole of MLP project FBV analysis and comparison of link sire performance
- Report on Wells Classing results

Given variation between sires and the foundation dams, there may be value in grouping the F1 ewes into similar groups or types as listed above and comparing objective measurements and visual assessments between groups of F1 ewes, irrespective of Sire.

All sites have maiden ewe data by end of 2020 (A2 is from 1.5 yr old to 2.5yr old)

- Creation of conception, litter size and ewe rearing ability and NLW FBVs
- Comparison of fixed effect adjustments of the F1 ewes and then estimate the impact of maiden lambing between years and between sites at PW/Y and A2 ages
- Comparison of 3 classing methods at PW/Y and A2 with objective data
- Comparison of 3 classing methods between PW/Y and A2
- Comparison of PW and A2 objective data
- Correlations of maiden lambing with all other traits

To be determined in later Annual Plan Updates

All A3 data will be collected by end of 2021

All A4 data will be collected by end of 2022

All A5 data will be collected by end of 2023

All A 6 and some A 7 data will be collected by mid 2025

Another year – 2025/26 - should be allocated for final research papers, peer review and validate before final publication of the MLP outcomes can be published.

APPENDIX C: Link Sires

Sires that provide internal MLP across site linkage.

MLP LINK SIRES

		MLP Sites											Linkage with AMSEA Sites												
ID	Sire Name	BAL 15	BAL 16	ML 16	ML 17	PING 16	PING 17	MAC 17	MAC 18	NE 17	NE 18		SA 19	MUR 19	NE VIC 19	YARD 19	YASS 19	BOOR 19	BAL 19	SA 20	MUR 20	YARD 20	BAL 20		
	Ewe Base	Fine	Fine	Fine-Med	Fine-Med	Meat Repro	Meat Repro	Two skin types	Two skin types	Super Fine	Super Fine	MLP Total	Ridgeway Advance	Muresk	Dookie	Research Stn	Bogo	Rosevlle Park	Jigsaw Farms	Ridgeway Advance	Muresk	Research Stn	Jigsaw Farms	AMSEA TOTAL	AMSEA Sites COMBINED MLP &
6012502007707115	Centre Plus Poll, 707115		1					1	1			3												0	3
6001052013130545	Collinsville Poll, 130545 (Apollo)				1			1				2								1		1		2	4
5023022014140055	Cressbrook, 140055									1	1	2												0	2
5036552013130941	Darriwell, 130941 (Buddha)	1						1				2												0	2
5035432012120014	Glen Donald, 120014			1					1			2												0	2
5050692012120012	Greendale, 120012		1	1								2												0	2
5000482012120715	Haddon Rig, 2.715					1			1			2												0	2
5003832011003542	Hazeldean, 11.3542		1						1			2												0	2
5003832011000043	Hazeldean, 11.43	1				1						2												0	2
5003832013004930	Hazeldean, 13.4936							1				1									1		1	2	3
6008152009090918	Leahcim Poll, 090918	1	1	1		1						4												0	4
6090402010100081	Merinotech WA Poll, 100081	1				1						2												0	2
5034712014140012	Miramoona, 140012									1		1					1		1					2	3
5046372012120652	Moojepin, 120652						1	1				2												0	2
6015022015150073	Moorundie Poll, NE73						1			1		2	1				1		1					3	5
5000632013130389	Mumblebone, 130389	1	1									2												0	2
5032982015150073	Nerstane, 150073									1	1	2		1		1								2	4
5038552010100R56	One Oak No.2, R56	1	1	1		1						4												0	4
6012792015150697	Petali Poll, 150697									1		1			1			1						2	3
5050112015150280	Tallawong Merinos, 150280				1						1	2												0	2
5045722011ESA004	The Mountain Dam, 11/ESA004	1	1									2												0	2
5000132015150282	Trefusis, 150282				1					1		2												0	2
6092512014140477	Trigger Vale Poll, 140477			1	1		1	1		1		5												0	5
6012362011110004	West Plains Poll, 110004 (Mercenary)				1	1	1	1		1		5												0	5
5022502013130149	Wurrook, 130149			1							1	2												0	2
5004122012120175	Woodyarrup, 120175		1									1										1		1	2
		7	7	6	5	6	4	7	4	8	4	58	1	1	1	1	2	1	2	1	1	1	1	13	71

Not formal MLP link Sires — Sire linked across 3 or more sites — **TOTAL** 26 link sires

Formal MLP Link Sires

APPENDIX D

MLP Model Flock and Enterprise Scenarios

Listed below are templates for ram breeder and ram buyer flock structures and selection strategies. At this stage it is a generic model, the assumptions will vary between regions, sheep types and flock structures, time and age of culling etc. These are important variables that could change economic outcomes and influence optimal answers to the research questions.

At a later date and through broad consultation, the assumptions and templates can be created for different regions and sheep types and selection and culling regimes.

The key variable assumptions are;

- Mortalities and when they occur
- Conception rates
- Lambs born
- Age of ewe joining
- Selection and culling timing and strategies

For optimal / cost benefit advice to ram breeders, 6 current scenarios will be assessed per 1,000 ewes. They vary in the amount of data, age at data collection and emphasis on visual classing and use of indexes. Visual classing will use the professional classing protocols.

Ram Breeding Scenario A (no Breeding Values)

- Ram progeny are visually classed at weaning with 10% culling, 20% culling at 10 months of age and a further 20% culling at hogget age
- Ewe progeny are visually classing at weaning with 5% culling and at hogget age prior to joining with a further 30% culling
- Breeding ewes are not re-classed but ewes failing to rear a lamb on her second attempt are culled
- Sires are classed annually with a 10% culling

Ram Breeding Scenario B (PW Breeding Values Rams only)

- Ram progeny are measured at Post Weaner age, visually classed at weaning with 10% culling, 10 months of age with a further 20% culling and at hogget age prior to joining with a further 20% culling
- There are no ewe measurements with classing at weaning (5% culling), and at hogget age prior to sale with a further 20% culling
- Breeding ewes are re-classed annually with 5% culling and ewes failing to rear a lamb on her second attempt are culled
- Sires are classed annually with a 10% culling

Ram Breeding Scenario C (Yearling/Hogget Breeding Values on rams and ewes)

- Ram progeny are measured at Yearling age, visually classed at weaning (10% culling), with a further 40% culling at hogget age prior to sale
- Ewe progeny are measured as hoggets, classing at weaning (5% culling) and classed at hogget age prior to joining
- Breeding ewes are re-classed annually with a 5% culling and ewes failing to rear a lamb on her second attempt are culled
- Sires are measured in the off season and classed annually with a 10% culling

Ram Breeding Scenario D (Yearling Breeding Values on rams, Hogget and repeat Adult measurement on the ewes for fleece, carcass and reproduction on breeding ewes)

- Ram progeny are measured at Yearling age, visually classed at weaning (10% culling), with a further 40% culling at hogget age prior to sale
- Ewe progeny are measured as hoggets, classing at weaning (5% culling) and classed at hogget age prior to joining
- Breeding ewes are measured annually for fleece and reproduction with a 5% culling and ewes failing to rear a lamb on her second attempt are culled
- Sires are measured in the off season and classed annually with a 10% culling

Ram Breeding Scenario E (Yearling Breeding Values on rams, Hogget and repeat Adult measurement on the ewes for fleece, carcass and reproduction on breeding ewes) with the use of genomic associations

- All progeny is genotyped at birth or tagging
- Ram progeny are measured at Yearling age, visually classed at weaning (10% culling), with a further 40% culling at hogget age prior to sale
- Ewe progeny are measure as hoggets, classing at weaning (5% culling) and classed at hogget age prior to joining
- Breeding ewes are measured annually for fleece and reproduction with a 5% culling and ewes failing to rear a lamb on her second attempt are culled
- Sires are measured in the off season and classed annually with a 10% culling

Ram Breeding Scenario F (Selection using Raw Data, Sire Adjusted Means and or ASBVs only)

- These scenarios can be run at PW / Y and A2 ages
- There is no visual classing, culling on objective data only
- (Need to complete flock profiles, adjust classing % so each scenario is self-replacing)

Ram Breeding Scenario G (An above scenario to be determined later) with high reproduction and selling "CFA" after 3 lambs at 4.5 year old)

PROFILE MERINO RAM BREEDER FLOCK STRUCTURE

				EWES JOINED			1,000
		Profile		EWES to LAMB		**1.0%**	990
				EWES AT MARKING			969
		Assumptions bolded.					
BRAND	AGE					NUMBERS	
	Years			Ewes @ Mark	Ewe sales	Lambs	Ewes
6	1.5	Ewes at Joining					**229**
		Mortality Join to Mark	**3.0%**				
		Ewes at marking		222			
		Lambing % to joining	**85%**				
		Number of lambs				195	
		Mortality Mark to Join	**1.0%**				
5	2.5	Ewes at Joining					220
		Mortality Join to Mark	**3.0%**				
		Ewes at marking		214			
		Lambing % to joining	**98%**				
		Number of lambs				216	
		Mortality Mark to Join	**1.0%**				
		Double Dry and Culls	**5.0%**		11		
4	3.5	Ewes at Joining					201
		Mortality Join to Mark	**3.0%**				
		Ewes at marking		195			
		Lambing % to joining	**98%**				
		Number of lambs				197	
		Mortality Mark to Join	**1.0%**				
		Double Dry and Culls	**5.0%**		10		
3	4.5	Ewes at Joining					183
		Mortality Join to Mark	**3.0%**				
		Ewes at marking		178			
		Lambing % to joining	**98%**				
		Number of lambs				179	
		Mortality Mark to Join	**1.0%**				
		Double Dry and Culls	**5.0%**		9		
2	5.5	Ewes at Joining					167
		Mortality Join to Mark	**4.0%**				
		Ewes at marking		160			
		Lambing % to joining	**95%**				
		Number of lambs				159	
		Mortality Mark to sale	**1.0%**				
1	6.5	CFA's for sale			159		
		Total Ewe Sales			188		
		Ewes joined					1,000
		Lambs				945	
		Ewes at marking		969			
		Marking % to ewes joined	95%				
		Ewe lambs				473	
		Mortality Mark to class	**8.0%**				
		Ewe Hogg at classing				435	
		Ewe Hogg joined				229	
		% culled	47%				
		Ewe Hogg culled	206				
		Ram lambs marked				473	
		Mortality Mark to Sale	**8.0%**				
		Rams at Classing	435				
		Rams classed out	**30.0%**				
		Rams Sold as culls	130				
		Rams avail for "Sale"	298	30%	ewes joined		
				63%	lambs maked		
		Rams required	**2.0%**				20
		Annual requirement					7

PROFILE MERINO RAM BUYER FLOCK STRUCTURE

				EWES JOINED			1,000
		Profile		EWES to LAMB		**1.0%**	990
				EWES AT MARKING			968
		Assumptions bolded.					
AGE	AGE				NUMBERS		
Brand	Years			Ewes @ Mark	Ewe sales	Lambs	Ewes
6	1.5	Ewes at Joining					**229**
		Mortality Join to Mark	**3.0%**				
		Ewes at marking		222			
		Lambing % to joining	**80%**				
		Number of lambs				183	
		Mortality Mark to Join	**1.0%**				
5	2.5	Ewes at Joining					220
		Mortality Join to Mark	**3.0%**				
		Ewes at marking		213			
		Lambing % to joining	**95%**				
		Number of lambs				209	
		Mortality Mark to Join	**1.0%**				
		Double Dry and Culls	**5.0%**		11		
4	3.5	Ewes at Joining					201
		Mortality Join to Mark	**3.0%**				
		Ewes at marking		195			
		Lambing % to joining	**95%**				
		Number of lambs				191	
		Mortality Mark to Join	**1.0%**				
		Double Dry and Culls	**5.0%**		10		
3	4.5	Ewes at Joining					183
		Mortality Join to Mark	**3.0%**				
		Ewes at marking		177			
		Lambing % to joining	**95%**				
		Number of lambs				174	
		Mortality Mark to Join	**1.0%**				
		Double Dry and Culls	**5.0%**		9		
2	5.5	Ewes at Joining					167
		Mortality Join to Mark	**4.0%**				
		Ewes at marking		160			
		Lambing % to joining	**95%**				
		Number of lambs				159	
		Mortality Mark to sale	**1.0%**				
1	6.5	CFA's for sale			159		
		Total Ewe Sales			188		
		Ewes joined					1,000
		Lambs				915	
		Ewes at marking		968			
		Marking % to ewes joined	92%				
		Ewe lambs				458	
		Mortality Mark to class	**8.0%**				
		Ewe Hogg at classing				421	
		Ewe Hogg joined				229	
		% culled	46%				
		Ewe Hogg culled	192				
		Wether lambs marked				458	
		Mortality Mark to weaning	**8.0%**				
		Wethers weaned	421				
		Wethers lambs retained					
		Wethers lambs for sale	421				
		Rams required	**2.0%**				20
		Annual requirement					7

APPENDIX E

List of MLP Project Add-On Projects relevant to MLP Analysis and Reporting.

ON 368 MLP Add-On Wells Classing Scoping Trial, AMSEA - Completed
Stage 1 of Wells Classing alternative classing proposal (classing within sire progeny groups)

ON 514 MLP Add-On Wells Classing Trial, AMSEA – Ongoing (17/18 to 22/23)
Stage 2 of Wells Classing alternative classing proposal (classing within sire progeny groups)

ON 369 MLP Add-On Balmoral wethers, AMSEA 2015 drop – Completed
F1 wether data at Yearling age
(MLA carcass data TBC)

ON 447 MLP Add On Improving Prediction of Ovine Foetal Aging; AGBU - Completed
Comparison of foetal ageing of AI'ed foundation dams with lambing rounds for 2017 drop

ON 448 MLP Add-On Pingelly wethers Stage 1, Murdoch Uni - Completed
16 and 17 drop wethers assessed until 20 months of age

ON 449 MLP Add-On MerinoLink wethers, MERINOLINK, last milestone Jun 2019 – Completed
16 drops assess at yearling age and 17 drops assessed at A2

ON-486 WEC for ASBVs (Mini-FLOTECH Dawbutts) - Completed
Assessing a more sensitive worm testing method that could allow testing at lower worm burdens

ON 487 MLP Add-On Reproduction Efficiency, CSIRO - Completed
Lambing Round data from the 17 and 18 drop ewe and wether progeny
Yearling data on the 17 and 18 drop F1 wethers

ON 511 MLP Add-On Resilience CSIRO (all wethers to 10mth data) – Finish July 21
17 drop Macquarie wethers resilience tested at 10 months
17 and 18 drop New England wethers resilience tested at Y and A2
50% of wethers of each drop fed in feedlot and slaughtered at Y (MLA carcass data TBC)

ON 521 MLP Add-On Genetic Evaluation, Productivity Efficiency and Profit, Murdoch Uni Finish July 21

16 and 17 drop wethers assessed at A3
Wethers assessed in project for feed intake, whole body energy and production under different feeding regimes.
Wethers to undergo footrot challenge post project TBC

ON 536 MLP Add-On Macquarie Wethers - NSWDPI - Completed
16 and 17 drop wethers to 10 months assessments
(MLA carcass data TBC)

ON 607 MLP Add-On AMH Hormone - Adelaide University – Finish Dec 2025
Anti Mullerian Hormone collected on 18 drop New England F1 ewes at 6 weeks, 9 months and A3 and compared to lifetime reproduction performance. It is also being replicated with the 18 drop Centre Plus lambs.

ON 617 AMSEA Link Sire Funding 2018-2021 to the value of $188,900 – To April 21
MLP link sires are being used for 19, 20 and 21 drop Sire Evaluation progeny

ON 641 MLP Add-On Balmoral Wethers - Completed
Y and A2 data collected on 16 drop F1 wethers

ON 643 MLP Add-On Yield comparison mid-side pin & fleece wool – TBD
Comparison of midside, pin and whole fleece yield samples on Macquarie 18 drop (Y) and MerinoLink 16 drop (A3) and MerinoLink 17 drop (A2) F1 ewes

ON 716 Follicle Density Proof of Concept Adelaide University – TBD
While data is not being collected on MLP sheep the outcomes may lead to optical coherence tomography (OCT) to assess follicle depth, fibre diameter and skin depth

Semen Testing with APIAM (Paid by entrants, no formal contract)

APPENDIX F

MLP Site and Project Report Templates

To be added

Other MLP Report templates

To be added

APPENDIX G

MLP Site Protocols

To be added