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David Blacktop
BELL GULLY
171 Featherston Street,
Wellington

Dear Mr Blacktop

Colour Measurement – Y Value

My name is Stephen Fookes of Havelock North. I have been asked by Bell Gully to provide my opinion:

- On whether the changes Cavalier Wool Holdings ("CWH") has made to its scouring lines have resulted in an increase in Base Y value;

- On each of the matters discussed in the letter from Dr Garth Carnaby to Mr Stock dated 19 February 2011 and his conclusions under each heading; and

- On whether it is possible for a merchant/exporter/domestic customer to buy greasy wool for scouring with a lower Base Y value while holding all other wool characteristics constant.

I confirm that I have not previously been contracted to, or been employed by CWH or any of its shareholders. I was Chief Executive Officer of New Zealand Wool Testing Authority Ltd ("NZWTA"), the major wool testing company for the independent and impartial sampling, testing and certification of New Zealand apparel and interior textiles wools, for 30 years until the end of 2008. NZWTA provided services to CWH and New Zealand Wool Services International ("WSI"), as well as most other wool trading companies. I retired from NZWTA at the end of 2008, and no longer have any commercial engagement with CWH through NZWTA.

I have been provided with a copy of the Code of Conduct for Expert Witnesses (Schedule 4 of the High Court Rules) and I have read and agree to comply with the code. The issues I address in this report are within my own area of expertise.

In summary my opinion is:

- I disagree with Dr Carnaby that it is not possible to alter Base Y through the scouring process. Based on my commercial experience and information I have gained from trials and interaction with wool scouring and processing companies, I believe there are chemical additives,

techniques in eliminating iron staining, drying temperature controls, and some possible mechanical treatments that can improve Base Y value;

- Figures 6, 7 and 8 of CWH's authorisation application provide a reliable indication that there has been an improvement of approximately 1 unit of Base Y value for scoured wool over the ten year period at Hawkes Bay Wool Scour, while the greasy wool analysis indicates there has been no significant shift in the Base Y of North Island wools;

- While a single test result for colour values has a Maximum Retest Range of 3 units for a two subsample, four reading test, the actual within laboratory precision is 1.4 units. The effect of combining sets of data improves the precision by approximately the square root of the number of components combined. An individual scoured wool test is conducted in 7,000 kg components. As the average scoured wool delivery is around 16,000 kg, this means there are three tests on average for each data point. This would make the precision 1.2 units on a single test parcel. I understand that the data presented is based on tests on commercial deliveries. The effect of combining some thousands of tests into the data presented would mean the trends would have very high precision, and accuracy, and be without any significant bias. It is for this reason I consider the trends to be reliable;

- I understand from CWH that there has been no significant change in its application of chemical bleaching agents or any significant change in the wool types processed in the corresponding period which could explain this trend;

- CWH have made modifications to their pre-scouring processes that they believe may be the key contributor to the improvement in Base Y values shown in the trend. From my experience, improvements in Base Y values over the period could be attributed to a single processing factor, or a combination of small contributing processing factors. While it is not necessarily possible to solely pin-point the sole technical contributor as the reason for improvement in Base Y value, the fact remains that, based on the data presented, there has been an improvement of approximately 1 unit of Base Y value over the ten year period. I cannot be certain that the pre-scouring processes have been the only technical contributor as there may have been other advertent or inadvertent processing changes that have contributed to the change;

- I believe that there is commercial benefit to merchants, exporters, dye-houses and manufacturers through increased brightness due to a higher Base Y value; and

- It is possible to select greasy wools with a lower Base Y value while maintaining the other characteristics to meet contract specifications.

1. Experience and Qualifications

I have a diploma of Wool Science gained from TAFE, Albury in 1966, and a Diploma in Dairy Technology from University of West Sydney in 1968.

My work experience includes:

- Australian Objective Measurement Project as a research Officer from 1970 to 1974. This project was a joint Commonwealth Scientific and Industrial Research Organisation (CSIRO)/Australian Wool Corporation project to establish the feasibility of commercial measurement of raw wool characteristics;

- From 1976 to 1978 as Technical Manager of NZWTA, establishing wool measurement strategies for the New Zealand wool clip;

- From 1978 to 2008 as Chief Executive Officer of NZWTA, managing the measurement strategies for raw wool, and the application of those measurements to commercial processing and manufacture. This involved my active participation in the development of test methods and regulations for raw and semi-processed wool through the International Wool Textile Organisation ("IWTO"), the standards setting body. The establishment of the IWTO Test Method 56 for the measurement of the Colour of Raw Wool was a component of this work;

- I have been a member of the IWTO Technical Committee and its working groups since 1978, and I am currently secretary of the Committee;

- I am chairman of the National Council of New Zealand Wool Interests, the New Zealand body of IWTO;

- I am a director of Wool Testing Authority Europe, the sole IWTO licensed wool testing and certification body for the Northern Hemisphere for raw wool; and

- I am a director of a commercial wool using company using raw wool measurement strategies for product application.

2. IWTO Test Method 56 and determination of Y value

- The laboratory Test Method (IWTO Test 56) has been developed to simulate the state of the wool at the time of dyeing in the manufacturing process. This involves scouring representative samples of the wool in a laboratory scour, even if it had been commercially scoured prior. The samples are then conditioned to a low moisture content and passed through a laboratory carding machine, called a Shirley Analyser. This process will generally result in a higher Base Y value compared to the "As Is" result from a commercial wool scouring process. However, the laboratory preparation process may be less severe than the scour opening process, or other processes in the scouring operation. While the preparation of the test sample process is often referred to as "perfect scouring" it is not necessarily correct, as it takes no account of changes in commercial wool scouring processes since the 1990's when the test method was first used for commercial trading;

- The first standardised test method for the colour measurement of raw wool was established by Wool Research Organisation of New Zealand ("WRONZ") in 1977 (NZS 8707 -1977), and was further amended in 1984. At that time, it was introduced as a commercial test to the greasy and scoured wool marketing systems. The test was finally accepted as an IWTO test method (IWTO 56) in 1999 as a test method under evaluation, and subsequently was adopted as a full test method for commercial trading;

- The test is conducted by preparing representative samples with a view to achieving their colour potential and measuring them on a spectrophometer. The reflectance values of X (red), Y (green) and Z (blue) are measured and reported. The IWTO test method provides for strict procedures to be applied in the calibration of each of the two spectrophometers used for each test;

- The key wool testing organisations worldwide participate in the Independent Laboratory Round Trial Group round trials on a twice weekly basis to ensure harmony exists between the main certification bodies. These laboratories are situated in New Zealand, Australia, South Africa and the United Kingdom. They report their results to IWTO on a six monthly basis. They are members of the IWTO licensed laboratories;

- The test (IWTO 56) is conducted on representative samples that have been prepared in a laboratory, with the aim of removing all impurities so that colour potential can be measured. This is because that wool will pass through a range of wet and dry processes before it is dyed, and the key value to a processor is in the ability to mix dyes to their optimum efficiency to ensure uniformity of colour and brightness;

- The values of importance in colour measurement are yellowness (Y-Z) and brightness (Y). Wools cannot be dyed lighter or brighter than their actual colour;

- The laboratory test (IWTO 56) involves cleaning the wool with a non ionic detergent and passing it through a laboratory carding machine to remove any residual contaminants. This roughly equates to the condition the wool would be in after it had been scoured and at the dying stage in commercial production and manufacturing. No chemical additives, such as bleach, are used in the test method. It is important to note that during the evaluation process in the late 1990's there was a change to the test process, as the cleaning technology applied to the test samples was possibly polishing the fibres, and giving an artificially higher Base Y value; and

- The IWTO Test Method IWTO 56 provides for the reporting of both "Base" X, Y and Z values and "As Is" X, Y and Z values. "As Is" colour is measured on the sample of wool submitted without any further processing. It may be conditioned to a standard regain. This test is often used to determine the performance of an individual scouring company. The normal process of comparison is by subtracting "As Is" colour from Base colour. "As Is" colour can be easily changed through changing processes in scouring. In my experience I would expect that a scourer would be satisfied if the difference between "Base" and "As Is" colour was between 2 and 3 units on each value on most types of wool scoured in New Zealand.

3. Trends in CWH's Base Y

- Based on my commercial experience and information I have gained from trials and interaction with wool scouring and processing companies, I believe there are chemical additives, techniques in eliminating iron staining, drying temperature controls, and some possible mechanical treatments that can improve Base Y value;

- For example, addition of bleach is known to increase Base Y value. I observe that the Base Y value in the CWH scoured wool data is about 2 units higher than the greasy wool set at the start of period. It is assumed that this is caused by the addition of bleach (hydrogen peroxide) as a relatively constant and standard practise, and is the cause of the difference. Consequently, this demonstrates that Base Y value can be improved through scouring;

- I have observed Graphs 6, 7 and 8 as presented in the CWH application. While I have not verified the individual data base I conclude from the graphs presented that there has been an increase in Base Y value of approximately 1 unit for CWH scoured wool

during approximately 10 years, while the graph on North Island greasy wool indicated very little change in Base Y value over the same period;

- Assuming that the range of wools was similar continuously through CWH's scour over the period, then this would indicate that there was a significant improvement in the process to achieve a higher Base Y value. I understand from CWH that the range and quality (including Base Y value) of greasy wools has not increased over the period;

- Furthermore, the fact that the use of the standard bleach, hydrogen peroxide, remained constant assists the conclusion that an effect other than hydrogen peroxide had caused the Base Y value to improve;

- I consider the trends shown to be reliable. The size of the data set would remove any effects of precision of an individual test, and would only be affected by a bias introduced. If that had been the case, it would have been detected through laboratory round trials and commercial responses;

- In this respect, while a single test result for colour values has a precision of 1.4 units, not 3 units as suggested by Dr Carnaby, for a two subsample, four reading test, the effect of combining sets of data improves the precision by approximately the square root of the number of components combined. An individual scoured wool test is conducted in 7,000 kg components. As the average scoured wool delivery is around 16,000 kg, this means there are three tests on average for each data point. This would make the precision 1.2 units on a single test parcel. I understand that the data presented is based on tests on commercial deliveries. The effect of combining some thousands of tests into the data presented would mean the trends would have very high precision, and accuracy, and be without any significant bias; and

- Based on my experience, my opinion is that the improvements in Base Y values over the period could be attributed to a single processing factor, or a combination of small contributing factors. The fact that the data shows an improvement is sufficient, and would require significant research to demonstrate conclusively that it was a single processing factor. The scour staff, who have concluded that it is likely to be contributed to by pre-scouring preparation, would probably be in the best position to know the impacts of the changes implemented.

4. Value of Improvements in Base Y Value

- In my experience a significant number of manufacturers place a high value on Base Y value. This may be for two reasons. Firstly, Base Y value (brightness) is the key differentiating component of colour measurement that can identify bright wools that can be dyed in pastel and rich colours. My experience with the major manufacturing companies using New Zealand wool is that the majority increasingly rely on Y value. They then include that as part of their contract specification for purchasing wool from merchants/exporters. Secondly, a number of manufacturers include a Base Y value in their contract specifications to ensure that they are not receiving wools that are over blended with inferior wools that are likely to produce Y minus Z (yellowness) results that meet specifications, but are dull;

- While research in the 1980's and 1990's indicated price premiums for Base Y values, there has been a significant change in the structure of the wool industry globally since then. From my observations over recent years it is evident that the requirement to

differentiate wools for brightness has increased in order for wool manufacturers to compete with synthetics. Logically, if their dependence on Base Y value has increased, then the price premiums estimated by Maddever and Aryal would at least have been maintained. I would concur with Dr Carnaby that the 4c/kg is likely to be conservative.

5. Ability to buy wools with a lower greasy Base Y Value

- Normal wool specifications from a manufacturer contain a number of objective measurement criteria that must be met for the delivery to conform with processing requirements. For scoured wool these would normally include yield, mean fibre diameter, vegetable matter, mineral ash, residual grease, length after carding and colour;

- When purchasing wool from an auction sale, or a private merchant, these measurements are normally available on each of the greasy wool components that would be destined for that scourment;

- The wool buyer determines the buying strategies, and the blending options, when purchasing the greasy raw wool for the scourments. On average around 13 different greasy raw wool lots go into a single scourments. Each of these will have been purchased with knowledge of their individual objective measurements. It is completely feasible for the buyer to adjust any of the characteristic in the buying strategy without changing other characteristics.

In conclusion, I have approached this issue to establish the validity of claims that there has been a significant increase in Base Y value in CWH scour in Hawkes Bay over a ten year period. I do not attempt to evaluate any comparison with any other wool scours.

Stephen J Fookes