Criminalistics Branch
Forensic & Analytical Science Service
[redacted]

NSW GOVERNMENT | Health Pathology

In the matter of:	Developments in DNA testing
Date:	1st June 2023

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1. This statement made by me accurately sets out the evidence that I would be prepared, if necessary, to give in court as a witness. The statement is true to the best of my knowledge and belief and I make it knowing that, if it is tendered in evidence, I will be liable to prosecution if I have wilfully stated in it anything that I know to be false, or do not believe to be true.

2. I am currently employed as the Operations Director of Criminalistics at the NSW Health Pathology Forensic & Analytical Science Service. I have held this position since February 2018 and have been employed as a Forensic Biologist since 1989. (A copy of my CV is attached and marked "A").

3. My scientific qualifications are Bachelor of Arts (Natural Science) (Honours), Master of Science of the University of Dublin, Trinity College, Ireland and Master of Science Management of the University of Technology, Sydney and I have specialised knowledge based on my training, study, and experience.

4. The questions contained in the letter from the Special Commission of Inquiry into LGBTIQ Hate Crimes, dated 15th May 2023, together with my response, are set out below.

5. *The Inquiry understands that the methods and practices associated with DNA testing changed and evolved significantly over the period relevant to the Inquiry's terms of reference, namely from 1970 to 2010.*

6. *The Inquiry requests the provision of a statement, by an appropriate person, namely a forensic biologist or other suitably qualified person, addressing the following topics. The statement should address these topics both in respect of the period from 1970 to 2010, and also (where applicable) in respect of the present day:*

Q1. The establishment and history of FASS (formerly the Division of Analytical Laboratories)

7. In 1969 the Government Analyst laboratory moved from Macquarie Street into a facility in Lidcombe and this NSW Health Department laboratory was renamed as the Division of Analytical Laboratories (DAL).

8. In 1971, the NSW Health Division of Forensic Medicine at Glebe was responsible for functions in the areas of Forensic Pathology and Forensic Biology.

9. In 1986 Forensic Biology became part of DAL.

10. In 1993, Forensic Biology relocated geographically from the Forensic Medicine facility at Glebe to the DAL site in Lidcombe.

11. In 1996, Western Sydney Area Health Service took over operation of DAL and it became part of the Institute of Clinical Pathology and Medical Research (ICPMR).

12. In 2012 DAL was renamed as the Forensic & Analytical Science Service (FASS).

13. On 1 December 2012, the NSW Forensic & Analytical Science Service was established within NSW Health Pathology. NSW Health Pathology (NSWHP) is an administrative division of the Health Administration Corporation, which was established on 1 May 2012 under s 9 of the *Health Administration Act 1982* (NSW).

14. The NSWHP Instrument of Establishment dated 14 January 2013 included FASS, described as follows:

    Manage and coordinate the Forensic Analytical Science Service (FASS) that has been established as a Unit of the Division to ensure the provision of integrated, sustainable responsive, efficient, high quality forensic and analytical scientific services.

15. NSW Health Pathology FASS comprises three (3) key services being:

    a. Forensic Medicine
    b. Criminalistics (Forensic Biology/DNA, Illicit Drug Analysis Unit, Chemical Criminalistics Unit)
    c. Forensic & Environmental Toxicology.

Q2. The role of FASS in supporting NSWPF investigations. Please outline the various ways in which this support is provided, including interactions between FASS and the NSWPF Crime Scene Unit.

The following information focuses on the services provided to NSW Police Force (NSWPF) by the Forensic Biology/DNA (FBDNA) Unit at FASS.

16. NSWPF submit evidence exhibits to FBDNA for examination and testing including the identification of biological substances, recovery and extraction of DNA, generation of DNA profiles, interpretation, and reporting of findings.

17. References samples from individuals are submitted for DNA analysis and comparison to crime profiles on the DNA database in accordance with the permissible matching table s93 of the *Crimes (Forensic Procedures) Act 2000* which legislates the permitted restricted searching between indices/categories.

18. Prior to the availability of DNA, testing was carried out to identify protein markers and ABO blood grouping.

19. FASS is the custodian of the NSW DNA database and is responsible for uploading DNA profiles to the NSW and National database and reporting DNA database links to NSWPF.

20. DNA links may be scene to scene, person to scene or familial links to potential relatives of the donor of a crime scene sample. Link information is provided to NSWPF via the NSWPF Exhibit (Miscellaneous Property) and Forensic Information System (EFIMS), or as a report to the NSWPF DNA Management Unit.

21. Expert statements and testimony is provided by FASS biologists as required, regarding DNA testing, for court proceedings.

22. Information is provided to the FBDNA laboratory by NSWPF relating to the exhibits submitted for examination and testing. The amount of information provided varies.

23. Communication between FBDNA staff and NSWPF may occur in relation to cases or individual results prior to or following the provision of results. This may be a biologist seeking to elicit more information as to the context of the examination to assist in the determination of an appropriate examination schedule or NSWPF exploring the meaning of results, the opportunity for further work or conducting a review of unsolved matters.

24. FBDNA staff participate in a range of educational forums to communicate the testing and methods employed by the laboratory to NSWPF. This aims to improve comprehension as to the meaning of results, awareness of capabilities and as a quality improvement feedback mechanism.

25. The Forensic Science Service (FSS) governance structure supports and directs key strategic and operational interaction between FASS Criminalistics and NSWPF. Committees operating within this governance include the following:

    FSS Executive Committee meets every four months with the purpose to provide senior executive strategic direction, endorsement, leadership, advice, and decision making on matters relevant to the partnership and the delivery of Forensic Science Services within NSW.

    FSS Operational Review Committee meets quarterly with the purpose of reviewing the service provision, operational performance, financial management, resources management and issues/risk management between NSWPF and FASS.

26. Sub-committees of FSS with relevant experts from FASS, the Crime Scene Services Branch, Identification Services Branch and the Science and Technology Unit of the Forensic Evidence & Technical Services Command operate under the FSS Operational Review

Committee providing advice and briefings on the particular focus areas, including the following:

a. **Action Plan Sub-Committee**: Implements activities to address actions identified in review processes.
b. **FB/DNA Sub-Committee:** Discusses joint operations between the FASS FBDNA service and NSWPF.
c. **FEAC (Forensic Evidence Advisory Committee)/Cold Case:** Supports the review and application of new technology to historical unsolved cases.
d. **Science and Research Projects Sub-Committee**: Co-ordinates and prioritises research, reviews emerging technologies and innovation for future enhancements.
e. **FASS-FETS ICT Working Group:** Provides strategic direction and leadership to ensure ongoing transfer of information between NSWPF and FASS IT systems relating to the forensic analysis of samples from crime scenes.
f. **SAIK (Sexual Assault Investigation Kit) Back capture Sub-Committee:** Overseeing a project to examine historical sexual assault kits.

27. Arrangements between FASS and NSWPF were formalised in a Service Level Agreement in 2017, which is ongoing.

Q3. The tests and technologies employed by FASS, prior to the introduction of DNA testing, to analyse biological material collected from crime scenes and exhibits, and to identify persons who may have contributed to that biological material.

28. Prior to, and since the introduction of DNA testing, examinations were conducted to detect biological materials primarily semen, blood, and saliva but could also include hair, urine, and faeces. This included preliminary screening tests and species identification.

29. Currently, and approximately since the early 2000's, examination also targets the recovery of skin cells referred to as 'trace' or 'touch' DNA.

30. Prior to the introduction of DNA testing and during the early years of DNA testing, testing was carried out on a number of polymorphic (exist in different forms) proteins including:
    a. Haptoglobin
    b. Phosphoglucomutase
    c. Erythrocyte Acid Phosphatase
    d. Group Specific Component
    e. Adenylate Kinase

31. ABO blood grouping was carried out on blood and suitable semen samples.

32. Statistical calculations were carried out to determine the expected frequency of occurrence in the population of a particular protein or combination of protein types recovered from a crime scene sample. This assisted in ascertaining the level of support for a proposition that the types recovered originated from a person who also had the same types rather than a match by chance. The statistical level of support was typically very low with little capability to rule out matches by chance.

33. An identified mismatch between a crime sample type and a person reference sample was conclusive.

Q4. The introduction of DNA testing at FASS as relevant to criminal investigations.

34. Prior to 1989, NSW cases requiring DNA testing were sent overseas as the testing was not available in the NSW FBDNA laboratory.

35. DNA testing in NSW FBDNA began in 1989/1990 with a system called Restriction Fragment Length Polymorphism (RFLP). The system provided a capability for discrimination but was limited by requiring large sample sizes of good quality DNA. RFLP was utilised on limited major crime cases for 'in case' matching. As no database existed, a crime scene profile could only be compared to a specific person nominated by NSWPF.

36. Around 1990 forensic laboratories began investigating the analysis of DNA using PCR (Polymerase Chain Reaction) which targets specific parts of the DNA and copies or amplifies these areas millions of times. PCR had many advantages over the earlier technology including far greater sensitivity, an increased ability to amplify degraded DNA, and the availability of commercial DNA typing kits, which increase reliability, reproducibility, and timely processing.

37. During 1994/1995 FBDNA introduced PCR targeting DQA and Polymarker Amplitype reverse dot blot typing kits. The major limitation of these systems was the low discriminating power between individuals.

38. To overcome this limitation, the forensic community examined a different PCR procedure that involved determining the size variation that existed due to short tandem repeats (STRs). There are thousands of STR markers located at various locations in human DNA and they have become the method of choice for use in forensic DNA analysis. This form of analysis allowed for more definitive discrimination between individuals and could operate with DNA of lesser quality and quantity.

39. For a short period of time from 1994, FBDNA used a quadruplex system developed by the Forensic Science Service in the United Kingdom.

40. In 1997 Applied Biosystems released a 10-marker multiplex kit called Profiler®, and shortly thereafter Profiler Plus®.

41. In 1998 Profiler Plus®, targeting 9 markers and a sex marker, was validated, and introduced for DNA analysis in FBDNA. This system significantly improved the discriminating power compared to previous PCR based kits.

42. Prior to DNA databases, there was no capability to search a crime scene profile against a database of individuals. DNA samples could only be compared 'in case' namely on specific request between cases and nominated individuals.

43. The NSW DNA Database commenced in 2000 concurrently with the commencement of the *Crimes (Forensic Procedures) Act 2000*. The *Crimes (Forensic Procedures) Act 2000 (NSW); Crimes (Forensic Procedures) Regulation 2014 (NSW)* regulate access, use and management of the NSW DNA Database. The Secretary of NSW Health is the person responsible for the care, control and management of the DNA Database. FASS manages the database in accordance with set procedures based on the legislation. All searching and matching against the database is performed only by authorised FASS staff.

44. The National Criminal Investigation DNA Database (NCIDD) was established in 2001 and is managed by the Australian Criminal Intelligence Commission (formerly CrimTrac).

45. Following the development of DNA databases, DNA profiling became a more routine investigation tool, and its application was expanded to volume crime.

Q5. Advances since then in technologies employed by FASS in relation to DNA testing and the identification of contributors to DNA recovered during testing.

IMPROVED RECOVERY OF DNA PROFILES FOR MATCHING PURPOSES:

46. DNA testing involves a number of individual analytical steps including extraction, quantification, amplification, and capillary electrophoresis. Current DNA testing has improvements in each of the individual analytical steps. Further information on these steps is set out below:

47. **Extraction**: The chemistry used to extract DNA has improved significantly. The use of magnetic bead-based extraction kit superseded the use of previous chemical extraction methods (e.g. chelex) The current method has a greater capability to recover purified DNA.

48. **Quantification**: The introduction of real time PCR quantification techniques has improved capability to provide a more robust estimate of the amount of DNA for downstream processing compared to previous probe based technology. This extends to the capability to estimate the amount of male DNA within a sample, in addition to the amount of total human DNA. This allows for samples to be targeted for downstream processing with the male specific DNA typing kt. Estimation as to the quality of the recovered DNA is also available with current quantification methods.

49. **Amplification:** A significant advancement occurred in 2012 with the introduction of PowerPlex 21®. This typing kit targets 20 highly variable markers as well as a sex marker. PowerPlex 21® is a highly discriminating DNA typing kit with increased sensitivity and ability to work on degraded and inhibited samples.

50. Due to the number of DNA markers, PowerPlex 21® is also more useful for comparisons between family members (familial matching) reducing the chance of missing a familial link.

51. **Capillary electrophoresis** has been carried out on 3500xl genetic analysers since 2013, with an increase in sensitivity over the former instrument.

52. By enhancing the performance at each step of the process, more DNA profiles are recovered and suitable for upload to the DNA databases, which is a key tool to identify possible contributors to the samples.

53. The current analytical system at FASS FBDNA has the capability to generate an uploadable autosomal DNA profile from as little as 10 cells, although the optimal target is approximately 120 cells.

AUTOMATION

54. In 2009 FBDNA introduced automated DNA processing which, among other benefits, reduced the risk of contamination which can occur with manual handling.

55. In 2014, the automation of DNA processing was completed to include all steps of the process for the majority of samples. Given the 2013 implementation of the highly sensitive PowerPlex 21® typing kit and ability to generate DNA profiles from a small number of cells, automation was important to ensure quality results and minimise risks of contamination due to operator manipulations.

SPECIALISED DNA ANALYSIS:

56. Specialised DNA typing can be used to complement autosomal DNA testing (PowerPlex 21®) or in circumstances where autosomal testing may not be useful.

Male specific Y-STR typing

57. In 2007, FBDNA introduced the Yfiler™ typing kit which targets DNA exclusively from male individuals. Y-STR DNA profiles are inherited on the paternal line and have value in linking individuals and males on the same paternal line.

58. Y-STR testing is of particular value in cases with a mixture of DNA from female and male sources, where only the male DNA is of interest. The most common application is in sexual assault allegations.

59. In 2019 the newer Yfiler Plus™ kit was introduced with a greater number of markers leading to higher power of discrimination and improved chemistry enhancing performance with challenging samples.

60. Y-STR testing is also utilised for familial searching to identify biological relationships to the donor of a crime sample.

61. Since 2019 Y-STR DNA profiles have been able to be uploaded for searching on the national NCIDD-Integrated Forensic Analysis (NIFA) database. The NIFA database allows direct matching to people on the same paternal line.

62. Capability to conduct Y-STR analysis and uploading to a searching database is a highly valuable tool. Y-STR analysis and databasing is a new avenue for identifying male

contributors to DNA profiles either as a direct DNA match or linking to someone on the same paternal line.

Mitochondrial DNA sequencing

63. In 2015 FBDNA implemented mitochondrial DNA sequencing. Mitochondrial DNA testing is most frequently applied to analysis of highly compromised samples such as skeletal remains and hair samples which may not be suitable for alternative DNA analysis methods. Mitochondrial DNA has applications in missing persons investigations as it can be used to match against relatives on the maternal line.

64. Since 2019 mitochondrial DNA profiles have been able to be uploaded for searching on the national NIFA database. The NIFA database allows direct matching to people on the same maternal line.

Ancestry and phenotyping

65. In 2021 FBDNA implemented the analysis of samples to predict ancestry and external physical characteristics using new technology known as Massively Parallel Sequencing (MPS). MPS technology has also been utilised to expand mitochondrial sequencing which increase's the power of discrimination.

66. Prediction of ancestry can also assist when reviewing cases for suitability for forensic investigative genetic genealogy.

IDENTIFICATION OF CONTRIBUTORS

Database searching

67. A dedicated links team within the FBDNA Case Management Unit provide NSWPF DNA Management Unit with intelligence links following direct matching of scene to scene and person to scene samples on the NSW and National DNA database.

Probabilistic genotyping software

68. In 2013 FBDNA introduced probabilistic genotyping software, STRmix™. This software enabled analysis of mixed DNA profiles that were previously unable to be interpreted. This significantly increased the amount of usable DNA profiles able to be compared to potential contributors.

Mixture searching

69. In early 2021, capability to conduct searches of DNA mixtures against the DNA database was developed which expanded the opportunity to detect contributors to DNA mixtures. This opened a new databasing opportunity to identify potential contributors to DNA profiles.

Familial searching

70. Familial searching against the NSW DNA database began in 2013. Familial searching on the national DNA database was introduced in 2018 following the release of NCIDD-Integrated Forensic Analysis (NIFA). This searching is applied, in accordance with the NSWPF policy, to serious crimes to search for individuals on the DNA database who may be related to the

donor of the crime scene samples. Candidate lists of potential relatives are generated by a search and can provide valuable intelligence to an investigator.

Q6. The Inquiry understands that in or around 2012, there were significant developments in the technology available with respect to DNA testing. Please explain the timing and nature of those developments, including when they were adopted by FASS. In doing so, please also outline the means by which contributors to biological material could be identified following those developments.

SIGNIFICANT CHANGES IN 2012/2013

Refer also to information in section 5.

a) Introduction of the expanded marker PowerPlex 21® DNA typing kit.
b) Introduction of the 3500XL genetic analysers.
c) Introduction of Probabilistic Genotyping interpretation software STRmix™ v1.05.
d) Introduction of familial searching and comparisons on the NSW database.

71. The combination of the new genetic analyser and amplification with the PowerPlex 21® DNA typing kit led to an increase in capability to generate DNA profiles from small amounts of DNA. There was also an improvement in tolerance for samples exposed to environmental conditions causing degradation and/or inhibitory substances such as clothing dyes. The increase in the number of DNA markers targeted enabled better differentiation amongst individuals and more effective familial searching and kinship matching.

72. The implementation of this analytical system including PowerPlex 21® and 3500xl genetic analysers at FASS FBDNA resulted in the capability to generate an uploadable DNA profile from very low numbers of cells.

73. The 2013 introduction of STRmix™ interpretation software enabled the assisted deconvolution of mixed DNA profiles. This improved the capacity for some profiles which were previously unable to be interpreted to become useful for identification purposes.

74. Prior to the introduction of interpretation software, biologists carried out manual interpretations of mixed DNA profiles in order to determine individual contributor profiles. This was a binary approach using guidelines established in the laboratory and was typically limited to mixtures of lower complexity (typically no more than 2 contributors), reasonable quantities of DNA and good quality DNA. Statistical calculations were carried out to assess the weight of the evidence assessing the likelihood of obtaining the mixture given opposed propositions regarding the contributors. This methodology continues to be applied by biologists for DNA data of a non-complex nature including single source profiles, and mixtures of lower complexity.

75. STRmix™ is an expert system that applies a fully continuous approach to DNA profile interpretation and is particularly useful for mixtures of a more complex nature. The earlier binary methods of DNA interpretation have been superseded by continuous models such as STRmix™, as they make substantially better use of the DNA profiling data whereas binary models by necessity, discard and simplify the available information. In addition, continuous

models remove some of the criticism regarding subjectivity in profile analysis and attempt to ensure consistency in DNA profile interpretation and reporting across different laboratories.

76. Using the software, DNA profiles of a reference person sample could be compared to the deconvoluted mixtures, and a likelihood ratio generated to provide a numerical weighting assessing the proposition of obtaining the observed mixture given a particular individual was a contributor compared to the alternative proposition of obtaining the observed mixture given a particular individual was not a contributor. The statistical calculations in the software used all the evidence provided in the DNA mixture data, whereas in the manual interpretation process a more binary approach was used with equal weights given to determined DNA combinations.

77. Familial searching and comparisons have been conducted on the NSW DNA database since 2013 and the National Database since 2018, in accordance with the NSWPF Familial Searching Policy.

78. NSW familial searching is invoked by NSWPF when an uploaded DNA profile does not result in a direct match on the NSW or National Database. Familial searching produces a list of candidates on the DNA database who may be related to the donor of the DNA in the crime sample. This could be a parent or child, a sibling or more distant relative such as an uncle, nephew or cousin. Reports are provided to NSWPF who may pursue investigation of the potential biological relative in their enquiries.

Q7. Please identify any specific databases available to FASS at a state, national or international level for the purpose of identifying contributors to DNA recovered during testing for the purpose of criminal investigations, and the process by which comparison of recovered profiles to profiles contained within those databases is undertaken.

DNA DATABASES

79. 2001: NSW DNA database commenced for direct searching of autosomal DNA (Profiler Plus® typing kit). The NSW DNA database is managed by FBDNA Case Management Unit.

80. 2007: Person to scene matching on NCIDD (National Criminal Investigation DNA Database). NCIDD is managed by the Australian Criminal Intelligence Commission.

81. 2014: Scene to scene matching on NCIDD.

82. 2018: Familial searching at state and national level on NCIDD Integrated Forensic Analysis (NIFA). This included Y-STR searching, mitochondrial DNA searching, Kinship/pedigree searching and a Disaster Victim Identification module.

83. NSW Police can request DNA profiles from FBDNA to search on Interpol databases or provide to another country to search on a specific database. This is generally requested through the NSWPF DNA Management Unit and facilitated through the Australian Federal Police.

DATABASE MATCHING

84. DNA profiles from person reference samples and crime samples are uploaded onto the DNA database with an index/category. The permissible matching table s93 of the *Crimes (Forensic Procedures) Act 2000* legislates the permitted restricted matching between indices/categories. The database is live, and searching is continuous. Uploading and linking on the NSW DNA database occurs in real time.

85. Typically, once a day, DNA profiles are uploaded to NCIDD, and links downloaded to the FBDNA Laboratory Information Management System (LIMS).

86. Since January 2021, mixed DNA profiles can be searched against the NSW DNA database in a one off 'point in time' search. This was an expansion of capability to search individual DNA profiles uploaded to the database.

87. Additional comparison of DNA profiles may take place within a case, for example a victim's DNA profile may be compared to a DNA profile recovered from a nominated suspect's body or clothing. This occurs outside the database as the victim's person reference samples are not uploaded to the searching database.

Q8. Please outline the processes in place at FASS for the storage of exhibits and DNA swabs. In addressing this topic, please comment on:
a. When FASS began storing exhibits and/or DNA swabs in its own facilities;
b. The way in which exhibits, and DNA swabs are stored; and
c. Any processes in place for returning exhibits and/or DNA swabs to the NSWPF now, and prior to the time when FASS began storing exhibits and/or DNA swabs in its own facilities.

a. When FASS began storing exhibits and/or DNA swabs in its own facilities.

88. Exhibits not consumed in analysis, historically and to current time, are returned to NSWPF following completion of the examination and testing at FBDNA.

89. Exhibits can be returned for re-examination if required, for example, following a cold case review.

90. While in the custody of FBDNA, exhibits are stored in secure locations, currently with barcode identifiers, with historical practice of labelling exhibit bags in writing or printed barcodes on receipt at FBDNA.

91. Samples removed from exhibits and/or swabs have been retained since 1986, following acquisition of freezer storage capacity.

92. DNA extracts have been retained since the commencement of DNA testing.

93. Processed substrates used to collect DNA from exhibits (e.g., swabs and tapelifts) and other substates such as swatches of material removed from an exhibit are discarded following extraction and DNA testing.

b. The way in which exhibits, and DNA swabs are stored;

94. While in the custody of FBDNA, historically and to current time, perishable items that require refrigeration are placed into a designated fridge location.

95. While in the custody of FBDNA, historically and to current time, items not requiring cold storage are placed into exhibit boxes and placed in secure locations.

96. Exhibits are examined in the FBDNA Evidence Recovery Unit (ERU), and appropriate samples are taken for testing either within the ERU and/or in the DNA laboratory.

97. FBDNA began storing samples removed from exhibits at minus 20°c in 1986 following the acquisition of cold storage capability. This continues to occur in the FBDNA ERU.

98. Historically and currently, DNA extracts are retained indefinitely in secure cold storage.

99. Currently, information relating to stored untested swabs or exhibits is conveyed to NSWPF via EFIMS (e.g. stored swabs from a sexual assault investigation kit or from Post-mortem samples). Prior to EFIMS, notations referring to stored samples were recorded in FBDNA case files.

100. Historically, individual biologists retained logbooks recording stored samples and locations relating to cases for which they had conducted an examination of exhibits. Currently stored locations are retained in the electronic casefiles.

101. In the early 1990's samples taken from blood samples from individuals were retained in cold storage and room temperature.

102. Following the *Crimes (Forensic Procedures) Act 2000*, person reference samples are stored in a secure location at room temperature indefinitely, unless a destruction order is received.

c. Any processes in place for returning exhibits and/or DNA swabs to the NSWPF now, and prior to the time when FASS began storing exhibits and/or DNA swabs in its own facilities.

103. Following completion of a case, the exhibits are packed, sealed, and despatched to police via the FASS Forensic Receipt Unit (FRU).

104. Records of dispatch of exhibits to police is recorded in the FBDNA LIMS and exhibit movement is visible to NSWPF in EFIMS.

105. Prior to the electronic information exchange between FBDNA and NSWPF, the receipt and despatch of exhibits was registered in an exhibit book.

Q9. In relation to historical or 'cold case' investigations, please identify and comment on:
a. Factors which may affect the ability of forensic biologists to recover DNA from exhibits;
b. Factors which may contribute to the degradation of DNA on exhibits; and
c. Where exhibits have been preserved and DNA recovered, the reliability of DNA testing results including the reliability of the identification of contributors to DNA profiles.

In answering this question, please consider DNA obtained from bodily fluids (blood, saliva, semen) as well as DNA obtained from skin cells and trace DNA.

a. Factors which may affect ability to recover DNA from exhibits

106. The initial task of a forensic biologist examining an exhibit is to locate biological material. This involves physical observation and the use of screening tests. Several factors will affect the ability to locate biological material.
    - Identification of visible staining which may be affected by colour of exhibit, lighting conditions and/or dilution of staining through washing, or age of the stain.
    - Type of screening test available which might be applied to the whole item or is a 'spot test'.
    - Information regarding areas of contact (for skin cells/trace DNA) in order to test the right area.

107. The next step is to sample the exhibits to submit for DNA testing. Factors which will affect the ability to recover, extract and generate DNA profiles include:
    - Collection device used e.g. cut out/swab/tapelift.
    - Type of substrate - porous/non-porous/compromised samples (eg skeletal remains). This affects how much DNA is retained on the substrate, the effectiveness of sampling and how easily DNA is released in the DNA extraction process.
    - Inhibitors such as fabric dyes which may co-extract with DNA and inhibit DNA profiling.
    - Extraction method used- affects the quantity and purification of DNA.
    - Requirement for additional steps such as differential extraction to separate cell types or requirement to carry out concentration steps.
    - Sensitivity of DNA typing kits.
    - Quality of the DNA.
    - Quantity of the DNA.
    - Dilution of DNA through washing or application of liquid screening tests.

b. Factors which may contribute to the degradation of DNA on exhibits

- Exposure to environmental factors such as heat, moisture and UV will degrade DNA.

- Exposure to chemicals (e.g., in cleaning agents).
- Exposure to microorganisms.
- Length of time the DNA is subjected to adverse environment factors.
- Age of the DNA.
- Storage conditions of samples.

c. Where exhibits have been preserved and DNA recovered, the reliability of DNA testing results including the reliability of the identification of contributors to DNA profiles

108. Analytical methods used in FBDNA undergo in house verification or validation prior to implementation. Validation is the process used to gather the necessary data to assess the ability of a method to obtain a reliable result, to determine the conditions under which the method can be used and to determine the limitations. Verifications are typically smaller studies which might apply to minor modifications of a method.

109. The FBDNA laboratory has eighty-seven (87) validation documents relating to current applications, covering every aspect of the methodologies. This includes validation of DNA typing kits and an assessment of the STRmix™ interpretation software using constructed mixtures up to and including mixtures with 5 contributors.

110. Interpretation software (STRmix™) is used to deconvolute (unravel) mixtures into possible contributor profiles. STRmix™ requires the forensic biologist to indicate the number of contributors in the mixture. The same DNA mixture can be deconvoluted by STRmix™ under the assumption of different numbers of contributors.

111. The determination of the number of contributors to a profile is a task carried out by experienced forensic biologists who undergo significant training to carry out this determination. The 'true' number of contributors is always unknown. A forensic biologist uses knowledge, experience, and expertise to provide the best estimate of the number of contributors based on the DNA profile and assumptions based on case and sample circumstances. Biologists are aware of complicating factors such as appearance of artefacts, the effect of degradation, inhibition, DNA quantity and mixture proportions. For all reported results indicating the determination as to the number of contributors to a mixture, two forensic biologists independently review the mixture. Scientists may, on occasion, reasonably differ in their opinion as to the number of contributors to a profile. Other profiles may have only one reasonable interpretation. The aim is to assign the minimum number of contributors that can reasonably explain the DNA mixture.

112. There are occasions when a mixture with an indeterminate number of contributors has a single DNA profile with high quantities allowing the DNA profile of a single contributor to be identifiable and used for matching purposes.

113. Likelihood ratios (LRs) are used to provide information as to the scientific weight for two competing hypotheses:

114. For example, for a two (2) person mixture the LR will assess:

115. H1 The likelihood of obtaining the evidence profile if 'named person' and an unknown person are the contributors.

116. H2 The likelihood of obtaining the evidence profile if two unknown persons are the contributors.

117. The ability of STRmix™ to calculate LRs for known contributors and to exclude people known not to have contributed DNA to a sample has been assessed both in developmental validation and by FASS in-house studies. The results of mixture studies conducted provided information that contributed to policy development within FASS in relation to complex mixture interpretation using STRmix™.

118. The methods and interpretation tools used are able to produce reliable and reproducible results of DNA present on a sample, including matching to potential contributors to the DNA recovered. However, the methods used cannot typically determine how a DNA profile was deposited, when DNA was deposited and whether the deposition was through malicious or benign acts. Other information obtained through biological fluid testing or case context information may allow a qualified forensic biologist to give expert opinion to address these questions.

119. Over time evidence handling practices have improved in-line with increased knowledge and improved sensitivity of tests. Contamination prevention mechanisms improved dramatically after the advent of PCR based DNA typing in the late 1990s and continued to improve with the introduction of increasing more sensitive analytical methods and DNA typing kits. Due to this, historical cases are more prone to DNA contamination, than modern cases handled, examined, and tested under more stringent evidence handling standards.

Q10. Please provide any other information in relation to DNA testing and the identification of contributors to DNA recovered during testing which you consider may be of assistance to the Inquiry.
Where the maker of the statement refers to a policy, procedure, guideline or other document for the purpose of their statement, a copy of the relevant document (historical or current) should be annexed to the statement. In the event that it would be appropriate for more than one person to address the various topics identified above, the Inquiry is content to receive separate statements from those persons.

120. The FBDNA laboratory has an extensive quality assurance programme in place to ensure uniform and reliable testing and reporting and to detect and prevent errors. This is achieved in a variety of ways including method validations, use of standard operating procedures, extensive staff training and competency assessments.

121. The laboratory participates in external and internal forensic proficiency testing programmes programs across a range of activities including the identification of biological fluids, the recovery and generation of DNA profiles using autosomal DNA typing (PowerPlex 21®), Y chromosome testing (YfilerPlus™) and mitochondrial DNA sequencing.

122. Proficiency tests also test capability to identify true contributors to DNA samples and exclude true non-contributors and the generation of LRs using STRmix™.

123. There are many quality checks within the FBDNA laboratory including DNA sample transfer system checks, contamination minimisation protocols, the use of positive and negative controls where appropriate.

124. A quality management unit supports the FASS leadership group, their activities and functions and the laboratories of FASS. It ensures that the laboratory services provided meet the needs of users and provides a framework for compliance with the relevant international standards and requirements. The FBDNA laboratory has been accredited by NATA (National Association of Testing Authorities, Australia) against ISO/IEC 17025 since 1999.

Attached document:

Signature: _____

Date: 2nd June 2023

NSW GOVERNMENT Health Pathology

[redacted]

Sharon Neville
B.A (Hons), M.Sc., M.Sc.M

TERTIARY ACADEMIC QUALIFICATIONS

1985: B.A. Honours (Natural Science),
University of Dublin, Trinity College, Ireland.

1988: Master of Science (Research),
Department of Histopathology and Morbid Anatomy,
University of Dublin, Trinity College, Ireland.

2005: Master of Science Management,
University of Technology, Sydney.

PROFESSIONAL EXPERIENCE

Operations Director, Criminalistics (February 2018-current)
Forensic & Analytical Science Service,
NSW Health Pathology

Positions previously held within the Criminalistics Branch:

- Acting Deputy Director, Criminalistics Branch (2014-2018)
- DNA Laboratory Manager (2009-2014)
- Acting Manager Forensic Biology/DNA (2008 - 2009).
- Group Manager, Sexual Assault and Serious Crime Units (2003 - 2008)
- Senior Forensic Biologist 2003.
- Forensic Biologist 1989

PROFESSIONAL PROFILE

Thirty years' experience specialising in the field of Forensic Biology/DNA, primarily in the recovery and identification of biological material, DNA typing and interpretation to the highest level of complexity, including the use of expert DNA interpretation systems. Experienced in the provision of expert statements and court testimony.

Approximately 10 years' experience in the roles of Deputy Director and Operations Director, providing operational and tactical leadership to the Criminalistics service within the NSW Health Pathology Forensic & Analytical Science Service (FASS), providing a high quality, efficient and innovative service for Illicit Drug Analysis, Forensic

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Biology/DNA and Chemical Criminalistics, to meet the organisational strategies, customer requirements and operational plans.

PROFESSIONAL AFFILIATIONS:

- ANZ Forensic Science Society
- International Society for Forensic Genetics
- Academy of Forensic Science

Member of interagency collaborations to support strategic and operational directions in Forensic Science:

- Forensic Science Service Executive Committee
- Forensic Science Service Operational Review Committee
- Action Plan Sub-Committee
- Forensic Biology/DNA Sub-Committee
- Science and Research Projects Sub-Committee
- Illicit Drug Analysis Unit/Chemical Criminalistics Sub-Committee
- FASS-FETS ICT working group
- Missing Persons, Unidentified and Destitute Review Committee
- 2019 NSW Forensic Process review
- 2022 Forensic Process review
- 2023 business case for enhancement of Criminalistics

CURRENT AND PREVIOUS ADDITIONAL KEY ROLES/RESPONSIBILITIES:

- National Association of Testing Authorities (NATA) Technical Assessor for Forensic Biology /DNA.
- NSW representative-Biologist Specialist Advisory Group (BSAG).
- Mentor for the national Y chromosome Specialist Working Group
- Reviewer for Australian Journal of Forensic Science
- Co-Supervisor for Master of Philosophy Candidate *Knowledge driven judgements: Understanding DNA success rates towards evidence-based triage and reporting strategies – A NSW study*.
- NSW FASS representative on the Australian New Zealand Forensic Executive Committee ANZFEC (Governance body, National Institute of Forensic Science)
- ANZFEC representative on the Forensic Summit 2016 organising committee
- Training Officer Forensic DNA 1996-2011.
- Member of national Beta testing validation team, in house verification team and trainer for the STRmix expert system for DNA interpretation.
- Member of evaluation review team and system operator for the True Allele expert system for DNA interpretation.

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- External co-supervisor UTS Honours student: *Investigation into the effects of Ethylene Oxide on downstream DNA analysis.*
- NSW representative – Australasian Scientific Working Group on Forensic DNA interpretation and statistics (STATS SWG).
- Deployed by the Australian Federal Police to Thailand in 2005 as a DNA reporting biologist for the Disaster Victim Identification Operation.
- Chair of FASS Research, Training & Professional Development Working Group.

PROFESSIONAL DEVELOPMENT:

- Australian New Zealand School of Government *Towards Strategic Leadership*
- Public Sector Women in Leadership NSW Summit (Masterclasses *Maximising your influence and engagement for optimal public sector organizational, behavioural and cultural change*" and '*Resilient leadership*')
- NSW Public Service Commission *Ethics and Leadership in the Public Sector*
- Women in Leadership Symposium
- Public Sector Women in Leadership
- Change Management
- Agile project management
- Frontline Managers program
- Project Management
- Business Case Development
- Accelerated Implementation Management (AIM)
- Managing People through Change & Building Personal Resilience
- McCarthy Mentoring program

Publications/External Presentations (sample across last 5 years)

Wilson-Wilde, L., Yakovchyts, D., Neville, S., Gunn, P., Investigation into ethylene oxide treatment and residuals on DNA and downstream DNA analysis, Science and Justice 57 2017.

Bright, J., Allen, C., Fountain, S., Gray, K., Grover, D., Neville, S., Poy, A., Taylor, D., Turbett, G., Wison-Wilde, L. *Australian population data for twenty Promega PowerPlex 21 short tandem repeat loci.* Aust. Journal of Forensic Sciences 2014.

Bright, J., Neville, S., Curran, J., Buckleton, J. *Variability of mixed DNA profiles separated on a 3130 and 3500 capillary electrophoresis instrument*. Aust. Journal of Forensic Sciences 2013

2018 Australian Institute of Medical Sciences conference *FASS overview*

2017 International Symposium on Forensic Genetics, Seoul

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Hitchcock. C., Neville, S. Poster presentation "*DNA Automation-The Good, the Bad and the Ugly"*

2017 NSW Police Force Forensic Intelligence Results Management Team. *National Criminal Investigation DNA Database Integrated Forensic Analysis*

2017 ANZ National Institute of Forensic Science Joint Specialist Advisory Group meeting *Forensic Science Summit 2016*

2014 Forensic Medicine and Science Sydney Conference *"Advances and challenges in DNA testing"*

2014 ANZ Forensic Science Society "*Advances and challenges in DNA testing"*

2014 NSWPF Expert Referral Team Professional Development Day –Trending issues and Hot Topics: *DNA advances and challenges relevant to investigators.*

2014 International Symposium on the Forensic Sciences of the Australian and New Zealand Science Society: Poster presentation "The *recovery of trace DNA from underpants and implications for casework"*

2013 Crime Scene Services Branch Managers meeting on contamination minimisation protocols: *A new world of sensitivity.*

2013 NSW Police Forensic Services Group Strategic Management Meeting: *DNA advances and the Way Forward.*

2013 Office of the Director of Public Prosecutors ODPP *"DNA today: An assessment of PowerPlex 21 and STRmix in criminal casework*.

2013 Judicial Commission Seminar: *DNA advances and the Way Forward*

2012: "Genetics in the courts (DNA evidence) Current and future trends", Sydney Forensic Medicine and Science Network

2012 Office of the Director of Public Prosecutors (ODPP): *A DNA odyssey – the introduction of the Expert System STRmix at FASS.*

2012 Public Defenders: *Introduction to the new generation multiplex PP21 and the use of the expert system STRmix in DNA interpretation.*

2012 Preconference workshop ODPP: *The way forward in DNA analysis and interpretation- Introduction to the new generation multiplex PP21 and the use of the expert system STRmix in DNA interpretation.*

2012 NSW Crime Commission*: Advances in Forensic DNA analysis.*