Deviation Request Form (DRF)

Directions: The Initiator will complete Sections A through C. Additional continuation pages can be included if necessary.

Initiator	Lindsey Admire	**Date**	03/14/2019

A. Requested deviation applies to (Technical Procedure – include specific section):

Physical Evidence Section - Trace Unit; Technical Procedure for Hair Analysis (Effective Date: 01/07/2019)

Add 5.6.4 to reflect new hair root screening technique using hematoxylin to determine the number of nuclei present in telogen roots.

B. Requested deviation:

Add additional procedural steps to the Physical Evidence Section - Trace Unit; Technical Procedure for Hair Analysis (Effective Date: 01/07/2019) regarding submitting telogen roots for DNA analysis.

See additional page for procedure regarding sending telogen roots for DNA analysis.

C. Necessity for the deviation:

The Physical Evidence Section - Trace Unit; Technical Procedure for Hair Analysis (Effective Date: 01/07/2019) does not include a screening technique for hair roots in the telogen growth phase. In-house research has shown that screening telogen hair roots using hematoxylin to stain the nuclei could potentially increase the likelihood of developing a DNA profile due to the presence of 11 or more nuclei.

D. Technical review and Authorization (to be completed by the Quality Manager and/or Technical Leader)
Comments(to include merits and impacts):

This deviation only affects the sending of telogen hair roots for DNA analysis.

Approved	☑	Yes	☐	No	Duration	one year
Signature	Lindsey Admire Digitally signed by Lindsey Admire DN: CN=Lindsey Admire, E=ladmire@ncdoj.gov, C=US Reason: I am the author of this document Location: Date: 2019-03-14 15:49:02 Foxit PhantomPDF Version: 9.3.0				Date	03/14/2019

E. Quality Assurance Authorization (to be completed by the Quality Manager, Forensic Scientist Manager or designee)

Acceptable within general QA guidelines and good laboratory practice?	☑	Yes	☐	No
Significant negative impact to Crime Laboratory Quality System?	☐	Yes	☑	No

Restrictions/limitations:

This DRF is for the use of the Physical Evidence Section - Trace Unit; Technical Procedure for Hair Analysis (Effective Date: 01/07/2019).

☑	Authorized	☐	Rejected	Signature	Amy H Brewer-Slish Digitally signed by Amy H Brewer-Slish DN: C=US, OU=NC State Crime Laboratory, CN=Amy H Brewer-Slish, E=abrewerslish@ncdoj.gov Reason: I have reviewed this document Location: Date: 2019-03-18 15:54:35 Foxit PhantomPDF Version: 9.3.0	Date	3/18/2019

5.6.4 **Hair Roots in the Telogen Growth Phase**

5.6.4.1 The hair root screening procedure described below uses hematoxylin to stain any nuclei present in the root area of any hair in the telogen growth phase. The stained nuclei is then counted to determine the root's suitability for DNA analysis.

5.6.4.1.1 If the hair is mounted on a microscope slide, remove the entire hair from the slide. Rinse the hair in xylene to remove any adhering mounting media.

5.6.4.1.2 Soak the root end of the hair in absolute ethanol for 30 minutes.

5.6.4.1.3 Soak the root end of the hair in Modified Harris Hematoxylin for 3 minutes.

5.6.4.1.4 Rinse the root end of the hair with deionized water, followed by absolute ethanol.

5.6.4.1.5 Place the hair on a microscope slide and temporarily mount in xylene or xylene substitute.

5.6.4.1.6 View the stained hair root with a transmitted light microscope and examine for the presence of nuclei. The nuclei are dark red or purple in color and usually oval in shape.

5.6.4.1.7 Count the visible nuclei.

5.6.4.1.7.1 If more than 10 nuclei are present the entire hair or the root may be removed using a new sterile blade and sent for DNA analysis.

5.6.4.1.7.2 If less than or equal to 10 nuclei are present the root will not be removed and the hair will be recommended for mitochondrial DNA analysis.

Technical Procedure for Hair Analysis

1.0 Purpose – This technical procedure shall be followed for the examination of hair evidence.

2.0 Scope – This procedure applies to all hair cases in the Trace Unit.

3.0 Definitions – N/A

4.0 Equipment, Materials, and Reagents

4.1 Equipment

- Stereomicroscope
- Comparison microscope

4.2 Materials

- Glass microscope slides and cover slips
- Forceps
- Scalpel and blades
- Scribe
- Microcentrifuge tubes
- Well plates
- Fingerprint lifting tape
- Pasteur Pipettes
- Probes

4.3 Reagents

- Cytoseal 280
- Permount
- Xylene
- Xylene substitute
- Ethanol (anhydrous) 200 proof
- Deionized water
- Norland Optical Adhesive
- Clear nail polish
- 10 % bleach solution

5.0 Procedure

5.1 Analytical Approach

5.1.1 There are two types of examinations that are often requested of a hair-trained Forensic Scientist: a screen for DNA suitability and a microscopic hair analysis.

5.1.1.1 Screening for DNA suitability involves examining the hair evidence for roots that may be suitable for DNA analysis.

5.1.1.2 Microscopic hair analysis is a general term that encompasses many different methods of examination including, but not limited to, animal classification, racial classification and the comparison of questioned human hairs to known standards. The method(s) of examination used in a microscopic hair analysis is dependent upon the case information available.

5.1.2 Analytical Approach – Screen for DNA

5.1.2.1 Review the request for analysis.

5.1.2.2 Open evidence container and describe the evidence present.

5.1.2.3 If no questioned hair is present, the examination is complete. See **5.7.8.5**.

5.1.2.4 Process the item to remove any hair evidence adhering to the item following the Trace Unit Technical Procedure for the Collection and Preservation of Evidence.

5.1.2.5 Using a stereomicroscope or by temporarily mounting (see **5.3.2**), the collected hair evidence will be screened for any human hairs with roots that may be suitable for DNA analysis. See **5.5.2**.

5.1.2.6 If no evidence is suitable for DNA analysis, the examination is complete. See **5.7.3.6**.

5.1.3 Analytical Approach – Microscopic Analysis

5.1.3.1 Review the request for analysis.

5.1.3.2 Open evidence container and describe the evidence present.

5.1.3.3 If no questioned hair is present, the examination is complete. See **5.7.8.5**.

5.1.3.4 Process the item to remove any hair evidence adhering to the item following the Trace Unit Procedure for the Collection and Preservation of Evidence.

5.1.3.5 If required standards are not present, the analyst shall request standards following the Laboratory Procedure for Obtaining Evidentiary Standards. If standards are not submitted, the evidence may be returned. See **5.7.8.3.3**.

5.1.3.6 The known standards are opened and an initial visual evaluation and macroscopic examination is performed. See **5.2**.

5.1.3.7 The collected hair evidence is screened using a stereomicroscope and any hair(s) that appear to be macroscopically similar to the known hair standards are

mounted on microscope slides. See **5.3**. No further analysis will be performed on hairs that are found to be macroscopically different from the known hair standards.

5.1.3.8 The known standards are mounted.

5.1.3.9 Using a light microscope, the Forensic Scientist examines macroscopic and microscopic characteristics of the hairs. See **5.4**.

5.1.3.10 Multiple examination procedures may be used based on the request made by the agency. Those determinations are as follows:

5.1.3.10.1 Animal Classification. See **5.5.1**.

5.1.3.10.1.1 Determine if the hair is human or animal.

5.1.3.10.1.2 If requested, the type of animal from which the hair originated may be determined.

5.1.3.10.1.3 The Trace Unit does not compare animal hairs.

5.1.3.10.2 Somatic Origin Classification. See **5.5.3**

5.1.3.10.2.1 If possible, the somatic origin (head, pubic or other body area) shall be determined. Only head and pubic hairs shall be compared to a known standard.

5.1.3.10.2.2 If somatic origin cannot be determined based on microscopic characteristics, the hair may be deemed not suitable for comparison with the submitted standards.

5.1.3.10.3 Racial Classification. See **5.5.4.**

5.1.3.10.3.1 Determine only the racial classification of the submitted hair.

5.1.3.10.3.2 No comparison is required in these cases.

5.1.3.10.4 Hair Comparison. See **5.5.5**.

5.1.3.10.4.1 Compare questioned hairs to the known hair standards submitted.

5.1.3.10.5 Force Determination. See **5.5.6.**

5.1.3.10.5.1 The Forensic Scientist may determine if a hair was forcibly removed.

5.1.3.10.6 Other

5.1.3.10.6.1 There may be times when an agency requests a variation on the above listed types of analysis. If the request falls within the scope of the technical procedures, the analysis shall be permitted.

5.1.3.11 Once all visual and microscopic examinations have been completed, the Forensic Scientist shall issue a report stating his or her findings. See **5.7.**

5.2 Evaluation of Known Standards

5.2.1 It is requested that a known head and/or pubic hair standard be submitted from all parties involved in each case.

5.2.1.1 A known head and/or pubic hair standard consists of 50 plucked, full-length hairs from all around the region of interest.

5.2.1.2 A standard may consist of fewer than 50 hairs if the analyst documents enough properties to differentiate between individuals. These properties may include macroscopic and/or microscopic characteristics.

5.2.2 In addition, the submitted standards may be deemed inadequate for comparison. Some of these factors may include:

5.2.2.1 An insufficient quantity and/or variety of hairs submitted;

5.2.2.2 Hairs without both pulled and shed roots present (cut hairs, hair fragments);

5.2.2.3 Hairs where too much time has elapsed such that the standard does not adequately represent the hair at the time of incident; or

5.2.2.4 Standards that are comprised solely of bland and/or gray hairs.

5.3 Preparation of Slides

5.3.1 Place the hair on a clean microscope slide and apply a thin film of an appropriate mounting medium, such that the hair is totally covered. Place a glass cover slip on top of the hair and mounting medium.

5.3.2 Application of Mounting Media

5.3.2.1 It is permissible to mount hairs in a temporary mounting medium, such as water or xylene, or a non-temporary mounting medium, such as Cytoseal or Norland Optical Adhesive.

5.3.2.2 If a temporary mounting medium is used, the hairs shall be retrieved and placed into the original packaging after the examination is complete.

5.3.2.3 A mounting medium, such as Cytoseal or Norland Optical Adhesive, may be used so long as, based on the Forensic Scientist's training and experience, it flows properly and has not yellowed.

5.4 Initial Examination

5.4.1 After the collection and/or mounting process, the macroscopic and/or microscopic properties of the hair are evaluated.

5.4.2 The following is a list of characteristics that may be used for classification and comparison of hairs. The characteristics listed below are not all-inclusive and may or may not be present in every hair.

5.4.2.1 Macroscopic Properties

- Color
- Form
- Shaft length
- Overall shaft thickness

5.4.2.2 Microscopic Properties

5.4.2.2.1 Cuticle

- Colors
- Scale Patterns
- Damage

5.4.2.2.2 Cortex

- Pigment characteristics (e.g., color, size, shape, distribution)
- Ovoid bodies
- Cortical fusi
- Chemical treatment (e.g., dyes, bleaching)
- Banding

5.4.2.2.3 Medulla

- Presence/Absence
- Patterns
- Cellular size

5.4.2.2.4 Shaft

- Size
- Cross sectional shape
- Length
- Attached debris
- Parasites
- Disease

5.4.2.2.5 Root

- Pigments
- Cortical fusi
- Presence of follicular tissue
- Growth stage
- Shape
- Force determination
- Putrid

5.4.2.2.6 Tip

- Shape (e.g., frayed, cut, split, natural taper, singed)

5.5 Examination Procedures

5.5.1 Animal Classification

5.5.1.1 The characteristics of the hair shall be examined and the Forensic Scientist determines if the hair is of human or animal origin. Without prior approval from the Technical Leader, Forensic Scientist Supervisor or the Forensic Scientist Manager, no further analysis shall be performed on hairs determined to be of animal origin.

5.5.1.2 If specifically requested and approved, additional characterization of the hair as to family/genus/species may be done.

5.5.1.2.1 The type of hair shall be determined (guard or fur).

5.5.1.2.1.1 Guard hairs with the root and tip intact provide the most information during analysis.

5.5.1.2.2 The scale pattern can be determined either by using the microscope or by scale casting.

5.5.1.2.2.1 When making scale casts, the Forensic Scientist shall note the root end and tip end of the hair.

5.5.1.2.2.2 There are numerous ways to make scale casts, some of which are listed below. This list is not all inclusive and

the Forensic Scientist may employ other techniques if they are not destructive, the hair can be retrieved from the casting medium, and a successful scale cast has been achieved on positive controls.

- Norland Optical Adhesive method
- Nail Polish method

5.5.1.2.3 By examining the guard hair, the animal's family and sometimes genus can be determined. The following factors are used to determine the family and possible genus with the aid of the microscope:

- Root
- Medulla
- Tip
- Color
- Banding patterns
- Scale pattern

5.5.2 Screen for DNA

5.5.2.1 The characteristics of the hair shall be examined and the Forensic Scientist determines if the hair is human.

5.5.2.2 Human hairs shall be examined for the presence of roots that may be suitable for DNA analysis. Hairs with suitable roots, as determined by the Forensic Scientist's training and experience, shall be retained for DNA analysis.

5.5.2.3 When necessary, the roots shall be removed and submitted to the Forensic Biology Section. In some cases, a hair with root suitable for DNA analysis may be too small to have the root removed. In those cases, the hair will be sent in its entirety for DNA analysis. See **5.6**.

5.5.3 Somatic Origin Classification

5.5.3.1 The characteristics of the hair shall be examined and the Forensic Scientist determines if the hair is human.

5.5.3.2 If possible, the somatic origin (head, pubic or other body area) of the hair shall be classified. Factors may be used to aid in the determination of the somatic origin of the hair include, but are not limited to:

- Length
- Macroscopic form
- Medulla
- Diameter

- Chemical treatment

5.5.4 Racial Classification

5.5.4.1 The characteristics of the hair shall be examined and the Forensic Scientist determines if the hair is human.

5.5.4.2 If possible, the racial classification of the hair shall be determined. Factors that may be used to aid in the determination of the racial classification of the hair include, but are not limited to:

- Cross sectional shape
- Pigment pattern
- Macroscopic form

5.5.4.3 If the hair has a root that may be suitable for DNA analysis, the hair root or the entire hair may be sent to the Forensic Biology Section for further testing. See **5.5.2**.

5.5.5 Hair Comparison

5.5.5.1 The characteristics of the hair shall be examined and, if possible, the Forensic Scientist determines if the hair is human, the racial classification, and somatic origin.

5.5.5.2 If the hair is human head or pubic hair and is suitable for microscopic comparison, based on the analyst's training and experience, then it shall be compared to the known standards.

5.5.5.2.1 The comparison process involves a direct comparison of the questioned hair and the known standard along the entire hair, utilizing all of the microscopic characteristics that are present in the hair.

5.5.5.3 If the Forensic Scientist finds questioned and known hairs to be microscopically consistent, or to have similarities with slight differences, and the hairs may establish an association (e.g. victim to suspect; victim to scene), then:

5.5.5.3.1 A second Forensic Scientist, who is qualified in hair comparisons, shall confirm these microscopic comparisons. A verification review shall be completed in FA and the microscope slides shall be initialed and dated by the verifying Forensic Scientist. The verifying Forensic Scientist will also note in FA the contents of all slides verified.

5.5.5.3.2 A representative sample of the hairs shall be sent for DNA analysis. See **5.6.** Additional hairs may be recommended for DNA analysis.

5.5.6 Force Determination

5.5.6.1 The characteristics of the hair shall be examined and the Forensic Scientist determines if the hair is human.

5.5.6.2 By examining the growth phase and structure of the hair root, the Forensic Scientist determines if the hair could have been forcibly removed.

5.5.6.3 This is usually done in addition to a comparison.

5.5.6.4 If there is no root present, a force determination cannot be performed.

5.6 Submitting Hairs for DNA Analysis

5.6.1 DNA analysis is conducted on probative associations, when possible, on head hairs and/or pubic hairs found to be microscopically consistent, or to have similarities with slight differences to a known hair standard. Others hairs may be submitted for DNA analysis based on the training and experience of the Forensic Scientist.

5.6.2 DNA analysis can be conducted on hairs with adhering root tissue. If no adhering tissue is found, no further analysis can be conducted by this Laboratory. Mitochondrial DNA analysis may be recommended. See **5.7.9.7**.

5.6.3 Hair Roots in the Anagen or Catagen Growth Phase

5.6.3.1 Removal of the hair root from the glass microscope slide is critical for DNA testing. Care shall be taken so that the questioned hair is not contaminated with foreign debris and/or fluids. The procedure for removal of the hair root from the glass microscope slide for DNA analysis shall be as follows:

5.6.3.1.1 Sterilize all tools prior to use.

5.6.3.1.2 Carefully break the cover slip around the root of the questioned hair using a scribe.

5.6.3.1.3 Place a drop of xylene on the exposed root area. Remove broken pieces of the cover slip.

5.6.3.1.4 Using a new blade, cut the root end from the hair and remove from the slide.

5.6.3.1.5 Briefly rinse the root in xylene to remove any adhering mounting media.

5.6.3.1.6 Thoroughly rinse the root in deionized water, followed by 100 % ethanol, followed again by deionized water.

5.6.3.1.7 Place the hair root into a labeled microcentrifuge tube. Place the tube into a labeled manila envelope.

5.6.3.1.8 The remaining portion of the hair shall be labeled with the corresponding root sub-item number on the slide.

5.6.3.2 In some cases, the mounted questioned hair will be of insufficient length to have the hair root removed and sent for DNA analysis. The procedure for removal of the hair from the glass microscope slide for DNA analysis shall be as follows:

5.6.3.2.1 Sterilize all tools prior to use.

5.6.3.2.2 Carefully break the cover slip around the questioned hair using a scribe.

5.6.3.2.3 Place a drop of xylene on the exposed hair. Remove broken pieces of the cover slip.

5.6.3.2.4 Remove the entire hair from the slide.

5.6.3.2.5 Rinse the hair in xylene to remove any adhering mounting media.

5.6.3.2.6 Thoroughly rinse the hair in deionized water, followed by 100 % ethanol, followed again by deionized water.

5.6.3.2.7 Place the hair into a labeled microcentrifuge tube. Place the tube into a labeled manila envelope.

5.6.3.3 In some cases, the questioned hair will not be mounted. The procedure for removal of a hair root or submission of a hair in its entirety for DNA analysis shall be as follows:

5.6.3.3.1 Sterilize all tools prior to use.

5.6.3.3.2 Using a new blade, cut the root end from the hair. Or, if the hair is of insufficient length, the root will not need to be removed.

5.6.3.3.3 Thoroughly rinse the hair or hair root in 100 % ethanol, followed by deionized water.

5.6.3.3.4 Place the hair or hair root into a labeled microcentrifuge tube. Place the tube into a labeled manila envelope.

5.6.3.3.5 The remaining portion of the hair shall be secured (e.g., placed on a piece of tape, placed on a post-it note, etc.) and labeled with the corresponding root sub-item number, unless the hair has been submitted in its entirety.

5.7 Guidelines for Hair Examination Result Statements

5.7.1 A methodology statement shall be added to all reports that do not indicate if hairs were

macroscopically and/or microscopically examined.

5.7.1.1 Example: The following methodologies were used in the examination of this case: visual examination and microscopy.

5.7.2 The wording of the results shall accurately describe the evidence at hand.

5.7.3 The report shall address all unknown hairs present in a case, whether microscopically compared or not.

5.7.3.1 In cases where there are multiple victims/suspects listed and standards are not provided for all of the individuals, a statement shall be added at the beginning of the report which informs the reader what comparisons were made.

5.7.3.1.1 Example: Items A, B, and C were examined for the presence of hairs that could be associated with the submitted standards from ___ only. A hair standard was not provided from _____.

5.7.4 Screen for DNA

5.7.4.1 If there are hairs with roots suitable for DNA analysis:

5.7.4.1.1 Example: Examination of Item A revealed the presence of several hairs with roots that may be suitable for DNA analysis.

5.7.4.2 If some hairs are being included/excluded on the basis of race (i.e., when suspect and victim are of different races):

5.7.4.2.1 Example: Examination of Item A revealed the presence of several hairs with macroscopic/microscopic Negroid characteristics that may be suitable for DNA analysis.

5.7.4.2.2 Example: Item A was examined for the presence of hairs with macroscopic/microscopic Caucasian characteristics. No hairs of this type were noted.

5.7.4.3 If the roots of the hairs were removed:

5.7.4.3.1 Example: The roots of these hairs were removed, assigned Item(s) #___ and sent for DNA analysis.

5.7.4.4 If the hairs were retained but roots were not removed:

5.7.4.4.1 Example: Examination of Item A revealed the presence of several hairs. Some of these hairs had roots that may be suitable for DNA analysis. These hairs have been assigned Item(s) # _____ and will be retained in the laboratory. The remaining hairs were not suitable

for DNA analysis. No further examination was performed.

5.7.4.5 Retained hairs sent back to the Trace Unit for root removal:

5.7.4.5.1 Example: Item # ____ was previously analyzed by _____. The results of that analysis can be found in the laboratory report dated _____. Item # _____ was retained in the laboratory in the event the roots needed to be removed for DNA analysis. The roots from these hairs were removed, assigned Item(s) # ____ and sent for DNA analysis.

5.7.4.6 If no evidence is suitable for DNA analysis:

5.7.4.6.1 Example: Examination of Item A revealed the presence of several hairs. No hairs suitable for DNA analysis were noted. No further analysis was performed on this item.

5.7.4.7 If the hair was sent for DNA analysis in its entirety:

5.7.4.7.1 Example: This hair was assigned Item A-1 and submitted in its entirety for DNA analysis.

5.7.5 Racial Classification

5.7.5.1 Example: Examination of Item A revealed the presence of several hairs with Caucasian characteristics.

5.7.6 Animal Classification

5.7.6.1 Example: Examination of Item A revealed the presence of one hair found to be of animal origin and exhibiting characteristics of the deer family.

5.7.7 Hair Comparison

5.7.7.1 Consistent

5.7.7.1.1 Only applicable to head and pubic hairs.

5.7.7.1.2 No significant differences were observed between the questioned and known hairs (i.e., characteristics exhibited by the unknown hair fit within the range of characteristics present in the known standard).

5.7.7.1.2.1 Example: The hair in Item A was found to be microscopically consistent with the hair in Item B. Microscopically consistent means characteristics exhibited by the unknown hair fit within the range of characteristics present in the known standard.

Therefore, the hair in Item A could have originated from the same source as the hair in Item B.

5.7.7.2 Inconclusive

5.7.7.2.1 Questioned and known hairs exhibit similarities in characteristics, but slight differences were noted.

5.7.7.2.1.1 Example: The hair in Item A exhibited both similarities and slight differences to the hair in Item B. Similarities with slight differences means minor variations were noted between the characteristics exhibited by the unknown hair and the range of characteristics present in the submitted known standard. Accordingly, no conclusion could be reached as to whether or not the hair in Item A could have originated from the same source as Item B.

5.7.7.2.2 Questioned hair or hair standard is of a limited nature.

5.7.7.2.2.1 Example: Due to the nature/condition of Item A, no conclusion could be reached as to whether or not Item A could have originated from the same source as Item B.

5.7.7.2.3 Questioned and known hairs exhibit overlapping characteristics.

5.7.7.2.3.1 Example: The hair in Item A exhibited overlapping characteristics with the hair in Items B and C. Overlapping characteristics means characteristics exhibited by the unknown hair fit within the range of characteristics present in more than one known standard. Accordingly, no conclusion could be reached as to whether or not the hair in Item A could have originated from the same source as Item B or C.

5.7.7.3 Not Consistent

5.7.7.3.1 Numerous differences were found between the questioned and known sample (i.e., characteristics found in the questioned hair cannot be found in the known sample). These differences shall be the basis for exclusion.

5.7.7.3.1.1 Example: The hair in Item A was found to be macroscopically/microscopically different from the hair in Item B. Macroscopically/Microscopically different means distinct characteristics exhibited by the

unknown hair were not noted within the range of characteristics present in the submitted known standard. Therefore, the hair in Item A could not be associated with the submitted standard from __ (Item B).

5.7.8 Force Determination

5.7.8.1 Example: The hair in Item A has characteristics that indicate it was forcibly removed.

5.7.9. No Analysis

5.7.9.1. No analysis is performed due to the outcome of DNA analysis.

5.7.9.1.1. DNA results correlate two items of evidence (e.g., suspect's DNA profile is identified on the victim's vaginal swabs).

5.7.9.1.1.1 Example: Based on the results of DNA analysis, the above listed evidence is being returned without analysis. If you have any questions, please contact the Forensic Scientist who issued this report.

5.7.9.1.2 An unknown DNA profile was developed on an item of evidence (e.g., vaginal swabs).

5.7.9.1.2.1 Example: Due to the fact that there is an unknown DNA profile noted in the Forensic Biology report dated *mm/dd/yy* by *analyst*, the above listed evidence is being returned without examination at this time. If you have any questions, please contact the Forensic Scientist that issued this report.

5.7.9.2 No Questioned Items Submitted

5.7.9.2.1 Example: Due to the fact that no questioned hair evidence was submitted for analysis, the above listed known standards are being returned without examination. If you have any questions, please contact the Forensic Scientist that issued this report.

5.7.9.3 Standards Not Submitted

5.7.9.3.1 No analysis is performed because all standards have not been submitted to the laboratory.

5.7.9.3.1.1 Example: Due to the fact that no suspect/victim/elimination standards were submitted, the above listed evidence is being returned without

examination. The evidence may be resubmitted for hair analysis accompanied by the suspect's/victim's/elimination's head/pubic hair standards.

5.7.9.3.2 A pending DNA analysis has not been completed due to a DNA standard that has been requested, but not submitted.

5.7.9.3.2.1 Example: The standards previously requested by the Forensic Biology Section have not been submitted. Per Trace Unit policy, the hair analysis will not be performed until the pending DNA analysis has been completed. If you have any questions, please contact the Forensic Scientist that issued this report.

5.7.9.3.3 Analysis has been discontinued because the requested standards have not been submitted.

5.7.9.3.3.1 Example: The hair standards previously requested by the Trace Unit have not been submitted; therefore, no further analysis could be performed.

5.7.9.4 Pubic hair combings collected more than 48 hours after the incident occurred.

5.7.9.4.1 Example: Item A was not examined, as it was collected more than 48 hours after the incident occurred.

5.7.9.5 No questioned hair evidence present.

5.7.9.5.1 Example: Because no questioned hair evidence was submitted for analysis, the above listed known standards are being returned without examination. If you have any questions, please contact the Forensic Scientist who issued this report.

5.7.9.5.2 Example: Examination of Item A did not reveal the presence of any hairs.

5.7.9.6 Improper Collection of Hair Evidence.

5.7.9.6.1 Example: Item A was improperly collected/packaged and will be returned without examination.

5.7.9.6.2 Example: Because the evidence collection envelopes/victim kit paperwork indicates that the pubic hair combings were collected after the pubic hair standard, Item A was improperly collected. Therefore, Item A is being returned without examination

5.7.9.7 Common Environment.

5.7.9.7.1 Example: Because it cannot be determined when or how a hair was deposited on an item from an environment common to both the victim and suspect, a hair analysis cannot be performed on Item A.

5.7.9.8 Consent.

5.7.9.8.1 Example: Based on the submission information provided the suspect's involvement is not in question; therefore, the above listed evidence is being returned unanalyzed by the Trace Unit. Should the suspect's statement or other information in the case change, please contact the Trace Unit prior to re-submission.

5.7.10 Qualifying Statements

5.7.10.1 Qualifying statements shall be included in the formal report if their inclusion further explains the conclusion or provides necessary information to the reader regarding the interpretation of the conclusion.

5.7.10.2 Qualifying Statement Regarding Passage of Time

5.7.10.2.1 Because hair is a biological material, it can change with the passage of time. A qualifying statement may be added to the report when, based on the Forensic Scientist's training and experience, a large lapse of time has occurred between the date of the crime and the collection of the standard.

5.7.10.2.1.1 Example: Hair characteristics can change with the passage of time and [amount of time] has passed between the date of the crime and the collection of these known hair standards.

5.7.10.3 Qualifying Statement Regarding Featureless / Bland Hairs, Gray Hairs and Bleached Hairs

5.7.10.3.1 Featureless/bland hairs (excluding gray hairs) are hairs that have little pigment and may have a fine diameter, an absent medulla, etc. They are lacking many of the characteristics used in the evaluation, examination and comparison of hairs.

5.7.10.3.2 Gray hairs are hairs that have no pigment and may have an absent medulla. They are lacking most of the characteristics used in the evaluation, examination and comparison of hairs.

5.7.10.3.3 Bleached hairs are hairs that have been chemically treated. Bleaching will remove pigment from the hair and give the hair a characteristic

yellow hue. A clear line of demarcation may be present and the hair shaft may appear brittle with disturbed scales.

5.7.10.3.4 Because many characteristics are absent and less information is available to make these comparisons, the Forensic Scientist shall be cautious with his/her conclusions in these circumstances. A statement qualifying any comparison conclusions made regarding featureless hairs shall be included in the formal report.

5.7.10.4 Qualifying Statement Regarding Racial Classification

5.7.10.4.1 In racial classification, the Forensic Scientist forms an opinion based on the macroscopic and microscopic properties of the hair.

5.7.10.4.2 A qualifying statement shall be added to state that the racial determination of the hair may not be indicative of the individual's outward appearance.

5.7.10.5 Qualifying Statement Regarding Force Determinations

5.7.10.5.1 When determining if a hair has been forcibly removed, it is not possible for the Forensic Scientist to determine how, when or why the hair was forcibly removed. A qualifying statement shall be added to communicate this.

5.7.10.6 Qualifying Statement Regarding Hair Comparisons and DNA Analysis

5.7.10.6.1 A statement as to the non-individualizing nature of hair examinations shall be included on the report.

5.7.10.6.1.1 Example: "The conclusions rendered in this report apply only to comparisons with the submitted standards (Item A and Item B). Should future investigation develop additional information or individuals related to the case, please contact the Forensic Scientist that issued this report.

The comparison of the microscopic characteristics in hairs does not constitute a basis for absolute personal identification. The probative value of hair comparisons may be affected by the results of DNA analysis."

5.7.10.7 Qualifying Statement Regarding Mitochondrial DNA Analysis

5.7.10.7.1 A statement regarding the option of mitochondrial DNA testing shall be included on the report when the results of a hair comparison may

establish an association (e.g. victim to suspect; victim to scene). Example: It is recommended that this sample be outsourced for mitochondrial DNA testing.

5.7.10.7.2 A statement regarding the option of mitochondrial DNA testing shall be included on the report when the results of a hair comparison may establish an association (e.g. victim to suspect; victim to scene) and/or a hair root is sent for DNA analysis. Example: Should DNA analysis of the hair root yield no profile, it is recommended that the remaining portion of the hair be outsourced for mitochondrial DNA testing.

5.7.10.7.3 A statement regarding the option of mitochondrial DNA testing shall be included on the report when the hair analyst has exhausted the examination capabilities of the North Carolina State Crime Laboratory and questioned hairs remain that may be suitable for mitochondrial DNA analysis.

5.8. Standards and Controls – N/A

5.9. Calibration – N/A

5.10. Maintenance – No maintenance is required in this procedure. However, the procedure does utilize instruments that require maintenance. See the individual technical procedures for the operations of those instruments.

5.11 Sampling and Sample Selection

5.11.1 No sampling is performed. When sample selection occurs, it shall be based on the Forensic Scientist's training and experience.

5.11.2 In general, each unknown hair shall be compared separately to the range of characteristics in the known standard(s) provided.

5.11.3 Sample Selection Guidelines

5.11.3.1 If a number of unknown hairs are submitted from the same location and are believed to have been deposited at the same time during the same event (e.g., a clump of hairs), they may be treated as a group.

5.11.3.2 If a large quantity of hairs is present in a clump, a number of the unknown hairs shall be selected by the Forensic Scientist as representative of the entire unknown sample. The selection shall be based primarily on characteristics such as length, coarseness, and color as observed by the Forensic Scientist. All hairs included in the representative unknown sample shall be compared to a known standard.

5.11.3.3 The Forensic Scientist shall choose hairs for further analysis based on an initial

macroscopic examination and comparison to the known standard. If the questioned hair does not fall into the range of characteristics in the known standard (e.g., length, race) or was not recovered from a controlled location (e.g., victim's panties), it does not need to be mounted for further comparison.

5.11.3.4 Hairs found to be suitable for DNA analysis may be excluded on the basis of race if the race of the subject is known (i.e., suitable root on a Caucasian hair from a Caucasian victim's clothing does not require submission for DNA analysis if the subject is Negroid).

5.11.4 Situations in which examinations may be discontinued are as follows:

5.11.4.1 Pubic hair combings collected more than 48 hours after the incident occurred shall not be analyzed.

5.11.4.2 Based on the results of DNA analysis, the hair evidence may be returned unanalyzed.

5.11.4.3 If the DNA report states that an unknown profile of the appropriate gender has been found in an item of evidence that would provide the same information as the hair analysis, the hair evidence may be returned pending the identification of the unknown profile (e.g., unknown male profile on the victim's vaginal swabs would mean the victim's pubic hair combings could be returned unanalyzed until the unknown profile is identified).

5.11.4.4 If DNA analysis is pending and Forensic Biology has requested the DNA standards more than two weeks ago, the hair evidence may be returned without analysis.

5.11.4.5 If the Forensic Biology Section is returning a case without analysis because it is consensual, all hair evidence may be returned without analysis.

5.11.4.6 If hair standards for all parties involved in the case are not submitted, the evidence may be returned to the agency unanalyzed. The agency will be notified to submit the requested standards.

5.11.4.7 If it is known that the parties involved in the case share a common environment, the evidence may be returned to the agency unanalyzed.

5.11.4.8 If questioned items or hair standards have been improperly collected, the evidence may be returned to the agency unanalyzed.

5.12. Calculations – N/A

5.13 Uncertainty of Measurement – N/A

6.0 Limitations

6.1 It is not be possible to state that a hair originates from a particular person to the exclusion of all others based on a comparative hair examination.

6.2 Hair examinations may be limited where a considerable length of time exists between the deposition of questioned hairs and the collection of known hair samples.

6.3 Gray hairs typically have no color and are lacking many of the characteristics used to determine the racial and somatic origin of hairs. Therefore, they will be identified only as gray hairs with no conclusion as to their racial or somatic origin. In addition, these hairs are not suitable for microscopic comparison.

6.4 This Laboratory does not perform mitochondrial DNA testing; therefore, it will be recommended that samples be outsourced for mitochondrial DNA testing when the results of a hair comparison may establish an association between the victim and suspect.

7.0 Safety

7.1 Items may have blood or other body fluids present. Use protective equipment when dealing with items that may contain biohazard material.

7.2 Care shall be exercised when using solvents such as xylene and xylene substitute. Consult Safety Data Sheets for information on safe use for reagents listed in this procedure.

7.3 Glass pipettes, razor blades, and probes are sharp and can be dangerous.

8.0 References

8.1 ASTM Guidelines

SWGMAT. "Forensic Human Hair Examination Guidelines." *Forensic Science Communications* 7.2 (2005).

8.2 Books

DeForest, P.R., R.E. Gaensslen and H.C. Lee. *Forensic Science: An Introduction to Criminalistics.* New York: McGraw-Hill, 1983.

F.B.I. *Proceedings of the International Symposium on Forensic Hair Comparisons*. Washington, D.C.: The Laboratory Division, 1985.

Gaudette, B.D. *The Forensic Aspects of Hair Examination*. RCMP, Central Forensic Laboratory, 1988.

Hepworth, W.G. *Identification of the Dorsal Guard Hairs of Some Mammals of Wyoming*. Wyoming: Wyoming Game and Fish Department, 1974.

Robertson, J., ed. *Forensic Examination of Hair*. London: Taylon & Francis, 1999.

Saferstein, R., ed. *Forensic Science Handbook.* Volume I. Englewood Cliffs, NJ: Prentice Hall, 1983.

8.3 Journal Articles

Deedrick, D.W. "Hairs, Fibers, Crime, and Evidence." *Forensic Science Communications* 2.3 (2000).

Deedrick, D.W. and S.L. Koch. "Microscopy of Hair Part I: A Practical Guide and Manual for Human Hairs." *Forensic Science Communications* 6.1 (2004).

Deedrick, D.W. and S.L. Koch. "Microscopy of Hair Part II: A Practical Guide and Manual for Animal Hairs." *Forensic Science Communications* 6.3 (2004).

McCrone, W.C. "Characterization of Human Hair by Light Microscopy." *The Microscope* 25.1 (1977): 15-30.

Oien, C.T. "Forensic Hair Comparisons: Background Information for Interpretation." *Forensic Science Communications* 11.2 (2009).

9.0 Records – N/A

10.0 Attachments – N/A

Revision History		
Effective Date	Version Number	Reason
09/17/2012	1	Original ISO Document
02/01/2013	2	• Added 5.7.3.2 • 5.7.6.2.1.1 Added "Example" • 5.7.9.3 Added bland to header • 5.7.9.3.1 added bland, changed list of colors to "little color" • Added 6.3
08/30/2013	3	• 5.1.3.5 added macroscopically different statement. • 5.5.2.2 added retained for DNA statement. • 5.5.2.3 added when necessary • 5.5.4.5.2 added representative sample. • 5.6.3.6 changed distilled to deionized • 5.7.1 deleted reports shall read as listed below. • 5.7.3.1 example was moved to 5.7.3.1.1and nuclear was added

		• 5.7.3.2 added included. Example was moved to 5.7.3.2.1 • 5.7.3.3 moved sentence from 5.7.3.1 and 5.7.3.2 to 5.7.3.3 • 5.7.6.3.1.1 added macroscopic • 5.7.8.11 moved up to 5.7.8.1. Added new description for 5.7.8.1.1. • 5.7.8.1.1.1 changed unanalyzed to without analysis • 5.7.9.2, 5.7.9.3, 5.7.9.4, 5.7.9.5 added qualifying statement regarding • 5.11.4.3 is now 5.11.4.6 • added 5.7.3.1, 5.7.3.2.2, 5.7.3.3, 5.7.8.1.2, 5.7.8.1.2.1, 5.7.8.2, 5.7.8.2.1, 5.7.8.3, 5.7.8.3.1, 5.7.8.3.1.1, 5.7.8.3.2, 5.7.8.3.2.1, 5.7.8.4, 5.7.8.4.1, 5.11.4.3, 5.11.4.4, 5.11.4.5 • removed 5.7.9.1.1, 5.7.9.1.2
10/18/2013	4	Added issuing authority to header
08/29/2014	5	• Updated header to Physical Evidence Section – Trace Unit, issuing authority to Physical Evidence Section Forensic Scientist Manager. • Updated all references in procedure from Trace Evidence Section to Trace Unit • 5.5.2.3.1 moved to 5.11.3.4 • 5.5.4.3.2 moved to 5.7.6.3.1 and reorganized • 5.5.4.3.3 moved to 5.7.6.1.2 and reorganized • In entire document, changed unworked to unanalyzed, changed species determination to animal classification, changed race determination to racial classification • 4.2 – added microcentrifuge tubes • 4.3 – added 10% bleach, removed polaroid film coating • 5.1.1.1 – removed upload into CODIS • 5.1.1.2 – added human • Reworded and expanded 5.1.3.8.1.2, 5.2, 5.5.5.2 • Added 5.1.3.8.2, 5.5.3 • Removed 5.1.3.8.4.2, 5.3.1, 5.5.3.2, 5.5.3.4, 5.5.4.2, 5.5.4.3 • 5.3 – changed to preparation of slides • Moved 5.3.1.1, 5.3.1.1.1, 5.3.1.1.2, 5.3.1.2, 5.3.1.2.1, and 5.3.1.3 up one outline level • 5.3.1.2.1 - Added xylene, etc • 5.5.1.1 – removed other • 5.5.1.2.2.2 – removed polaroid film coat method • 5.5.2.2, 5.5.4.2, 5.5.5.1 – added additional information • 5.5.5.3.2 – removed Section • 5.6.3.4 – removed scalpel with a • 5.6.3.7 – changed 2.2ml spin ease tube to microcentrifuge tube • 5.11.4.5 – changed with to without
03/20/2015	6	• Added 5.1.2.3 • 5.1.2.4 – removed “if necessary” • 5.1.2.5 – Previously 5.1.2.4 which has been reworded and expanded.

		• Added 5.1.2.6, 5.1.3.3 • 5.1.3.4 – removed "if necessary" • Added 5.1.3.5 • 5.1.3.10.1.3 – removed last sentence regarding submission to FBI for further testing • 5.1.3.10.3.1 – changed race to racial classification • 5.1.3.10.4.1 – removed "from all parties involved in the case" • 5.1.3.10.5.1 – changed "attempts to" to "may" • 5.4.1 – removed "using a microscope" • 5.5.1.1 – removed "In most cases,". Added "without prior approval from the Technical Leader, Forensic Scientist Supervisor or the Forensic Scientist Manager" to the last sentence. • 5.5.1.2 added approved. • Removed 5.5.1.2.4 and 5.5.1.2.4.1 • 5.5.2.3 – added "In some cases a hair with root suitable for nuclear DNA analysis may be too small to have the root removed. In those cases the hair will be sent in its entirety for nuclear DNA analysis." • Added 5.5.4.3 • 5.5.5.2 – removed "from the case" • 5.5.5.2.1 – changed "sample" to "standard" • 5.5.5.3.1 – changed "standard samples" to "known standards", changed "results" to "establishes", changed "signed" to "initialed and dated". Added "The verifying Forensic Scientist will also note in FA the contents of all slides verified." • 5.5.5.3.2 – removed "or mitochondrial DNA" • 5.6.2 – removed statement regarding sending samples for mitochondrial DNA testing and stated it may be recommended samples be sent. • 5.6.3 – specified hair root • 5.6.3.3 – added "Remove broken pieces of the cover slip." • 5.6.3.4 – removed "Remove pieces of the cover slip.". Added "and remove from the slide". • Added 5.6.3.8 • Added 5.6.4, 5.6.4.1, 5.6.4.2, 5.6.4.3, 5.6.4.4 and 5.6.4.5 • Added 5.6.5, 5.6.5.1, 5.6.5.2, 5.6.5.3, 5.6.5.4, 5.6.5.5, 5.6.5.6 and 5.6.5.7 • 5.7.2.1.1 – added "only. A hair standard was not provided from _____." • Added 5.7.3.4 and 5.7.3.4.1 • Added 5.7.3.5 and 5.7.3.5.1 • Added 5.7.3.6 and 5.7.3.6.1 • Added 5.7.3.7 and 5.7.3.7.1 • 5.7.6.1.2 – changed "sample" to "standard"

		• 5.7.6.1.2.1 – added "Microscopically consistent with means characteristics exhibited by the unknown hair fit within the range of characteristics present in the known standard." • Added 5.7.6.2.3 and 5.7.6.2.3.1 • Added 5.7.8.3.3 and 5.7.8.3.3.1 • Added 5.7.8.5, 5.7.8.5.1 and 5.7.8.5.2 • 5.7.9.2.2 became 5.7.9.2.1.1 • 5.7.9.3.1 – added "(excluding gray hairs)" • 5.7.9.6 – added header • 5.7.9.6 became 5.7.9.6.1 • Added 5.7.9.7, 5.7.9.7.1 and 5.7.9.7.2 • Added 6.4
12/11/2015	7	• 5.1.1.1 – added "nuclear" before DNA • 5.1.3.11 – added See 5.7 • 5.2.1.1 – added "from all around the region of interest" • 5.2.1.2 – reworded • 5.2.2.1 – added "or" • Added 5.2.2.4 • 5.3.1 – removed "Permanent Mounts" and moved 5.3.1.1 up one outline level • 5.3.1.2 – added to 5.3.1.1 • 5.3.2 – renamed to "Mounting Media" • 5.3.2.1 – changed "more secure storage" to "the original packaging" • 5.3.3 – became 5.3.2.2 • 5.4.2.1 – changed structure to form • 5.4.2.2.1 – changed scales to cuticle • 5.5.2.2 – added "nuclear" before DNA • 5.5.5.3 and 5.5.5.3.1 – reworded • 5.5.5.3.2 – changed sent to recommended • 5.6.1 – reworded • 5.6.4.3 – removed the word "again" • 5.7.3.3.1 – added "nuclear" before DNA • 5.7.6.2.1.1, 5.7.6.2.3.1 and 5.7.6.3.1.1 – added clarifying statements • 5.7.6.2.2 – added "Questioned" • 5.7.6.3.1 – reworded • 5.7.6.3.2.1 – changed "exhibits" to "exhibited" • Added 5.7.8.6, 5.7.8.6.1, 5.7.8.6.2, 5.7.8.7, 5.7.8.7.1, 5.7.8.8 and 5.7.8.8.1 • 5.7.9.3 – Reworded to include gray and bleached hairs • 5.7.9.3.1 – changed color to pigment • Added 5.7.9.3.2 and 5.7.9.3.3 • 5.7.9.3.4 – Was originally 5.7.9.3.2. Changed "the" to "these", "comparison" to "comparisons"

		• 5.7.9.7.1 and 5.7.9.7.2 – removed "may establish an association between victim and suspect" and changed to "may establish an association (ex. victim to suspect; victim to scene)" • 5.7.9.7.2 – removed "a hair in its entirety" • Added 5.7.9.7.3 • 5.11.4.2 – reworded • 5.11.4.3 and 5.11.4.4 – added "nuclear" before DNA • 5.11.4.5 – removed "as well" • Added 5.11.4.7 and 5.11.4.8
01/07/2019	8	• 4.2 – added well plates, fingerprint lifting tape, pasteur pipettes, and probes • 4.3 – added Permount • 5.3.2 – added "application of" • 5.5.5.3 – changed ex. to e.g. • 5.6.1 – added "probative association" • Added 5.6.3 • Moved 5.6.3, 5.6.3.1, 6.6.3.2, 5.6.3.3, 5.6.3.4, 5.6.3.5, 5.6.3.6, 5.6.3.7, 5.6.3.8, 5.6.4, 5.6.4.1, 5.6.4.2, 5.6.4.3, 5.6.4.4, 5.6.4.5, 5.6.5, 5.6.5.1, 5.6.5.2, 5.6.5.3, 5.6.5.4, 5.6.5.5, 5.6.5.6, and 5.6.5.7 down one outline level • 5.6.4, 5.6.4.1, 5.6.4.2, 5.6.4.3, 5.6.4.4, and 5.6.4.5 – previously 5.6.5, 5.6.5.1, 5.6.5.2, 5.6.5.3, 5.6.5.4, 5.6.5.5, 5.6.5.6, and 5.6.5.7 • 5.6.5, 5.6.5.1, 5.6.5.2, 5.6.5.3, 5.6.5.4, 5.6.5.5, 5.6.5.6, and 5.6.5.7 – previously 5.6.4, 5.6.4.1, 5.6.4.2, 5.6.4.3, 5.6.4.4, and 5.6.4.5 • Added 5.7.1 and 5.7.1.1 • 5.7.7.2.1.1 – Reworded similarities with differences definition • 5.7.7.3.1.1 – Reworded not consistent with definition • 5.7.10.6.1.1 – Separated from 5.7.10.6.1 and added an additional comparison statement • 5.7.10.7.1 – changed ex. to e.g. • 5.7.10.7.2 – changed ex. to e.g. • 5.7.10.7.3 – spelled out NCSCL • 7.2 – added SDS statement • Added 7.3 • 8.1 – removed "SWG" • Throughout document removed "nuclear" from any reference to "nuclear DNA analysis"