DOT&PF NOA Sampling and Classification Protocols

1. Intent

A. Identify acceptable naturally occurring asbestos (NOA) sampling protocols and classification methods for owners, contractors, and others seeking immunity under AS 44.42.400 – AS 44.42.430. These sampling protocols are to be utilized for sampling materials that are not applicable to those identified in the California Air Resources Board Method 435 (CARB 435 dated June 6, 1991). The sampling methods and testing results are to be used in preparing Sampling and Analysis Plans, Asbestos Compliance Plans, Dust Control Plan, and Maintenance and Operations Plan for submission to the Alaska Department of Transportation and Public Facilities (ADOT&PF).

B. Construct efficient infrastructure that improves safety and health for the public using safe and effective construction methods in areas where NOA may be present to minimize exposure to NOA. Early identification of potential occurrences of NOA in construction embankments, excavations, and material and quarries allows public and private entities to take a proactive approach to avoid and/or minimize worker and public NOA exposure, and to construct efficient transportation utility, and building infrastructure. The sampling and classification protocols identified herein outline the procedures necessary to determine the applicability of NOA handling protocols in the planning, design, construction, and maintenance of aggregate materials for Alaska's infrastructure.

2. Problem Statement

The location and concentration of naturally occurring asbestos is determined by geologic processes. The presence of NOA varies widely within geologic formations. The United States Geological Survey (USGS) defines asbestos within a geologic formation as "… bundles of fibers that can be easily separated from the host matrix or cleaved into thinner fibers…"Primarily a classification for identifying ore, this definition does not represent all NOA formations in Alaska.

Aggregate materials are typically a large component of every infrastructure project and developing these material sources is labor intensive and expensive. A dependable and repeatable sampling and classification method is important to assess aggregate materials in NOA-prone areas that a reasonable and repeatable sampling and classification method be established. Because of Alaska's vast area, wide ranging geologic formations, lack of detailed geological mapping, and largely undeveloped infrastructure network and material site inventory, sampling protocols and broad material site classification for undeveloped material sources is necessary to construct needed infrastructure. The challenge is to quantitatively represent narrow veins or confined geologic strata of potentially high NOA concentration to the much larger quantity of lower NOA concentration source material that will be used in large quantities for road, airport, utility, or building foundation materials.

3. General

The analysis and sampling methods identified herein are to be used during reconnaissance and preliminary design phases to assess the NOA potential within prospective construction material sources and construction areas, and to determine — by quantitative methods— initial suitability for use as final gravel surfacing or sub-base material. These protocols, recommendations, sampling methods, and geological investigations are used as an assessment of NOA content and are considered supplemental to those specified for geotechnical characterization by Department personnel in the AKDOT&PF *Geotechnical Procedures Manual (GPM)* (2007). Use the GPM for reference on Department processes, procedures, formats, and expectations for geotechnical investigations.

In addition, these sampling protocols complement, but do not replace, the sampling required under CARB 435 for processed material (i.e., material stockpiles, conveyer belts, and/or existing ground surfaces previously covered with processed material). CARB 435 sampling of developed sources must be addressed in the applicant's Site Specific Plan(s). Classification of material sites identified herein does not relieve owner from further testing/sampling of developed construction material as conditions warrant, or as identified in the owner's site specific plans.

Where there are conflicts between documents, the following precedence is established:

1. Alaska DOT&PF Naturally Occurring Asbestos Sampling and Classification Protocols;
2. CARB 435 Method (June 6, 1991);
3. Alaska DOT&PF Geotechnical Procedures Manual.

If questions arise regarding this order of precedence, address questions to:

Chief Engineer, Division of Design and Engineering Services
Alaska Department of Transportation and Public Facilities
P.O. Box 11500, Juneau, Alaska 99811

4. Personnel

In order for the Department of Transportation and Public Facilities (ADOT&PF) to review and approve plans using NOA under the auspices of Alaska Statute and Alaska Administrative Code, all geologic investigations, sampling, reporting, and characterizations of undeveloped geologic formations must be completed by a Certified Professional Geologist (CPG). [1] A geologist selects test sampling locations in accordance with guidance provided herein. The judgment of the geologist must be applied toward obtaining samples which must be most representative of the pit area.

5. Bulk Testing Method for Asbestos Content

The CARB 435 Method (dated June 6, 1991) with the lowest detection limit of 0.25 percent using the "400 non-empty point" calculation is the test method used to determine the percentage of NOA

[1] For reference, http://commerce.alaska.gov/dnn/cbpl/professionallicensing/professionalgeologists.aspx

contained within gravel or other aggregate material. Analysis is performed by laboratories certified by the National Institute of Standards and Technology's National Voluntary Laboratory Accreditation Program (NIST/NVLAP). The analytical results are reported in percent asbestos fibers which is the percent number of asbestos fibers contained in 400 randomly chosen particles of a bulk sample. Report the percentages of each asbestiform and combine percentages to determine total asbestos concentrations. The sampling methods identified within the CARB 435 Method are supplemented herein.

6. Sampling Protocols and Material Site Classification for Undeveloped Material Sources or Non-processed Material

These sampling methods and material site classifications are to be used where the sampling methods identified in Section 5 of CARB 435 Method or ASTM D7521-13 do not apply. For purposes of providing guidance on reconnaissance sampling methods for different material conditions, the following project conditions are anticipated, and recommendations provided. However, it is the responsibility of the owner and the investigator to determine which sampling method will best represent the homogeneity and constructed use of the material for the project.

- Quarries (developed or undeveloped) and rock sources: Sampling Methods identified herein.
- Unprocessed material from proposed material sites consisting primarily of silt, sand, gravel, and other granular material other than rock or muck: Sampling Methods identified herein.
- Processed Material to be used for Construction: Section 5 of CARB 435 Method.
- Existing Developed Surfaces (Road or Airport Surfaces): Section 5 of CARB 435 Method.

7. Preliminary Investigations

Prior to field investigations, the 'project owner'[2] shall conduct all reasonable investigations of the project area including but not limited to: known material source locations; identification of past or present 'designated areas' nearby to site; geologic mapping, reports, and investigations. See the *GPM* for more information. The project owner will determine whether NOA is likely to be encountered and whether the project owner will seek immunity provided under Alaska Statute[3].

The project owner should determine the land status and land ownership of proposed material use areas and seeks appropriate permissions for further field investigations. Landowners should know that sampling and testing results are part of the public record and may be used by the Department for purposes of site characterization for NOA presence.

8. Sampling Methods for Quarries

This sampling method is used on sites either previously or presently developed with large exposures and where it is possible to visually identify NOA formations. Perform a preliminary geological survey of the proposed quarry or excavation area. If NOA is evident, complete targeted sampling. If possible, roughly

[2] As defined in the Alaska Administrative Code.
[3] For specific Alaska Statute references, http://www.dot.state.ak.us/stwddes/desmaterials/noa.shtml

categorize rock types or strata into relative NOA potential concentrations areas - low, medium, or high – based on visual inspection, existing materials data, previous geologic characterization (e.g., geologic mapping), and surface sampling. If concentration areas can be determined, proceed with Sampling Concentration areas protocols below. If concentration areas cannot be determined, proceed with Random Sampling Methods identified below.

Low concentration would be characterized by the following:

- Trace amounts of NOA favorable lithology (listed under High)
- Minor to moderate amount of NOA low favorable lithology (basalt, gabbro, marble)
- Unmetamorphosed felsic and intermediate plutonic rocks
- Unmetamorphosed felsic and intermediate volcanic rocks
- Unmetamorphosed sedimentary rocks
- Metamorphic pelitic rocks, such as shist, shale, paragneiss
- Limestone

Medium concentration would be characterized by the following:

- Moderate to major NOA favorable lithologies
- Marble, possibly including meta-dolomite
- Moderate to major Unmetamorphosed basalt
- Moderate to major unmetamorphosed gabbro
- Alkali-rich intrusive rocks, not described as metasomatized
- Unmetamorphosed dolomite

High concentration would be characterized by the following:

- Serpentinite
- Ultra-mafic rocks including:
    - Peridotie
    - Dunite
    - Pyroxenite
    - Harzburgite
    - Wehrlite
    - Lherzolite
    - Websterite
- Metamorphosed/metasomatized mafic volcanic rocks, such as:
    - Greenstone
    - Actinolitic (secondary amphibole-bearing) basalt
    - Altered basalt
    - Serpentinized ophiolotic rocks
- Metamorphosed/metasomatized mafic plutonic rocks, such as:
    - Meta-gabbro
    - Altered gabbro

    - Amphibolite
- Metamorphosed dolostones, due to regional or contact metamorphism, including:
    - Mg-rich marble
    - Skarns in dolostone
- Metasomatized alkaline intrusive and extrusive igneous rocks, such as:
    - Alkali-basalt, Trachyte, Hawaiite, Mugearite, Benmoreite, Phonolite
    - Syenite, peralkaline granite, nephelinite, ijolite
    - Carbonatite
- Highly sheared metasomatized igneous rocks, especially in regions of extensional deformation
- Metamorphosed iron formations

If these representative areas cannot be identified through preliminary reconnaissance techniques use the random location sampling process identified below. Reconnaissance investigations should not identify individual veins unless they are predominant features [>1 cm in width] of the surrounding material.

Targeted Sample(s)

Targeted samples verify and characterize the type of NOA present, if NOA can be readily identified. Targeted sampling is not to be used for quantifying or classifying NOA within a material site.

- Within the proposed quarry operations, collect three 'targeted' samples of suspected high concentration asbestos material of sufficient quantity for laboratory testing. Transmission Electron Microscopy {TEM} is recommended to identify the type, form, and size of NOA.
- Collect at least three adjacent host rock samples sufficient for laboratory testing or geologic characterization.

Within each representative area – low, medium, and high – complete the following sampling protocol. If changes to the representative sampling method are done, identify the changes and reasons for the change.

Sampling Concentration Areas

- For the low and high concentration areas, take one representative sample (three 3'x3' windows separated by 10 linear feet) on the proposed excavation face or quarry in an east-west or north-south line, whichever is more feasible or representative of the quarry materials.

- For the medium concentration area, identify on the face or quarry floor two representative samples (six 3'x3' windows areas separated by ten linear feet) in an east-

west or north-south line, whichever is more feasible. Areas must not overlap targeted area. [4]

- If along quarry face, the sample areas shall be linear and oriented at 30°. Mark with paint or suitable identification.
- Use visual observation assisted by manual fracturing, if necessary, to obtain a clean face.
- Accurately measure the width and length of suspected asbestos infills/veins or concentrations.
- Identify NOA areas (veins, infills, etc) with a marker.
- Characterize the hardness of suspected NOA source rock. Document and photograph each nine square foot area.

A. Surface Random Sampling Method for Large Pits. If preliminary geological reconnaissance cannot determine low, medium, or high concentrations of NOA in large quarries (proposed extraction for a project equaling or exceeding 10,000 cy), use the following sampling protocols.

- Identify the probable center face of proposed quarry operations for the proposed quantity for the project. Mark this point.
- Within 200 feet in any direction of the center point, identify and complete targeted sampling (target and adjacent), if targeted sampling is possible.
- Collect one representative sample (three 3' x 3' windows separated by 10 linear feet) at the following locations, relative to the quarry center:
  a. 1/3 distance left towards left edge of proposed excavation limit for this project;
  b. 3/4 distance left towards left edge of proposed excavation limit;
  c. 1/4 distance right towards right edge of proposed excavation limit;
  d. 2/3 distance right toward right edge of proposed excavation limit;
  e. If additional representative samples are desired, take them at 30 foot offsets from points above.

B. Determining NOA Percentage with Surface Sampling

The following determinations are considered a minimum for the preliminary quantification of NOA material sites for purposes identified in AS 44.42.420(b)(1) and the 17 AAC 97.020.

C. Identify the surface area of potential NOA material on all representative samples (exclude targeted and host rock samples). Assume the surface area is representative of the volume within the representative windows, unless the sampling surface is asbestos vein. Assume all material (NOA and host) has equal specific gravity (i.e., 2.5). Calculate the percentage of asbestos by mass of each window area. Determining NOA Percentage with Subsurface Sampling

[4] If the initial geologic assessment of concentration areas concludes that the medium NOA concentration areas may represent smaller areas than the high and low concentration areas, then the CPG may reduce representative samples in the medium concentration area from two to one, and increase the number of 'windows' from three to four in each representative area – low, medium, and high.

Identify and complete drill or excavation spacing relative to the size of the anticipated excavation. Drill or excavate at least 12 samples using an exploratory drilling method that provides the best recovery method of in-situ material, or utilizing pit exploration. Identify representative samples within each drill core or excavation pit for laboratory sampling (CARB 435) and send to laboratory. Determine Preliminary NOA Percentage based on laboratory results.

D. Sampling for Cut Areas in Areas with Medium or High NOA Potential

This is the minimum sampling protocol required along infrastructure corridors for long linear projects where material cuts are proposed, and a non-NOA surfacing material has been identified. In areas with medium or high potential for NOA presence, at least one sample (either through drilling or surface exploration) is taken from each proposed cut area exceeding 500 cubic yards. In addition, the geologist must traverse all proposed cut areas exceeding 500 cubic yards and investigate for NOA bearing materials. If targeted sampling identifies NOA > 5%, project owner should avoid cut area. If avoidance is not practicable, follow protocol for establishing at least one representative sample (three 3' x 3' windows, separated by 10 linear feet) Sampling Methods for Material Sites.

E. Sampling for New Construction in Existing Infrastructure Areas

To identify best construction practices for excavating potentially NOA material in previously disturbed infrastructure areas, the following sampling and testing is required.

- One sample (suitable in size for laboratory testing) for each 500 cubic yards of newly disturbed area;
- Other sample tests as requested by owner;

9. Determining Preliminary Asbestos Concentration

If representative sampling in concentration areas was possible, determine the Preliminary Asbestos Concentration (PAC) within each concentration area (low, medium, high) by increasing the NOA concentration (observed or tested) by one-third, and average the samples for the PAC. For NOA determination in concentrated areas , use the Truncated Mean methods only if more than three representative samples were taken from each concentration area.

For random sampling methods, determine the PAC within the proposed material site by increasing the NOA concentration (observed or tested) by one third, and average the samples to determine the PAC. Next, calculate a Truncated Mean (TM) of the samples (assuming at least 12 'windows' were sampled), by discarding the highest and lowest NOA values of each window, and averaging the remaining NOA concentrations. For example, for each twelve representative sample lot, discard the highest and lowest concentration sample or larger number if more samples are available. Average the remaining samples. Identify whether the PAC is within +or- 15% of the (TM). If it is, TM is PAC. If not, PAC is PAC. Use the following:

PAC = ($\sum$ (estimated mass NOA content of N samples) x 1.33)/N

TM = ($\sum$ (estimated NOA content of truncated {N-2) samples)/N-2))

IF PAC = TM ± 15%, then TM = PAC

IF PAC ≠ TM ± 15%, then PAC = PAC

Do not include targeted or host rock samples in the PAC or TM calculations.

10. Material Site Classification

If PAC is less than 0.1, and no individual sample is > 5% NOA (other than targeted samples), no further testing is required unless new observations warrant resampling and retesting. The material site is considered a non-NOA material source unless further testing changes this classification.

If PAC is between 0.1 and 0.25, or if any individual sample is > 5% NOA, then the material site is considered higher risk for NOA classification. Contingencies for NOA construction sampling, safety equipment protocols, and alternate material sites for surfacing material are highly recommended.

If PAC is greater than 0.25, the material site is considered NOA. Site cannot be used for gravel surfacing material unless further focused sampling using CARB 435 identifies definable non-NOA areas for targeted extraction.

11. Determining Preliminary Asbestos Concentration in Existing Infrastructure Areas

PAC = ($\sum$ (NOA percentage of N samples tested using CARB 435 method))/N

12. Testing

Samples collected using this sampling protocol will be tested using the CARB 435 test method.

13. Safety

Exposure to airborne asbestos fibers is a health hazard. Samples submitted for analysis may be friable and may release fibers during handling. Follow adequate safety precautions to minimize the inhalation of asbestos fibers. Handling of samples without precautions may result in exposure of the analyst and contamination of samples by airborne fibers.