The rapidly advancing field of nanotechnology offers potential benefits to almost all industries and products. According to the Woodrow Wilson International Center for Scholars' Project on Emerging Nanotechnology's *Nanotechnology Consumer Product Inventory*, nanomaterials are currently being used in over 500 consumer products. However, the environmental and human health risks associated with these materials are largely unknown. Before the environmental and general population risk of these materials can be measured or monitored, methods will be needed to collect, separate, detect, identify, and quantify the occurrence of nanomaterials in the environment over time. The rate of product development has outpaced the rate of methods development, and, unfortunately, the methods needed to monitor the environmental occurrence of nanomaterials are very limited or nonexistent. Only limited research has been conducted, in part due to the immense challenges of sampling nanomaterials in the environment (e.g., distinguishing between naturally-occurring nanoparticles and engineered nanoparticles). While EPA's Office of Research and Development (ORD) may eventually sponsor research to develop remote, in situ, and continuous monitoring devices to detect engineered nanomaterials at very low concentrations, the purpose of this initial effort is to identify and assess currently-available sampling and analysis methods. This state-of-the-science review focuses on soil, sediment, and groundwater environmental sampling. A companion research effort is focusing on air sampling and analytical techniques.

Due to the limited data available and the rapid advancements that are being made, a traditional literature search (i.e., using an abstract database to search peer-reviewed journals) is not expected to effectively capture the cutting-edge information on environmental sampling and analysis methods for nanomaterials, particularly those under development and those that have not been fully peer-reviewed. Because this research is current and ongoing, much of the applicable information is found in gray literature (e.g., conference proceeding, communications with research scientists and other experts). Additionally, many of the techniques for environmental sampling and analysis of nanomaterials may need to be adapted from trace sampling methods and methods used in quality assurance or characterization of manufactured nanomaterials; therefore, peripheral literature has also been identified and reviewed.

The approach to this review included three separate strategies:

1) Collection of available published literature using Dialog®;

2) Review of information from targeted sources, such as nano-specific journals, conference proceedings, grants databases, and research databases; and

3) Contacts with industry and academic experts.

This review summarizes the key characteristics that must be considered when collecting and analyzing samples in various environmental media. Based on results of the literature review, and personal communication with researchers, typical analytical methods and techniques that are currently used for nanomaterials are identified and briefly discussed.

The review also identifies several sources that provided information on analytical techniques and equipment for nanomaterials. However, little information was obtained for

sampling techniques that are specific for analysis of nanomaterials. Information obtained indicated that nanomaterial-specific sampling techniques have not yet been developed. Another area for which the search results provided little information is for differentiating anthropogenic (man-made) nanomaterials from natural nanomaterials. A number of potential sources that may provide additional information upon a more in-depth review were identified. As this review provides a current state-of-the-science review of active research topics at the time of writing, this review may require modifications as additional research is conducted.