Permafrost and frozen-soil investigation and reporting methods for waste-containment facilities

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Industrial and community facilities in Arctic climates often include storage and distribution of petroleum fuels, solid-waste landfills, and other waste-containment structures. These facilities commonly include berms, catchment basins, and ditches requiring lining with synthetic fabrics, grouts, or treated-soil liners. Incorporation of permafrost and frozen soils benefits many facility-design goals, depending on the nature of environmental site conditions. Evaluation of site conditions and reporting of environmental conditions is critical for proper design and evaluation of integrating permafrost and frozen soils into these facilities, and associated operations and management. Climatic conditions, geologic and hydrogeologic characteristics, thermal properties and potential temporal changes, and adequate permafrost descriptions are important elements for these applications. Frozen coarse-grain deposits, or fractured bedrock, with low ice contents will not provide a barrier for waste containment. However, ice-rich fine sands can provide better barriers than synthetic liner materials. A fuel-storage facility in Bethel, Alaska is presently undergoing secondary containment design and construction. This facility presents a good test case for a site with appropriate conditions for using permafrost and frozen soils in the containment design. Infiltration rates were measured in frozen, ice-saturated, silty sand. The average infiltration rate was 4.3×10^{-8} cm s^{-1}. Tests used a Diesel #2/Jet A-50 fuel mixture (heating fuel) consisting of predominantly Jet A-50. Laboratory results indicate hydraulic conductivities decrease as ice saturation increases. Environmental site conditions in Bethel result in active layer and permafrost sandy soils meeting Alaska standards for liners in petroleum facilities. Other facilities have conditions where permafrost or frozen soils do not have appropriate conditions for environmental barriers.