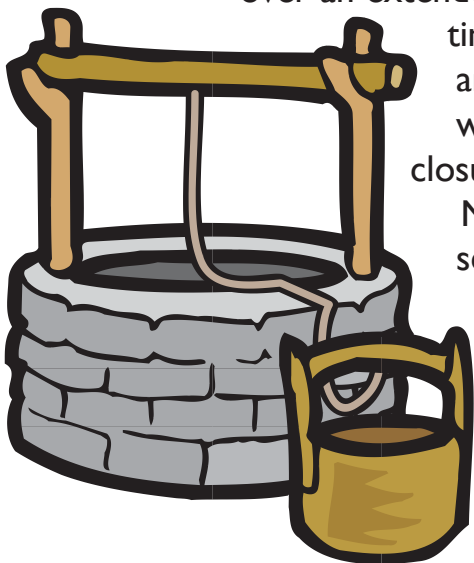


LAND

Monitored Natural Attenuation of Groundwater

Natural attenuation is the sum of natural processes that leads to the lessening of contaminant concentrations in groundwater over time. The DEQ will have a preference for processes that degrade or destroy contaminants. Monitoring and documenting these natural processes over time is referred to as Monitored Natural Attenuation (MNA).

The primary objective of Monitored Natural Attenuation is to **demonstrate** that natural processes will reduce contaminant concentrations in groundwater to levels below regulatory standards before a point of compliance is reached. The point of compliance can be a property boundary, a well, a stream or some other potential receptor. MNA as a remedial alternative is highly dependent on a good understanding of localized hydrogeologic conditions and may require considerable information and monitoring over an extended period of



time. MNA is **not** an approach that will lead to rapid closure of a site. MNA is seldom selected as a sole remedy. The DEQ expects source identification and removal. This includes free



product removal. Full delineation of the contaminant plume including sentinel wells below MCL is needed. It must be demonstrated that natural attenuation is occurring before MNA can be considered as a portion of the remedy at a site. **A steady or decreasing plume front must be established.** Institutional controls established and maintained by the responsible party will be required with any MNA remedy including, but not limited to, notices to property deeds, until attenuation to appropriate levels has been confirmed.

An initial period of monitoring of an approved monitoring well network is needed to establish the effectiveness of MNA as a remedial option. The monitoring well network should include contaminated wells and appropriate sentinel wells. An approved moni-

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toring well network should be sampled on a quarterly basis for at least two years to establish baseline trends. If MNA is subsequently approved, sampling of the monitor well network may eventually be decreased in frequency, however long term monitoring should remain at least semiannual.

Uncertainty associated with estimated rates of attenuation over protracted periods of time is a major consideration with MNA. Hydrologic and geochemical conditions amenable to natural attenuation can change due to natural or anthropogenic causes and the mobility of a plume can change over time. Natural attenuation of contaminants in groundwater must be monitored over significant periods of time to evaluate the continued performance of natural attenuation. MNA should not be considered a presumptive remedy, but should be evaluated along with active remediation options to restore groundwater to its designated beneficial use considering cost, technical practicability, meeting remedial objectives, and protection of human health and the environment.

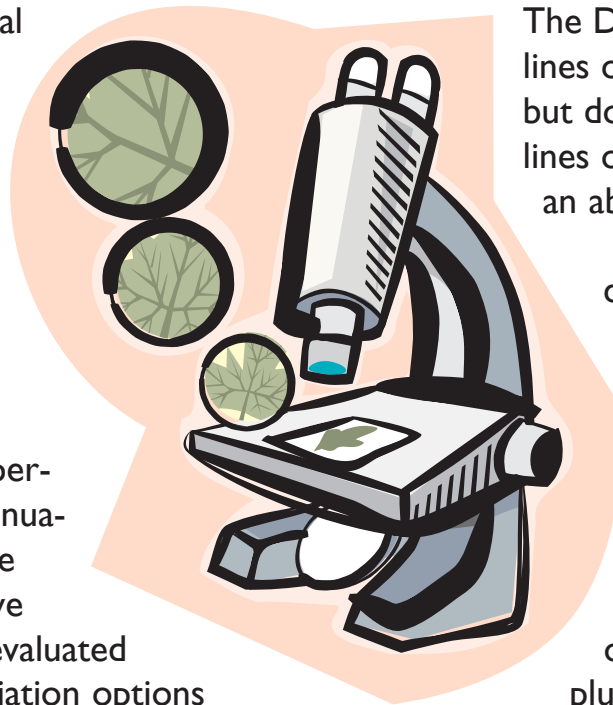
There are numerous types of natural attenuation, including biological and physical forms. Certain types of biological degradation require aerobic conditions and others require anaerobic conditions. Determining the type of natural attenuation or the lack of it is very important at a site. It is important to know what specific mechanism is responsible for the reduction of mobility, toxicity, or bioavailability of contaminants so the long

term effectiveness of the mechanism can be evaluated. Parameters evaluated to determine natural attenuation would necessarily be site specific, but common indicator parameters include the presence or absence of degradation daughter products, pH, Oxidation Reduction Potential (ORP), evaluation of local concentrations of iron, oxygen, sulfate and nitrates in groundwater, etc.

There are three general lines of evidence to support the conclusion that natural attenuation is taking place at a site. The DEQ prefers that all three lines of evidence be documented, but documentation of the first two lines of evidence will be considered an absolute minimum.

1. Observed reduction of contaminant concentrations along the flow path. This requires plume delineation and sentinel wells at the plume front that have contaminant concentrations below the regulatory standard. It should be demonstrated, over time, that a plume front is receding—or at least stable.

2. Documented loss of contaminant mass at the field scale. Monitoring data should demonstrate chemical and geochemical indications of a decrease in the parent compound with an associated increase in daughter compound concentrations. This should include demonstrated changes in appropriate electron acceptors and/or donor concentrations. **NOTE:** The toxicity and mobility of transformation products may be greater than the original contaminant and should be evaluated to determine if implementation of a MNA remedy is appropriate and protective in the long term.



3. Laboratory or field data that supports the occurrence of degradation and gives rates of degradation.

Any approved MNA program should include a contingency plan with a list of triggering events (e.g., exceeding a regulatory level in a

sentinel well, significant changes in one or more specified marker parameters etc.) and established responses to those triggering events. If contaminants leave the site or have left the site, active remediation should be initiated and adjacent property owners notified.

Suggested reading:

EPA OSWER Directive 9200.4-17P Use of Monitored Natural Attenuation at Superfund, RCRA Corrective Action, and Underground Storage Tank Sites, dated April 21, 1999.

Monitored Natural Attenuation of Petroleum Hydrocarbons, U.S. EPA Remedial Technology Fact Sheet dated May 1999.

Monitored Natural Attenuation of Chlorinated Solvents, U.S. EPA Remedial Technology Fact Sheet dated May 1999.

Handbook of Groundwater Protection and Cleanup Policies for RCRA Corrective Action, Section II, Monitored Natural Attenuation, U.S. EPA, September 2001.

Technical Protocol for Evaluating Natural Attenuation of Chlorinated Solvents in Ground Water, EPA/600/R-98/128, September 1998.

MONITORED NATURAL ATTENUATION CHECK LIST

- _____ DEQ approval of Site Characterization including contaminant plume delineation.
- _____ DEQ approval of Site Conceptual Model
- _____ Identify type(s) of Natural Attenuation processes and parameters to evaluate
- _____ Demonstrate that Natural Attenuation is taking place with an approved monitoring well system
- _____ Develop Contingency Plans and triggering events
- _____ DEQ approval for MNA
- _____ Evaluate performance over time (Monitor the Natural Attenuation)

