Kelly Air Force Base

Installation Restoration Program

Monitored Natural Attenuation Fact Sheet

January 1999

A fact sheet providing information about one strategy for treating contaminated groundwater

The purpose of this fact sheet is to describe a treatment technology, Monitored Natural Attenuation, considered acceptable by the Environmental Protection Agency (EPA) along with other engineered solutions.

Description of the Technology

Monitored Natural Attenuation (MNA) is a strategy which allows natural processes to reduce contaminant concentrations to acceptable levels. **Natural Attenuation (NA)** involves physical, chemical and biological processes which reduce the mass, toxicity and mobility of subsurface contamination. These processes may naturally occur, and in many cases, they may reduce risk to human health by reducing the contamination to acceptable levels.

There are several processes that comprise natural attenuation. These include:

- ***biodegradation*** - breakdown of contaminants by microorganisms in the environment, some times forming non-harmful by-products like carbon dioxide and water
- ***chemical stabilization*** - reduction in contam inant mobility caused by chemical processes
- ***dispersion*** - the process of mixing that occurs when liquid flows through a porous medium
- ***volatilization*** - transfer of chemical from liquid to vapor; evaporation
- ***sorption*** - attachment of compounds to geologic materials by physical or chemical attraction

Natural attenuation, by definition, occurs naturally. However, EPA has stated that use of natural attenuation as a specific treatment method is not a "do nothing" approach. It involves sampling, active monitoring, modeling and evaluating contaminant reduction rates to determine whether it is a feasible method for plume treatment.

When natural attenuation is used as a cleanup strategy, sampling must be conducted throughout the project to confirm that the processes are occurring at expected rates. The responsibility falls on those required to clean up the site to verify natural processes are reducing contaminant levels as predicted. Sampling and analysis provides the data necessary to determine whether natural attenuation is actually reducing the mass, toxicity and mobility of the contaminant. If not, the data can be used to take other appropriate action.

Components of Monitored Natural Attenuation

Monitored Natural Attenuation is still considered a "cutting edge" remediation process; therefore, the criteria for establishing **MNA** as a means of cleanup at a specific site are extremely stringent. There are three criteria by which **MNA** is judged.

- Source Control
- Performance Monitoring
- Contingency Planning

Remediators must prove that the requirements associated with these three criteria will be met before regulatory agencies will approve its use.

The first component of **MNA** is the establishment of source control measures. These measures ensure that contaminants at a site will not continue to migrate and the source of contamination will not hinder the process of natural attenuation. Source control measures include the removal, treatment or containment of contaminants at the evaluated site. With this process, the source of contamination will be blocked or

eliminated, preventing further pollution.

A second component of the Monitored Natural Attenuation remedy is performance monitoring. Performance monitoring is the process by which natural attenuation becomes Monitored Natural Attenuation. This process may be the most important step in evaluating the use of **MNA** at a particular site. Without performance monitoring, natural attenuation may occur, but there would be no record of its effectiveness or means of predicting future success, which is why performance monitoring is vital to the **NA** process. Performance monitoring must continue as long as contamination remains above regulatory requirements.

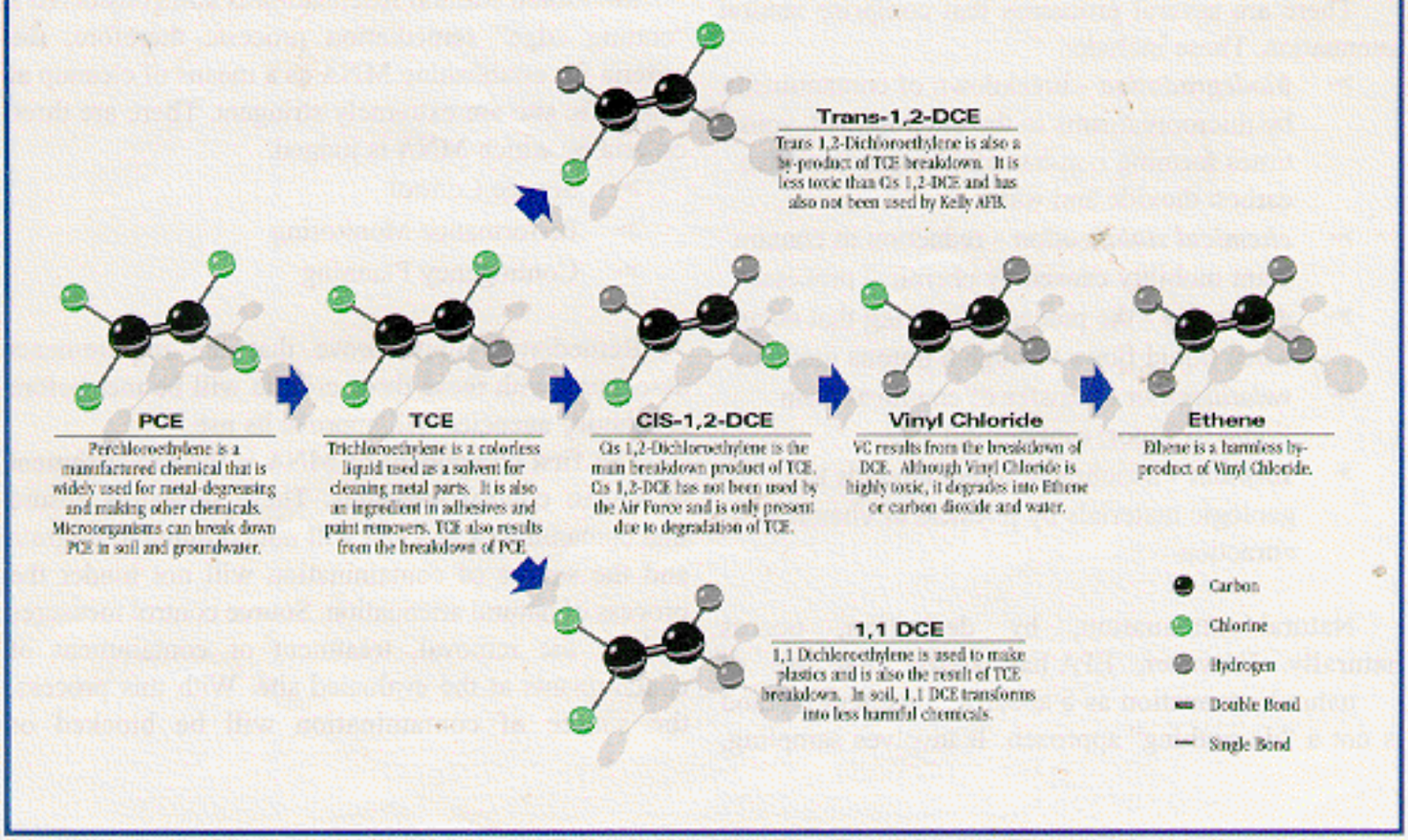
The monitoring program must be designed to:

- Demonstrate that natural attenuation is occurring
- Identify any potentially toxic transformation products resulting from biodegradation
- Ensure no adverse impact to receptors (both environmental and human)
- Detect new releases of contaminants that could impact the effectiveness of the **MNA** process
- Demonstrate the effectiveness of established institutional controls
- Detect changes in environmental conditions either on land, in the water or in the animal community that may also reduce the effectiveness of the **MNA** process
- Verify achievement of cleanup objectives

The third component of Monitored Natural Attenuation is the development of a contingency plan. A contingency plan is a "backup plan" to Monitored Natural Attenuation in the event that **MNA** does not meet the expectations of the cleanup plan. The contingency plan must also contain criteria by which **MNA** will be judged inefficient or ineffective. These criteria could include any of the following:

- Increases in contaminant concentrations in the soil or groundwater at specified locations
- Increases in contaminant concentrations in near source wells which may indicate a new or renewed release of contaminants
- Contaminants are identified in wells located outside the original contaminant plume

Breakdown of PCE



- Contaminant concentrations are not decreasing at a sufficient rate to meet remediation objectives
- Changes in land or groundwater use will adversely affect the use of Monitored Natural Attenuation as a cleanup remedy

Monitored Natural Attenuation works with nature to ensure that contamination is effectively cleaned up. Use of **MNA** is subject to extreme scrutiny by environmental regulators and is only identified as a component of a remediation project if it can be proven to be the best remediation alternative after evaluating all other options.

Scientific Support for Use of Monitored Natural Attenuation

Before the components of Monitored Natural Attenuation can be measured, three lines of evidence must be evaluated to determine if **MNA** is worth submitting as a possible remediation process.

The first line of evidence is historical background. Historical data demonstrates that there is a decrease in the size and concentration of the contaminant plume. This decrease must be depicted in the data as a trend; thereby, ruling out one-time coincidences. This trend must be shown over time at appropriate monitoring and sampling points.

The second line of evidence relates to geochemical (rock) and hydrogeologic (groundwater) data. Geochemical and hydrogeological information will show if conditions are favorable for **NA** processes to occur. This second line of evidence relies on chemical and physical data to show how the contaminant mass is being destroyed.

The third line of evidence comes from biological studies. This line of evidence demonstrates that the environment is suitable to degrade the contaminants. The data gathered in this line of evidence usually occurs from microcosm studies. Microcosm studies are carried out in a laboratory experiment designed to mimic site conditions.

The Environmental Protection Agency suggests that at a minimum, the investigator should obtain either the first and second lines of evidence or the first and third lines of evidence. Historical data alone does not prove the contaminants are being destroyed; however, chemical, physical and biological data can show the contaminants are not decreasing just by dilution but are being degraded. Together, these lines of evidence demonstrate whether **NA** is a viable remediation technology.

Advantages and Disadvantages

There are several advantages and disadvantages associated with Monitored Natural Attenuation. Each should be carefully considered during site characterization and evaluation of remediation alternatives.

Potential advantages of Monitored Natural Attenuation include:

- Generates less volume of remediation wastes, such as treated plume water, reducing potential cross-media contamination and reducing the risk of human exposure to contamination
- Fewer surface structures are required. Less ecological disruption
- May apply to all or part of a site
- May be combined with other active remedial measures
- Lower overall remediation costs than active remediation methods

Potential disadvantages of Monitored Natural Attenuation include:

- Long-term monitoring is necessary
- Possible longer time frames to achieve remediation objectives
- Site characterization may be more complex and costly
- Intermediate breakdown compounds may be more toxic than initial contaminants
- Extensive education and outreach efforts are involved to explain Monitored Natural Attenuation to the public

For More Information
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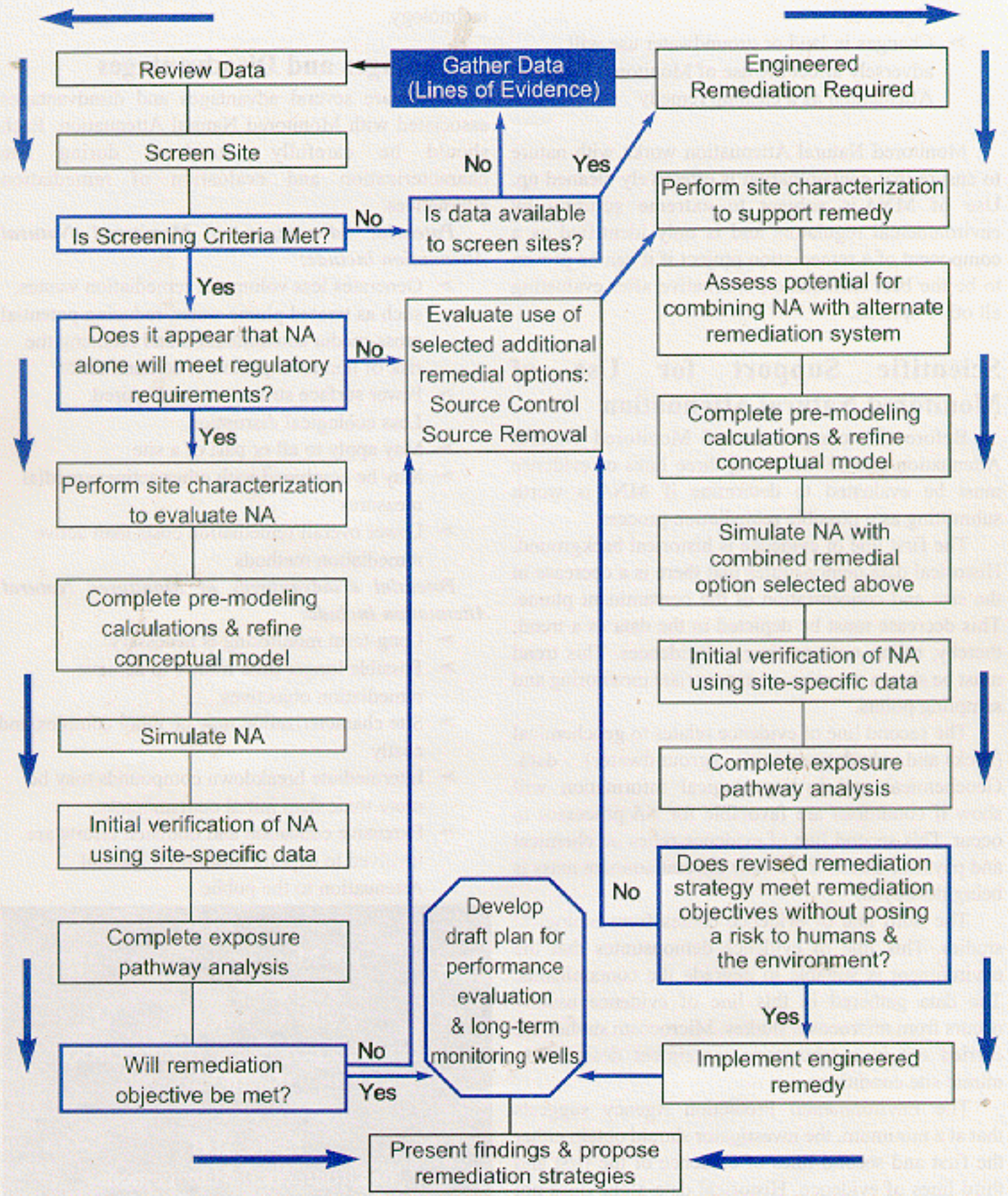
MNA SELECTION PROCESS



Legend

Initial Phase of MNA process | Milestones in the MNA process | Steps of the MNA process | Final phase of MNA process