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5.3 Periodic Evaluations

Periodic evaluations are performed by the project team or an independent review team. The evaluation of remedy performance and optimization (USEPA 2014b) compares actual remedy performance to the interim and site objectives, and any other performance criteria described in the decision documents and other plans. The long-term management plan includes a schedule for conducting periodic evaluations, who is responsible for performing the periodic evaluations, data that will be collected, documentation, and the decision-making process. Periodic evaluations can be done at any time during the remediation life cycle, and are scheduled to evaluate technical parameters such as contaminant migration for each major component of the selected remedial approach. The periodic evaluations could also include a postremedy implementation remediation potential assessment. At CERCLA sites, this process is formalized in five-year reviews. In addition to formal periodic evaluations, technology performance is routinely evaluated by the O&M team to determine its success or the need to modify or adjust specific remedy components.

Scheduled periodic evaluations compare predicted and actual progress toward meeting interim and site objectives. Remedy performance can be graphed and evaluated in real time relative to the predicted performance for each key remedy component. For example, the rate of contaminant migration and attenuation could be compared to the expected change (calculated or modeled) after implementing each remedy component. Interim objectives and corresponding performance metrics may include contaminant concentration trends, mass flux reduction, plume stability, plume capture, and more. The long-term management plan describes the monitoring program needed to collect data that corresponds to the performance metrics so that progress towards meeting interim objectives can be evaluated. The plan specifies monitoring locations, analyses, sampling frequency, and DQOs. The selected remedy components, performance model, and baseline conditions inform the specifics of the monitoring plan. Such a monitoring program produces the necessary data to evaluate remedy performance over the duration of the remedial approach using the DQO process.

The following list presents a typical remedy performance process and the metrics that can be used during periodic evaluations for some common remedy components. Actual details will vary depending on site-specific remedy components, interim objectives, and performance metrics.

Compare performance metrics

- Compare actual and predicted contaminant concentrations for each major element of each key remedy component implemented.
- Compare actual rate of change to predicted rate of change for each key remedy component implemented.
- Evaluate data to determine whether the remedy is progressing toward interim or site objectives at a satisfactory pace.

Based on these comparisons of performance metrics

- Determine whether optimization or modification can correct an inadequate remedy. If not, reevaluate alternative technologies and remedial approaches and determine the remediation potential.
- Implement necessary steps required to correct the remedy component performance.

Evaluate the performance of engineered remedy components

- Evaluate actual performance indicators (such as run time efficiency, capture zone, mass removed, and performance trends).
- Compare actual performance to design specifications, interim and site objectives, and corresponding performance metrics documented in the long-term management plan.
- Evaluate potential outside influences, including contamination that may influence remedy protectiveness.
- Consider other variations, such as weather, new groundwater withdrawals, groundwater flow fluctuations causing or resulting in a rise or lowering of the water table, and contaminants in groundwater flowing on to the site from another source.

Evaluate the performance data for attenuation-based remedy components (such as MNA, engineered caps, and hydraulic migration control systems)

- Develop multiple lines of evidence consistent with design conditions (groundwater geochemical parameters, levels of degradation products, and contaminant concentrations at compliance monitoring points).
- Determine plume behavior (expanding, stable, or contracting within the site/site segment?).
- Evaluate contaminant trends in the plume (decreasing, stable, or increasing).

Evaluate other factors

- Evaluate effectiveness of ICs.
- Confirm barriers to accessing contaminated media, such as buildings and other structures, surface activities, wetlands, and endangered species habitats and subsurface hydrogeologic difficulties.
- Estimate new influx of residential housing that may impact risk assumptions.

Periodic evaluations include a site inspection and evaluation of IC implementation, effectiveness, and stakeholder roles and accountabilities. The IC evaluation includes zoning and other local code and use restrictions, and verifies that any proposed changes are consistent with provisions in the decision documents. The periodic evaluations also verify that ICs are being implemented and any gaps in performance are identified. Monitoring may also identify shifts in compliance that indicate a need for revision or increased attention to ICs. When warranted, decision documents can be modified to set forth changes to ICs while maintaining protective site conditions. Monitoring confirms that access controls and markers designated in the long-term management plan are in place over the duration of the project life cycle (see Figure 6). Results of periodic evaluations become a part of the Administrative Record at CERCLA sites (USEPA 2010a, ITRC 2016b) or the analogous documentation for sites in RCRA, state or other federal cleanup programs.

The long-term management plan includes an evaluation of the effectiveness of ICs and zoning requirements. USEPA (2012a, 2012b) also details required components and implementation of ICs; USEPA (2011d) provides guidance on the evaluation and validation of ICs during CERCLA five-year reviews, which can also be used for any type of periodic evaluation.

The periodic evaluation checklist shown in Table 13 includes additional example questions for key topics, which further augment the example presented above. The decision logic applied to the site performance metrics is designed to aggressively and efficiently advance the remedial approach towards meeting developed interim and site objectives. Note that the objectives of the periodic evaluations are broader than CERCLA five-year reviews, and therefore the criteria in Table 13 are more extensive.

Table 13. Periodic evaluation example checklist for specific topics

Source Characterization	
	Does remedy operation data indicate that the source may not be fully characterized?
	Are contaminant properties known and considered?
	Are COCs site specific behavior patterns and conditions fully identified and understood?
	Has the level of uncertainty in the horizontal and vertical mapping of source area mass and lithology been identified?
	Has the mass been evaluated?
	Have distal plume portions been characterized, sufficiently?
	Evaluate the ability of current technology to effectively characterize the site (for example, bedrock geology)
CSM	
	Does the CSM reflect current understanding of site conditions? For example, how has land use changed?
	Does the current CSM adequately explain plume behavior and remedy performance?
	Based on the current CSM, are all receptors adequately protected?
	Is the site adequately characterized to support meaningful evaluation of remedy performance and remediation potential?
Hydrogeology and Plume Behavior	
	Are plume dynamics well understood? Is plume increasing, shrinking, or stable?
	Is the influence of any off-site extraction wells (pumping rates) well understood?
	Are contaminant concentrations decreasing at a rate that will achieve site objectives within the time defined by the decision document?

Source Characterization	
	Has the influence of uncertainty associated source mass, hydrogeology, mass flux, matrix diffusion, and other parameters been evaluated and accounted for in the time frame estimate?
	Is the evaluation of the mass balance sufficient to determine:
	• original mass released
	• mass removed by remedial operations
	• remaining residual mass in the dissolved plume and immobilized within the soil lithology (lower permeability units in particular)?
Technology Performance – Evaluate Site Specific Challenges	
	Evaluate intrinsic recalcitrant contaminants/complex hydrogeology or technology.
	Evaluate measurement methods (performance metrics) used to assess the technology performance.
	Evaluate level of technology performance needed to meet site objectives or interim objectives.
	Evaluate potential challenges for meeting site objectives and time frame based on appropriate technical factors and limitations (such as continued NAPL dissolution remaining immobilized residual mass in lower permeability or difficult to access lithology, capillary smear zone, or matrix back-diffusion limitations).
	Is achieving site objectives technically feasible?
Technology Alternatives Cost Effectiveness Analysis	
	Has a cost effectiveness analysis been conducted if an alternate technology is considered as a potential replacement of a technology currently in operation?
	Does a completed technology pilot test indicate that site objectives can be achieved?
	Is the proposed technology schedule to complete more favorable (based on time or resource consumption) than the current technology in operation, and is it acceptable to interested parties?
	Is the proposed alternative approach sustainable?
	Is an appropriate modification to the decision document required based on data gaps, source characterization, plume behavior and/or technology performance?