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Technical Impracticability Waivers: An underutilized tool for managing sediment sites

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A Superfund Record of Decision (ROD) for a sediment site documents the cleanup levels (CULs) directing the sediment cleanup, and it lays out the long-term objectives aimed at protecting sensitive receptors and restoring waterways to support fishing and recreation. Parties responsible for remedial design often struggle with designing sediment remedies that efficiently meet low-level CULs when incoming sediment sources and natural conditions control the expected cleanliness after remediation.

CULs are established for various chemicals in multiple media identified through a combination of the following:

- Applicable or relevant and appropriate requirements (ARARs)—promulgated standards in federal and state regulations.
- Risk-based goals—calculated through risk assessments that use assumed levels of exposure for humans and animals over certain periods of time to predict safe concentrations of chemicals in fish tissue and sediment.
- Background conditions—when ARARs and risk-based goals are lower than levels in the environment unrelated to the Superfund site, the CUL can be adjusted to reflect the background levels.
- Analytical limits—the CULs should not be lower than what a laboratory can measure in a sample. So, a risk-based goal can be adjusted upward to a detectable level.

CULs are usually set for multiple groups of chemicals including:

A. Legacy industrial chemicals with focused areas of higher concentrations in sediment (pink in Figure 1) surrounded by mid- to lower-level concentrations (peach, green). Cleanup can address the mid- and higher-level areas, but might not achieve very low-concentration goals calculated through risk assessments (dark blue) if the chemicals continually move into the site from diffuse, urban sources (e.g., stormwater runoff from highways represented by the aqua and green gradation in Figure 1).

B. Naturally-occurring chemicals, like metals, that can have some urban sources, but are also widely present due to geological conditions. Although Group B chemicals are naturally occurring, cleanup criteria for these chemicals can be developed through risk assessments. Such calculations might identify risk from natural conditions, and risk-based CULs would be unattainable if they are lower than geologically influenced conditions.

Figure 1: the colors represent concentrations of a single Group A analyte in surface sediment. Pink/peach indicates a higher-concentration area.

CULs are to be met after active remediation and/or a period of natural recovery over an exposure area (e.g., areas over which sport fish typically swim). But what if the CULs established in a ROD fail to account for natural conditions and are not adjusted upward sufficiently to an achievable background-based level? As more information comes to light after a ROD is issued, such as further understanding of natural background sources, it can be common for EPA to revisit the criteria set in a ROD. EPA documents such revisions in a ROD amendment, an erratum, or an explanation of significant differences document. Another approach lies with performing parties making the case to waive certain CULs defined in a ROD: this is, to request an ARAR Waiver for Technical Impracticability.

Technical Impracticability

We strive to design sediment remedies that are technically achievable over a reasonable course of action and, ideally, in a manner that maintains the waterway's function and does not cause more harm than benefit. For Group A type chemicals, this can mean addressing small, focused areas having the highest concentrations such that an average concentration after cleanup meets the CUL, as shown in Figure 2—a reasonable effort and cost yielding maximum benefit.

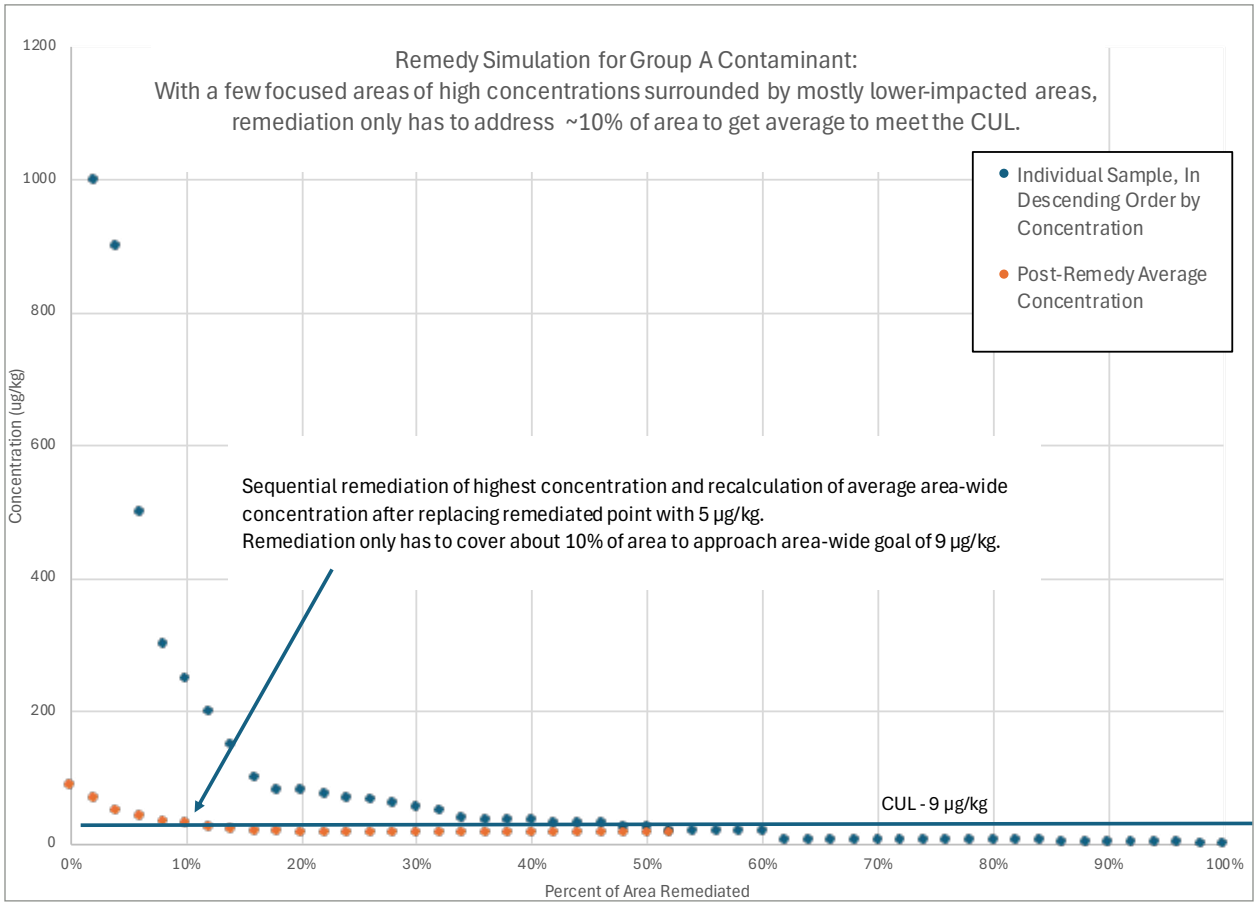

Figure 2: Remedy simulation for Group A contaminant

Sediment remediation should be technically feasible and use resources wisely. We usually identify relatively high concentrations of legacy industrial chemicals (yellow area for Group A chemicals in Figure 3) to indicate where their cleanup would lead to area-wide lower concentrations of all chemicals of concern (overlap of Group A and Group B chemicals in yellow area in Figure 3).

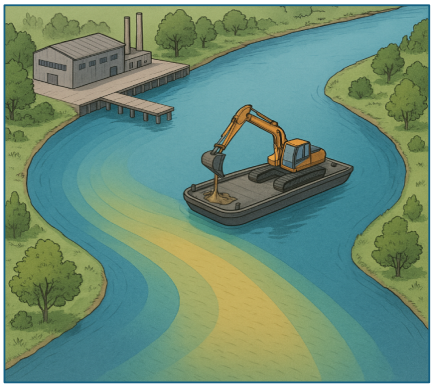

Figure 3: The colors represent concentrations of a single Group B analyte in surface sediment. Yellow indicates area also elevated for Group A chemical

For Group B chemicals, remediated areas might immediately be very low in concentration (e.g., matching the concentration in a coarse sand placed over the dredge surface), but the concentrations in the sediment will eventually re-equilibrate to the surrounding natural/regional concentrations (yellow-green to blue in Figure 3). If the goal is to achieve a CUL that is lower than background for a Group B chemical (navy blue in Figure 3 legend) immediately after construction, one would have to dredge or cap a very large area (or an impossibly large area). That is, there may not be an area large enough to dredge or cap that would ever result in the post-remedy sediment condition meeting a dark blue level (Figure 3).

Figure 4 shows an example of how, for a Group B chemical with concentrations close to background levels, a very large area would need to be remediated to achieve an average concentration immediately after construction at the CUL. In Figure 4, 60 percent of the study area needs to be remediated to achieve the CUL, because there are no discrete hot spots as there are for Group A chemicals.

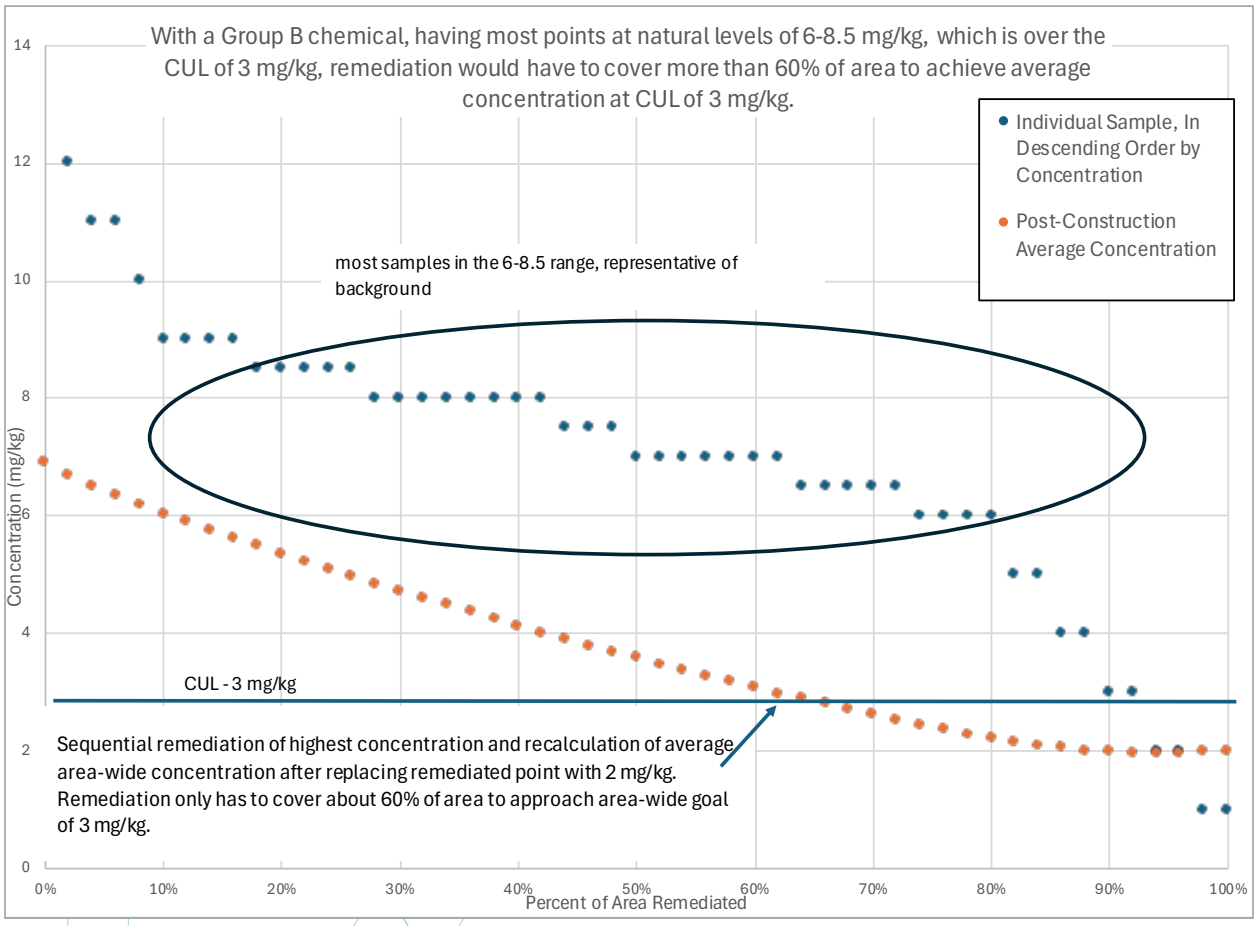

Figure 4: Area requiring remediation for Group B chemical with concentrations near background

Attempting to dredge that much sediment might not be technically feasible for a number of reasons:

- Deep and wide dredge cuts might be structurally unstable.
- Dredging equipment cannot reach below wharfs or very close to steep banks without undermining them.
- Construction work windows (fish windows) may be too short to accommodate the many weeks of dredging duration.
- The process of moving this volume of sediment from the river, to the land, to the landfill is logistically challenging and resource intensive (requiring significant fuel and resulting in unnecessary emissions).
- The supply of dredge equipment cannot meet the demand.
- Harbor traffic cannot be disrupted over a period sufficient to remove the large volume.
- The removal volume would be so great that the riverbed is essentially denuded.

Further, all of this remediation might not achieve the desired goal because the area will eventually reequilibrate to the surrounding, background conditions regardless of how much area is remediated. In Figure 3, this means that after remediation, the area becomes yellow-green and aqua again despite the dark blue goal.

Thus, the CUL (the goal) is technically impracticable.

We also seek to design remedial actions that consider green and sustainable practices. Actions in conflict with green principles include excessive fuel use and emissions for long-range transport of material out of the waterway and to a landfill, particularly when this material is not truly polluted (i.e., if the remedy is due to Group B chemicals in the green-blue range in Figure 3). Similarly, building a sediment cap for Group B chemicals to control for natural geological conditions in sediment porewater, if technically feasible, could require a lot of material dug up from a quarry (e.g., sand) and a lot of man-made amendments (e.g., activated carbon).

Therefore, the additional remediation extending beyond the yellow indicator in Figure 3 targets levels that are not sustainable over the long term. Besides being technically impracticable to clean up this much sediment, due to the reasons above, the excess construction imparts high resource and financial costs in exchange for no added benefit.

Is There Precedent?

The National Contingency Plan provides for the following types of waivers of ROD-defined ARARs:

- **Interim Measures Waiver:** The alternative is an interim measure and will become folded into a final remedial action that is expected to attain the federal and/or state ARARs.
- **Greater Risk to Health and the Environment Waiver:** Compliance with the requirement will result in greater risk to human health and the environment than other alternatives.
- **Equivalent Standard of Performance Waiver:** The alternative will attain a standard of performance that is equivalent to that required under the otherwise applicable standard, requirement, or limitation through use of another method or approach.
- **Fund-Balancing Waiver:** For EPA-funded response actions only, an alternative that attains the ARAR will not provide a balance between the need for protection of human health and the environment at the site and the availability of fund monies to respond to other sites that may present a threat to human health and the environment.
- **Technical Impracticability Waiver [TI Waiver]:** Compliance with the requirement is technically impracticable from an engineering perspective, so an alternative remedial strategy is proposed. That strategy can be the use of a higher, more attainable, CUL.

EPA developed guidance in 1993 outlining the TI waiver process specific to groundwater restoration (USEPA 1993). However, over the following couple of decades, EPA issued only 91 waivers across 85 Superfund sites nationwide, with a precipitous drop in the use of TI waivers since 2011.

There may be no direct precedent for the use of a TI waiver for sediment Superfund sites because all of the waivers EPA has granted and published online are related to groundwater and surface water sites. Most often drinking water-related standards have been waived, typically because the groundwater under

consideration is not, and will not be in the future, used as a source of drinking water; so a lack-of-exposure rationale supports the waiver. In approved TI waivers, engineering factors presenting technical impracticability to implement a remedial action include complex geology and hydrogeology, presence of contaminants with unique properties, and a drawn-out anticipated timeframe to operate a treatment system before the conservative goals are achieved. Metals were the contaminant of interest in roughly half of the approved TI waivers.

Conclusions

The precedent of metals-related TI waivers for groundwater provides an opportunity for adapting the concept to sediment sites, where cleanup criteria have been codified for background-sourced and naturally occurring metals (referred to as Group B chemicals in this article). Using the TI waiver as a tool to focus sediment cleanups away from diffuse inputs and more squarely on detrimental concentrations of legacy pollutants (Group A chemicals in this article) can streamline remedial designs and monitoring programs, bringing resolution of an impacted sediment site closer to the finish line.

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