

Table 2: Final Corrective Action Quick Reference Table

Result	Description	Ref. Notes
Recommended Final Remedy Performance Standards (general)	Developed from May 1, 1996 Advance Notice of Proposed Rulemaking -- includes concepts of overall protection, media cleanup objectives and remediation of sources	1
Final Remedy Performance Standard #1	Protect human health and the environment	2
Final Remedy Performance Standard #2	Attain media cleanup objectives are broad objectives made up of media cleanup levels, points of compliance and remediation time frames	3
Final Remedy Performance Standard #3	Remediate the sources of releases to eliminate or further reduce threats to human health and the environment	4
Supporting Topics	Description	Ref. Notes
Public Participation	Opportunity for public review and comment should take place: prior to remedy proposal; when tentative remedy decision has been made; when final remedy decision is made; and when tentative decision is made that Corrective Action is complete	5
Media Cleanup "Levels"	Site specific cleanup concentrations protective of human health and the environment	6
Points of Compliance	Locations where media cleanup levels should be measured and achieved	7
Remediation Time Frame	Site-specific remedy implementation schedule	8
Remedy Evaluation/Balancing Factors	Long-term reliability and effectiveness; reduction of toxicity, mobility or volume; short-term effectiveness; implementability; capital as well as operation and maintenance costs; community acceptance; and state acceptance	9

Remedial Expectations	Tool to help regulators and owner/operators focus resources on remedial alternatives that are likely to achieve performance standards and fair well in with respect to the evaluation/balancing criteria. Expectations address: treatment of principal threats, engineering controls for low-level threats, institutional controls, innovative technologies, groundwater restoration, contaminated soils	10
Preference for Treatment	Long-standing policy for remedies that involve treatment (primarily focused on “principal threats”)	10, 11
Land Use	Long-standing policy to recognize current as well as reasonably anticipated land use.	12
Groundwater Use	Media cleanup objectives and remedial expectation point toward remediating groundwater to levels that are consistent with designated use	13
Technical Impracticability	A determination by the overseeing regulatory program that, for certain media or constituents at certain facilities or portions of facilities, it may be technically impracticable from an engineering perspective to achieve media cleanup objectives.	14
Institutional Controls	Non-engineering methods (usually, but not always, legal controls) intended to affect human activities in such a way as to prevent exposure to hazardous substances.	15

Reference Notes for Table 2: Final Corrective Action Results

1. **Recommended Final Remedy Performance Standards**

These “results” for final remedies were developed from guidance contained on pages 19448-19450 in the May 1, 1996 ANPR. The three recommended performance standards (dealing with overall protection, media cleanup objectives, and remediation of sources) in this context were previously referred to as “threshold criteria” in the July 1990 Subpart S proposal. Proposed Subpart S included a performance standard that required remedies to “comply with standards for management of wastes.” EPA no longer believes this remedy criterion needs to be expressed, since compliance with applicable waste management standards is automatically required under existing RCRA Subtitle C and D regulations.

2. **Recommended Performance Standard #1 - Protect Human Health and the Environment.**

The protection of human health and the environment is a general mandate from the RCRA Sections 3004(u) and (v) and other Sections (e.g., Section 3008(h)) require Corrective Action as necessary to protect human health and the environment. Repetition of this overarching performance standard is necessary to reinforce the principle that the entire cleanup must meet this standard. For example, providing an alternative drinking water supply may be necessary to achieve this performance standard while other actions are being implemented to achieve the remaining two performance standards discussed below.

3. **Recommended Performance Standard #2 - Attain Media Cleanup Objectives**

As discussed in the 1996 ANPR, EPA believes that the concept of media cleanup objectives includes three components: media cleanup levels, points of compliance, and remediation time frames. If Corrective Action is proceeding in advance of Agency oversight, facility owner/operators should be careful to document their decisions about media cleanup levels, points of compliance, and remediation time frames to support review of the remedy. If Corrective Action is overseen by a regulatory agency, EPA believes that these three components should generally be recommended by the facility owner/operator in the remedy recommendation and established by the overseeing agency in the final remedy decision.

Media cleanup objectives should be appropriate to the assumptions regarding current and reasonably anticipated land use(s), and current and potential beneficial uses of water resources.

4. **Recommended Performance Standard #3 - Remediation of Sources**

Remediation of the sources of releases of contamination is typically a critical part of Corrective Action activities. In this context, “sources” include both the location of the original release as well as locations where significant mass of contaminants may have migrated. EPA’s continuing emphasis on remediation of sources of releases reflects the Agency’s strong preference for remedies that are protective in the long term and is consistent with the Agency’s strong and longstanding preference for treatment to permanently reduce the toxicity, mobility or volumes of

materials that pose a substantial inherent threat to human health or the environment due to their toxicity or mobility. As discussed in the 1990 proposal and the 1996 ANPR, the emphasis on remediation of release sources does not preclude remedies that include containment or other physical or institutional controls, provided the potential for future releases from any remaining source areas is adequately controlled and long-term protectiveness is provided.

5. **Public Participation for Remedy Selection and Completion**

EPA continues to believe that public involvement is a critical part of the remedy selection process. For that reason, EPA believes that the public should generally have an opportunity to provide comment at a minimum: prior to a remedy proposal to allow community acceptance to be weighed as remedy balancing factor where appropriate (see note number 9 below); at the time a tentative remedial decision has been made; when a final remedial decision is made; and when a decision is made that no further Corrective Action is necessary (i.e., Corrective Action is complete). These opportunities for public input should be in addition to opportunities provided at the initiation of Corrective Action and at the time in which a significant interim measures are proposed and selected. EPA anticipates that the public review and comment procedures currently used for draft RCRA permits in 40 CFR Part 124.10 -12 (or authorized state equivalent) will be most appropriate for review and comment on tentative remedy decisions. Following public review and comment of a tentative remedial decision, the overseeing Agency should make the final decision and provide that decision along with a concise statement of the reasons for the decision and a response to significant comments, to the facility owner/operator, all persons who submitted comments on the tentative remedy selection, all persons on the facility mailing list (if a mailing list is required for the facility) and, where appropriate, other interested or appropriate persons.

EPA recognizes that at some facilities or portions of facilities, owner/operators may choose to go forward with remedy selection and implementation absent real-time agency oversight. For example, an owner/operator of a low priority corrective action facility might plan to sell or redevelop a portion of that facility and might want to complete cleanup prior to such sale or redevelopment. EPA strongly cautions facility owner/operators who make this choice to document their remedy selection and implementation decisions carefully. In situations where facility owners/operators go forward with remedy selection and implementation absent real-time agency oversight, future Agency assessments of the need for additional corrective action at the site will likely be influenced by the level of documentation of the remedy created by the owner/operator. Because Agency guidance sets out what the Agency generally believes should be conducted to select and implement a protective remedy, a well-documented decision appropriately considering the factors the Agency has recommended is less likely to warrant further corrective action, than a decision which was not documented in this manner.

Similarly, the Agency emphasizes again that it is important for facility owners/operators who proceed without real-time Agency oversight to involve the public and other interested citizens in remedy selection and implementation decisions. Specifically, the owner/operator should provide opportunity for notice and comment on remedy recommendation, make any public

comments it receives available to the public, and respond to any comments including how the owner/operator factored public comments into any corrective action decision. Based on its experience in implementing the corrective action program, and the effect of public input on site-specific remedy design and implementation, EPA may find the owner/operator's remedy unsatisfactory and require additional corrective action where the public has not been given a full and fair opportunity to participate. Because of the value of public participation to the remedial action, the Agency generally should give heightened scrutiny to requests for determinations that corrective action is complete when the subject remedies have been selected and implemented without adequate public involvement.

EPA continues to emphasize that the Agency's regulations do not prohibit a facility owner/operator from going forward with corrective action, including remedy selection and implementation, in advance of oversight or direction from the Agency; however, the owner operator is cautioned to make sure they are aware that such actions not preclude the Agency from requiring additional measures in the future.

EPA's most comprehensive public involvement guidance for RCRA Corrective Action under permits and 3008(h) orders are identified in Chapter 4 of RCRA Public Participation Manual, EPA 530-R-96-007, September 1996. In addition, Chapter 5 provides good information on how to involve the public. Chapter 4 of the manual calls for: early participation, consistency with Superfund, and shared responsibility for public participation activities. A copy of Chapter 4 of this manual is provided in the Communication section of the Corrective Action Tool Book.

6. **Media Cleanup Levels**

There is often confusion between the terms "media cleanup objectives" and "media cleanup levels" used in Agency guidance. Media cleanup levels are site-specific concentrations of individual hazardous constituents in a given medium that should be achieved as part of a Corrective Action remedy. Media cleanup objectives are the combination of media cleanup levels, points of compliance, and remediation time frames. Note, in the 1990 proposal, media cleanup levels were referred to as media cleanup standards.

As discussed in the 1990 proposal and the 1996 ANPR, EPA believes that media cleanup levels should be established consistent with available, protective, risk-based cleanup levels (e.g., MCLs or appropriate State cleanup levels) or, when such levels do not exist, to protective cleanup levels developed for the site in question (e.g., using a site-specific risk assessment). Both approaches should be based on a site-specific, risk-based decision.

When available media cleanup levels are used, the assumptions used to develop the standardized cleanup levels should be consistent with the site-specific conditions at the facility in question. For example, use of MCLs promulgated under the Safe Drinking Water Act, or other more stringent State drinking water standards, would generally be appropriate as media cleanup levels for groundwater that has been appropriately identified as a current or potential

source of drinking water. As described in the preamble to the 1990 proposal (30804), alternative levels protective of the environment and safe for other uses could be established for groundwater that is not an actual or reasonably expected source of drinking water. This is also consistent with the Superfund NCP, which states that, generally, drinking water standards should not be chosen as preliminary remedial goals for groundwater that is not a current or potential future source of drinking water (1990 NCP preamble 55 FR 8733).

For human health, EPA's risk reduction goal remains to reduce the threat from carcinogenic contaminants such that, for any medium, the excess risk of cancer to an individual exposed over a lifetime generally falls within a range from 1×10^{-4} to 1×10^{-6} and, for non-carcinogens, the degree to which exposure would no longer cause deleterious effects. For non-carcinogenic constituents, this is generally interpreted as not exceeding a Hazard Index of one. In addition to protecting human health, media cleanup levels should protect against unacceptable cross-media transfer and unacceptable risks to ecological receptors. Issues associated with unacceptable risks to ecological receptors may also require that individual constituents achieve cleanup levels that are more conservative than 1×10^{-6} for human health. EPA's latest guidance on ecological risk assessment is provided in the June 1997 Interim Final Ecological Risk Assessment Guidance for Superfund: Process for Designing and Conducting Ecological Risk Assessments (EPA 540-R-97-006). References: National Contingency Plan, 55 Federal Register 8733, March, 1990.

7. **Points of Compliance**

Points of compliance are the site-specific locations at which the concentrations of individual hazardous constituents should be measured and achieved. Points of compliance should be established at the same time as media cleanup levels and remediation time frames. Points of compliance should be established for all affected media subject to a final remedy. If corrective action is proceeding in advance of Agency oversight, facility owners/operators should be careful to document their decisions about points of compliance to support future review of their remediation. If corrective action is being overseen by a regulatory agency, EPA generally expects that points of compliance will be recommended by the facility owner/operator in the remedy recommendation and established by the overseeing agency in the final remedy decision.

For groundwater, the media cleanup levels should generally be achieved throughout the contaminated groundwater or when waste is left in place, up to the outside boundary of the area(s) encompassing hazardous wastes or hazardous constituents that are being managed in place as part of a remedial action. This is typically referred to as the "throughout-the-plume/unit boundary point of compliance for groundwater.

For air, cleanup levels should generally be achieved at the location of the most exposed individual, or at other specified points of exposure closer to the source of the release, as necessary to protect human health and the environment.

For surface water, cleanup levels should generally be achieved at the point where releases enter

surface waters, or within a specified mixing zone in sediments or surface water.

For soils, cleanup levels should generally be achieved at any point where direct contact exposure to the soils may occur and at any other points necessary to protect against unacceptable cross-media transfer.

For surface water sediments, cleanup levels should generally be achieved throughout the sediments or at other specific locations in sediments or surface water as necessary to protect human health and the environment.

8. **Remediation Time Frames**

Remediation time frames are the time periods and schedules over which remedies will be implemented as well as the estimates of when cleanup levels will be achieved at points of compliance.

As discussed in the 1990 proposal and the 1996 ANPR, EPA continues to believe that program implementers and facility owners/operators should generally consider the following factors when estimating remediation time frames: the extent and nature of contamination and the potential risks to human health and the environment from exposure to contamination prior to completion of the remedy; the practical capabilities of remedial technologies in achieving the media cleanup levels and other remedial objectives; the availability of treatment and/or disposal capacity for wastes managed during implementation of the remedy; and the desirability of utilizing technologies that are not currently available but which may offer significant advantages over already available technologies in terms of effectiveness, reliability, safety, or ability to achieve media cleanup levels and other remedial objectives. In addition to these factors, the EPA believes that when developing a remediation time frame estimate, program implementers and facility owners/operators should generally also consider: community preferences; financial resources of facility owners/operators; and current and reasonable anticipated future land and water use. Implementers may find it useful to at times distinguish between time frames associated with implementing a remedy (e.g., installing a certain remedial technology) and the time frame associated with achieving a media cleanup level at a point of compliance. This distinction should allow implementers to set schedule for constructing a remedy, for which there is generally less uncertainty, as compared to only setting schedules for achieving a media cleanup level, for which there is often greater uncertainty as discussed below. An example could be that at a particular site it will take 6 months to install a groundwater pumping and treatment system, but the best estimates might be that it will take approximately 10 years of operation to achieve the media cleanup level in the ground water at the points of compliance.

EPA is aware that there may be uncertainty in estimating remediation time frames at some sites. Examples include situations where remedies are implemented in stages or where there is uncertainty with how long a particular technology (e.g. pump and treat) will take to reach objectives. In these cases, program implementers and facility owners/operators should clearly explain the reasons for the imprecision of their remediation time frame estimates in the remedy

documentation or, in situations where EPA requires a facility owner/operator to implement a remedy, in the remedy recommendation.

9. **Recommended Remedy Evaluation/Balancing Criteria**

Depending on site-specific circumstances, any number of remedial alternatives might satisfy the three recommended remedy performance standards. For example, as discussed in the 1996 ANPR, remedies can attain media cleanup standards using various combinations of removal, treatment, engineering and institutional controls. While many remedies might meet the remedy performance standards, each will present a different combination of other attributes such as long-term protectiveness and implementability. As discussed in the 1996 ANPR, a formal evaluation of remedial alternatives is not always necessary, nor is it necessary to always have a formal evaluation of more than one alternative if a single remedial option is determined by the overseeing regulatory program to be acceptable. The recommended remedy evaluation/balancing criteria described below can be used, where appropriate, to help select the “best” remedy by balancing the pros and cons of various alternatives, or they can be used to judge how well a single remedial option would likely perform when a formal evaluation of multiple alternatives is not warranted. If an owner/operator proposes only one alternative for consideration, the overseeing regulatory program may (1) accept the proposal, (2) request modification, or (3) request that the owner/operator develop additional alternatives to allow for a comparison between potential options. In determining whether an evaluation of multiple alternatives is warranted, the overseeing regulatory program should consider such factors such as site complexity, community feedback, uncertainties associated with remedial performance (e.g., a natural attenuation remedy), etc.

EPA’s current thinking is that seven evaluation/balancing criteria are generally appropriate: (1) Long-term reliability and effectiveness, along with the degree of certainty that remedies will remain protective of human health and the environment, considering, as appropriate: the magnitude of risks that will remain at a site from untreated hazardous wastes and hazardous constituents and treatment residuals; and, the reliability of any containment systems and institutional controls; (2) Reduction of toxicity, mobility or volume through treatment of hazardous wastes and hazardous constituents, including how treatment is used to address principal threats posed by the facility, and the degree to which remedies employ treatment that reduces the toxicity, mobility or volume of hazardous waste and hazardous constituents, considering, as appropriate: the treatment processes to be used and the amount of hazardous waste and hazardous constituents that will be treated; the degree to which treatment is irreversible; and the types of treatment residuals that will be produced; (3) Short-term effectiveness and short-term risks remedies pose, along with the amount of time it will take for remedy design, construction and implementation; (4) Ease or difficulty of remedy implementation, considering, as appropriate: the technical feasibility of constructing, operating and monitoring the remedy; the administrative feasibility of coordinating with and obtaining necessary approvals and permits from other agencies; and the availability of services and materials, including capacity and location of needed treatment, storage and disposal services; (5) Capital and operation and maintenance costs, and the net present value of the capital and

operation and maintenance costs; (6) The degree to which remedies are acceptable to the surrounding community; and, (7) The degree to which remedies are acceptable to the state in which the subject facility is located.

The recommended primary balancing criteria of long-term reliability and effectiveness, reduction of toxicity, mobility or volume through treatment, implementability, and cost were discussed in detail in the 1990 proposal. EPA's thinking on these criteria has not changed significantly since that time. Although the Agency is not reviewing the primary remedy balancing criteria in detail here, it notes that, in applying the criteria of long-term effectiveness and reduction of toxicity, mobility or volume through treatment, program implementors and facility owners/operators should generally give great weight to the Agency's strong and longstanding preference for remedies that involve treatment to permanently reduce the toxicity, mobility or volumes of materials that pose a substantial inherent threat to human health or the environment due to their toxicity or mobility (i.e., are "principal threats" discussed as part of the Agency's remedial expectations for final Corrective Action remedies).

The remedy balancing criteria of community and state acceptance were not explicitly discussed as remedy balancing criteria in the 1990 proposal and are therefore discussed below. EPA's latest thinking is that these two recommended criteria are important to ensure that program implementors and facility owners/operators appropriately involve communities in cleanup activities and, in cases where states are not selecting corrective action remedies, appropriately consider state views. Adding community and state acceptance as recommended evaluation/balancing factors have the added advantage of making the recommended corrective action remedy balancing factors explicitly conform with the remedy balancing criteria used in the Federal CERCLA program. EPA believes this will generally reduce the likelihood that individuals might question the ability of a remedy approved by one program to satisfy the requirements of the other program.

10. **Remedial Expectations**

Remedy expectations are not binding requirements; rather, they reflect collective experience and are designed to guide development of remedial alternatives. In effect, remedial expectations allow program implementers and facility owner/operators to profit from prior EPA experience and focus resources on the most plausible remedial alternatives. Many of these expectations were first described in the CERCLA National Contingency Plan (NCP) (40CFR430(a)(1)), and were also described in the May 1, 1996 ANPR.

- (1) EPA expects to use treatment to address the principal threats posed by a site whenever practicable and cost-effective. Contamination that represents principal threats for which treatment is most likely to be appropriate includes contamination that is highly toxic, highly mobile, or cannot be reliably contained, and that would present a significant risk to human health and the environment should exposure occur. The term "cost-effective" does not necessarily imply least costly.

- (2) EPA expects to use engineering controls, such as containment, for wastes and contaminated media that can be reliably contained, pose relatively low long-term threats, or for which treatment is impracticable. Future land use should be considered when evaluating the appropriateness of engineered controls.
- (3) EPA expects to use a combination of methods (e.g., treatment, and engineering and institutional controls), as appropriate, to achieve protection of human health and the environment.
- (4) EPA expects to use institutional controls such as water and land use restrictions primarily to supplement engineering controls as appropriate for short- and long-term management to prevent or limit exposure to hazardous wastes and constituents. EPA does not expect that institutional controls often will be the sole remedial action.
- (5) EPA expects to consider using innovative technology when such technology offers the potential for comparable or superior treatment performance or implementability, less adverse impact, or lower costs for acceptable levels of performance when compared to more conventional technologies.
- (6) EPA expects to return usable groundwater to their maximum beneficial uses wherever practicable, within a time frame that is reasonable given the particular circumstances of the site. When restoration of groundwater is not practicable, EPA expects to prevent or minimize further migration of the plume that represents a threat to human health or the environment, prevent exposure to the contaminated groundwater, and evaluate further risk reduction. EPA also expects to control or eliminate surface and subsurface sources of groundwater contamination
- (7) EPA expects to remediate contaminated soils as necessary to prevent or limit direct exposure of human and environmental receptors and prevent the transfer of unacceptable concentrations of contaminants (e.g., via leaching, runoff, or airborne emissions) from soils, including subsurface soils, to other media.

11. **Preference for Treatment**

Despite EPA's longstanding preference for remedies that involve treatment to permanently reduce the toxicity, mobility or volumes of materials that pose a substantial inherent threat to human health or the environment due to their toxicity or mobility, program implementors and facility owners/operators often struggle to find an appropriate balance between approaches that emphasize reductions in toxicity (e.g., through treatment to reduce toxicity, mobility or volume) and approaches that emphasize preventing exposure (e.g., through engineering and institutional controls). While preventing exposure may appear to be the most direct near-term means of reducing risk, permanent reduction of the toxicity, mobility and/or volume of contaminated material can be the most cost-effective means of reducing risk over time. For example, at a facility where the remedy relies, in part, on engineering controls to prevent exposure there could

be: associated operation and maintenance costs; the need to maintain the RCRA facility permit for the life of the remedy; increased Agency involvement to monitor the continued effectiveness of the remedy; and, need for institutional controls. In cases where treatment to reduce toxicity, mobility or volume is chosen, EPA does not necessarily expect the remedy to involve treatment alone. For example, under some site-specific conditions, highly toxic contaminated material could be treated so that the concentrations of hazardous constituents, while still above media cleanup levels, would support a reliable containment remedy.

The exact balance between reduction in toxicity, mobility or volume and exposure control will best be established on a case-by-case basis in consideration of site-specific conditions; however, as discussed in the 1996 ANPR, the Agency's consistent and longstanding policy is to place special emphasis on remedies that provide adequate protection of human health and the environment over the long term. For this reason, the Agency continues to prefer remedies that involve treatment to permanently and significantly reduce the toxicity, mobility, or volume of highly toxic or highly mobile waste. Program implementors and facility owners/operators are cautioned against too great a reliance on exposure control remedies when alternatives that include treatment to permanently reduce toxicity, mobility or volume are available, affordable and practical.

While EPA maintains a preference for treatment, the clear emphasis is to focus treatment on contamination identified as "Principal Threats" (see expectations in note 10 above). Guidance on determining whether contamination represents a "principal threat" which should treatment is generally appropriate can be found in documents developed by the Superfund program but are also relevant to the RCRA Corrective Action program. Those guidance documents are titled, "A Guide to Principal Threat and Low Level Threat Wastes," Superfund Publication 9380.3-06FS, November 1991, which is included the Workshop Toolbox; and, "Rules of Thumb for Superfund Remedy Selection," OSWER Directive No. 9355.0-69, August 1997 which is available to download at <http://www.epa.gov/superfund/resources/rules/index.htm>. The "Rules of Thumb" guidance includes important information pertaining to principal threats which updates the 1991 guidance previously mentioned.

12. **Land Use**

EPA believes that current and reasonably anticipated future land use should generally be explicitly considered during the site-specific development of media cleanup objectives. EPA believes that media cleanup objectives should be appropriate to the assumptions regarding current and reasonably anticipated land use(s) and current and potential beneficial uses of water resources. Consideration of current and reasonably anticipated future land use has always been part of the Corrective Action program. In the 1990 proposal, EPA indicated, "...contaminated soil at an industrial site might be cleaned up to be sufficiently protective for industrial use but not residential use, as long as there is reasonable certainty that the site would remain industrial." (55 FR 30803) The role of current and reasonably anticipated future land use was discussed in detail in the 1996 ANPR. EPA's views have not changed significantly since that time.

Additionally, EPA strongly encourages program implementers, as appropriate, to select remedies that encourage some type of beneficial use of properties, rather than just leaving contaminated properties fences and unused.

Program implementors and facility owner/operators are cautioned against automatically restricting assumptions of future land use to extrapolations of the current use or relying only on designated zoning or industrial use codes to establish land use assumptions. In addition to the considerations of any given facility owner/operator, community concerns and plans also should be considered when making decision on reasonably anticipated future land use. Where it is possible, EPA encourages owner/operators and program implementors to begin a dialogue with the community on land or water use prior to considering final remedies. As an additional benefit of early land use discussions, investigations can be better tailored to assess actual risks or to collect information to help in remedy selection or implementation. Additional guidance on incorporating reasonable future land use assumptions in remedial decision-making is available in "Land Use in the CERCLA Remedy Selection Process," OSWER Directive No. 9355.7-04, May 25, 1995, which can be found in the Corrective Action Workshop Toolbook. The Superfund program is in the process of updating this guidance to included discussion on land re-use.

Land use decisions are typically also only as good as the "institutional controls" (see institutional controls note # 15 below) put in place to ensure that the use doesn't change, or if it does, that the remedy could be reopened to make sure conditions are protective of new alternative uses. The earlier institutional controls are determined, the better equipped the owner/operators, communities, and developers will be to address future land use issues.

13. **Groundwater Use**

As stated above (note # 10 above), EPA generally expects to return usable groundwater to their maximum beneficial uses wherever practicable. This expectation, along with the "Attain Media Cleanup Objectives" recommended performance standard (note # 3 above), are designed to point program implementers toward considering groundwater use as a factor in evaluating and selecting final remedies.

EPA is concerned that the lack of current use of the groundwater as drinking water at a particular site could be used inappropriately as justification for a non-drinking water use determination. Factors that generally should be considered in making groundwater use decisions include: (1) whether the use determination was based on a Comprehensive State Ground Water Protection Program (CSGWPP) that has been endorsed by EPA and has provisions for site-specific decision-making; or (2) in the absence of a State CSGWPP, whether the determination was based on EPA-endorsed State classifications or other State designations and/or Federal groundwater guidelines (e.g., Class I, II, and III groundwater). EPA believes the following factors (from "Final Comprehensive State Groundwater Protection Program Guidance, December 1992, Figure 2-1) should generally be used to set relative

priorities of groundwater resources:

- Intrinsic sensitivity, hydrogeologic regimes and flow patterns (recharge discharge areas), geologic/hydraulic parameters and local hydrogeologic setting;
- Quantity and potential yield;
- Ambient and/or background groundwater quality as determined by monitoring;
- Potential for remediation where contamination already exists;
- Current use;
- Reasonably expected future use based on demographics, land use, remoteness, quality, and availability of alternative water supplies;
- Values attributed to groundwater resources (see Appendix B of CSGWPP Guidance);
- The interactions and potential contamination impacts between surface water and groundwater and the value of groundwater quality to the maintenance of ecosystem integrity; and,
- Inter-jurisdictional characteristics.

For more information regarding CSGWPPS, refer to OSWER Directive 9283.1-09, "The Role of CSGWPPs in EPA Remediation Programs," April 4, 1997 at <http://www.epa.gov/superfund/resources/csgwpp/role.pdf> .

14. **Technical Impracticability**

Technical impracticability was discussed in detail in the 1996 ANPR and the 1990 Subpart S proposal, and the Agency's views have not changed significantly since that time. The Agency continues to believe that, for certain media or constituents at certain facilities or portions of facilities, it may be technically impracticable, from an engineering perspective, to achieve media cleanup objectives (recall media cleanup objectives include concepts of media cleanup levels, points of compliance and remediation time frames). Detailed Agency guidance on this subject can also be found "Guidance for Evaluating the Technical Impracticability of Ground Water Restoration" (EPA 540-R-93-080). As stated in the 1996 ANPR, recognizing technical impracticability does not indicate that the Agency is scaling back the general goal of returning contaminated groundwater to beneficial uses. Technical impracticability decisions should generally be based on appropriate technical justification that should be provided by the owner/operator. Where technical impracticability is determined for a defined area, the Agency expects that an alternative remedial strategy would be implemented that is: (1) technically practicable; (2) consistent with the overall remedial objectives for the site; and (3) controls the source(s) of contamination and exposures to human and environmental receptors. Additionally, program implementors should recognize that technical impracticability determinations should be made for a geographically defined area (ideally in three dimensions if appropriate); this reference to a "defined area" means that while it may be technically impracticable to achieve a certain cleanup level in one area, it may still be technically practicable, and therefore appropriate, to achieve the same cleanup level outside that area. Program implementors should also keep in mind that a determination of technical impracticability in the RCRA Corrective Action program is an acknowledgment of the current understanding of site conditions and

available remedial technologies. Additional measures may be required, as appropriate, by EPA in the future if subsequent advances in remedial technologies make attainment of media cleanup objectives technically practicable.

Program implementers considering technical impracticability determinations should keep abreast of advances in remedial technologies, especially with regard to advances (e.g., using heat, surfactants, etc.) made in enhanced extraction of non-aqueous phase liquid (NAPL) contamination. Experience has shown that relying solely on “pump and treat” to remediate NAPL contaminated groundwater is typically inefficient and often ineffective with regard to achieving a restoration objective. Therefore, technical impracticability determinations being considered for NAPL contaminated groundwater should generally include an evaluation of enhanced recovery techniques, rather than basing the technical impracticability determination solely on the apparent inability of pump and treat to achieve objectives.

Helpful resources include:

Remediation Technologies Screening Matrix and Reference Guide, Third Edition, Federal Remediation Technologies Roundtable, <http://www.frtr.gov> (Handout included in Tool Book)

Remediation Case Studies: Fact Sheet and Order Form, EPA542-F-98-023, Federal Remediation Technologies Roundtable, Searchable database of case studies at <http://www.frtr.gov> (fact sheet included in Tool Book)

EPA Remediation and Characterization Innovative Technologies (EPA REACHIT) Fact Sheet, USEPA, 1998, On-line database at <http://ww.epareachit.com> (fact sheet included in Tool Book)

15. **Institutional Controls (long-term physical or land use controls)**

Final remedies at RCRA Corrective Action facilities can incorporate a range of physical requirements, operation and maintenance requirements, and land use designations. For the most part, EPA believes that remedies which rely on operation and maintenance or physical controls should be completed (e.g. should be at the stage where continued operation and maintenance or maintenance of a physical control are no longer necessary) before a facility owner/operator seeks a determination that corrective action is complete. However, the Agency also recognizes that in some instances, after there is no more need for long-term monitoring or active operation and maintenance, it could be appropriate to find that corrective action is complete when hazardous waste or hazardous constituents are left in place at a facility. EPA believes this will most often be the case when corrective action decisions are based on non-residential land use assumptions. In such situations, EPA strongly believes that the remaining restrictions on facility use should be adequately and accurately recorded to ensure that future property owners do not unknowingly violate the conditions in a corrective action remedy and, thereby, risk exposure.

In 1990, EPA proposed that the Regional Administrator could require facility owners/operators to provide notice (by means of a deed notice) whenever hazardous waste or hazardous constituents were left in place after remedy completion. The notice would have consisted of a notation in the deed to the facility property or a notification through some other instrument routinely searched when property ownership was transferred. Under the 1990 proposal, this notice requirement would have applied whether hazardous waste or hazardous constituents were left in place on discrete units (e.g. a landfill) or diffused throughout any given medium. The Agency continues to believe that providing information on the deed through informational devices like deed notifications (or notifications in other instruments) is generally appropriate when hazardous waste or hazardous constituents are left in place at a facility. However, EPA's views on the use of protective institutional controls for such remedies has evolved since 1990. The following discussion represents EPA's most current approach.

When a deed notification, or notification in another instrument, is required, EPA believes it should clearly indicate the types, concentrations, and locations of hazardous waste or hazardous constituents that remain at a facility in addition to the land use or other assumptions on which the remedy selection was based. The Agency further believes determinations that corrective action is complete are generally appropriate only when any long-term monitoring associated with a remedy is complete. This is, in EPA's view, analogous to the completion of post-closure care.

Since the 1990 Proposal, the Agency has learned that when corrective action is deemed complete, and the site ceases to be subject to the same level of regulatory oversight, use of an informational device that provides information on the deed, such as the use of the deed notice or deed notification alone may not provide a sufficiently protective remedy in all cases. The reason is that an informational device like the deed notice, for example, is not an "interest in real property", meaning that it simply provides information, and does not exert any sort of proprietary control over the property in question. Recording a notice, for example, has little or no effect on a property owner's legal rights regarding the future use of the property. Neither the present owner, nor any successors would be legally bound by any use restrictions referred to in the deed notice.

Where a final remedy involves leaving hazardous waste or hazardous constituents in place above levels suitable for unrestricted use (such as remedies that rely on non-residential future land use determinations), the Agency strongly encourages the appropriate responsible state or local governments to require that any controls limiting exposure be appropriately established, implemented, monitored, and enforced in a manner that ensures long-term protection of human health and the environment. Such exposure controls may include non-engineering or "institutional controls", and may be most attractive to states and local governments that already have the statutory authority to implement such controls.

The term "institutional controls" refers to non-engineering measures (usually, but not always, legal controls) intended to affect human activities in such a way as to prevent exposure to

hazardous substances. Where a cleanup is protective for industrial, but not residential, exposures, institutional controls may be needed to prevent residential use from taking place at the site. Establishing effective institutional controls will in some cases depend upon the authority of state or local government entities to impose such controls. Therefore, it is extremely important to identify as early as possible what state and local authorities may have jurisdiction over a particular property, and what state and local provisions may provide the basis for institutional controls. In developing final remedies with institutional controls, EPA or the authorized state should consult with state or local governmental authorities to determine whether they would be willing to take the lead on enforcing institutional controls, and what concerns they may have should they be asked to play this role. Such consultation should take place during the analysis and evaluation stage, and not postponed until after the remedy is selected.

Institutional controls can be created in a variety of ways. Property law devices, or “proprietary” controls are perhaps the most common type of control. Controls established through some governmental entity’s regulatory authority, such as zoning restrictions or controls on well drilling, are a second category. Enforcement tools, such as unilateral or consent decrees issued under RCRA Section 30008(h) or CERCLA Section 106, can also be used to limit land use. In many cases, such controls may be most effective when different types (deed restrictions, informational devices, zoning restrictions, etc.) are layered on the same piece of property so that they are sufficient to prevent current and future exposure to humans and/or the environmental receptors above media cleanup levels.

The term “deed restrictions” should be understood as simply a catchall term for proprietary controls such as easements and covenants that are legally enforceable against subsequent owners. Absent some special authority under state law, only the conveyance of a property interest, such as an easement, creates an enforceable control. A distinctive feature of proprietary controls is that, because they are based on generally applicable property law, they can be implemented without the intervention of any federal, state or local regulatory authority. Easements are generally less useful where a large number of parcels are involved, and the current owner of the land is not subject to regulation under RCRA (or CERCLA). Easements may not be a practical way of preventing exposure to contaminated groundwater where a plume has spread over a wide area. Traditional common law doctrines can limit the enforceability of easements against successors in title. Things to consider when planning to use a proprietary type of control are: the nature and extent of the control to be imposed; whether the control will be binding on subsequent property owners; and whether the right to enforce the control can be transferred to other parties.

Governmental controls use the regulatory authority of a governmental unit to impose restrictions on citizens or sites under its jurisdiction. Since RCRA and CERCLA do not specifically authorize EPA to regulate land use in a comprehensive manner, EPA should generally turn to state or local governments to establish controls of such type. Examples of governmental controls are zoning laws/ordinances, local permits (building, etc), tailored ordinances, groundwater use restrictions, advisories, state registry of hazardous waste sites, and property

condemnation. The advantages of this type of control over proprietary controls are that they don't require the negotiation of parcel by parcel restrictions, and that the legal impediments to the long run enforcement of proprietary controls can be avoided; i.e. they remain effective as long as they are not repealed.

Enforcement tools available to EPA under RCRA and CERCLA may also be used to restrict the use of land. Enforcement authority might be used in two ways in establishing institutional controls. First, an enforcement instrument such as an administrative order or consent decree may prohibit the party named in the order or decree from using land in certain ways, or from carrying out prohibited activities at the specified property. Second, a consent decree may be used to require settling parties to put in place some other form of control, such as a proprietary control (for example, by conveying an easement to the government, or obtaining one from a third party). Enforcement authority may be based on orders under ss. 3008(h) and 7003 of RCRA.

It may be desirable to establish restrictions that run with the land and bind future landowners as well as the current owner/operator. This would be most likely where there is a desire to create restrictions that will outlive the RCRA permit or order. To accomplish this, it will generally be necessary to establish a proprietary or governmental control. For proprietary controls, there should generally be a transaction conveying a property interest (e.g. an easement) from the landowner to another party who is then the holder and enforcer of that interest. A permit or order may direct the owner/operator to convey such an interest to someone who will then be the enforcer. If a governmental approach appears promising, the permit or order would likely require the owner/operator to take steps to see that such controls are adopted by the local jurisdiction.

In addition to controls discussed above, it is generally advisable that the o/o also document, for the appropriate authorities, the land use assumptions on which the remedy selection was based, and to also inform them whenever any of the basic assumptions/conditions had changed over time so as to be inconsistent with the initial assumptions. Notification of changes in conditions is generally critical because, even if land and groundwater uses were restricted, there would typically be some remaining potential for migration of contamination and/or for exposure of potentially exposed populations and the environment to occur.