Comments on

Cleanup Goals Appropriate for DNAPL Source Zones

A discussion paper by the Cross-Program Ground Water Task Force established under EPA's One Cleanup Program Initiative

by
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We commend the task force for their efforts in addressing the issue of cleanup goals for DNAPL source zones. DNAPLs are present at many sites and there has been reluctance to approach the cleanup of these sites in a realistic fashion.

We have some comments on the problem statements and options in the discussion paper.

1. Site owners say that cleanup to drinking water standards (e.g., MCLs) is not a realistic goal for DNAPL source zones, yet they are rarely allowed to use alternative goals. Federal and State site managers continue to set such stringent goals within the DNAPL source zone, even though most technical experts agree that attaining MCLs within the DNAPL source zone is not possible with currently available technologies at most DNAPL sites. Site managers are not utilizing program flexibilities for setting alternative cleanup goals for this portion of the plume (e.g., technical impracticability decisions, containment zones, or similar).

We would modify this problem statement to say that attaining MCLs within the DNAPL source zone is not possible with currently available technologies at most DNAPL sites <u>within a reasonable time.</u> Clearly, the dissolution of residual DNAPL by flowing ground water is a very slow process, but it does happen and eventually, all the DNAPL will be dissolved and natural attenuation will clean ground water. This may take thousands of years. Cleanup goals have to acknowledge this fact and allow for extended clean up times while preventing exposure. Certainly, alternative goals or technical impracticability waivers are an important option.

2. **Technology developers say that continued adherence to overly stringent cleanup goals for DNAPL source zones inhibits the potential use of existing technologies and is detrimental to development of new methods**. Currently available in-situ treatment methods, such as thermal and oxidation technologies, can remove significant quantities of DNAPL from the source zone. However, site owners are reluctant to consider using such technologies in remedies because they feel that attaining MCLs in the source zone is not likely to be achieved, even with the most promising technologies.

This problem statement seems to say that there needs to be more research. We agree with that. But we do not agree that the most powerful technology should be applied at every site. The value of reducing the cleanup time from 2000 years to 1000 years may be relatively minimal. Depending on the risks, employing expensive technology now for benefits far in the future makes little sense.

3. **Federal and State site managers say that alternative cleanup goals often cannot be applied because the DNAPL source zone has not been distinguished from the overall plume.** For many sites, the DNAPL source zone has not been delineated. Regulatory officials are reluctant to use program flexibilities (e.g., technical impracticability decisions, containment zones, or similar) in these cases, because there is no basis for defining the portions of the plume where alternative goals are to be applied. Site managers say that site owners are not interested in delineating the DNAPL zone and typically want alternative goals to be applied to the entire plume, which would mean that none of the plume (neither source zones nor aqueous phase plumes) would be cleaned up. Continued adherence to stringent cleanup goals is the best way to make sure that DNAPL sites get cleaned up.

We understand that some regulators like to try to force technology and as long as people understand that is being done, it is not a problem. The problem is when an endless series of studies are requested to document why the goals cannot be met. Our ability to delineate the extent of DNAPL is very limited (EPA, 2003) and to what purpose? There may be no remedy for the DNAPL source zone. Why should money be spent to delineate the extent of DNAPL when we cannot do anything about it. We do not want to emphasize procedure over results. If there are risks from the groundwater plume, it must be contained, with the acknowledgement that the containment system will have to operate for a very long time. If we think we can remediate the source zone, then delineation of the extent of DNAPL may be worthwhile, but only for the purposes of planning the remediation, not for the procedural aspects of goal setting.

4. **Federal and State site managers are concerned that alternative cleanup goals have uncertain reliability and long-term costs.** Alternative cleanup goals, such as containment or exposure control, will require that ground water monitoring and site controls be maintained throughout the foreseeable future. The long-term reliability of containment systems and exposure controls is uncertain. Also the effectiveness of such system and controls often is not well documented. Containment systems have high capital costs, and hydraulic (i.e., pumping) containment systems also have high operating costs. Components used in containment systems have a finite operating life (e.g., pumps, wells, piping, flow barriers), and replacement costs are not typically considered during remedy selection. Institutional controls (e.g., deed covenants or well drilling restrictions) also have long-term costs associated with monitoring and enforcement. Long-term custodial care [9] of sites with DNAPL source zones cannot be maintained if site owners go out of business; or if Federal and State governments decide to eliminate funding for "orphan sites" at some time in the future. For sites where cleanup to MCLs can be achieved in the DNAPL source zone and throughout the plume, uncertainties, long-term costs and other disadvantages associated with long-term custodial care can be avoided.

We agree with this problem statement and believe the problem is lack of recognition of the last sentence, "For sites where cleanup to MCLs can be achieved in the DNAPL source zone and throughout the plume…". The Expert Panel on DNAPL Remediation stated "this goal [MCLs] is not likely to be achieved within a reasonable time frame in *source zones at the vast majority of DNAPL sites" (EPA, 2003). We would not want Federal and State site managers to have undue concern over the long term costs and uncertainties when there is no practical alternative.*

5. Federal and State site managers say that although source depletion is sometimes a cleanup goal, there is currently no accepted performance measures to determine the effectiveness of DNAPL mass removal. There is no agreement among technical experts on what performance measures should be used to indicate that DNAPL mass has been removed to the extent practicable from the DNAPL source zone. A 1996 EPA guidance says that long-term objectives for the DNAPL source zone are to (EPA, 1996; page 14):

> ...control further migration of contaminants from subsurface DNAPLs to the surrounding ground water and reduce the quantity of DNAPL to the extent practicable.

Although total DNAPL mass removed by recovery systems is relatively easy to measure, estimates of total mass present in the subsurface are highly uncertain and are typically underestimated. This means there is no good way to estimate the fraction of DNAPL mass removed from the subsurface with an acceptable level of confidence. In some cases, a sharp decline and "leveling off" of mass recovery over time has been used to indicate that DNAPL has been removed to the extent practicable. However, there is no standardized method for determining when the mass recovery has "leveled off". Also, "leveling off" of mass recovery can result from a poorly designed recovery system.

We agree that measuring the effectiveness of DNAPL mass removal is a problem, although we believe that there is agreement among experts that there are no methods for measuring the effectiveness of DNAPL removal projects. The Expert Panel on DNAPL Remediation stated "additional research will be necessary before this metric can be used to quantify the benefits of DNAPL source depletion" (EPA, 2003). We would support additional research on this problem.

6. Site owners say that source depletion should not be a cleanup goal because the potential benefits of DNAPL mass removal are outweighed by disadvantages. Some site owners believe that such efforts are unlikely to remove all of the DNAPL from the source zone, which means that a plume of contaminated ground water will persist and remedies to contain or otherwise manage the plume will still be required. Site owners also say that mass removal from the source zone is unnecessary as long as the entire plume is contained and institutional controls are established. Also, attempts to remove DNAPL mass could have detrimental effects, such as causing further migration of the DNAPL. Site owners say that containment of the plume, including the DNAPL source zone, is protective and consistent with EPA guidance (e.g.,the 1993 TI guidance).

We believe that source depletion should not be a cleanup goal, but for different reasons. We believe the cleanup goal should be the protection of health and the environment. The question of whether or not to attempt a DNAPL source zone cleanup has to be based on the costs and potential benefits. We believe the current state of the art is that DNAPL source zone cleanup is rarely going to be cost effective, but it should certainly be considered as an option in the feasibility / corrective action study.

7. **Managers of Federal and State cleanup programs say that flexibility in setting appropriate cleanup goals for DNAPL source zones is also a concern when revisiting operating remedies.** Improved decision making approaches will be helpful when selecting the initial remedy and also when revisiting operating remedies. Many DNAPL sites have remedies that were selected several years ago, when the state of knowledge concerning problems posed by DNAPLs was less advanced. Reasons for revisiting cleanup goals during the operating phase of a remedy could include:

-desire to reduce annual operating costs,
-desire to change to a more cost effective cleanup technology,
-lack of progress toward existing cleanup goals,
-new or previously unrecognized contamination problems, and/or
-changes in land use.

Those who are paying remedy costs (site owners, Federal and State cleanup programs) generally want to reduce long-term remedy costs. Since annual maintenance costs are higher for operating systems (e.g., pump and treat, in-situ treatment systems), site owners and cleanup programs would like to turn off these components of the remedy sooner rather than later.

We support meaningful reviews of remedies including revisions of goals as appropriate.

8. Federal and State site managers say that they should be able to revisit technical impracticability (TI) decisions. If a TI decision is made for DNAPL source zones (or for other site conditions), Federal and State site managers want to be able to revisit the TI decision at some time in the future when new cleanup technologies become available. Cleanup of the site is preferable to long-term custodial care for the reasons discussed above. EPA 's 1993 "Guidance for Evaluating the Technical Impracticability of Ground-water Restoration " states that TI decisions *""...will be subject to future review by EPA"* (EPA,1993b;page 25). However, this guidance also indicates that TI decisions can be permanent for Superfund sites if the remedy continues to be "protective." In contrast, the 1993 guidance indicates that TI decisions are not permanent for RCRA facilities (EPA,1993b;page 25).

We agree. There is really not a problem here, just lack of knowledge regarding guidance. We support review of all decisions when new data or technologies are available. We do not want to review merely for the sake of review or to revisit the technical impracticability decision because of personnel changes.

We would also like to comment on some of the options presented. We generally support additional guidance and research on DNAPL site cleanup.

Option 1 -Develop a fact sheet describing the potential benefits of DNAPL mass removal from the source zone,as well as the potential disadvantages.

The benefits of DNAPL mass removal are obvious. What is not obvious is can enough DNAPL can be removed to significantly improve ground water quality in a reasonable time frame. Do the costs of a DNAPL removal project coupled with the risk that even removal of a significant fraction of the DNAPL may still leave enough DNAPL to *adversely impact ground water quality for decades, justify benefits that are a hundred years in the future. We doubt a fact sheet can shed much light on this complex issue.*

Option 4 -Develop a policy memorandum re-emphasizing existing EPA policy that program flexibilities are to be used for DNAPL source zones, as a means of setting cleanup goals that are achievable in a reasonable time frame. Such program flexibilities may include TI determinations, containment zones, groundwater classification exemptions, or similar flexibilities that are available at a particular site from either the Federal or State cleanup program overseeing the cleanup at that site. The memorandum would reiterate EPA 's current policy that cleanup goals for DNAPL source zones should **not** include restoration of groundwater to drinking water standards, if this goal cannot be achieved in a "reasonable time frame " based on site conditions.
Advantages: No additional studies would be needed to develop such a policy. This is not a policy change because EPA's cleanup expectations (as stated in the regulations for Superfund) are to:*"...return usable ground waters to their beneficial uses wherever practicable, within a timeframe that is reasonable given the particular circumstances of the site"*(Federal Register,1990;§300.430 (a)(1)(F)).This memorandum would clarify EPA's national policy on cleanup expectations for DNAPL source zones, clarify that cleanup goals should be scientifically defensible, and apply only to sites where DNAPL source zones have been delineated.
Disadvantages: Such a policy memorandum would be similar to a policy issued by OSWER in 1995 (EPA, 1995) which has had little discernable effect on remedy decisions. No guidance would be provided on the types of sites where source depletion should (or should not) be included as a remediation goal, and therefore, would not provide much useful guidance to decision makers. This policy would only apply to sites where the DNAPL source zone has been delineated, which may be a small minority of sites. It is not clear whether such a policy memorandum would provide an incentive to delineate such source zones. Providing guidance on "reasonable time frame " may be difficult. This option does not address any of the concerns regarding TI determinations (Problem 8). Since there is currently insufficient guidance regarding what a "reasonable time frame " is for attaining cleanup goals, this policy may not be helpful unless this question is also addressed.

We agree that a restatement of policy regarding DNAPL source zones is meaningless without guidance on "a reasonable time frame".

We believe that all ground water should and can be cleaned up. It is merely a question of what is the most cost-effective cleanup remedy and how long it will take. Subsurface DNAPL may continue to dissolve and thus provide a source of ground water contamination for many years (the discussion paper states "…for many decades and, in some cases for the forseeable future." We do not share your optimism. A more accurate statement may be for many centuries and in some cases for millennia). Dissolution removes DNAPL from the source zone, albeit at an excruciatingly slow rate. We believe that for these sites, it is not necessary to have a TI waiver, it is only necessary to protect downgradient receptors from exposure using remedies such as pump and treat containment, permeable reactive walls, land use restrictions and point of use treatment.

The actual ground water remedy is natural attenuation.

We believe a feasibility / corrective action study must consider time in the same way that costs, technical risk, and possible adverse environmental impacts are considered. We would not attempt an expensive DNAPL source zone cleanup unless we were reasonably sure that ground water concentrations could be reduced significantly quickly, i.e. ten to twenty years. At most DNAPL sites, removal of 95 percent of the DNAPL still leaves a significant source zone that will be a source of ground water contamination for hundreds of years. While it is true that the 95 percent removal may speed up the time to reach MCLs by 95 percent, a 95 percent speedup of a two millenium cleanup still yields a time to reach MCLs of 100 years. The difficult question (assuming of course that we can predict both the effectiveness of DNAPL cleanup and the dissolution of DNAPL into ground water which we cannot (EPA, 2003)) is how much cost should we incur now for benefits that are 100 years in the future. Conventional cost analysis looks at the net present value of life cycle costs using a discount (interest) rate. Obviously, future benefits need to be discounted as well. The difficulty is predicting future benefits. The benefit of clean ground water is large, but if this benefit is far in the future, its net present value may be very small.

Similarly, we would not commit to pump and treat containment for millennia to protect ground water that is not currently being used; the benefits only occur when some one wants to use the ground water. While these benefits are large, they are uncertain and may be far in the future. A commitment to point of use treatment or alternative water supplies may be a more cost effective remedy. We can always attempt a DNAPL source zone cleanup or plume containment remedy in the future if it makes sense. To commit large amounts of current resources for benefits far in the future may not be reasonable.

Option 5 -Develop guidance on recommended methods and approaches for delineating the extent of the DNAPL source zone.
Advantages: This guidance would explain which characterization methods, including newly developed and conventional tools, are most helpful in delineating the spatial extent of the DNAPL zone. This would update existing guidance. This may encourage more site managers to characterize the DNAPL zone.
Disadvantages: There may not be a clear consensus on which characterization methods are most helpful. If there is no such consensus, then additional research and demonstration projects will need to be completed before such a guidance can be initiated (Project D). To be useful this document will need to do more than simply describe field methods. It will also need to address how field data should be evaluated, level of detail needed to for delineation of the DNAPL source zone as a function of the types of remedies being considered, value to be placed on direct versus indirect indicators of DNAPL, and other considerations.

An EPA Panel of Experts has already concluded that "… is an exceptionally difficult task and that much of the difficulty results from the inherent uncertainty in determining the magnitude and distribution of the DNAPL source zone mass prior to remediation." (EPA, 2003). We believe the panel of experts reached consensus on the issue of the difficulty of delineating the extent of the DNAPL source zone. Issuing guidance on what the experts believe is exceptionally difficult, may be premature.

Option 6 -Develop guidance providing a qualitative approach for determining when source depletion technologies should be implemented, or should not be implemented. This guidance would attempt to identify types of site conditions where: -MCLs are potentially achievable in the DNAPL source zone;
-MCLs are not likely to be achieved;
-benefits of source depletion efforts tend to outweigh disadvantages;and
-types of sites where source depletion should be included as a remediation goal (regardless of whether or not MCLs are likely to be achieved within the DNAPL source zone).

This guidance would be very useful.

Option 7 -Develop guidance on performance measures for the effectiveness of DNAPL mass removal, and on how to determine when active DNAPL removal efforts should be discontinued. Such measures could include trend analysis for mass removal rates, mass flux data, or other parameters for gauging remedy performance.

The EPA Panel of Experts reached a consensus that this was a research topic, implying it is probably not a good topic for guidance. There are no good ways of delineating the extent and quantity of DNAPL (EPA, 2003).

Option 8 -Develop guidance describing improved methods for comparing long-term remedies, which would allow a more realistic accounting of the costs and other disadvantages of long-term custodial care. This would include long-term costs of maintaining containment systems, equipment replacement, monitoring and enforcing institutional controls, and site monitoring.
Advantages: Currently there is no EPA guidance on this topic.This guidance would allow EPA to start fresh with new ideas for 1)utilizing the latest technologies;2)being responsive to a wide spectrum of stakeholders, including State and local governments, environmental groups and the general public;3)comparing costs and reliability issues associated with long-term custodial care.
Disadvantages: Currently there is no consensus on how to do such a comparison. Therefore, this project may not be feasible at present. No research activities are currently planned to develop or test potential improved methods for comparing long-term remedies.

We agree with this option. This was also recommended by the Expert Panel on DNAPL Remediation (EPA, 2003).

We also understand the difficulty in accounting for both costs and benefits that are far in the future. Current EPA guidance on costing of alternatives is to compare costs using a net present value analysis (EPA, 2000). This makes projected costs that are more than 30 years in the future insignificant. Many people believe that this may not be the appropriate analysis technique for long term projects. Pump and treat remedies may have a lower net present value than a DNAPL source removal project such as chemical oxidation because after 30 years, pump replacement costs, operating and maintenance *costs, and monitoring costs essentially discount to almost zero, while almost all the costs of chemical oxidation are current. Comparing remedies using costs discounted to the present where the time frames are much different may not yield the correct result. The comparison of benefits far in the future is even a more difficult problem, given the uncertainties and need to discount to the present.*

References

EPA, 2000, A Guide to Developing and Documenting Cost Estimates During the Feasibility Study, EPA 540-R-00-002.

EPA, 2003. The DNAPL Remediation Challenge: Is There A Case For Source Depletion?, Report Prepared by an Expert Panel to the Environmental Protection Agency, Office of Research and Development, Publication EPA/600/R-03/, dated December 2003.

Comments on the

Ground Water Use, Value and Vulnerability as Factors in Setting Cleanup Goals

A Discussion Paper by the Cross-Program Ground Water Task Force established under EPA's One Cleanup Program Initiative

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We commend the task force for their efforts in addressing the issue of cleanup goals. Cleanup goals are essential to RCRA and CERCLA. Goal definition is an important part of the remedy selection process. Many, if not most of the arguments regarding remedy selection are related to the disagreements regarding values and goals.

We agree with the statement that ground water has an intrinsic value. We agree that it should be cleaned up. The focus of our comments is on what is a reasonable time for cleanup. We believe that once we stop releasing contamination to the environment, that cleanup is inevitable. We believe that many remedial decisions are made using the postulate that if the cleanup takes too long, it is not occurring. Many people seem to have a pre-conceived notion of what a reasonable time frame is thus severely limiting the number of remedies that can be considered. We believe that cleanup time is an essential factor in the remedy selection process, just like cost, technical risk, and adverse environmental impact.

Problem Statements

1. There does not appear to be enough awareness by the general public, regulated community, and government officials pertaining to the various ground water functions, associated values and vulnerability of drinking water supplies to contamination. Adding to this problem is the lack of awareness and understanding of how aquifers are connected to other aquifers and to surface water, as well as long-term aspects of contaminant migration. Furthermore, there is uncertainty with respect to how various contaminants (individually and cumulatively)affect public health and environmental quality.

We agree with this statement. Knowledge of how ground water moves and how it is interconnected with the hydrologic cycle is essential for intelligent participation in the decision process. Education regarding the long term aspects of contaminant migration is fundamental. Many, if not most, ground water cleanups will have take many decades to reach their goals. Some will take centuries.

2. There appears to be an increasing demand for reliance on exposure controls rather than cleaning up contaminated ground water. Decisions not to cleanup may be short-sighted with regard to increasing future demands for clean drinking water supplies.

We do not agree with this problem statement. This problem statement implies that

decisions to not cleanup ground water are being made. Our view is that if the release of contaminant to the environment is stopped, natural attenuation will cleanup the ground water. It may take a very long time, but the cleanup is occurring. The real question to address is related to the CERCLA expectation "to return usable ground waters to their beneficial uses wherever practicable, within a timeframe that is reasonable given the particular circumstances of the site." (40 CFR 300.430(a)(1)(iii)(F)). We do not believe that there is an appropriate hard and fast rule for a reasonable cleanup time. Clearly, when people's drinking water is contaminated the response must be fast, aggressive, and a high priority. When there is current risk to human health, there should be a response to supply alternative sources of drinking water in days, and an active cleanup that begins within months. When groundwater in a formation that is not currently used for drinking water and has no prospect of being used for drinking water, and does not contribute to any significant ecological risk is to be cleaned up, we would argue that a much longer time is reasonable. Hundreds of years to clean up ground water for its intrinsic value alone may not be unreasonable. This philosophy is stated in EPA guidance (Rules of Thumb for Superfund Remedy Selection, p. 19):
Restoration Time Frames: Where the contaminated ground water is not currently used or an alternate water source is readily available, and there is no near-term future need for the resource, it will likely be appropriate to consider a longer time frame for achieving restoration cleanup levels. Where longer remediation time frames are appropriate, less aggressive remediation methods and/or more passive remediation approaches (such as source control combined with monitored natural attenuation) should be considered. Restoration time frames should be estimated for all viable remedial alternatives being considered for the site *(40 CFR 300.430(e)(4)*). Comparison of aggressive and passive remedial alternatives can provide a helpful basis for identifying the range of time periods that will be needed to attain remediation objectives, and will provide the basis for determining the remediation timeframe and technologies appropriate for the site. *(1990 NCP Preamble at 55 FR 8732;* and *Ground-Water Presumptive Strategy, page 1*6)

This philosophy is often ignored in practice.

3. There is a lack of agreement among stakeholders regarding methods to determine which ground waters are “reasonably expected ” to be sources of drinking water, and how those decisions should influence cleanup objectives. For example, some programs require cleanup to drinking water standards only for ground water currently planned to be used as a drinking water supply rather than considering multi-generational long-term needs. Other programs require cleanup to drinking water standards for ground water that, in the view of some stakeholders, would never be used as drinking water supply due insufficient quantity and quality. A related problem is the lack of clear direction on determining appropriate levels or degree of cleanup for ground water not determined to be a reasonably expected source of drinking water.

We agree with this statement. Clearly, expectations for ground water use impact what is a reasonable time for the cleanup.

4. Ground water cleanup activities and decisions are often not prioritized in a manner that would result in addressing the most pressing needs or maximizing the public health benefit of monies spent.

We agree with this problem statement. We would like to see prioritization on a national scale so that sites with contaminated ground water that are currently being used as a drinking water source are cleaned up first.

The issues of ground water value and cleanup time have been clouded by preconceived notions and repetitions of sound-bite like statements. One such statement is "pump and treat does not work". Of course, it works. As long as contamination is being removed from the ground water, it is working. The real question to be answered is pump and treat a cost effective remedy for the problem considering the use of ground water both at present and in the future. Another preconceived notion that has been encountered is that any cleanup that takes more than a lifetime is not effective. This imposes an arbitrary time limit that severely limits remedy selection and in some cases, prevents any remedy from being selected. For example, sites with residual DNAPL in the saturated zone may take over 100 years to reach MCL's using any currently known technology. We do not think that we should request a technical impractibility waiver for these sites; we would prefer to use point of use treatment, land use restrictions, and natural attenuation to cleanup the groundwater with acknowledgement that the process may take thousands of years. We would like to avoid cleaning up residual DNAPL by dissolution into ground water followed by pump and treat operations. While it is true that pump and treat operations will speed up the DNAPL dissolution process, the benefits of this increase in speed may be negligible compared to present costs, i.e. the value of lowering the cleanup time from 1000 years to 500 years is small. We would also like to consider fairly extreme measures to remove residual DNAPL. Residual DNAPL will continue to dissolve into percolating and flowing groundwater for hundreds or thousands of years. A cost-effective cleanup potentially removes this source of contamination to groundwater and lets natural attenuation cleanup the groundwater that is already contaminated. Assuming that no one is currently exposed to downgradient groundwater, a source cleanup remedy with natural attenuation may be more cost-effective than one that proposes containment of the plume by a pump and treat system.

There are many sites where ground water contamination travels extremely slowly. This is both an advantage and a disadvantage. The disadvantage is that it takes a long time to clean it up. The advantage is that it may take a long time to impact anybody. The cleanup decision is not irrevocable; if 100 years from now, a better remedy is available at a site where natural attenuation was chosen, some other remedy may be implemented. On the other hand, it may be more cost-effective to cleanup the groundwater now. One hundred years from now, the contaminant plume will have gone further, and more ground water will be contaminated.

It is not necessary to decide what ground water should be cleaned up; all ground water should be cleaned up. It is not necessary to decide whether cleanup is practical. It is only a question of how fast it needs to be done. Cleanup time may be evaluated along with the other remedy evaluation factors. The time to cleanup has to be weighed against the cost and other factors of each alternative remedy. Each site is different; there is no magic formula.

We would like to present some situations where we believe very long cleanup times may be reasonable. These are theoretical sites that have some relationship to real world sites.

There is a site on a karst aquifer where chlorinated solvents have contaminated ground water. It is suspected that there is residual DNAPL in the aquifer at multiple locations. Ten years of pump and treat have not significantly reduced concentrations. Several soil removal and treatment actions have been taken. Several tracer tests have yielded conflicting results resulting in some doubt about whether or not contamination has migrated off-site. There are both private and public water supplies utilizing off-post ground water. No off-post private wells are known to be contaminated but are monitored regularly. An off-post public water supply has installed treatment to remove chlorinated solvents.

This is a site where a rapid cleanup is difficult, if not impossible. We believe the most cost-effective solution for this site is to turn off the ineffective pump and treat system and continue off-site monitoring with a contingency plan to provide bottled water and well head treatment to any well, new or old, that has excessive concentrations of chlorinated solvents. We acknowledge that cleanup to MCL's everywhere may be several hundred years in the future. We would acknowledge that in a porous media aquifer, not karst, a pump and treat containment operation that ran for hundreds of years may be the best remedy taking into account of value of ground water currently used as a drinking water source. The fact that containment has evidently failed at the site and the inability to know where contamination is traveling through the karst tilts the scale to a exposure control and natural attenuation remedy.

There is a site the coast with ground water contaminated with both explosives and chlorinated solvents. All use of explosives and solvents has ceased at this site, but there is almost certainly contamination in the vadose zone that is continuing to leach contamination in the groundwater. All ground water flows towards the ocean and discharges

All of the options proposed in the discussion paper would be useful because they all would engender discussion of an important topic. The education of stakeholders may be the most important result of the implementation strategy chosen to address the stated problems. To have more acceptance of the scientific facts of groundwater contamination including acknowledgements of the slow rate of travel of groundwater contamination, the fact that much shallow groundwater ultimately discharges to surface water, and the fact that groundwater may take a very long time to cleanup using any known technology, would be useful.

We would like to add an option to the list: development of a guidance document discussing time as a cleanup parameter. This guidance document would include discussion of the basic facts of ground water and contaminant transport and suggestions for both remedial investigations and feasibility /corrective action studies. One of current failings of current remedial investigations is extensive concern of the extent of ground water contamination with very little acknowledgement of the future changes in the extent as the plume moves. We have heard people stand up and talk about plumes standing still based on little or no apparent movement in ten years. Because of sorption, this particular plume was traveling very slowly. In fact, simulations indicated that the plume *would eventually discharge to surface water with peak concentrations in surface water being attained between 100 and 150 years in the future. We are concerned that current guidance for ecorisk assessment does not adequately assess this situation. We would hope that guidance for assessing future risk would improve. Similarly, guidance for feasibility /corrective action studies must consider time as an element to be considered in the alternative evaluation. Guidance must also discuss the effects of molecular diffusion on contaminant movement. Over a few years, molecular diffusion is insignificant; over a few hundred, it is important.*

We believe our suggestions are entirely consistent with CERCLA, RECRA, the National Contingency Plan and State ground water quality laws and regulations. Situations have been encountered where people have made a priori decisions about what a reasonable time for cleanup is. We believe that issuing guidance on remedy selection emphasizing that reasonable time is not necessarily next year or next decade would improve the remedy selection process.