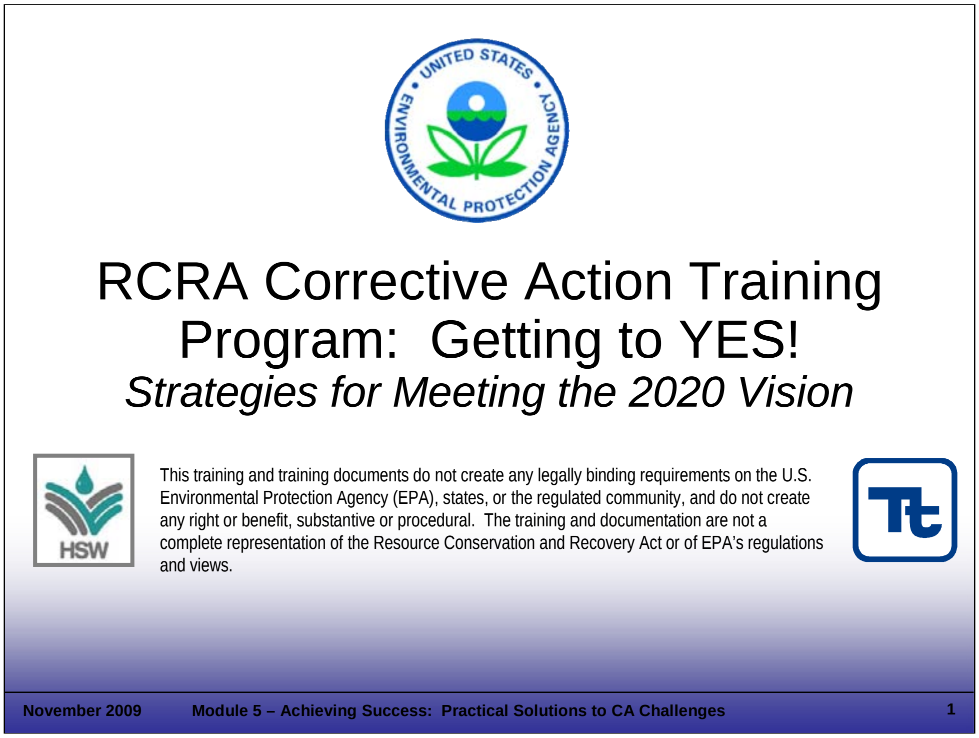


Notes:

Purpose

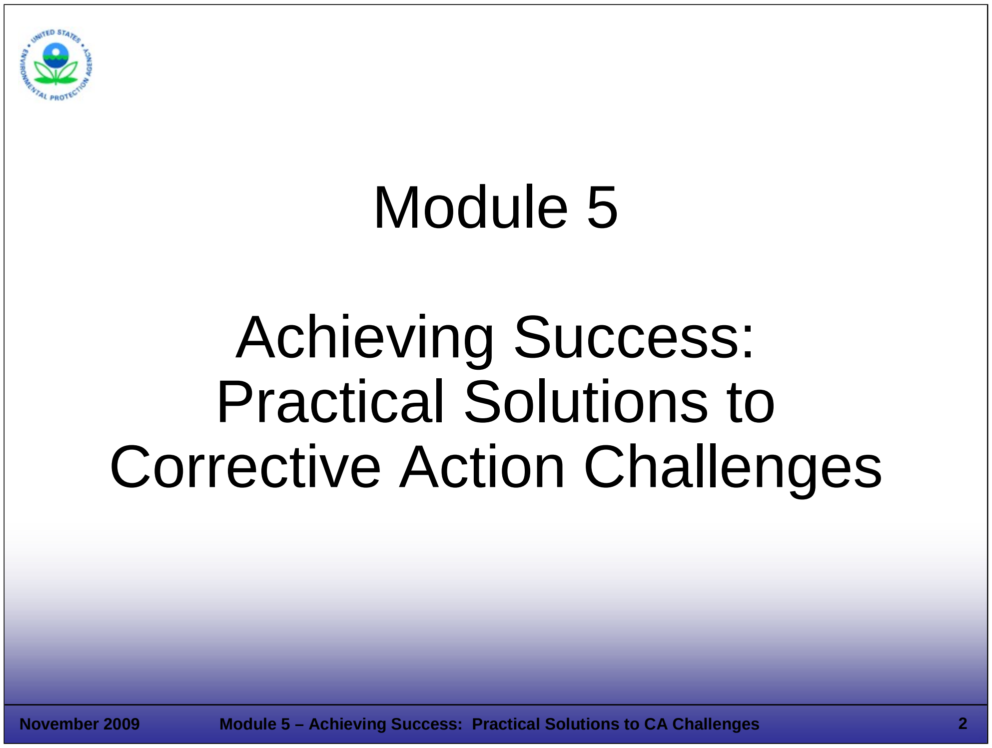
- Holder slide for Module 5, Achieving Success: Practical Solutions to Corrective Action (CA) Challenges.

Key Points

- This is a holder slide. No specific key points.

References

- None.



Notes:

<u>Purpose of Slide</u>

- Holder slide for Module 5, Achieving Success: Practical Solutions to CA Challenges.

<u>Key Points</u>

- No specific key points.

<u>References</u>

- None.

Module Overview

- Identify general principles for implementing practical solutions
- Review practical approaches to
  - Remedy selection and implementation
  - Field investigations and assessment

November 2009 Module 5 – Achieving Success: Practical Solutions to CA Challenges 3

Notes:

Purpose of Slide

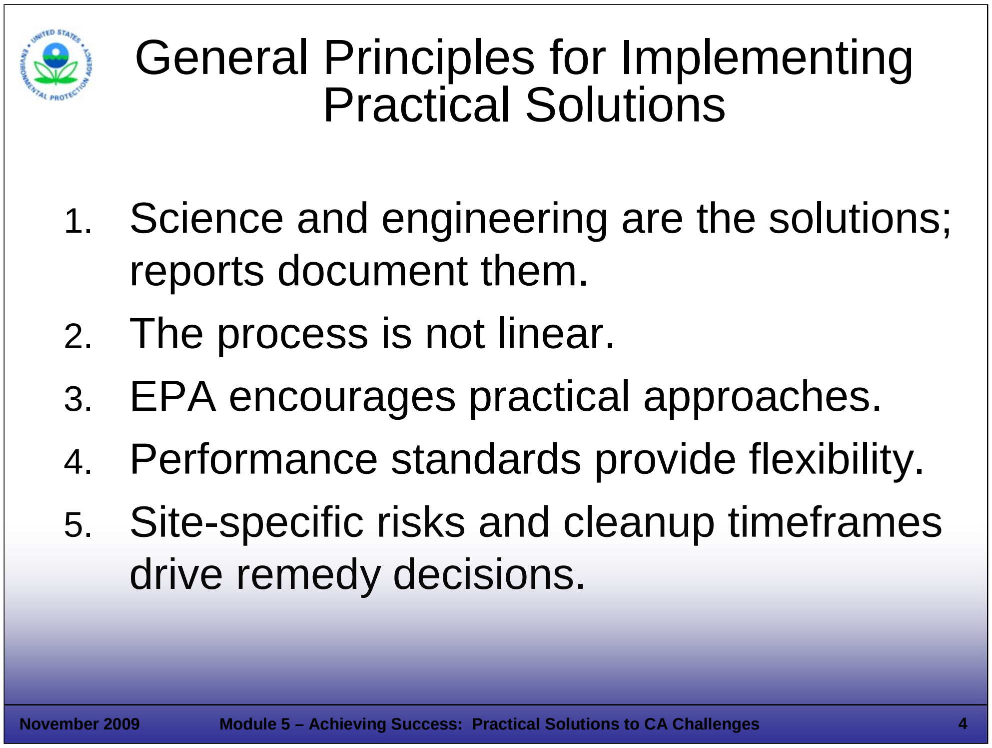
- This module reviews how the Resource Conservation and Recovery Act (RCRA) CA program can be implemented using flexible, practical approaches to expedite cleanups.

Key Points

- In order to discuss implementing CA in the real world, we will discuss:
  - General considerations for implementing practical solutions; and
  - Use of results-based, practical approaches to remedy selection, remedy implementation, and field investigations.

References

- None.



Notes:

Purpose of Slide

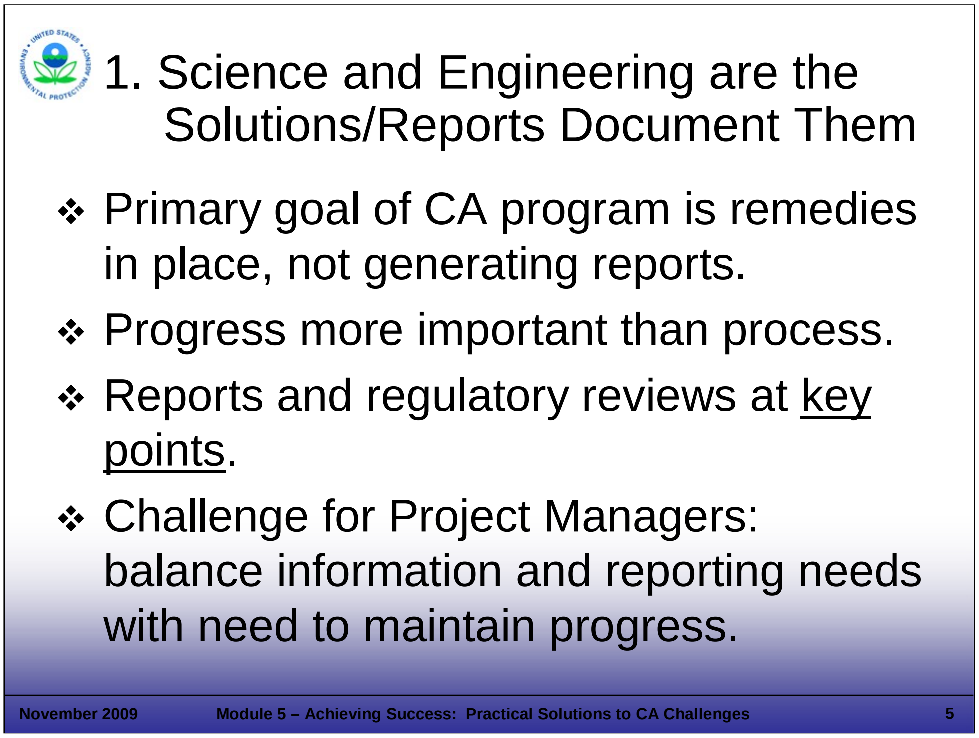
- Summarize key principles for proactive CA processes. Each of the points on this slide will be elaborated further in subsequent slides.

Key Points

- Science and engineering are the solutions; reports document them. This theme was discussed previously in Module 2. *Think progress versus process (*Principle 7 of the 8 principles covered in Module 2).
- The process is iterative, not linear – a number of activities leading to site cleanup can be performed concurrently.
- EPA encourages practical approaches to selecting and implementing remedies.
- Using performance standards provides flexibility to the CA process.
- Site-specific risks and cleanup timeframes need to be considered in the planning & implementation of remedies.

References

- None.



Notes:

Purpose of Slide

- Emphasize that the real goal of the CA Program is to get remedies in place, not to generate reports.

Key Points

- Remedial solutions will be selected, engineered, and constructed by professionals. Work plans, reports, and other documents support their efforts but they should not be more important than implementing a timely and effective cleanup. In addition to professional geologists (P.G.) and professional engineers (P.E.), some states have additional certifications such as Licensed Site Professionals (MA) and Licensed Environmental Professionals (CT).
- Real environmental progress is achieved when the remedy is constructed, not when a report is submitted.
- Major environmental reports require significant resources and can take months or years to finalize. If no remediation progress is made while work plans or reports work their way through the review and approval process, the process wins out over progress.
- The challenge for each Project Manager is to identify a streamlined reporting process that satisfies his or her needs for current and relevant information, but also maintains remediation progress at the site. It is important to maintain adequate documentation to ensure compliance and preserve EPA/state enforcement options.
- At some points in the CA process, reports and associated reviews will be needed; these reports should be integrated into the CA timeline where they will be out of the project's critical path.

References

- None.

Effective Documentation/ Reporting

- **Purpose**
  - Establish and track schedule
  - Certify technical soundness, safety, QA/QC
  - Document decisions
- **Content and design**
  - Dynamic: for real-time decisions
  - Informal: e-mail or teleconference with minutes
  - Short: tables and figures: minimal text
  - Clear: decision matrices
  - Certified: registered or licensed professional

November 2009 Module 5 – Achieving Success: Practical Solutions to CA Challenges 6

Notes:

Purpose of Slide

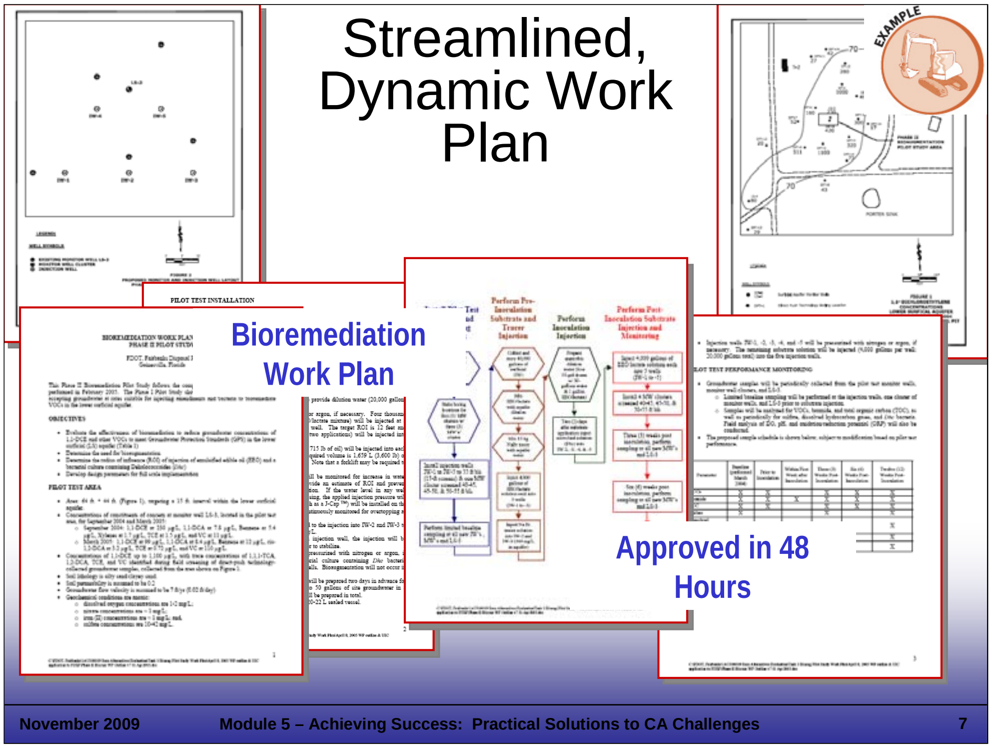
- Describe the appropriate role of documentation in the CA process.

Key Points

- If work plans are clear and succinct, they help to guide field and other activities (including the tracking of schedules) and help to streamline reporting on those activities. If the goals and protocols for a planned activity are well documented in the work plan, the resulting report can often refer back to the work plan, without additional discussions of procedures. Work plans and project documentation should be used strategically – to guide activities and document the rationale for important decisions.
- In most cases, the content and design of documents should be planned up front by the owner/operator (o/o) and agency. Goals for content and design can include documentation/reporting that is:
  - Dynamic – Documents should be dynamic, supporting real-time decisions.
  - Informal – Frequent, shorter communications can ensure all parties are on the same page. As much as is practicable, informal project updates and status reports (for example, e-mails and phone calls) can take the place of lengthy written status reports.
  - Short – Most seasoned report reviewers look first at conclusions, tables, and figures – the information-dense parts of a report. That is where most of the emphasis should also be placed in generating reports (not on lengthy discussions of site background and investigative procedures used [unless these are important to understanding the site]).
  - Clear – Decision rules should be incorporated, where feasible. Decision matrices and flow charts are one way to communicate decision points.
  - Documented – Professionals in their field (engineers, geologists, other state-licensed environmental professionals), generally should seal documents to certify their review and approval of the content. These certifications put a professional's reputation and registration behind the findings or approach.

References

- None.



Notes:

Purpose of Slide

- Provide an example of streamlined, but effective, documentation/reporting.

Key Points

- A bioremediation work plan was needed to implement bioremediation as an interim measure (IM) for volatile organic compounds (VOCs) in groundwater.
- E-mails and phone conversations (informal communications) were used to lay the initial groundwork for the work plan and to identify and address issues.
- Based on the initial communications, a concise work plan (6 pages) was submitted to the State, comprised mostly of tables, figures, and flow charts – text was minimal.
- The State reviewed and approved the work plan in 2 work days.
- This example points out the value of:
  - Effective, informal, communication and discussion of issues as an integral part of preparing formal documents; and
  - The value of short, information-dense documents.

References

- None.

2. Process is Not Linear

- Implement short-term, focused remediation (for example, Interim Measures) before assessment completed.
- Combine documents – such as RCRA Facility Investigations (RFIs) and Corrective Measure Studies (CMSs).
- Evaluate exposure pathways & potential risks early.

November 2009 Module 5 – Achieving Success: Practical Solutions to CA Challenges 8

Notes:

Purpose of Slide

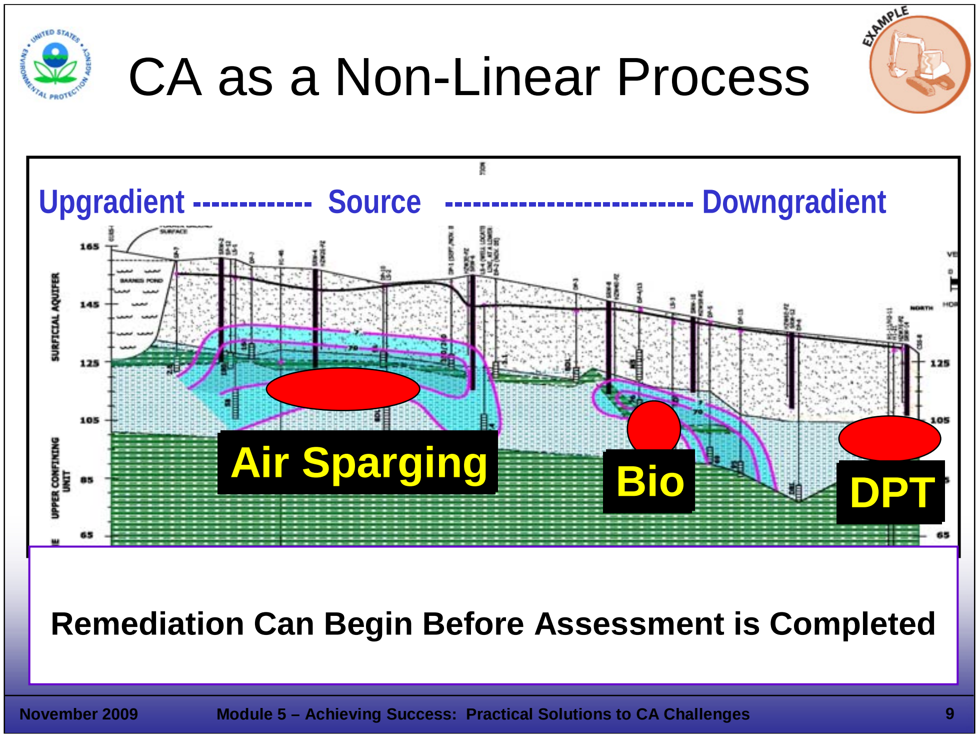
- Emphasize that CA is an iterative process.

Key Points

- In some cases, it makes sense to begin to implement remedial action before assessment of the site is completed. It can take years to characterize a complex site completely. During this time, interim measures and other site stabilization activities can be implemented based on the information collected to date. For example, if a concentrated source area of groundwater contamination is identified during a site assessment (RCRA Facility Investigation [RFI]), implementing a source control action (for example., excavation, pump and treat, partial nonaqueous phase liquid [NAPL] removal or containment) may help to address the principal threat at the site and to reduce the overall timeframe and cost of site cleanup while the site investigations continue.
- Combining several traditionally separate documents (for example, RFI and Corrective Measures Study [CMS]) into one submittal can save substantial time in the overall project schedule, as well as saving on production costs and reducing agency review time.
- A timely evaluation of the potential exposure pathways and risks posed by a site can be used to focus site assessment activities and remedy considerations to those pathways and receptors that comprise the significant risks.

References

- Federal Register (FR). 1996. Corrective Action for Releases from Solid Waste Management Units at Hazardous Waste Management Facilities, Advanced Noticed of Proposed Rulemaking (ANPR). 61 FR 19432. May 1.



Notes:

Purpose of Slide

- Present a case study of CA implementation through a non-linear CA process.

Key Points

- In the case of groundwater contamination with VOCs, two different remediation pilot studies (bioremediation and air sparging) were implemented during the ongoing site assessment (direct push technology [DPT] and well sampling) to address different source areas.
- Air sparging was implemented in an upgradient area of shallow groundwater contaminated with VOCs.
- Bioaugmentation was implemented in a downgradient area of deeper groundwater contaminated with VOCs, where air sparging was ineffective.
- By monitoring the effects of these pilot studies on contaminant levels and other site conditions over time, a good understanding of the remediation dynamics of the site was developed and these pilot systems were expanded and used as permanent remedies for the site.

References

- None.

Notes:

Purpose of Slide

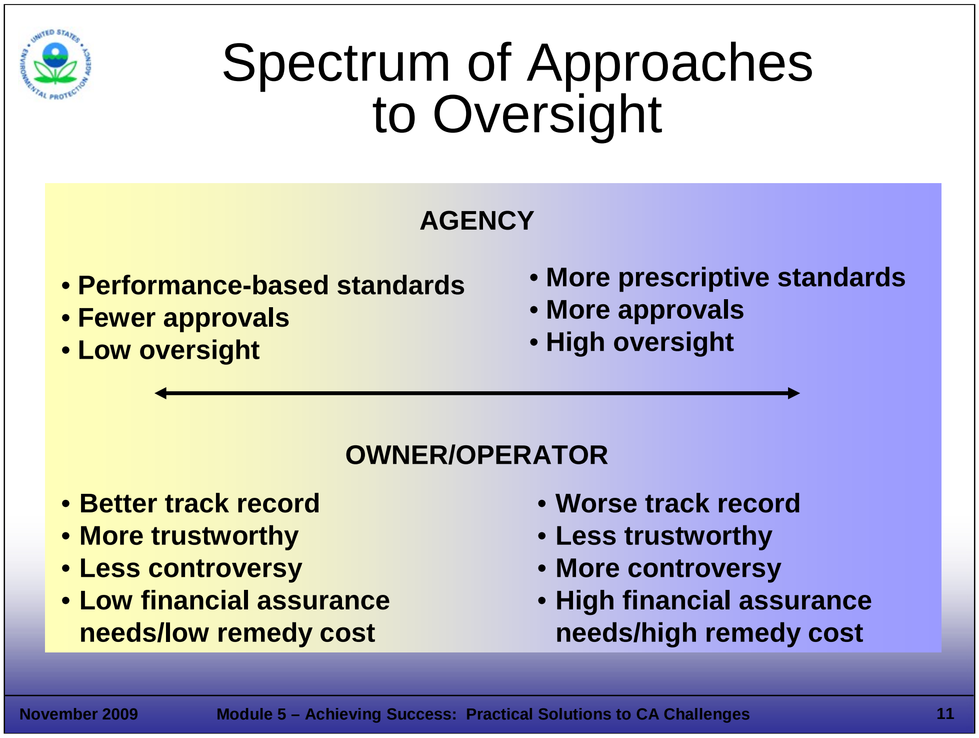
- Reiterate that EPA encourages practical considerations in the "process" because implementation challenges are rarely predictable. Emphasize CA program elements that support practical solutions.

Key Points

- Tailored oversight – The level of facility oversight should be based on facility-specific factors such as the facility's past track record, capabilities, level of trust, and other factors.
- Facility-lead agreements, permits, orders, and other agreements such as voluntary agreements – Use creativity in applying these mechanisms.
- Performance-based permits – Set performance-based standards to allow the focus to be long-term and on results, rather that short-term and on process. Ideally, the regulator establishes clear and reasonable performance standards in the CA order or permit. The facility must meet these standards, but has flexibility in determining how the standards are met.

References

- EPA. 2003. Results-Based Approaches and Tailored Oversight Guidance for Facilities Subject to Corrective Action under Subtitle C of the Resource Conservation and Recovery Act. EPA 530-R-03-012. September.
- FR. 1996. ANPR. 61 FR 19432. May 1.



Notes:

Purpose of Slide

- A range of approaches and mechanisms are available to achieve CA. The project manager must select the right approach on a facility-specific basis.

Key Points

- If an o/o is more cooperative, the regulatory agency should be willing to provide greater flexibility.
- The o/o's track record (e.g., compliance history, technical capability) is one of the key factors that an overseeing agency should consider when deciding the appropriate level of flexibility.
- In addition, financial assurance needs and cost of remedy should be considered.
- Generally, o/o's that demonstrate more cooperation and technical capability are better candidates for facility-lead or voluntary approaches. On the end of the spectrum are recalcitrant o/o's that are better candidates for enforcement approaches.

References

- None.

Notes:

<u>Purpose of the Slide</u>

- Provide an example where the facility and regulators are working together to expedite cleanup activities to facilitate demolition of an existing manufacturing facility, and to allow redevelopment of the site for use as a large, high-end commercial development (upper right photograph on slide). The cleanup is under a state Voluntary Cleanup Program.

<u>Key Points</u>

- The previous owner, who is responsible for site cleanup, is working closely with the new owner and State agency to clean up the site as demolition occurs, and between demolition and new construction.
- The picture in the upper left shows interim groundwater recovery operations. Note the monitoring well in the lower left photograph – the demolition contractor must keep wells that were not abandoned intact so sampling can continue as long as possible. Similarly, a geologist is sampling where the building used to stand (photograph at the lower right).
- Expedited cleanup is essential to the previous owner, who hopes to remediate the property to no further action levels with ICs – hence, the draft Declaration of Restrictive Covenant for the property (as shown on the slide). Further cleanup during or following new construction would be far more complex and expensive than remedial operations before and immediately following demolition.
- The stakeholders - the previous owner, new owner, and State agency - are successfully working together on practical solutions, primarily through frequent meetings, calls, and emails. There is minimal process involved in this project – it's all progress!

<u>References</u>

- None.

Facility-Lead Agreement University of VA

- 2 months to develop Facility Lead Agreement
- RFI completed in 16 months by UVA
- Verification sampling by EPA
- Statement of Basis: 2003
- CA Complete without Controls: 2004

November 2009 Module 5 – Achieving Success: Practical Solutions to CA Challenges 13

Notes:

Purpose of Slide

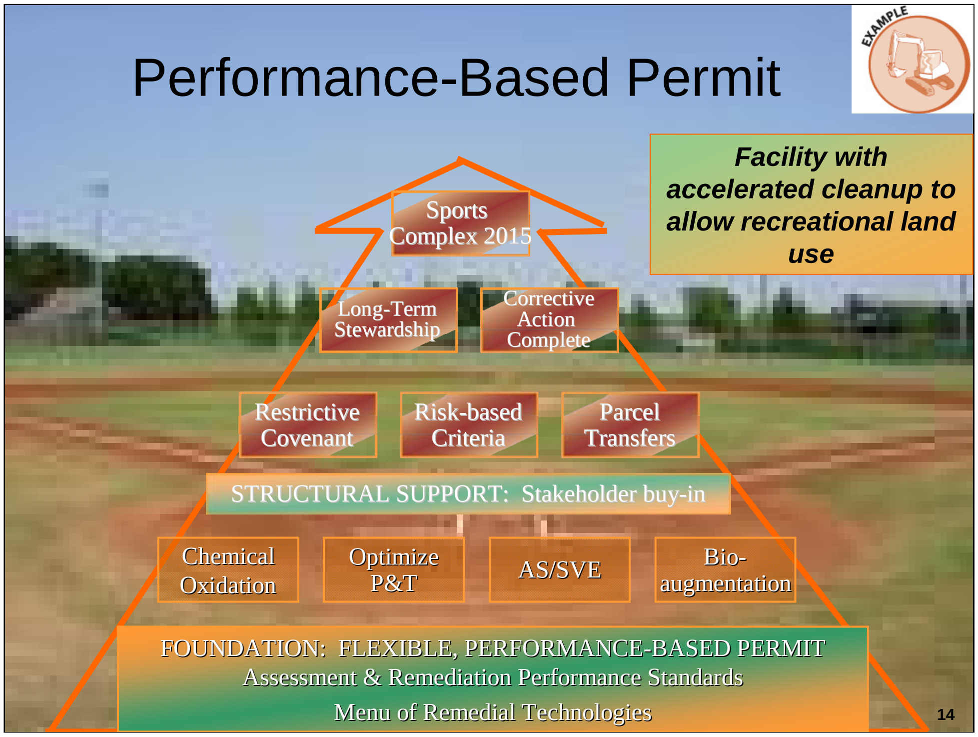
- Provide an example of a successful Facility-lead Agreement.

Key Points

- In 1999, EPA Region 3 identified the University of VA (UVA) as a high-priority facility on its RCRA Government Performance Results Act (GPRA) baseline, and there was no state or federal cleanup mechanism in place with the facility driving investigation and remediation of areas requiring cleanup (if any).
- After inspecting the facility in September 1999 and consulting with the VA Department of Environmental Quality (VDEQ), Region 3 determined that UVA was a good match for conducting CA investigations under the Region's new Facility Lead Program. This was the first such agreement put in place. The Facility-Lead Agreement required UVA to provide a site investigation schedule, a data quality assurance plan, time frames for achieving environmental indicators (EIs), and a plan for public participation. UVA was identified as a good candidate for the program as it had voluntarily begun to investigate its past waste disposal practices.
- As described in the EPA Region 3 Success Story documentation for this site, completion of the Facility-Lead Agreement took 2 months compared to an estimated 20 months to negotiate a 3008(h) consent order or to issue a Unilateral Administrative Order (UAO).
- UVA completed all field investigation activities, including three rounds of groundwater sampling and submitted a final report in October 2001. EPA conducted an additional round of sampling in May 2002 to verify UVA's results.
- In December 2003, EPA issued a Statement of Basis explaining the findings of the field investigation and EPA's conclusion that there are no unacceptable risks to human health or the environment associated with the facility (O-Hill area). EPA determined that no further CA is necessary and signed a Determination of CA Complete without Controls on March 1, 2004.

References

- EPA. Region 3 Success Story: Facility-Lead Agreement. Expediting RCRA CA at the University of VA. Accessed On-line at: http://www.epa.gov/reg3wcmd/ca/fl_success.htm.
- EPA. Region 3 Facility Lead Program Website. University of Virginia: Region 3 GPRA Baseline RCRA CA Facility Fact Sheet. Accessed On-line at: http://www.epa.gov/reg3wcmd/ca/fl_sites.htm.



Notes:

Purpose of Slide

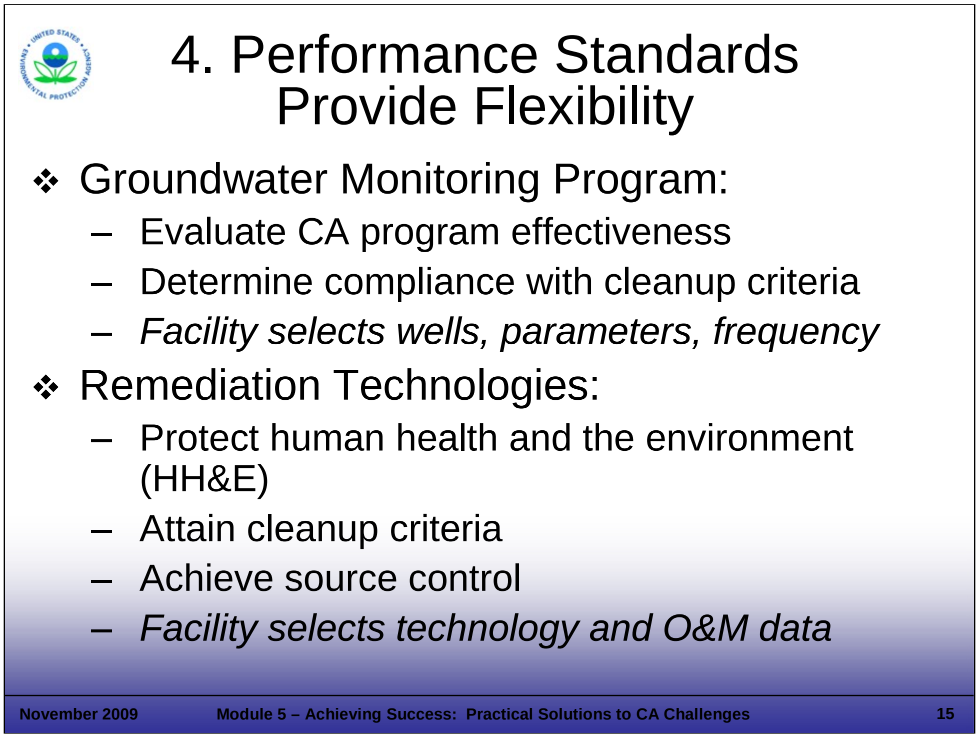
- Demonstrate how a performance-based permit can streamline the CA process. This example shows how a permit was used to support progress. While certain significant treatment system modifications may require permit modifications under 40 CFR 270.42, this course focuses on the flexibility that can be built into permits, through up-front planning. Examples are provided to illustrate how adjustments to field activities and treatment technologies can be planned for by including clear and appropriate performance standards in permits. The facility can then make changes within the specified parameters and report the changes to the agency, which provides review and oversight during the implementation process.

Key Points

- This slide was used earlier to introduce the concept of an Exit Strategy.
- The facility envisioned implementing one or more remediation technologies after the permit was issued, but it had not yet selected the technology. To eliminate the need for a future permit modification while meeting the need for public participation, several technologies were included in the permit application and CMS. No public comments were received and the permit was issued.
- The permit allows for any of the specified technologies to be implemented, as long as: (1) the technology meets performance standards established in the permit, (2) there is a 60-day notification to the State agency, and (3) the design is sealed by a professional engineer.

References

- None.



Notes:

Purpose of Slide

- Provide an example of how the threshold criteria were used as the underpinning for performance standards in one facility's permit that was structured to provide regulatory and technical flexibility. The slide lists the performance standards in the permit. The regulatory agency monitors implementation of the performance standards based on ongoing technical reporting by the facility.

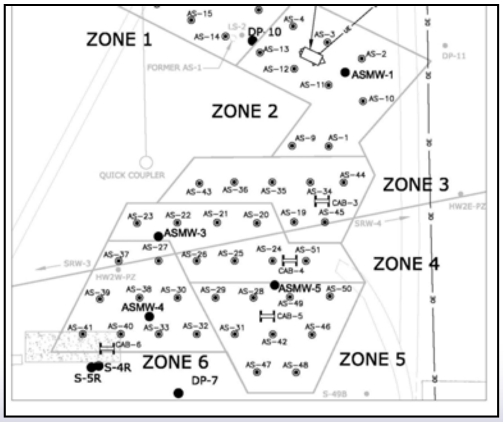
Key Points

- The facility is responsible for maintaining a groundwater monitoring program that meets two performance standards: (1) collect appropriate data for evaluating the effectiveness of the CA program over time and (2) collect sufficient data to evaluate compliance with cleanup criteria.
- The permit allows the facility flexibility in demonstrating compliance with the performance standards by simply specifying that water levels and water quality samples are collected at sufficient well locations, for appropriate chemical and physical parameters, and at appropriate frequencies. The facility may modify wells, parameters, and frequency over time, as long as the performance standards continue to be met.
- The facility is responsible for maintaining a remediation system that meets three performance standards: (1) protect human health and the environment (HH&E), (2) attain media cleanup standards, and (3) control sources. (These standards are the EPA threshold criteria.)
- The facility incorporated alternative technologies in the permit (for example, air sparging, bioremediation, and excavation). As long as performance standards are met, one or more of these technologies can be implemented or the existing system can be modified, with 60 days notice to the State. No permit modification is needed for these changes; they are reported in the next routine monitoring report.
- The permit allows the facility flexibility in demonstrating compliance with the performance standards by simply specifying that the facility collect sufficient analytical, hydrologic, and O&M data, rather than specifying exactly what data should be collected.

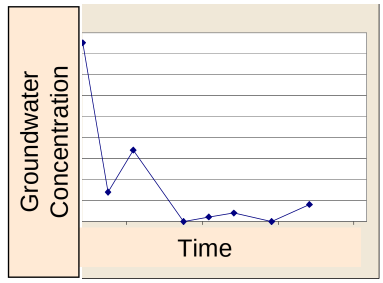
References

- None.

Success Achieved through use of Performance Standards



Modular Air Sparge System



Effective Bioremediation

November 2009 Module 5 – Achieving Success: Practical Solutions to CA Challenges 16

Notes:

Purpose of Slide

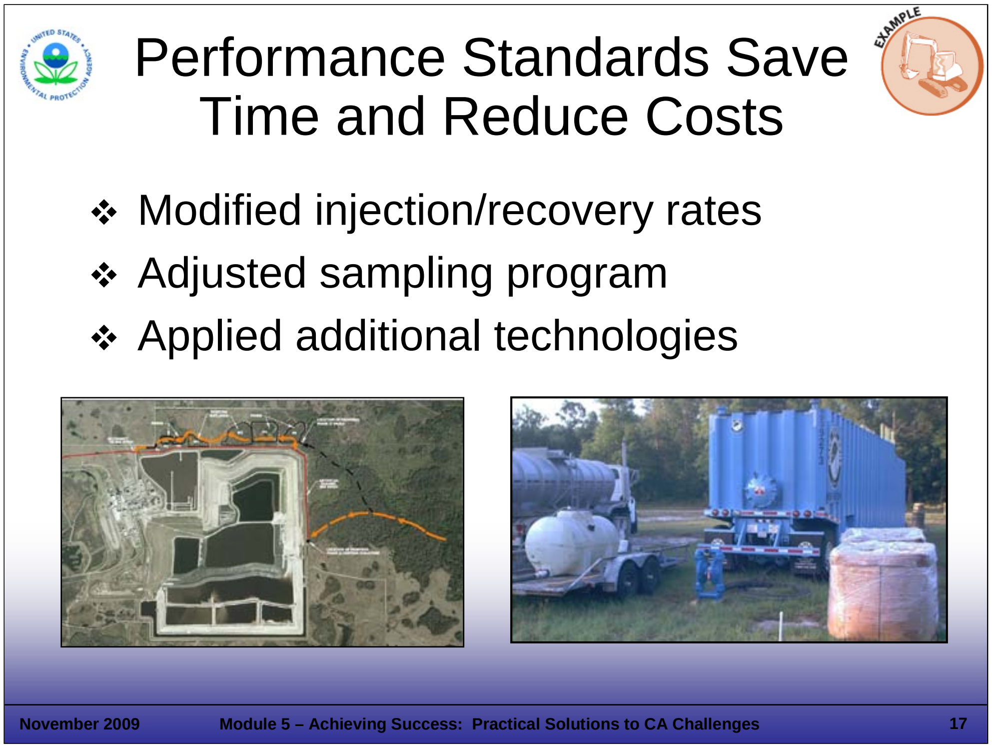
- Establishing performance standards in this facility's permit allowed the facility to make day-to-day decisions using pre-established criteria in the permit and to implement them without need for formal approvals.

Key Points

- By including multiple technologies in the permit, the following could be implemented without a permit modification and the associated cost and wait time for processing the modification:
  - Air sparge (implemented in a modular manner, as shown on the left, so portions could be turned off as the plume reduced in size); and
  - Bioremediation (graph shows order-of-magnitude drop in concentration levels).
- Use of performance standards allowed the following to be implemented without the need for permit modifications:
  - Modification of the existing pump and treat system (combined influent lines, turned off wells where cleanup complete, added recovery wells where necessary);
  - Effective implementation of pilot tests, full-scale implementation, and modifications/adjustments of new technologies; and
  - Adjustment of groundwater monitoring wells and sampling parameters over time.
- Faster, more efficient implementation of the remedy reduced the cleanup timeframe by 15 years and the estimated costs by $3 million. Savings were achieved in sampling, operational (energy), and maintenance costs.

References

- None.



Notes:

Purpose of Slide

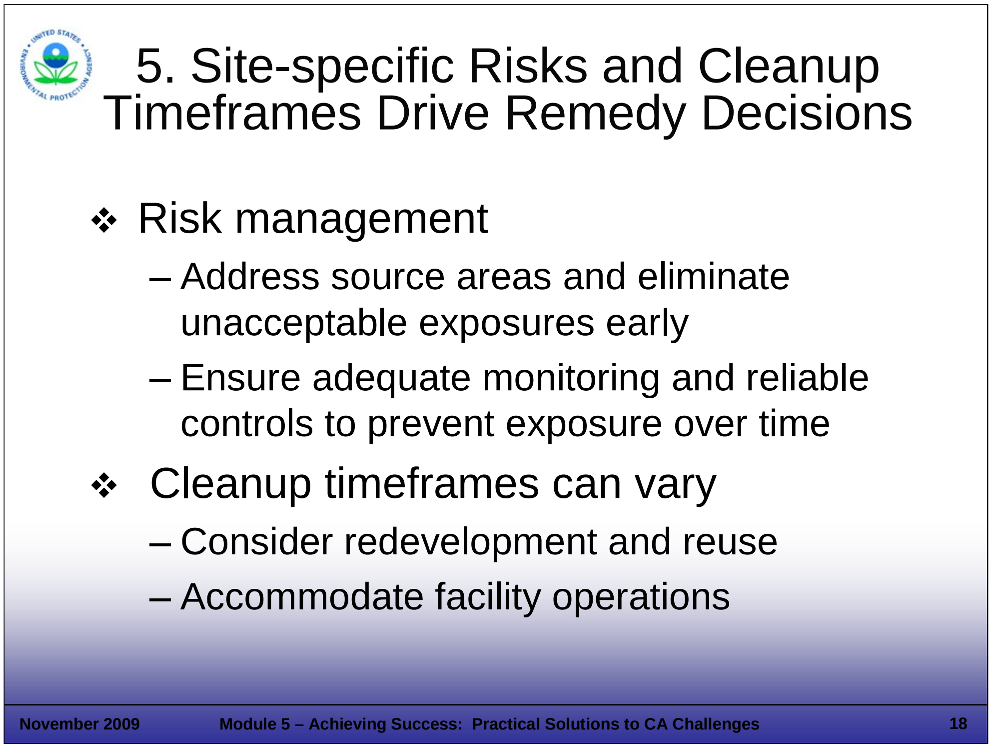
- Continue example.

Key Points

- By employing a performance standards approach, substantial savings in time and dollars were realized by efficiently making monitoring system and remediation system adjustments, without the need for formal regulatory approvals or permit modifications. This approach allowed:
  - Modifications to the existing remediation system, including changing groundwater recovery and injection rates, as cleanup progressed. The photograph on the left shows rerouting of treatment lines to improve operational efficiency. With energy and other operational costs running over $40,000 per month, combining influent from active groundwater recovery wells (many of which were shut down as the plume reduced in size) resulted in substantial savings.
  - Reduction in the number of groundwater monitoring wells and sampling parameters over time.
  - Efficient implementation of additional remediation technologies, such as bioremediation (right photograph). Adding bioremediation reduced the total time to reach cleanup criteria by over 20 years, as predicted by fate and transport modeling.
- Remediation systems can cost hundreds of thousands of dollars annually to operate. Efficient use of agreed-upon performance standards in place of lengthy regulatory review & approval cycles allows facilities to make timely decisions and changes to the remedy. This approach can result in a net improvement of environmental conditions, while, at the same time, saving substantial time and costs.

References

- None.



Notes:

Purpose of Slide

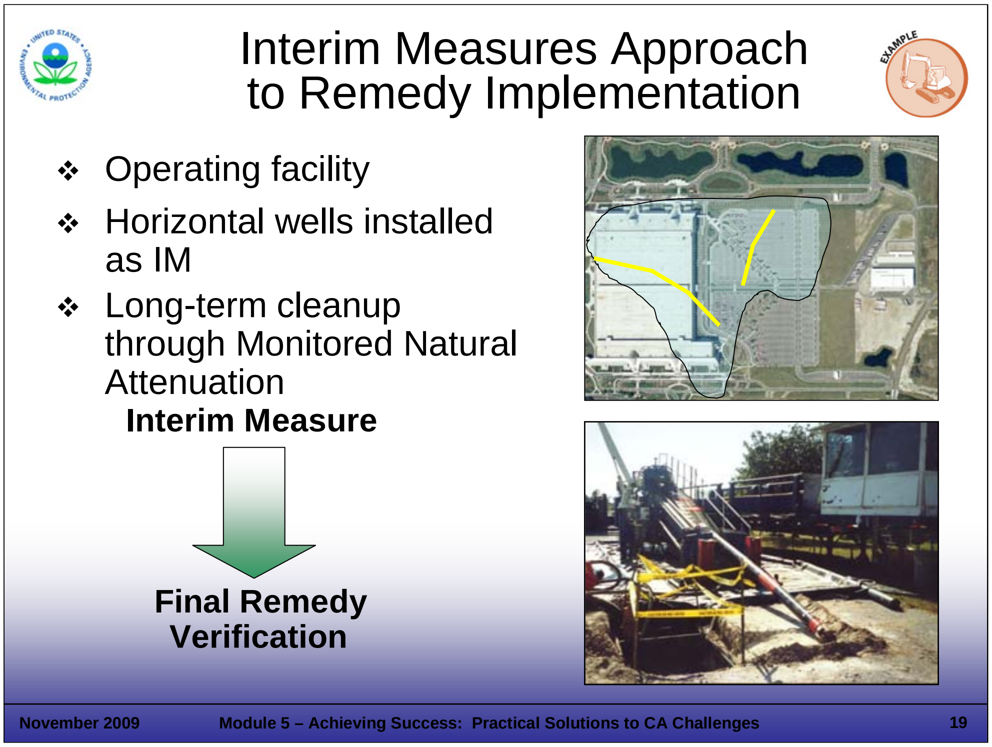
- Discuss several concepts associated with remedy selection and appropriate timing in CA.

Key Points

- Risk management – Immediate risks to human health and the environment (HH&E) presented by a site should be addressed in the short term (for example, remediating a source area near occupied buildings or intercepting a groundwater plume moving toward groundwater users). However, when the site has addressed short-term threats and is relatively stable (for example, EIs for controls on human exposure and groundwater have been achieved), a number of site-specific factors should be considered when evaluating an appropriate cleanup timeframe. Adequate monitoring and reliable controls must be implemented to prevent exposure, where longer-term cleanup approaches are implemented.
- Cleanup timeframe – The cleanup timeframe should be based on site-specific considerations of risk and other factors such as anticipated long-term site use and remediation costs. Examples of factors that can impact the timing of remedies include:
  - Redevelopment and reuse – A facility may want to expedite the schedule for cleanup of certain areas on a site in order to sell those parcels or change the land use (for example, from industrial to residential).
  - Operating facilities – Most of the RCRA facilities in the 2020 CA Universe will continue to be operating facilities, with little or no anticipated changes in use. For these facilities, where the current and anticipated use will continue to be industrial or commercial and the facility is adequately controlling contamination migration and exposure, a fair amount of flexibility should be used in deciding on the applicable cleanup schedules and timeframes. An operating facility's remedy should be designed based upon consideration of its ongoing industrial use.

References

- EPA. 2004. Handbook of Groundwater Protection and Cleanup Policies for RCRA Corrective Action for Facilities Subject to Corrective Action Under Subtitle C of the Resource Conservation and Recovery Act. Update. EPA 530-R-04-030. April.
- EPA. 2003. Results-Based Approaches and Tailored Oversight Guidance for Facilities Subject to Corrective Action under Subtitle C of the Resource Conservation and Recovery Act. EPA 530-R-03-012. September.



Notes:

Purpose of Slide

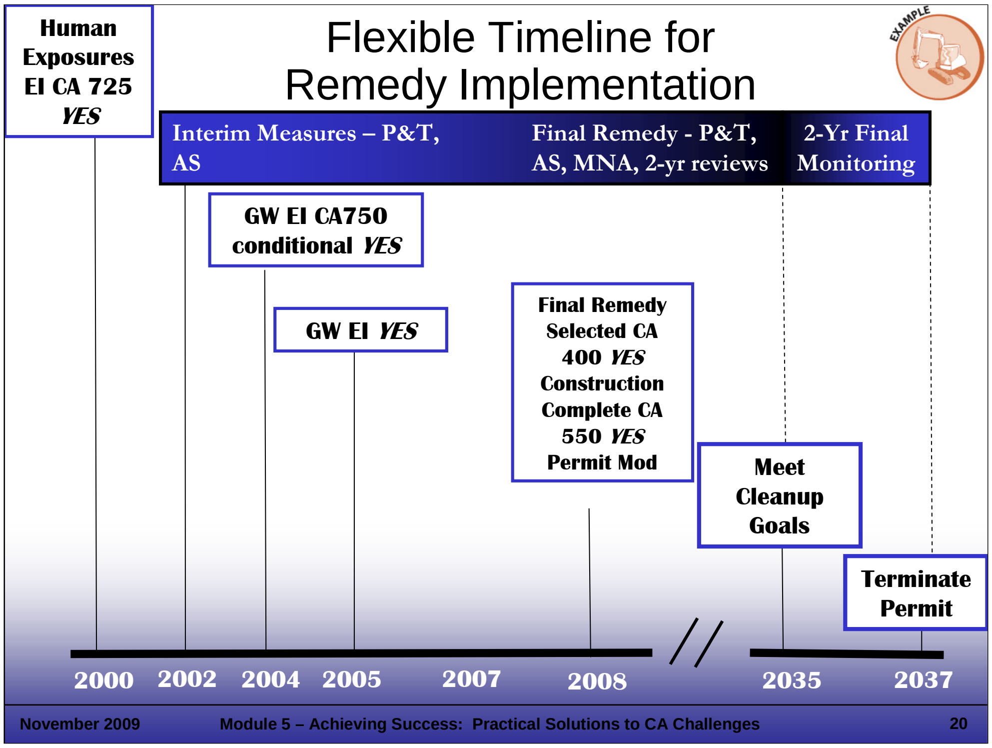
- Present a case study of how a short-term stabilization approach was implemented through an IM to achieve source control and facilitate long-term cleanup of the site.

Key Points

- This operating CA facility had a high-concentration VOC plume in the central portion of the site, underlying an existing building.
- The facility proposed horizontal recovery wells to capture the VOC source area plume as an IM; EPA and the State subsequently approved this IM.
- Groundwater modeling was performed to verify that the planned IM would support the long-term cleanup goals for the site.
- Because the horizontal wells were installed to control the “hottest” part of the plume, the less-concentrated dissolved plume was able to be addressed using monitored natural attenuation. Together, these actions met the performance criteria for a final remedy (that is, protection of HH&E, containment of the contamination, addressing the source area, and achieving media cleanup criteria over time).
- The facility was able to convert the IM and MNA to a permanent remedy for groundwater at the site through a simple permit modification.
- No CMS was required. A simple verification report was submitted to the regulatory agencies to convert the IM to a final remedy based on system operating information. The same report justified MNA based on the groundwater modeling results for the site.
- Through use of this IM approach, the facility saved 12 months and $100,000 in implementing the remedy compared to what a traditional CMS would have required.

References

- None.



Notes:

Purpose of Slide

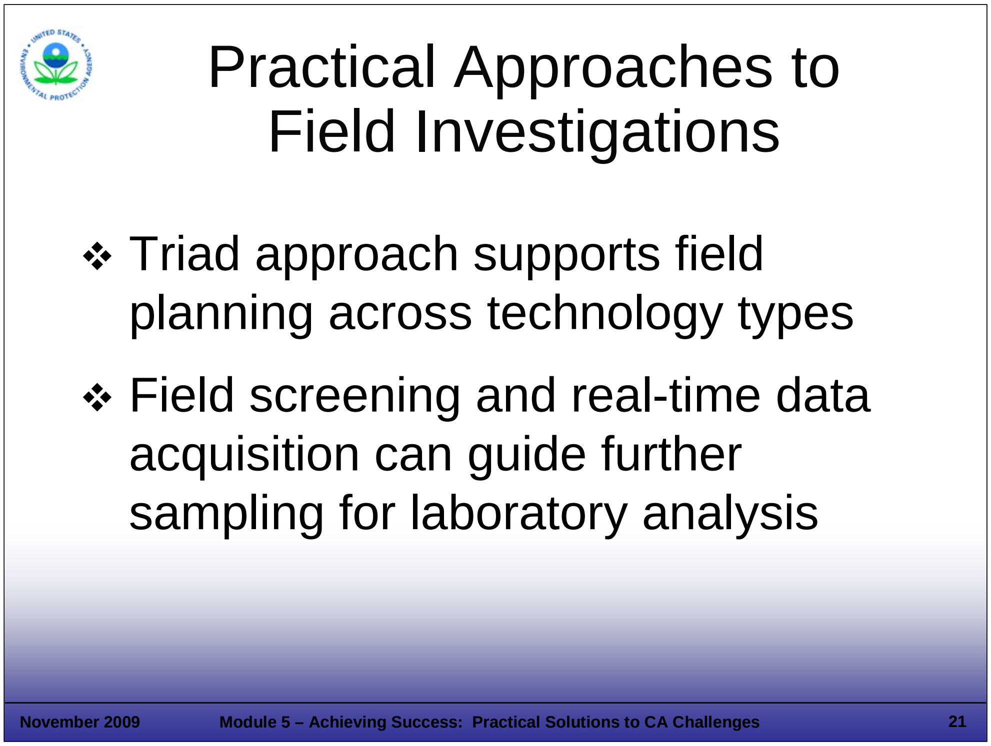
- Present timeline for the previous IM example (focusing on flexible timing).

Key Points

- As shown in the project schedule, the human exposure controlled EI was met in 2000 and the and groundwater EI was met in 2005 following implementation of the IM.
- The facility converted the IM plus MNA to a final remedy through a simple permit modification.
- Construction complete determination was achieved in 2008, well in advance of 2020.
- Because the source area is being effectively controlled by pump and treat and the surrounding plume is being effectively controlled by MNA, the facility is implementing a realistic schedule (with regulator approval) to meet final groundwater cleanup criteria by 2035.

References

- None.



Notes:

Purpose of Slide

- Review some field considerations related to remedy selection and design.

Key Points

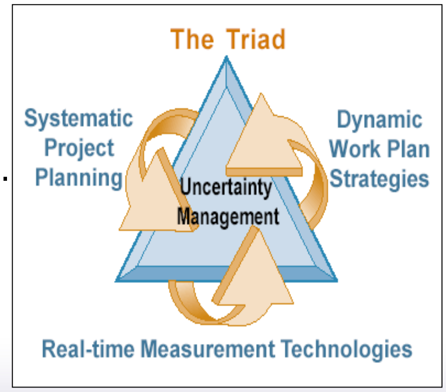
- Field strategies provide the data that will be used to select and design remedies and to monitor their effectiveness. Where presumptive remedies are planned or select technologies are being considered for a site, data collection should focus on those parameters that will support effective design.
- Triad is an EPA approach that can support planning for site data collection in a dynamic and cost effective manner.
- Evolving field sampling and field analysis techniques can supplement standard sample collection procedures and off site laboratory analysis.

References

- None.

Triad Approach

- Field analyses make dynamic work plan strategies possible.
- Real-time decisions are made using real-time data.
- Field-based methods can be more cost effective.
- Laboratory data is not replaced, but supplemented.



November 2009 Module 5 – Achieving Success: Practical Solutions to CA Challenges 22

Notes:

Purpose of Slide

- Describe Triad approach to site investigations and decision-making with an emphasis on real-time measurement technologies.

Key Points

- The Triad approach to decision-making for hazardous waste sites offers a technically defensible method for managing decision uncertainty using innovative characterization tools and strategies.
- Managing decision uncertainty increases confidence that project decisions (about contaminant presence, location, fate, exposure, and risk reduction choices and design) will be made correctly and cost-effectively.
- Systematic planning and dynamic work strategies provide for development of a conceptual site model (CSM) and flexible strategies using real-time measurement systems to guide real-time decisions regarding further investigation and refinements of the CSM.
- A focus on real-time measurement systems using field-based methods may allow more sampling data to be obtained than using conventional approaches because each sample can be collected/analyzed less expensively than a typical sample for off-site laboratory analysis.
- Laboratory analysis is not replaced, but is supplemented by the use of field technologies.

References

- EPA. 2004. Summary of the Triad Approach. White Paper by Deana Crumbling of the Office of Superfund Remediation and Technology Innovation (OSRTI). March 25.
- ITRC. 2003. Technical and Regulatory Guidance for the Triad Approach: A New Paradigm for Environmental Project Management. ITRC Sampling, Characterization and Monitoring Team. December.
- Multi-Agency Web Site. Triad Web Site. Triad Partners include EPA, Argonne National Laboratory, USACE, U.S. Navy, U.S. Air Force, State of New Jersey, and Interstate Technology Regulatory Council.

Practical Field Sampling and Analysis Methods

- Colorimetric Test Kits
- Immunoassay Methods
- Membrane Interface Probe (MIP)
- Direct Push Technology (DPT)
- Passive Diffusion Bags (PDBs)

November 2009 Module 5 – Achieving Success: Practical Solutions to CA Challenges 23

Notes:

Purpose of Slide

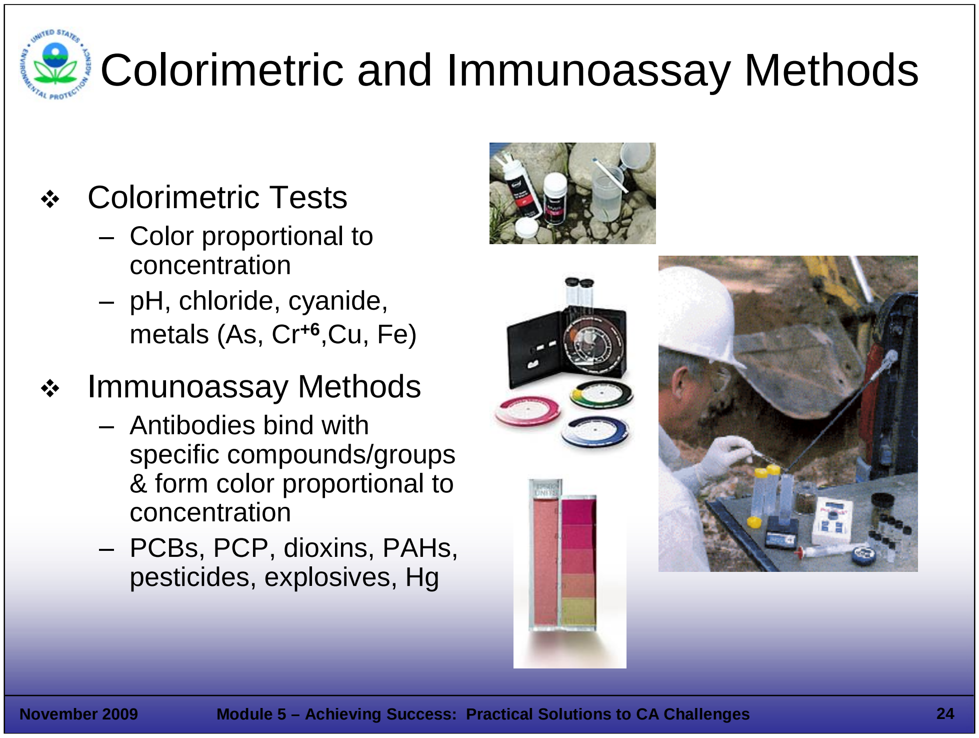
- List assessment procedures for evaluating and reevaluating the presence and distribution of contaminants (for example, dense nonaqueous phase liquids) as a component of the Triad approach.

Key Points

- A range of field sampling and analysis approaches support sound characterization of sites.
- Membrane Interface Probes (MIP) can be used to detect VOCs in soil/groundwater. The VOCs in the soil/groundwater rapidly diffuse through the heated polymer membrane of the MIP and then are swept by a nitrogen carrier gas to the land surface where VOCs are measured by detectors (e.g., photoionization detectors (PIDs) or flame ionization detectors (FIDs)).
- Direct Push Technology (DPT) uses hydraulic pressure and a rotary hammer to advance sampling devices into the subsurface to collect a series of soil, soil gas, or groundwater readings/samples at different target depths. Mobile laboratories allow some analytical techniques to be performed on-site, providing data that can support decisions regarding further investigation in a shorter time frame.
- Passive Diffusion Bags (PDBs) are comprised of polyethylene bags containing deionized (DI) water. Each bag is suspended on a weighted line next to the well screen where contaminants in the well water diffuse through the bag into the DI water until equilibrium is reached. The bag is then retrieved and emptied into sample bottles for analysis – preferably in a mobile laboratory.

References

- ITRC. 2003. An Introduction to Characterizing Sites Contaminated with DNAPLs. September.
- Multi-Agency Web Site. Triad Web Site. Triad Partners include EPA, Argonne National Laboratory, U.S. Army Corps of Engineers, U.S. Navy, U.S. Air Force, State of New Jersey, and Interstate Technology Regulatory Council.



Notes:

<u>Purpose of Slide</u>

Discuss colorimetric and immunoassay methods for field screening

<u>Key Points</u>

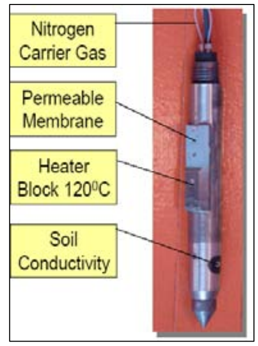
- Test kits are self-contained analytical kits that generally use a chemical reaction that produces color to identify contaminants, both qualitatively and quantitatively.
- Numerous different kits are used in the environmental field, in applications ranging from simple paper test strips used to assay various water quality parameters to sophisticated colorimetric reactions measured by UV fluorescence that give quantitative results for definitive site characterization. Test kits also can be used after an initial site characterization phase to monitor the operating conditions of a remediation system or to confirm that contaminated soils have been removed.
- Immunoassays methods use antibodies that bind with a target compound or class of compounds. Concentrations are identified through colorimetric reactions.

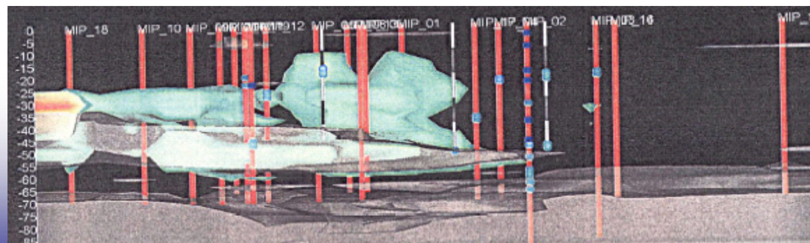
<u>References</u>

- CLU-In Website. Characterization & Monitoring, Test Kits. Accessed at: (http://clu-in.org/char/technologies/color.cfm.
- CLU-In Website. Chharacterization & Monitoring, Immunoassay & Enzymatic Assays. Accessed at: http://clu-in.org/char/technologies/immunoassay.cfm.
- Federal Remediation Technologies Weebsite. Field Sampling and Analysis Technologies Matrix and Reference Guide. Accessed at: http://www.frtr.gov/site/analysismatrix.html.

Membrane Interface Probe (MIP)

- Measures volatile organic compounds (VOCs) in soil and groundwater
- VOCs diffuse through heated permeable membrane
- Collected VOCs swept by carrier gas to land surface and measured by detectors





November 2009 Module 5 – Achieving Success: Practical Solutions to CA Challenges 25

Notes:

<u>Purpose of Slide</u>

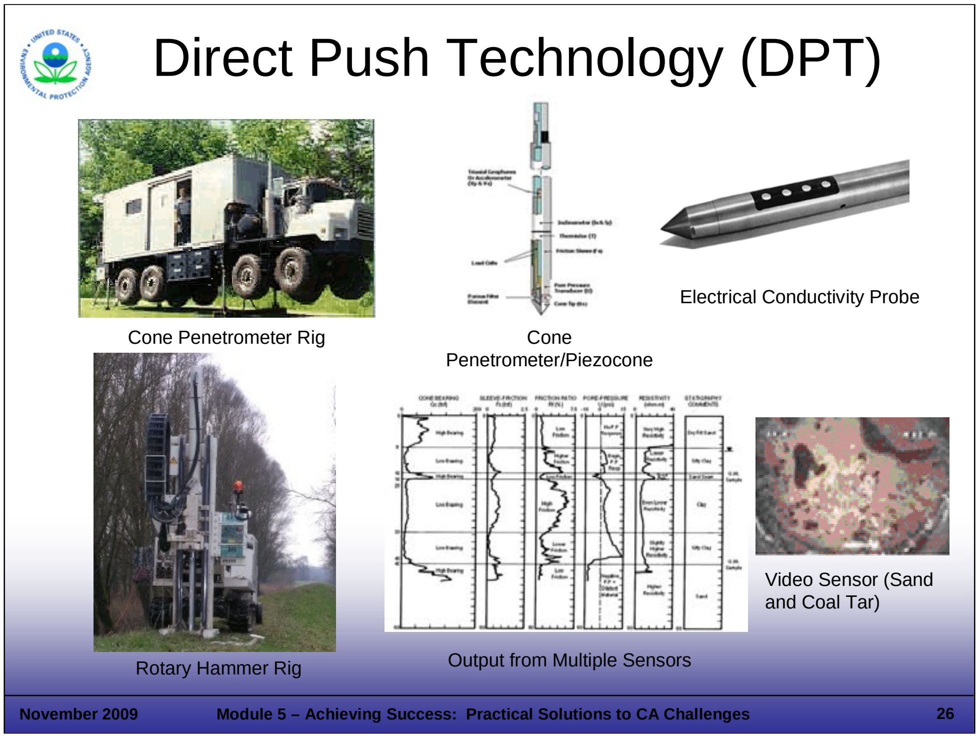
- Show and describe a MIP.

<u>Key Points</u>

- The technique is a rapid method for collecting quantitative VOC concentration data.
- The MIP probe is advanced using DPT to the target sampling depth.
- VOCs diffuse through a heated permeable membrane and then are swept by nitrogen carrier gas to the surface where they are measured by VOC detectors (photo ionization detector, flame ionization detector).
- The MIP is often combined with a soil conductivity probe to interpret lithology, producing a rapid and near real-time picture of the subsurface and contaminant distribution as shown in the above figure.
- When paired with analytical data (e.g., field or fixed lab), the method is reasonably accurate and can be considered semi-quantitative.

<u>References</u>

- ITRC. 2003. An Introduction to Characterizing Sites Contaminated with DNAPLs. September.



Notes:

Purpose of Slide

Describe use of DPT equipment in screening investigations.

Key Points

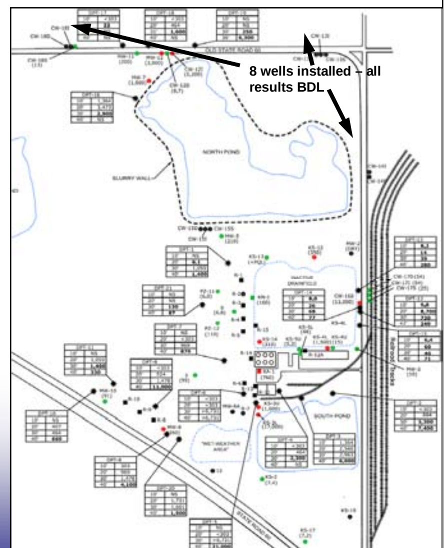
- The two major classes of direct-push platforms are cone penetrometer (CPT) and rotary hammer systems. CPT units advance sampling tools by applying a hydraulic ram against the weight or mass of the vehicle. Rotary hammer units add a hammer to the hydraulic ram to compensate for their lower mass.
- CPT and rotary hammer platforms fill different niches in the environmental field. CPT rigs can generally push to greater depths and push larger-diameter rods. Rotary hammer rigs are smaller, more portable, and require less training to use; they allow samples to be collected from places, including inside of buildings, that are inaccessible to a CPT rig.
- Geotechnical tools such as the CPT, piezocone, and electronic conductivity probe (shown above) are used to measure geotechnical properties of soils and groundwater held in soil pores.
  - The CPT measures resistance to penetration (tip resistance) and friction on the sides of the probe as it advances – soil type can be inferred from the readings of tip resistance and sleeve friction.
  - The piezocone measures pore pressures to estimate hydraulic conductivity
  - The conductivity probe measures the ability of soils to conduct an electrical current, a property which correlates with soil type. This can also be used to detect the significant change in conductivity caused by the presence of NAPL.
  - Use of multiple sensors, as shown in the figure above, allows the most accurate profiling of subsurface materials.
  - Downhole video imaging using miniature cameras allows visual characterization of soils, observation of features like fractures, and confirmation of free product, such as in the photo above.

References

- CLU-In Website. Characterization & Monitoring, Geotechnical Sensors. Accessed at: (http://clu-in.org/char/technologies/dpgeotech.cfm.

DPT/Chloride Screening

- DPT plus chloride field screening used to "chase" contamination
- Previous investigations used expensive monitoring wells
- Conceptual site model revised after study



November 2009 Module 5 – Achieving Success: Practical Solutions to CA Challenges 27

Notes:

Purpose of Slide

Provide example of effective use of DPT and field screening methods for site characterization.

Key Points

- In the last slide, we talked about use of DPT for geotechnical evaluations of soil properties. In this example, DPT groundwater sampling and field screening were used to delineate chloride contamination in groundwater.
- This site had been characterized historically by installing a series of shallow, intermediate, and deep wells in an attempt to delineate the contamination. As shown above, samples from a number of these wells have not detected any chloride, an expensive way to obtain that information. Because of the high cost of well installation, there were large portions of this 200+ acres site that had not been adequately characterized.
- DPT groundwater sampling involves pushing a small-diameter hollow steel rod into the ground to a selected depth and extracting a small water sample. The DPT sampling tool is hydraulically driven into the soil to the appropriate sampling depth below the water table, where an outer cylinder on the tool is pulled back, exposing a perforated stainless steel sample entry barrel. Hydrostatic pressure forces groundwater into the sample compartment and the probe is pulled to the surface to retrieve the sample.
- The DPT survey was conducted over a one-week period using a small rotary hammer rig like the one shown above to obtain groundwater samples at multiple depths (10-50 feet below ground surface) and at several dozen locations. The water samples were screened in real time by the field geologist using chloride test strips to determine the next sample depth or sampling location. Ten percent of the screened samples were sent to a lab for standard analysis; the correlation with screening results was good.
- As a result of the investigation, the previous site conceptual model was significantly changed:
  - Chloride was previously thought to be concentrated in the upper 25 feet of the aquifer because of an underlying semi-confining layer. Vertical screening of the groundwater across the site showed high chloride levels at greater depths.
  - Screening of off-site groundwater showed elevated chloride, which had not been previously shown.
  - Significant gaps between existing monitoring wells were characterized, giving a much better understanding of chloride distribution across the site.

References

None.

Passive Diffusion Bag

- VOC sampling of groundwater
- Permeable bag containing deionized water
- Contaminants diffuse into DI water
- Bag retrieved from well and sampled

Notes:

Purpose of Slide

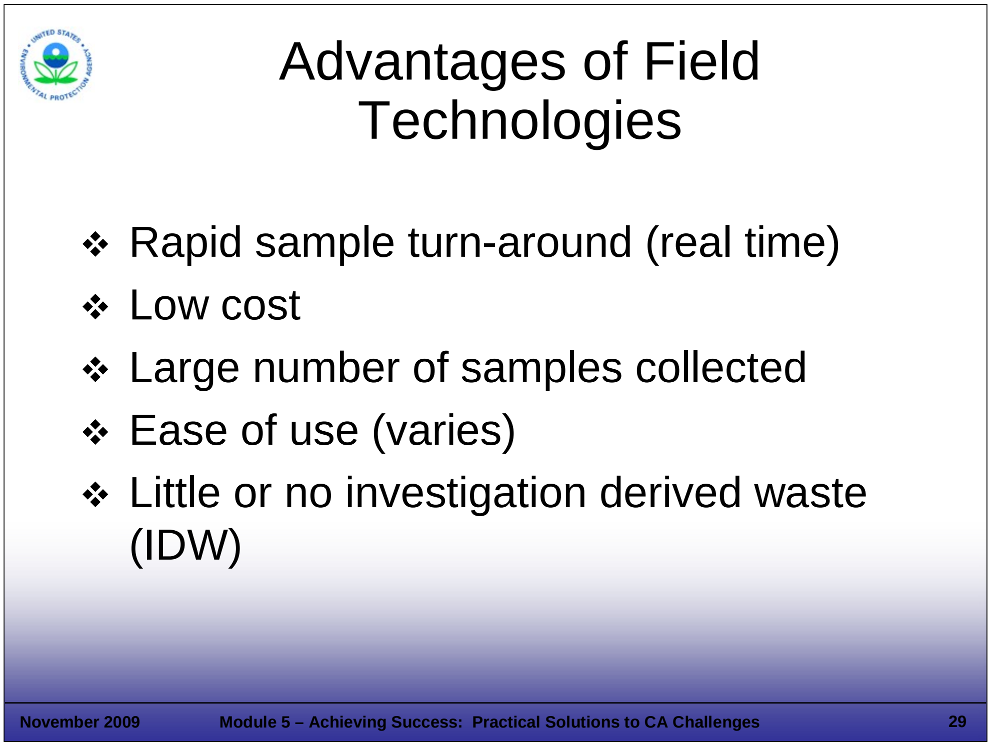
- Describe the use and advantages of passive diffusion bags (PDBs).

Key Points

- PDBs are used for VOC sampling of groundwater.
- A permeable polyethylene bag contains deionized (DI) water.
- The PDB is suspended on a weighted polypropylene line next to the well screen.
- Wells with long screens can have more than one PDB on the same or different lines.
- Contaminants in well water diffuse through the bag into DI water until equilibrium is reached .
- The PDB is retrieved from the well and emptied into sample bottles.
- Use of PDBs generally cuts labor & sampling equipment costs by over 50%.
- Because wells do not have to be purged before sampling, almost no investigation-derived waste is produced compared to traditional sampling methods.

References

- ITRC. Diffusion Sampler Page of Website. Accessed on-line at: http://www.itrcweb.org/teampublic_DPS.asp.



Notes:

Purpose of Slide

- Describe some advantages and disadvantages of the field technologies included in the previous slides.

Key Points

- The key advantages of these types of technologies include: real-time sample results, reduced costs, increased speed, and little if any investigation derived waste (IDW).
- Disadvantages include that these technology may be appropriate for only limited depths, may require additional or specialized training, and the data are not quantitative.

References

- ITRC. 2003. An Introduction to Characterizing Sites Contaminated with DNAPLs. September.

Summary

- To achieve progress, focus on practical solutions that protect HH&E.
- Practical solutions consider current and reasonably anticipated uses.
- Triad and field-based investigation approaches are available to support progress.

Notes:

Purpose of Slide

- Review key points included in Module 5, Achieving Success: Practical Solutions to CA Challenges.

Key Points

- Review the key points from the module.

References

- None.