"Regulatory Acceptance for New Solutions"

RPO
Remediation Process Optimization

Outline

- All about ITRC
- Introduction to RPO
- Regulatory Overview of RPO
- Elements of RPO
- Evaluating Performance & Monitoring
  - BREAK
- Remedy and Monitoring Optimization
- Cost benefit analysis
- Implementation & Tracking
- Stakeholder and Federal RPO Programs
- Case Study
- Summary and Conclusions

Purpose of ITRC

ITRC is a state-led, national coalition of regulators and others working to

- Improve state permitting processes and
- Speed implementation of new environmental technologies

Goals

- Achieve better environmental protection through innovative technologies
- Reduce the technical/regulatory barriers to the use of new environmental technologies
- Build confidence about using new technologies

Other Participants

- Industry representatives
- Academia
- Public stakeholders
- Federal agencies
  - U.S. Department of Energy
  - U.S. Environmental Protection Agency
  - U.S. Department of Defense
- Host organization
  - Environmental Council of the States
- State organizations
  - Western Governors' Association
  - Southern States Energy Board

Products & Services

- Regulatory and Technical Guidelines
- Technology Overviews
- Case Studies
- Peer Exchange
- Technology Advocates
- Classroom Training Courses
- Internet-Based Training Sessions

State Engagement Program

- Ensures ITRC documents are available, understood, and used
- Promotes multistate concurrence of technical and regulatory guidelines
- Coordinates Internet-based training
- Documents ITRC's successes
- Promotes regulatory innovation
- Promotes peer exchange

Benefits to States

- Access to peers and experts in other regulatory agencies
- Shortened learning curve by obtaining advance knowledge of new and used technologies
- Cost-effective involvement in demonstrations conducted in other jurisdictions
- Sounding board for problem solving
- Information and technology transfer
- Maximize limited resources
- Personal and professional development

Benefits to Industry

- Forum conducive to advancing technology and solutions
- Insight into the regulatory world
- Access to multiple state entities
- Opportunity for broader review of technology
- Unique and cost-effective approach to demonstration and deployment of new technology
- Mechanism to identify and integrate regulatory performance expectations among states

Benefits to DOE

- Facilitates interactions between DOE managers and state regulators
- Addresses DOE's remediation needs (metals, organics, asbestos, mixed waste)
- Several technical teams are dedicated to problems of particular concern to DOE

Benefits to DOD

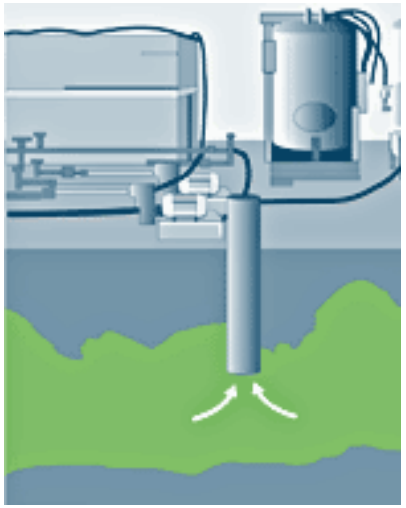
- Facilitates interactions between DOD managers and state regulators
- Addresses contaminants of concern to DOD (heavy metals, VOCs, PAHs, organic pesticides, solvents, etc.)
- Technical teams dedicated to problems unique to DOD (UXO, Small Arms Firing Range)

Benefits to USEPA

- Forum to facilitate idea sharing between regulators at the federal and state levels
- Unique and cost-effective approach for demonstrating and deploying new technology
- Mechanism for identifying and integrating regulatory performance expectations among states

Overview

- Who is the audience for this workshop?
- What to expect from this workshop?
  - RPO defined
  - Regulatory environment
  - The elements of RPO
  - Agency perspectives on RPO
  - Case studies
- Questions and answers



What is RPO?

Remediation Process Optimization (RPO) is the systematic evaluation and enhancement of site remediation processes to ensure that human health and the environment are being protected over the long term at minimum risk and cost.

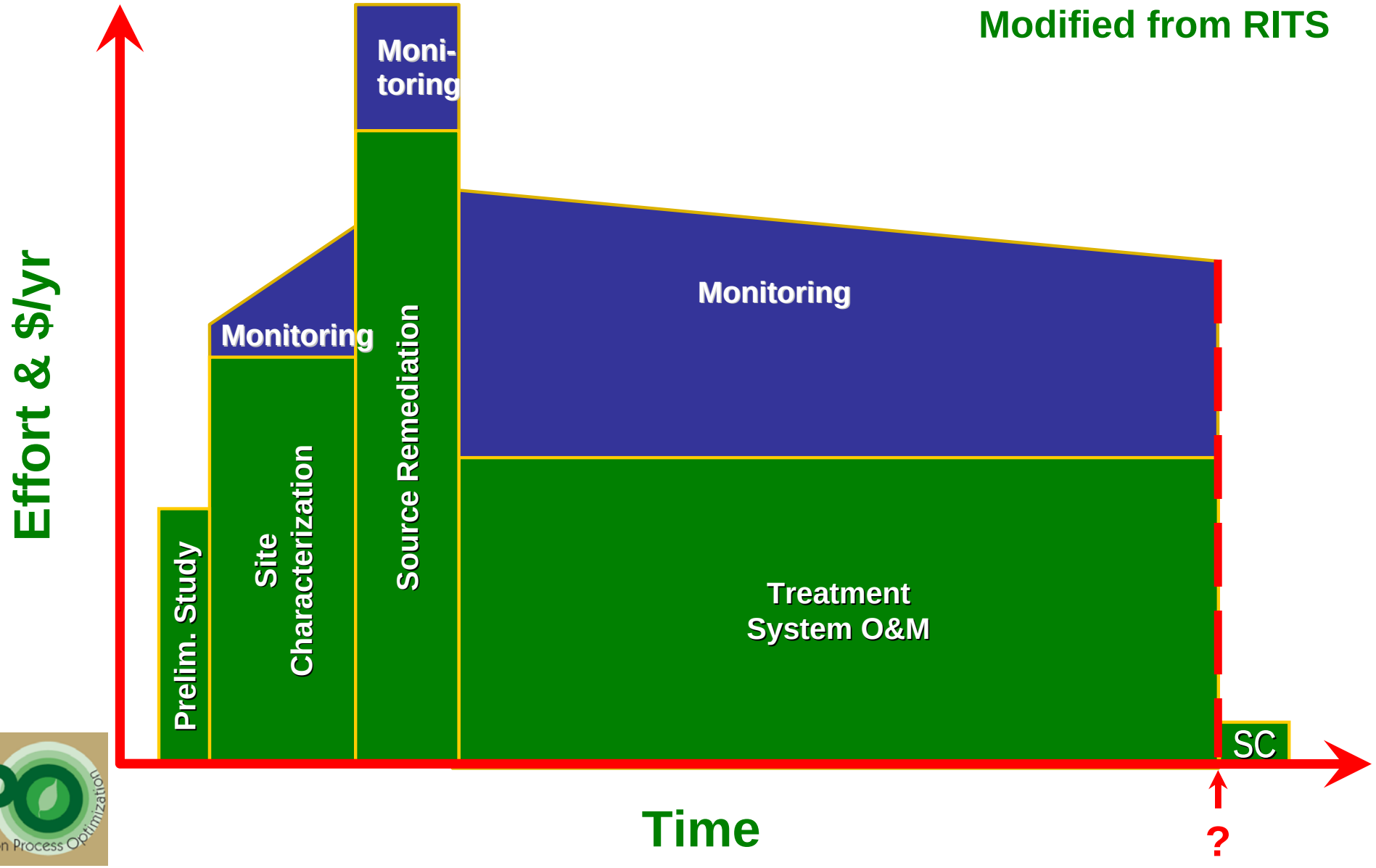
What is RPO?

- Some of the key underlying principles of RPO are:
  - Uncertainties are identified.
  - Protectiveness is the foremost objective.
  - A clear exit strategy is re-evaluated and articulated.
  - The assessment team is independent and multi-disciplined.
  - Cost efficiency is evaluated, but is not the primary goal.
  - Periodic updates occur.

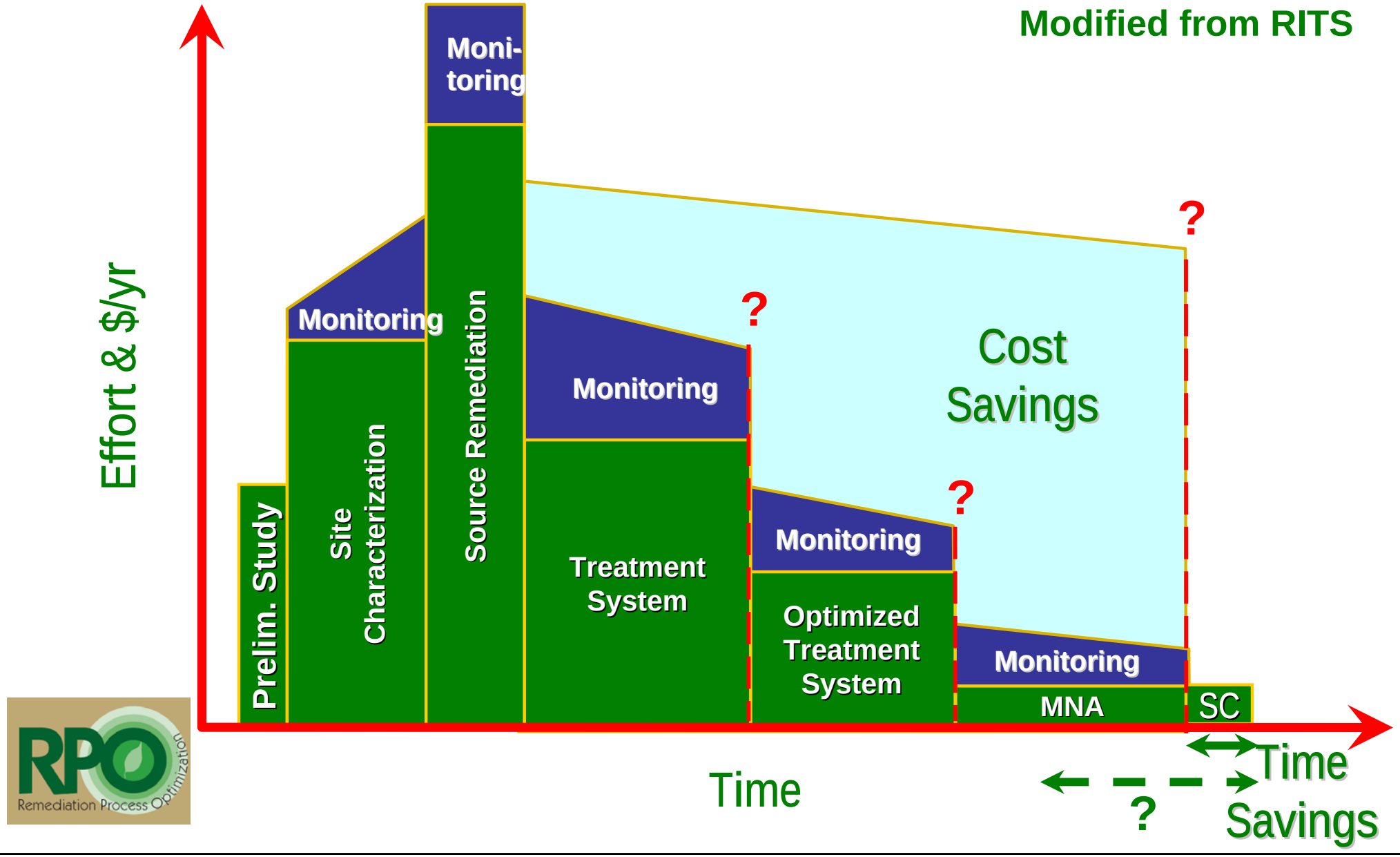
Why RPO?

- Federal, state, and private-sector organizations are spending billions of dollars to achieve cleanup of the environment.
- Throughout the remedial process, environmental conditions become more apparent and resources (not just financial) continue to diminish.
- New innovative remedial technologies are continuously being developed.

Typical Remediation Actions



Remediation Action with RPO



Regulatory Overview of RPO

- RPO can be viewed from an engineering or process perspective.
- The regulator or practitioner of RPO must take into account the regulatory environment.
- CERCLA, RCRA, and State-equivalent programs all contain common elements that support RPO.

CERCLA and RPO

- The CERCLA process involves the Feasibility Study (FS), Record of Decision (ROD), Remedial Design (RD).
- Optimization is considered throughout each of these phases and is implemented during subsequent phases.
- RPO evaluations are conducted during the Remedial Action (RA) operations and Long-Term Monitoring (LTM) phases.
- ROD changes are sometimes needed to implement RPO recommendations and are often made when:
  - There are changes in the understanding of site conditions.
  - The understanding of the remedial technology changes,
  - Costs can be reduced without effecting protectiveness.

CERCLA and RPO

- Under CERCLA, fund-led sites have a limited time in which Federal funds can be used, and afterwards the site costs are borne by the states as O&M. Since states have finite resources, RPO could greatly improve their ability to manage these O&M costs.
- Both the EPA and DOD have remedial optimization processes in place that are similar to RPO and are supported under CERCLA.
  - EPA utilizes process called Remediation Systems Evaluation.
  - DOE offers guidance on technology selection optimization.
  - Each DOD component has a specific program for implementation of optimization in both the RA operations and LTM phases.

RCRA and RPO

- The value of RPO process applies both to the regulated community and to environmental regulators.
- States may or may not be able to actively participate in or initiate RPO.
- RCRA permitting framework contains provisions for periodic assessment, however, this is not as extensive as RPO.
  - Careful review of semi-annual effectiveness reports.
  - Facility initiated permit modifications.
  - Incorporating flexibility into permit at beginning of the process.

State Regulatory Programs and RPO

- States often are delegated authority under RCRA or CERCLA to conduct site cleanup operations and often have their own specific regulatory framework. These operations may be either:
  - Publicly funded site remediation, or
  - Through responsible party oversight.

- As a result, states should have a high level of interest in the RPO process.

State Regulatory Programs and RPO

- No known direct references to RPO within state regulations, but many states have regulatory flexibility to pursue RPO.
  - Institutional control reviews can be broadly approached to include RPO.
  - Financial assurances can be a driver to increase efficiency.

Elements of RPO

- Site selection
- Building the RPO team
- Evaluating the exit strategy
- Evaluating performance
- Evaluating cost efficiency
- Remedy optimization
- Monitoring optimization
- Cost benefit analysis
- Implementation & tracking

Figure 1: Overview of Conducting an RPO Evaluation

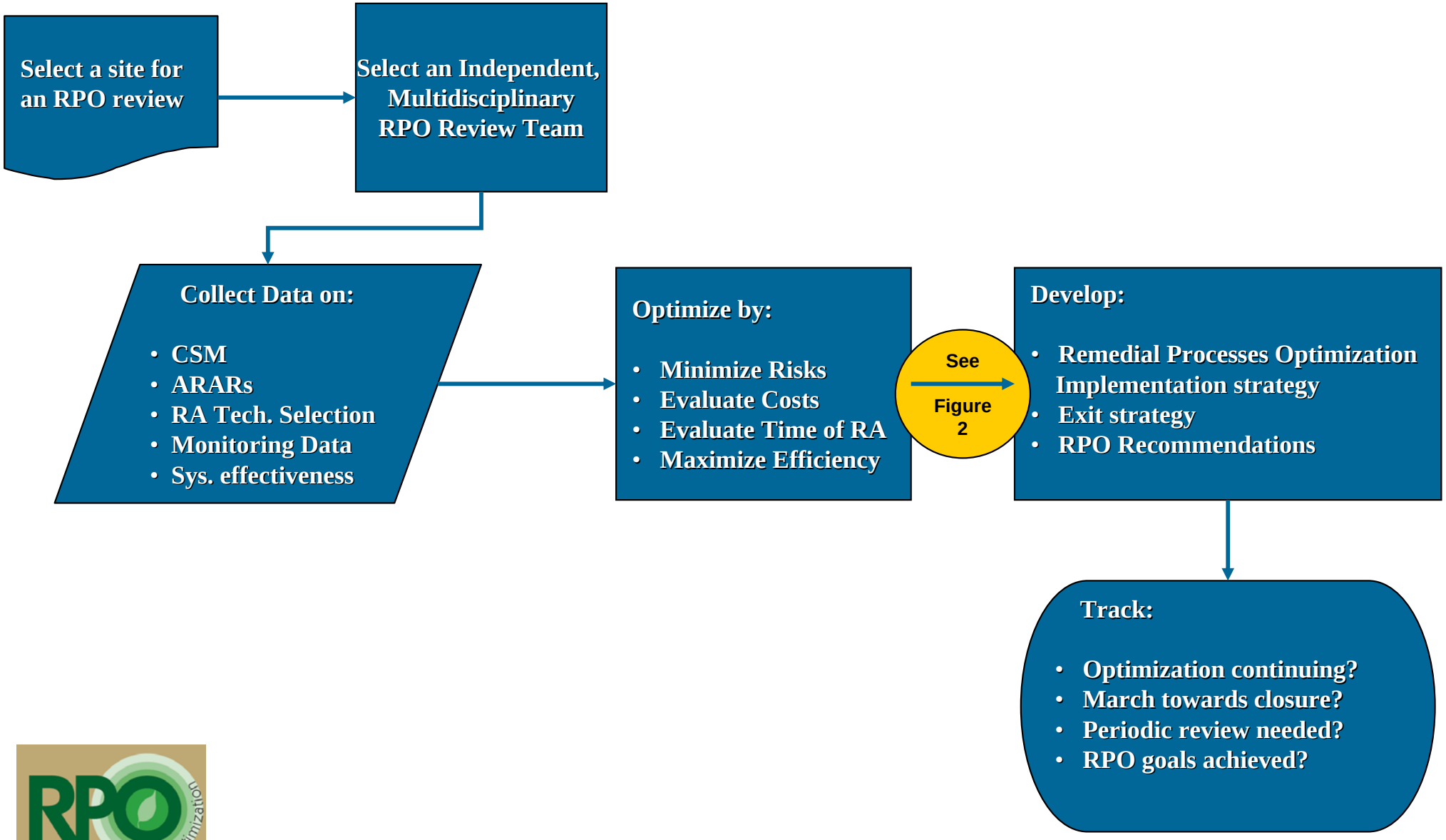
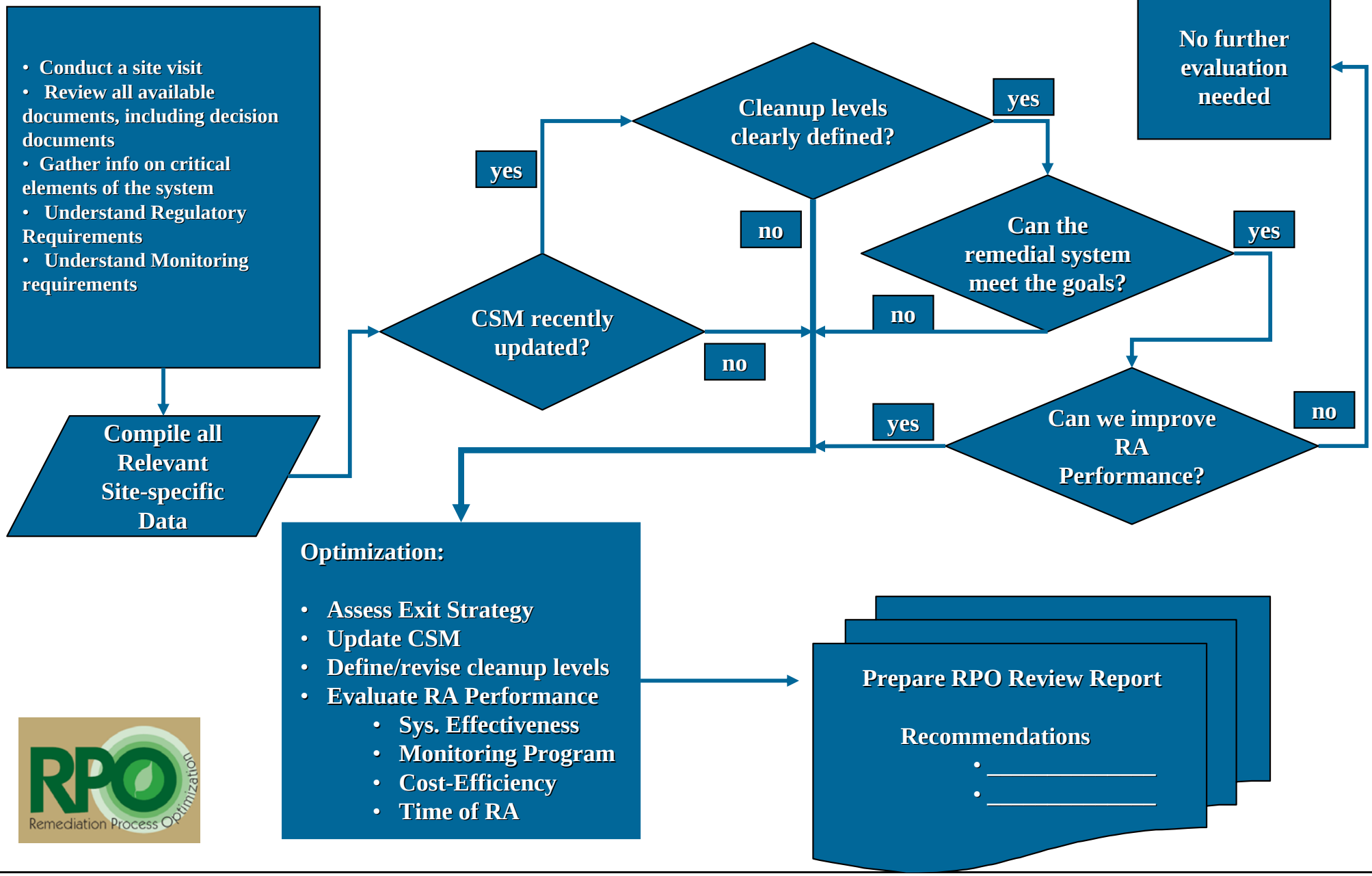


Figure 2: Process Elements of an Optimization



Site Selection Criteria - Overview

- Virtually all long-term remedial action sites can benefit from RPO.
- RPO redirects attention to potentially overlooked O&M issues.
- RPO reassures stakeholders.
- RPO does have upfront costs.
- RPO should help, not hinder, site managers & regulators.

Building the Team

- Diverse team of experts
- Regulatory Specialists, Engineers, Geologists, Risk Assessors, Chemists, Modelers, Statisticians, Field Experts, etc.
- Prior to visit review?
- Site consultant?
- Site regulator?
- Small or large team?

Site Selection Criteria - Prioritization

- There are three primary criteria for prioritizing RPO:
  - Concerns about the current system meeting its goals.
  - Sites where major changes in management approach (change in lead agency, changes in land ownership, etc) are imminent.
  - High Annual O&M costs associated with operation.

- Additional prioritization considerations:
  - Persistent site contaminant sources.
  - Complex site hydrogeology or geochemistry.
  - Sites that have not been optimized in “X” years.
  - Sites where clean-up is projected to take more than 10 years.

- Prioritization is important and is required!

Exit Strategy Assessment

- What is an Exit Strategy?
  - A long-range, documented process for achieving remediation objectives.
  - Includes a decision framework for tailoring the remedy to:
    - reductions or increases in the extent or degree of contamination.
    - other unexpected changes.
  - Developed addressing stakeholder considerations.
  - Includes assigned responsibilities for assessing progress.

Exit Strategy Assessment

- A good Exit Strategy contains:
  - A statement of the remediation objectives and the basis for them.
  - A summary of the conceptual site model.
  - A decision tree or flow chart explaining the decision process.
  - Provisions for periodic re-evaluation of project goals.
  - Means to verify cleanup, including identification of concentration “rebound”.
- Any RPO should include an assessment of the Exit Strategy

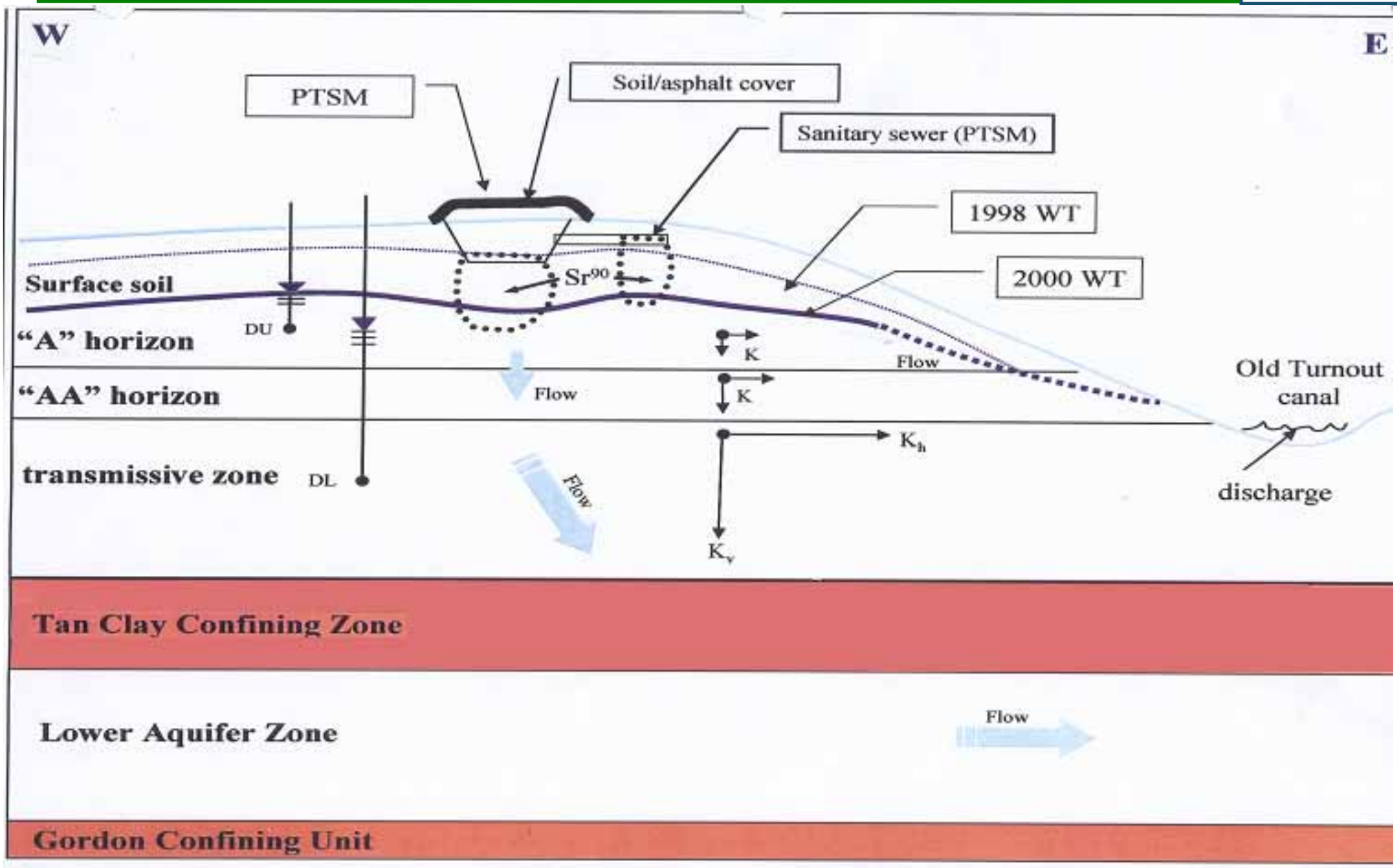
Exit Strategy Assessment

- Evaluating the Remediation Objectives:
  - Found in site decision document.
  - Verify goals are measurable and realistic given conceptual site model and remedy.
  - Realistic goals are ones that can be achieved with current technology in a reasonable timeframe.
  - Objectives may be based on defined standards (e.g., MCLs) or risk-based.
  - Risk assumptions should be verified.

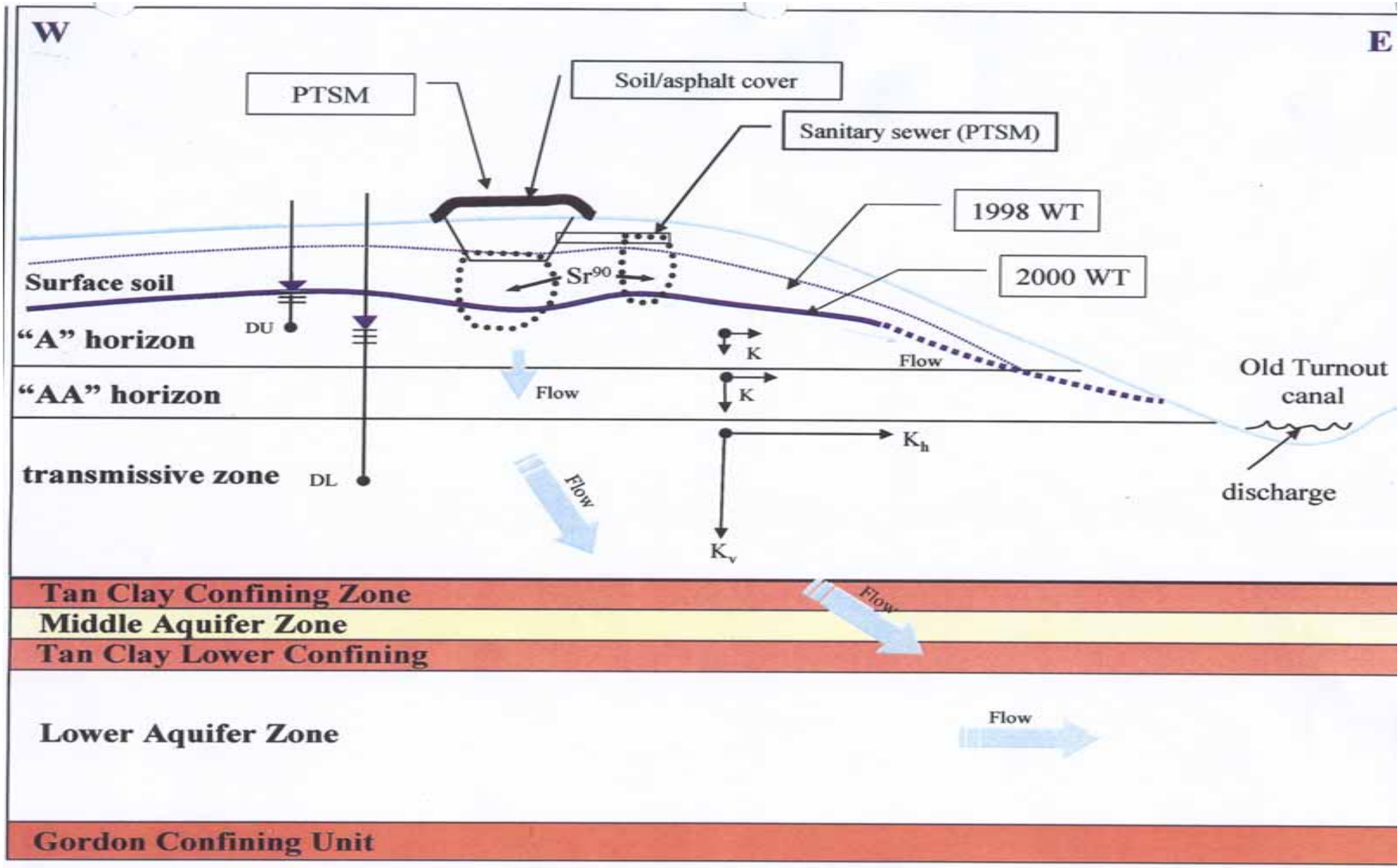
Exit Strategy Assessment

- Evaluating the Conceptual Site Model
  - A CSM includes: nature and extent of site contaminants and their fate and paths to reach receptors, the nature and location of possible receptors, effects of current or planned remediation activities, and future conditions (e.g., land use).
  - Is the current CSM consistent with the data recently collected as part of the remedy? Consistent with current land use?

Example Conceptual Site Model



Example Conceptual Site Model



Exit Strategy Assessment

- Evaluating the Completion Strategy and Decision Logic:
  - Is the remedy/approach appropriate for the goals?
  - Are there interim decision points for changing system and monitoring programs? Is the decision logic valid?
  - Are data collected to support evaluation of interim decisions and to assess progress toward clean up?
  - Is the end point clearly defined and is there a process to verify when this end point is achieved, including contingencies for any rebound?

Site Selection Criteria – Sample Site

Pump & Treat System at a TCE contaminated site:

- Primary goal – control offsite plume from impacting a water supply aquifer.
- Secondary goal – TCE mass removal to achieve regulatory goal of 5 ppb.
- System in operation for 8 years.
- Monitoring data inconclusive about plume capturing effectiveness:
  - Down-gradient water supply in jeopardy
  - Mass removal has reached asymptote
  - Reaching 5 ppb goal in reasonable time frame is questionable

Site Selection Criteria – Sample Site

- This site is a high priority candidate for RPO evaluation.
- The RPO team can evaluate:
  - The groundwater monitoring network.
  - Ground water elevations.
  - Historical TCE concentrations.
  - Flow and transport modeling to determine adequacy of capture.
  - Is mass removal effective in reaching the 5 ppb cleanup goal?
- The RPO team can assess and recommend alternative remedial strategy or revised cleanup goals.

Suggested Data to be Collected for Site Prioritization

Data to Be Collected	Explanation
Remedial action (RA) objectives	Restoration of affected medium to applicable beneficial use, containment, mass removal, etc.
Primary contaminants of concern (COCs) and affected media	The primary COCs as identified in the decision document, and the media targeted by the RA
Description of all RA components and related monitoring programs	Descriptions of each capture, extraction, and treatment element of all engineered, intrinsic, and administrative elements of the RA (pump and treat, soil vapor extraction, monitored natural attenuation, passive reactive barrier, institutional controls), and background, performance, compliance, and sentry monitoring well networks
Current status of RA	Pre-design, designed/not installed, under construction, installed, operational, completed
Date RA was implemented	Date of startup for active systems, date installation was completed for passive systems
Documented RA performance metrics	Numeric cleanup objectives, designed operating parameters, schedule and cost to complete estimates, projected mass removal rates

Suggested Data to be Collected for Site Prioritization

Data to Be Collected	Explanation
Conclusions of other performance reviews	The site RPM should indicate whether RA goals are being achieved and the source of supporting information (e.g., 5-year review)
Approximate historical and current annual operations and maintenance cost	This category should include all O&M costs for the RA and related monitoring systems—labor, electricity, materials, discharge fees, system monitoring costs , and consulting and oversight costs
Long-term monitoring costs	Sampling, analysis, QA, and reporting costs
Historical and current operating data	Groundwater/vapor extraction and discharge flow rates, COC concentrations at extraction and monitoring points; pump-cycling data, water levels, radii of influence for extraction/injection systems, notices of violation, etc.

Based on observations from conducting RPO or RPO-like reviews for hundreds of remedial components at more than 50 facilities nationwide, virtually all long-term remedial action sites can benefit from RPO.

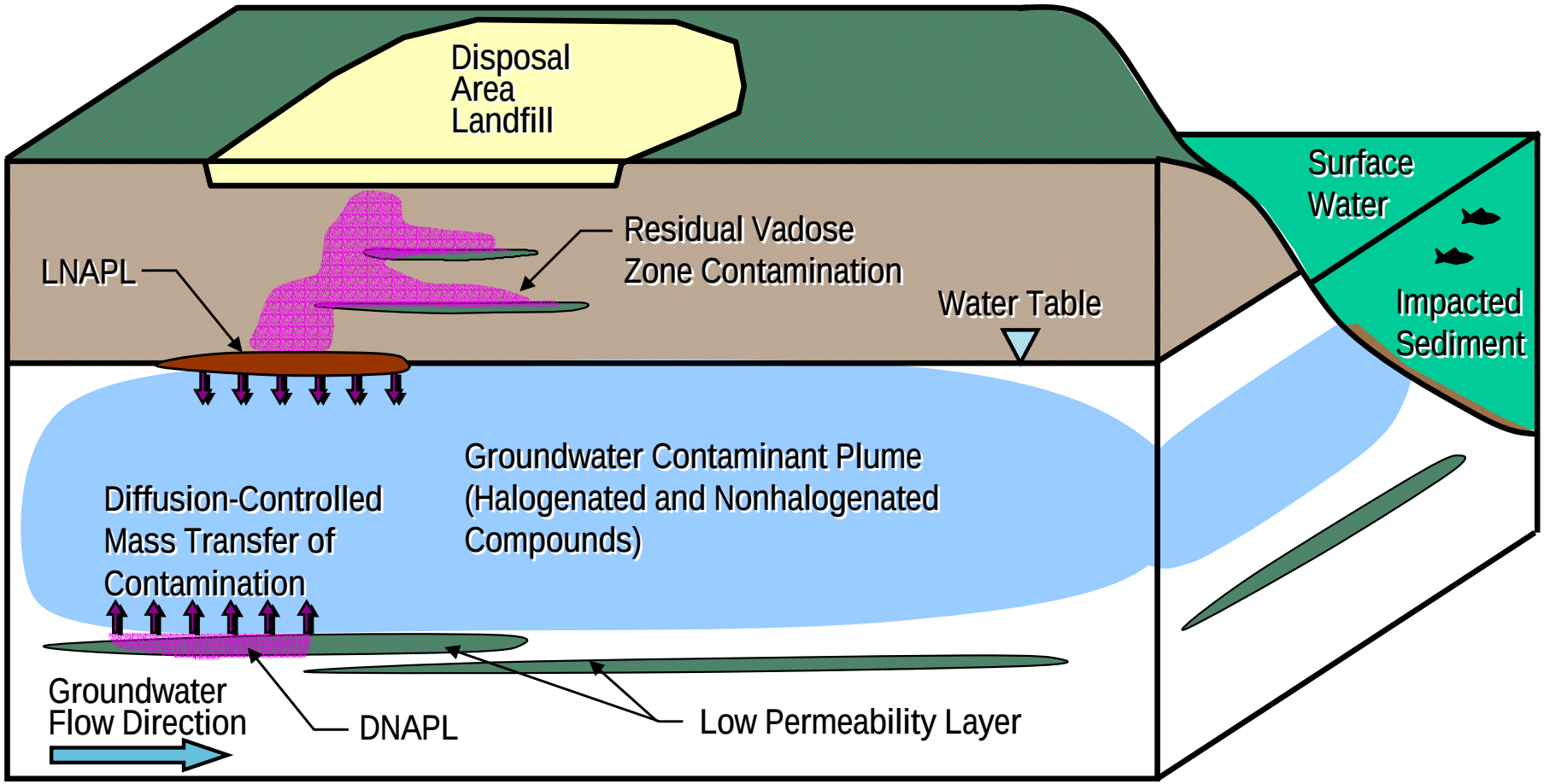
Evaluating Performance

- Remedial Component Performance Assessment:
  - Evaluating performance data.
  - Assessing remedial system effectiveness.
- Evaluating Monitoring Programs:
  - Number and locations of monitoring points.
  - Monitoring frequency.
  - Monitoring parameters and sampling procedures.

Evaluating Performance

- Performance Evaluation:
  - O & M data are analyzed and compared to cleanup criteria per the RA objectives.
  - Data used for performance evaluations:
    - Contaminant concentrations.
    - Ground water elevations.
    - Free-product thickness.
    - Geochemical parameter concentrations.
    - System operating parameters.
    - Mass removal rates
    - Operational history.

Performance Objectives

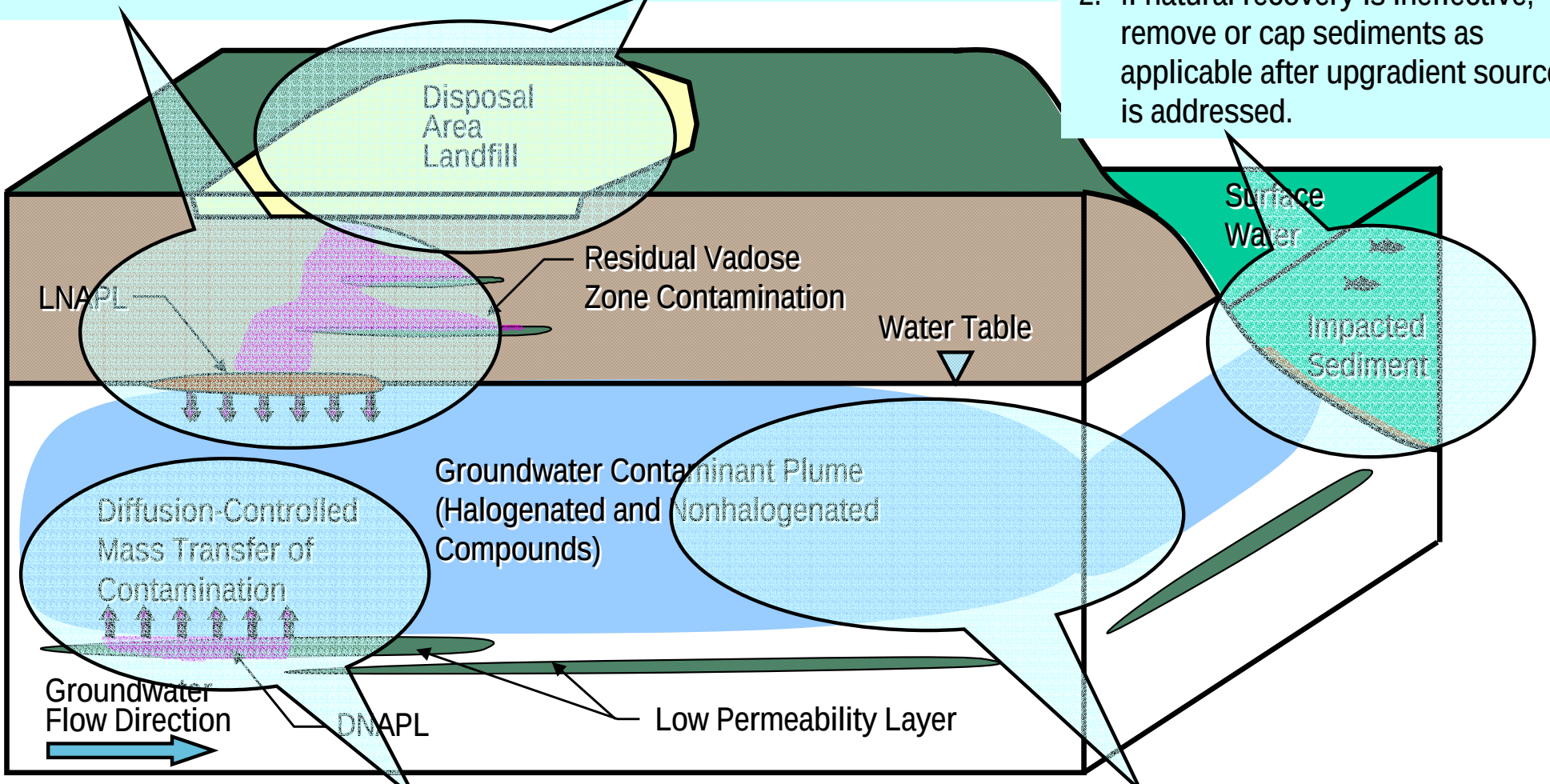


e Objectives

Performance Objectives:
1. Remove LNAPL to the extent practicable
2. Operate while cost effective by considering other components of treatment train and ability of MNA to reduce contaminant levels that are above cleanup goals

Performance Objectives:
1. Minimize infiltration of contaminants
2. Eliminate Surface Exposure

Performance Objectives:
1. Monitor for natural recovery.
2. If natural recovery is ineffective, remove or cap sediments as applicable after upgradient source is addressed.



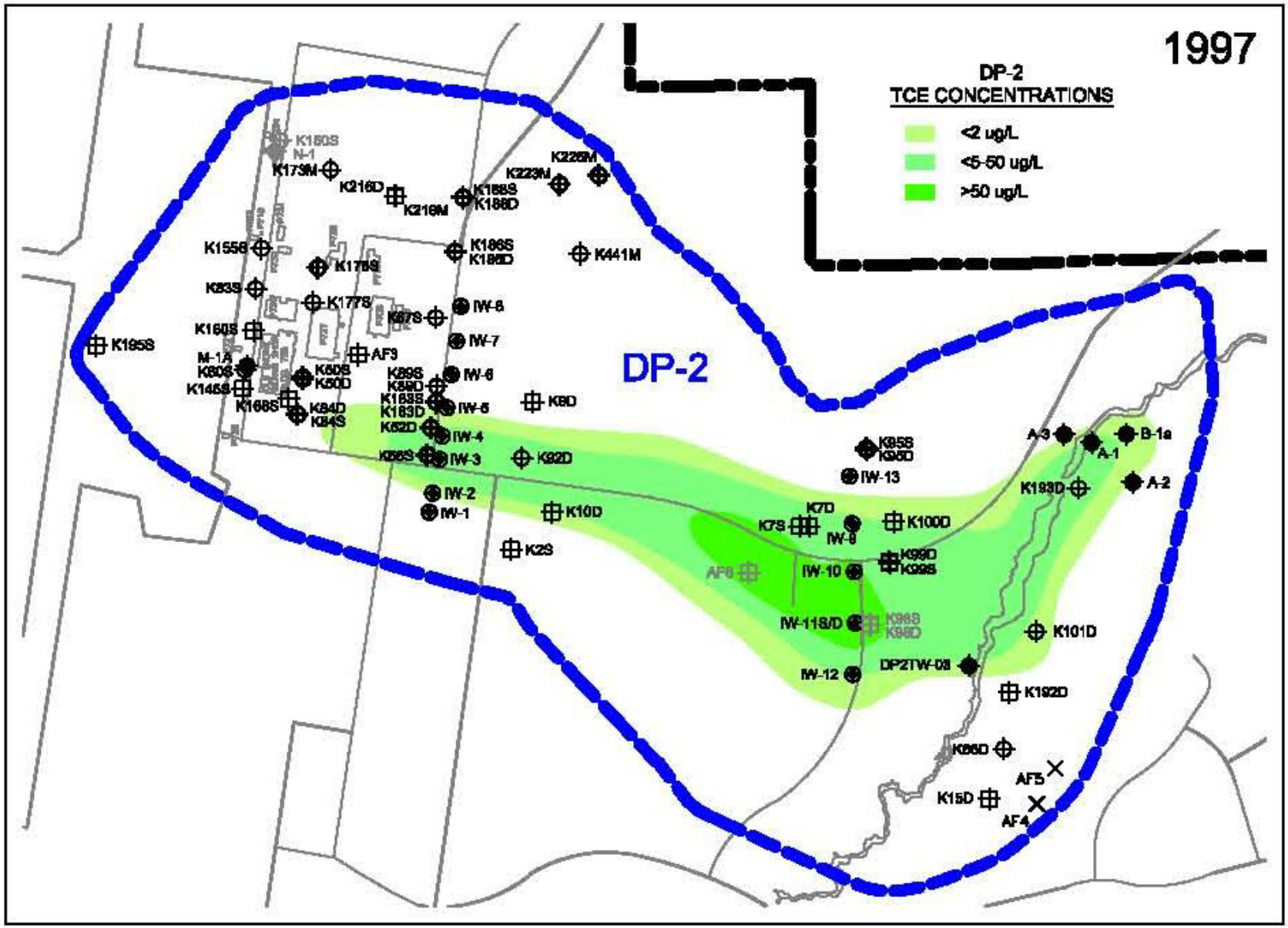
Performance Objectives:
1. Mass reduction in source area
2. Operate while cost effective

Performance Objectives:
1. Monitor and prevent migration of contaminants to surface water that are above action levels

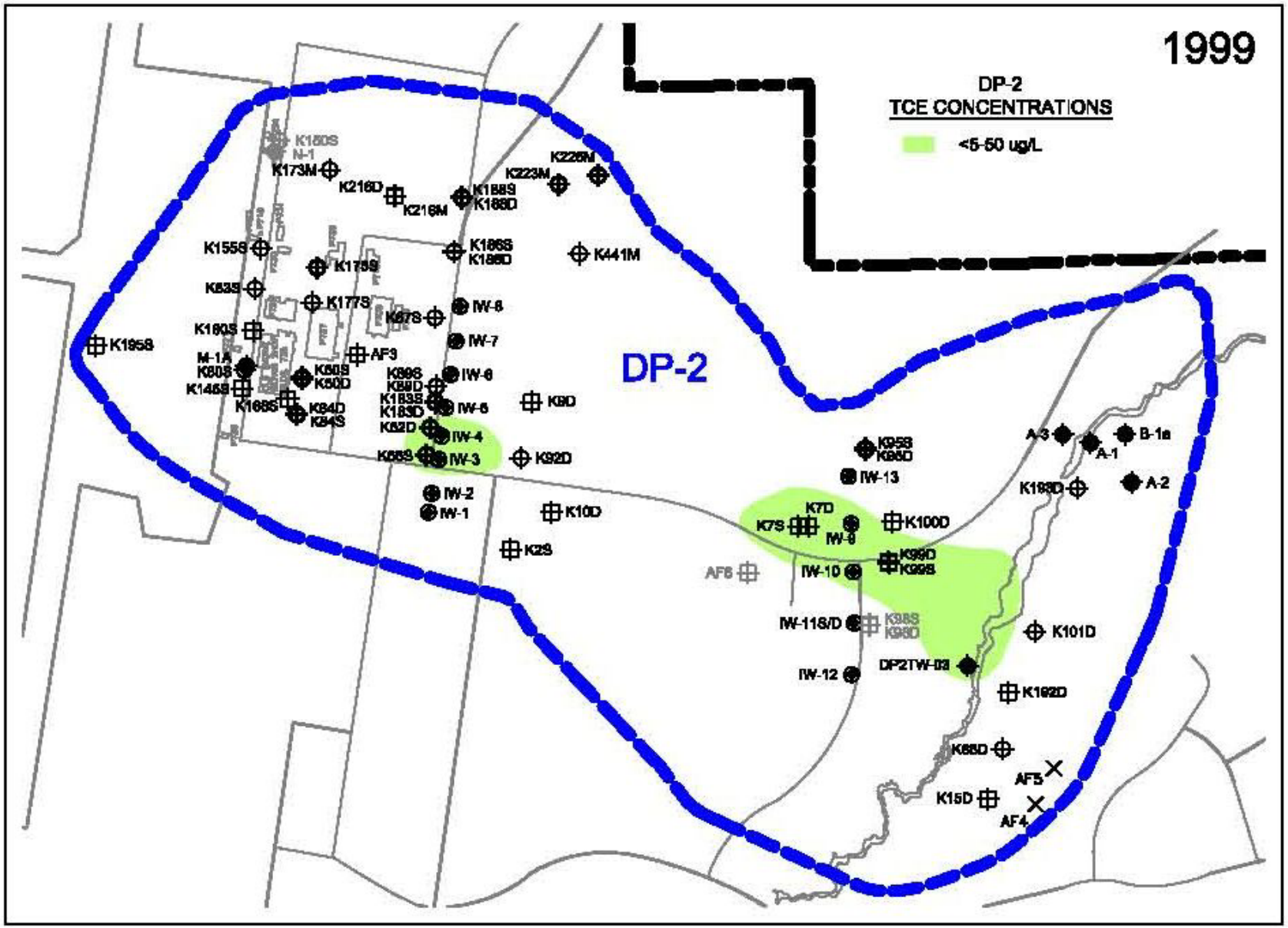
Analysis Tools

- Some of the analysis tools include:
  - Graphs of data for each monitoring point through time.
  - Potentiometric surface maps under pumping and non-pumping conditions.
  - Maps and cross-sections showing contaminant concentrations and distributions through time and space.
  - Time-series plots contaminant and geochemical data to evaluate natural attenuation and mass removal.
  - Comparison of treatment system influent and effluent concentrations through time assess effectiveness.
  - Mathematical Optimization models
- Use of readily available simple statistical tools for trend-analysis to advanced GIS software for visualization and analysis.

Analysis Tools – Plume Maps



Analysis Tools – Plume Maps



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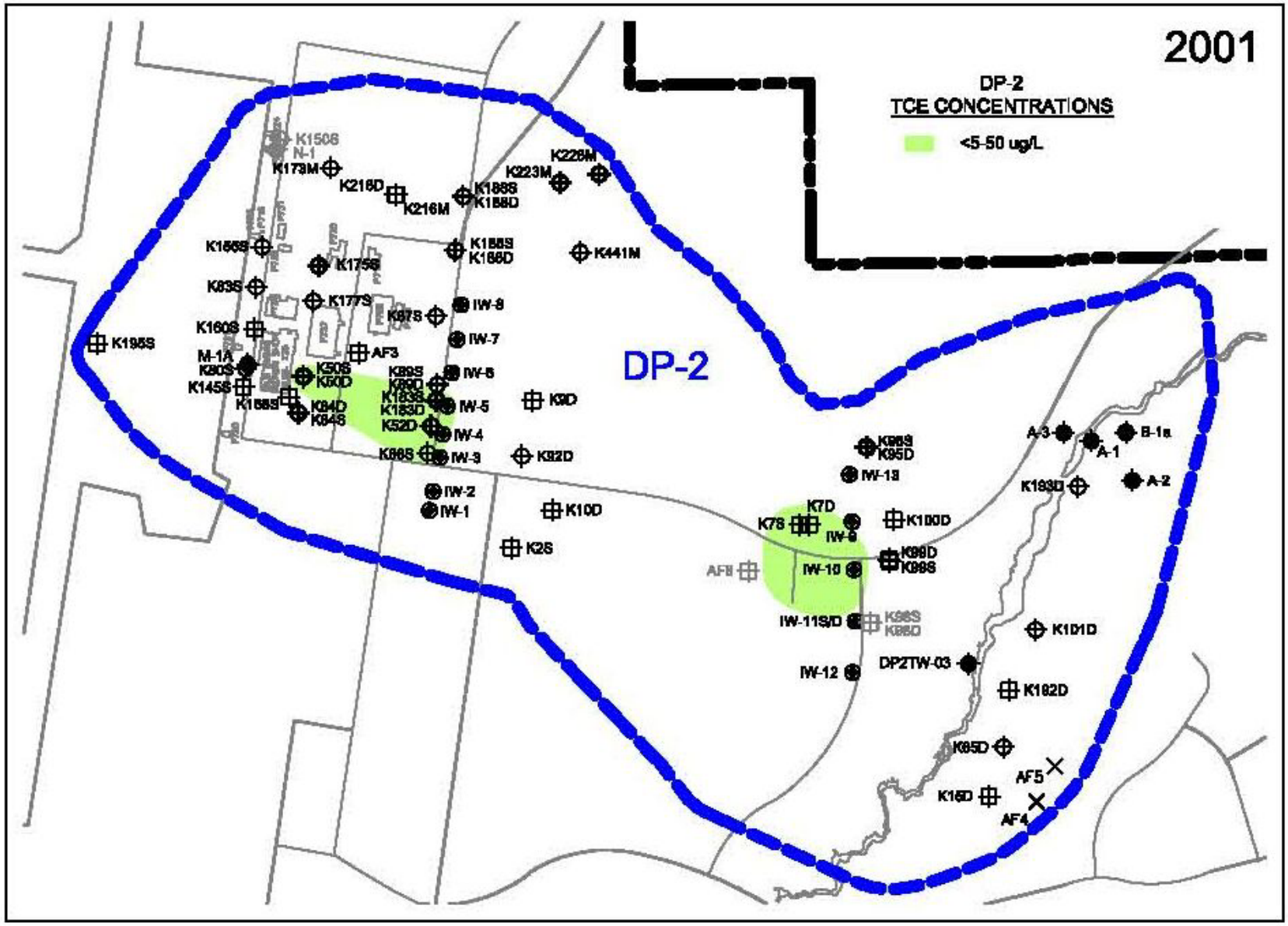
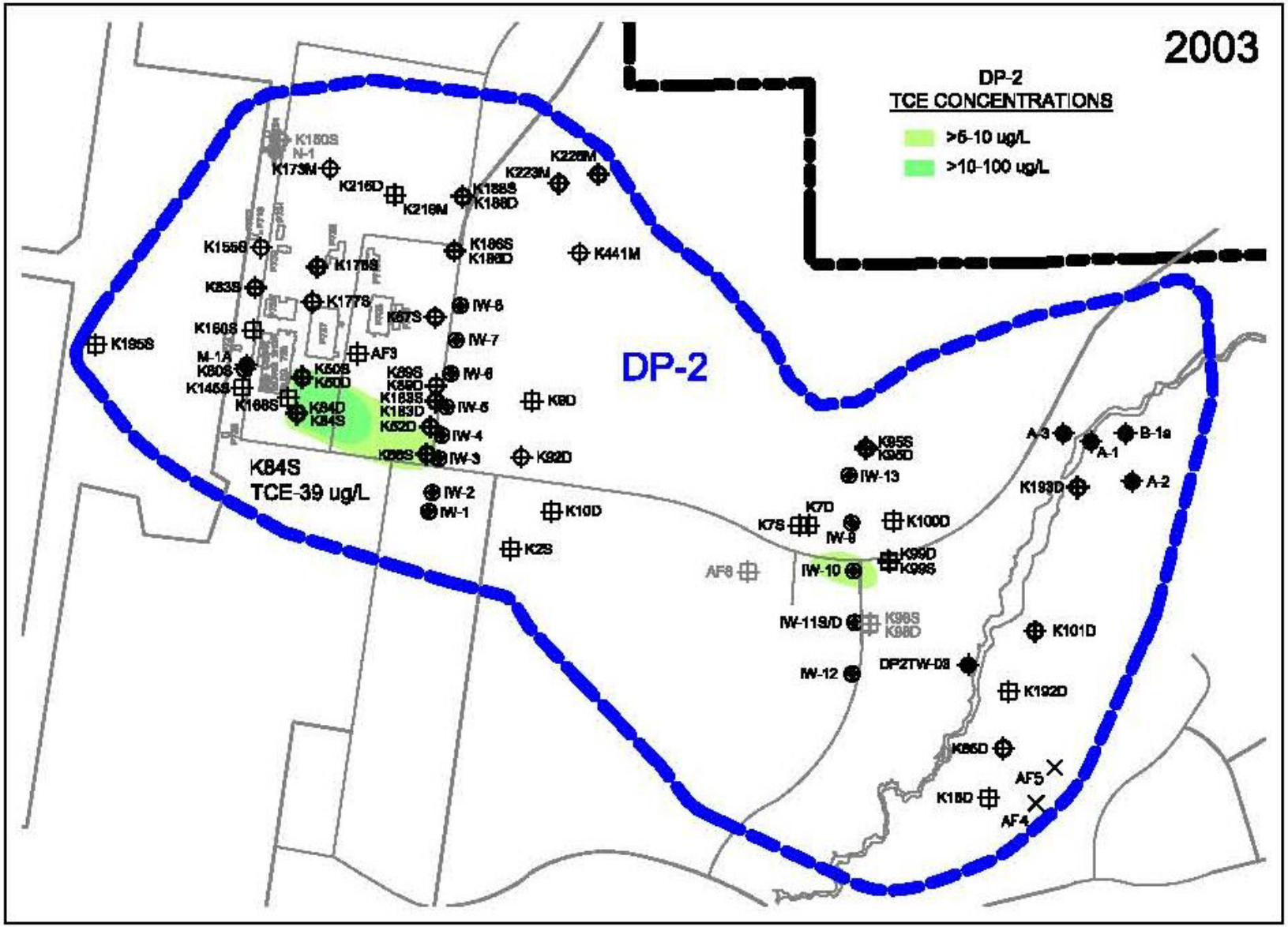
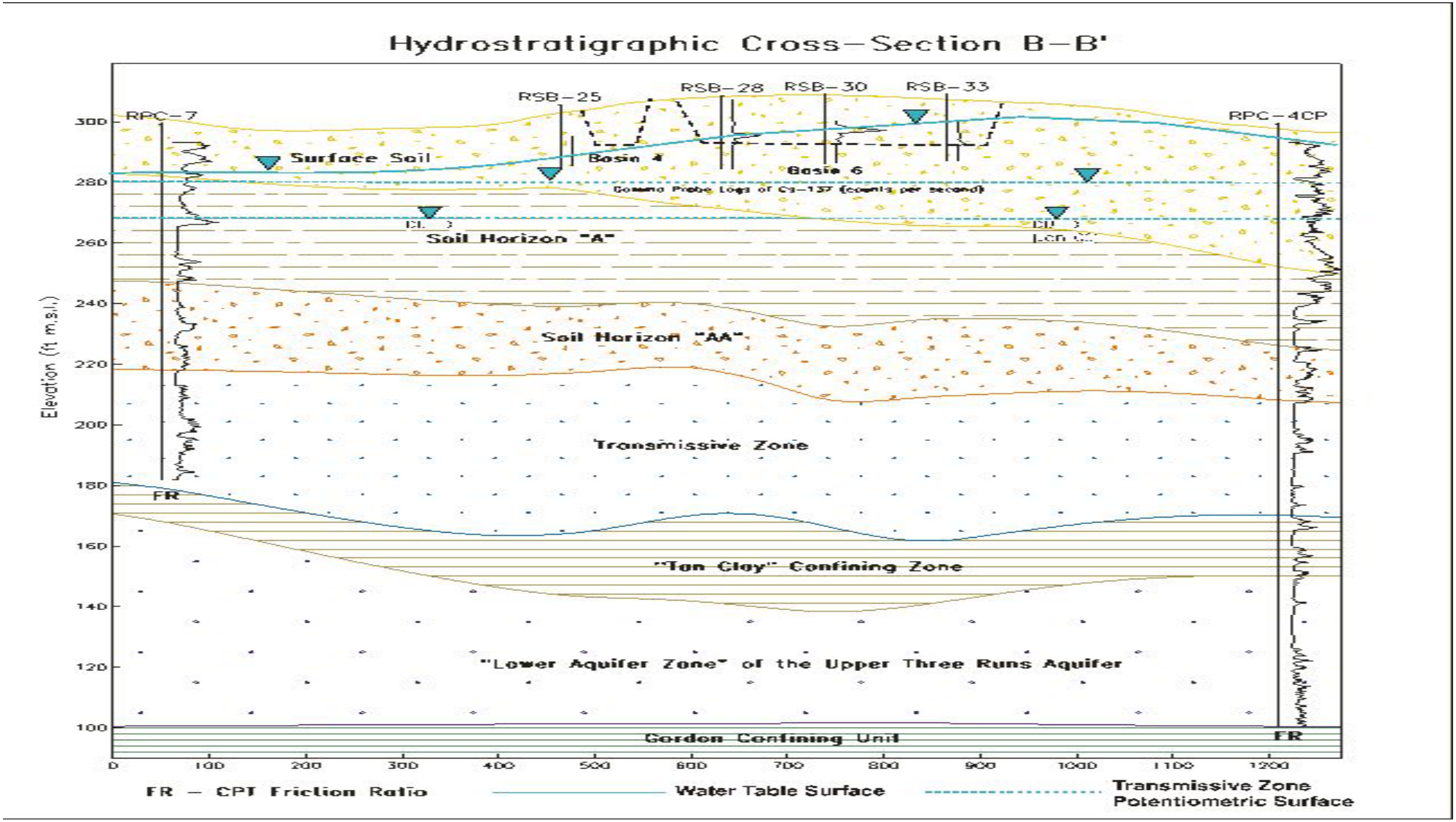


Analysis Tools – Plume Maps



Analysis Tools – Geological Cross-sections



Remedy Efficiency Assessment

Review Mass Recovery and Contaminant Reduction

Well ID	Pre-Remediation Dissolved Concentrations			Dissolved Concentrations Following 12 months of Remediation		
	Benzene (ppb)	Total BTEX (ppb)	MTBE (ppb)	Benzene (ppb)	Total BTEX (ppb)	MTBE (ppb)
OW-1*	860	4,490	110	< 5	ND	ND
OW-2*	13,000	60,300	5,500	< 5	ND	25
RW-1	5,200	6,650	14,000	6	ND	89
RW-2*	13,000	20,800	16,000	ND	ND	ND
RW-3*	4	9	7	ND	ND	ND

- The mass of contaminant should be estimated prior to and during remediation to determine the amount of contaminant reduction.

Remedial Component Performance Assessment

- Evaluating Performance Data:
  - For extraction and external treatment.
  - For *in situ* remediation or MNA.
  - For radius of influence measurements.
- Assessing Remedial System Effectiveness:
  - Technical limitations on remedy performance.
  - Adequacy of remedy design.
  - Life-cycle design limitations.
- Evaluating time of remedy operation:

Evaluating Performance Data

Determine the Degree of Hydraulic/Plume Capture

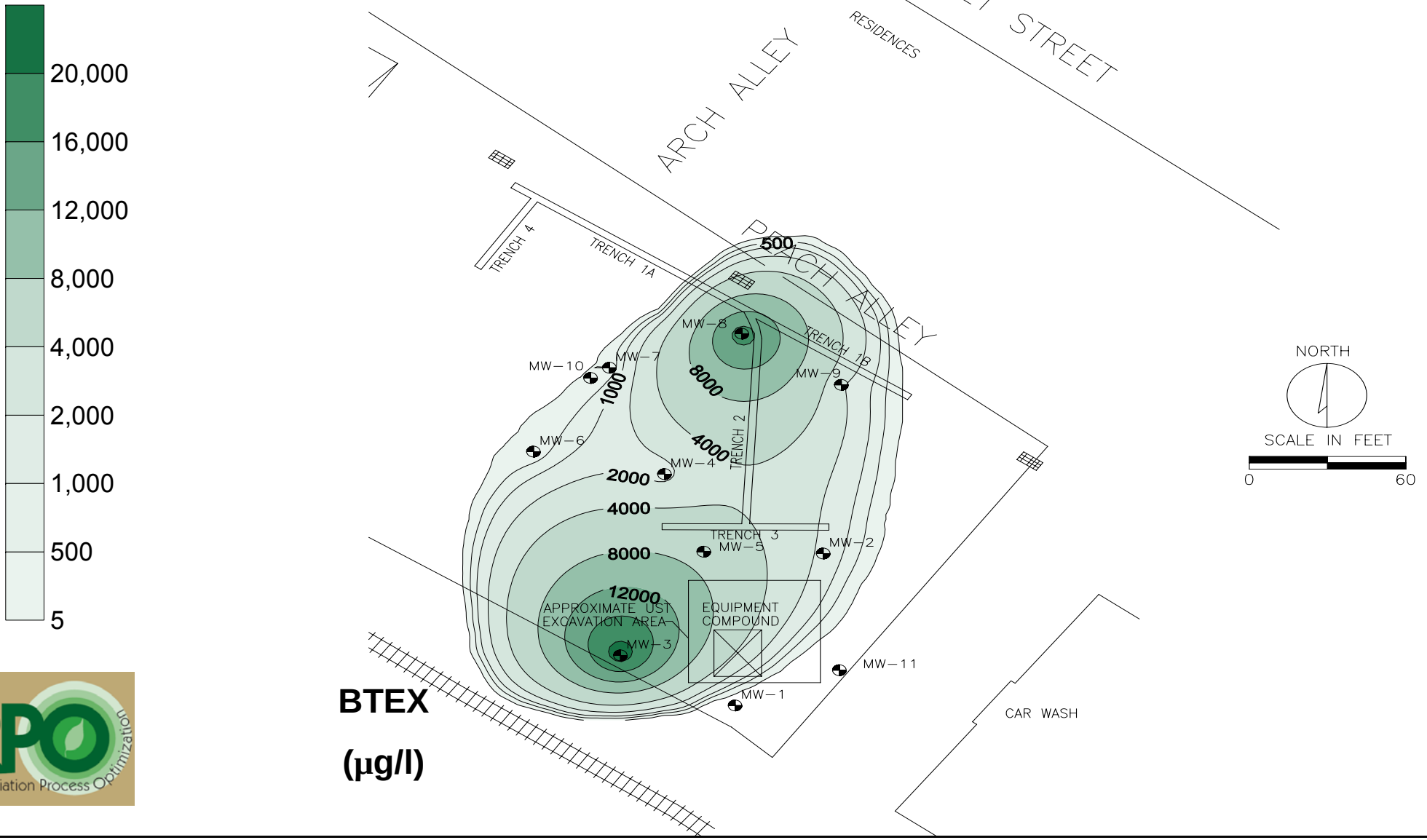
The effectiveness of the remediation system should be evaluated to determine if the design goals are being achieved.

For example:

- Are groundwater recovery wells providing adequate capture?
- Are SVE wells providing an effective ROI?

Evaluating Performance Data

Determine the Degree of Hydraulic/Plume Capture



Evaluating Performance Data

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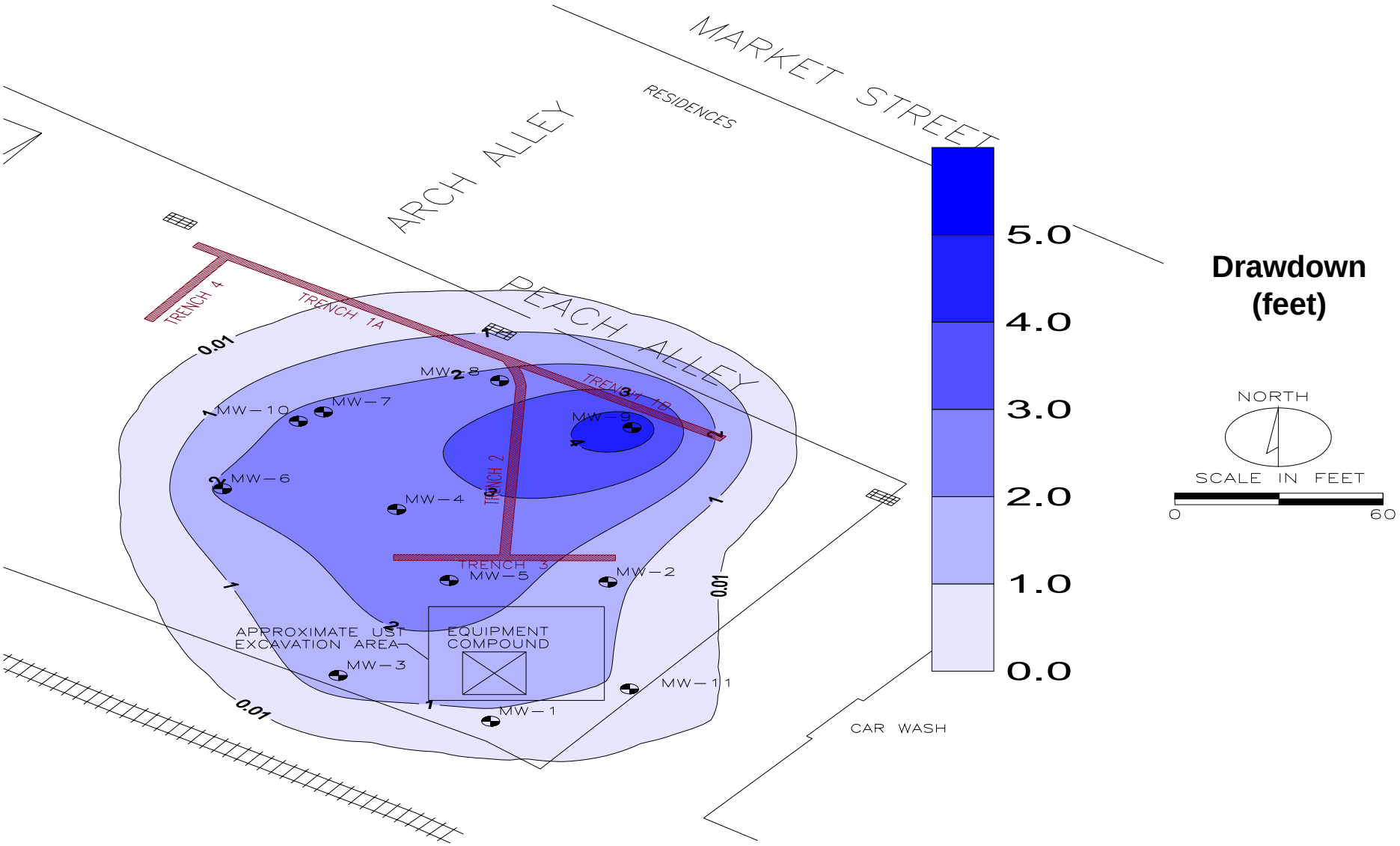
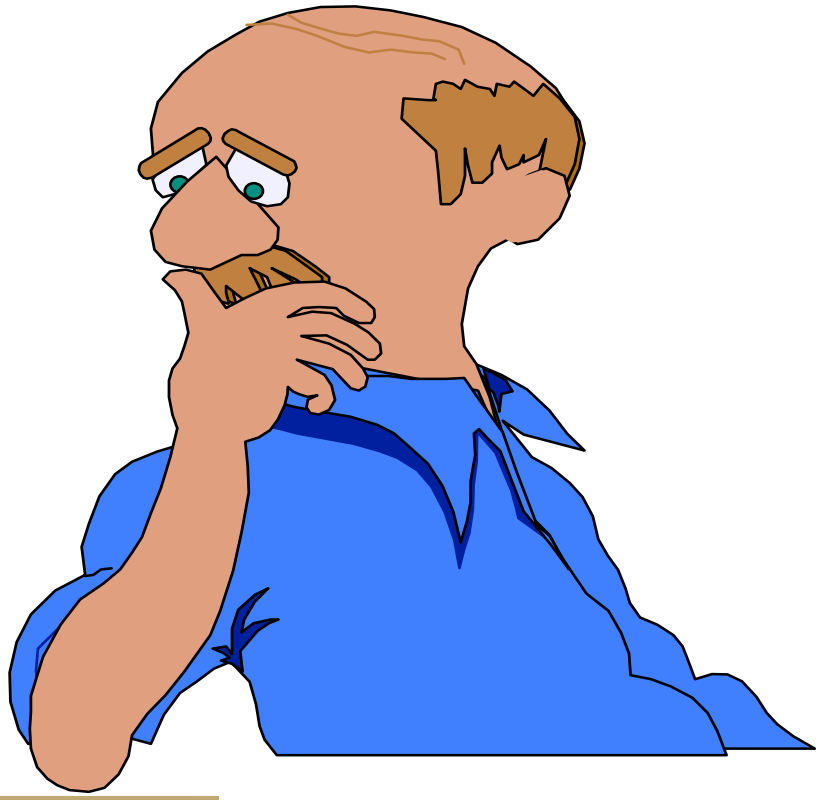


Evaluating Monitoring Programs

- Number and Locations of Monitoring Points:
  - Upgradient, compliance, sentry, performance monitoring wells and piezometers.
  - Role of each monitoring well.
  - Redundancy and optimization analysis of monitoring networks.
- Monitoring Frequency:
  - Change in the frequency of sampling.
  - Adequate frequency for long-term monitoring.
- Monitoring Parameters and Sampling Procedures:
  - Add or remove target analytes based on site-specific conditions.
  - Application of newer procedures for sampling and analysis.

Break

???



The ITRC Document: "Remediation Process Optimization: Identifying Opportunities for Enhanced and More Efficient Site Remediation" will be available in September.

Remedy Optimization

- Optimizing the Exit Strategy
- Optimizing the Remedial System
- Optimizing the Monitoring Program

Optimizing the Exit Strategy

- The RPO review report should address:
  - Overall protectiveness of the remedy and likelihood of attaining the cleanup goals.
  - Recommendations to enhance protectiveness.
  - Measures to increase the likelihood of achieving the RA objectives.
  - Means to reduce time required to complete the RA.
  - Opportunities for cost reduction without compromising remedy effectiveness

Optimizing the Exit Strategy

- Recommended Actions:
  - Cost benefit analysis to justify optimization recommendations.
  - Revised RA objectives based on updated site conditions and/or ARAR analysis.
  - Further refinement of CSM.
  - New technologies that would expedite the attainment of cleanup goals.
  - Optimize monitoring program to verify the proposed optimizations.

Optimizing the Remedial System

- System Optimization may include modifications to:
  - Extraction systems.
  - Treatment systems.
  - Monitoring programs.

- Alternative remedial systems

Optimizing the Remedial System

- Modifications can be classified as:
  - Minor modifications to existing systems.
  - Adding to or removing from or replacing the existing system components.

- Updating the overall remedial decisions such as:
  - Perform hotspot remediation.
  - Replace/supplement the technology with a new technology.
  - Use of institutional controls to achieve protection.

Evaluate System Up-time/Down-time

- System malfunctions should be evaluated to determine the causes. If there are recurring problems, the situation should be addressed appropriately to ensure that system operation and up-time is maximized.
- Telemetry units can be utilized to effectively manage RA systems. A high up-time can be achieved by reacting immediately to system shut-downs and proactively fixing system problems.
- It should be noted that effective system operation does not just require a high up-time, but also an effective system performance.

Monitoring Optimization Process

- The optimization process requires answers to the following:
  1) What is the goal of the monitoring program?
  2) Where should I monitor? How many points do I need?
  3) How often should I monitor? For how long?
  4) What contaminants do I need to monitor?
  5) How should I collect the samples?
  6) How do I evaluate and present my data so it's easy to understand?
  7) How do I ensure regulatory acceptance?
  8) How often should I perform monitoring optimization?

Optimizing the Monitoring Program

- Overall protectiveness is more important than reducing costs.
- Every sampling point should fill a specific need
- Increase/decrease in monitoring points, analytes or sampling frequencies.
- Examples of planning aspects and tools:
  - Process monitoring considerations.
  - Data Quality Objectives.
  - Simple modifications based on review of potentiometric surface or plume maps.
  - Software packages to use geostatistics or spatial & temporal analysis.

Monitoring Optimization

- Monitoring optimization provides opportunities for reducing monitoring programs and enhancing data quality.
- Monitoring Optimization is:
  - A systematic, iterative process.
  - Applicable to site-specific or installation-wide monitoring systems.
  - Appropriate for vadose zone or groundwater monitoring systems.

Remedy Cost Efficiency Assessment

Evaluate Cost and System Performance Data

- Compare projected and actual costs during O&M
- Identify capital costs for upgrades and modifications
- Determine the degree of hydraulic/plume capture
- Assess mass of contaminant removed
- Evaluate system up-time/down-time

O&M Costs to Consider

- Labor (field and office)
- Materials (sediment filters, activated carbon, oil for equipment, heat tracing in winter months, …)
- Utilities and fuel
- Monitoring including sampling and analysis
- Equipment lease/rental
- Offsite disposal fees (e.g., for sludges)
- Administrative costs (e.g., permitting fees, meetings, reporting, fines for violations)

Remedy Cost Efficiency Assessment

Compare Projected and Actual Costs During O&M

JOB # 02-00223

Task	BST Job #	Budgeted Amount	Monthly Billings					Total ACTUAL COST	Total BUDGETED
			8/28 - 10/1	10/2 - 10/29	10/30 - 11/26	11/27 - 12/31	1/1 - 1/28		
			Actual Cost	Actual Cost	Actual Cost	Actual Cost	Actual Cost	YTD	
Utility Mark-Out	02-00223-13-60-X	$ 3,574.00	$ 385.00	$ 288.00				$ 3,811.16	$ 3,574.00
Pre-Construction Meeting	02-00223-13-61-X	$ 2,800.00						$ 2,381.25	$ 2,800.00
Well Installation	02-00223-13-62-X	$ 49,580.00	$ 962.95	$ 272.75	$ 955.91			$ 43,541.81	$ 49,580.00
Equipment Procurement	02-00223-13-63-X	$ 2,588.00	$ 22.50	$ 1,062.75				$ 2,439.78	$ 2,588.00
Trenching	02-00223-13-64-X	$ 116,745.00	$ 16,359.73	$ 36,282.74	$ 80.50	$ 22,858.82		$ 100,837.50	$ 116,745.00
Wellhead Modifications	02-00223-13-65-X	$ 7,785.00	$ 6,240.02	$ 525.00				$ 6,765.02	$ 7,785.00
HVTPE Recovery Sys	02-00223-13-66-X	$ 141,872.00	$ 484.03	$ 73,252.61	$ 3,606.00	$ 800.15		$ 138,775.74	$ 141,872.00
Groundwater Treatment Sys	02-00223-13-71-X	$ 37,575.00		$ 1,282.77	$ 1,961.75	$ 2,210.00	$ 2,154.00	$ 8,216.32	$ 37,575.00
Pre-Operation System Check	02-00223-13-67-X	$ 3,656.00		$ 275.00	$ 262.50	$ 400.00	$ 67.50	$ 1,185.00	$ 3,656.00
System Start-Up	02-00223-13-68-X	$ 3,892.00			$ 1,564.65	$ 127.50	$ 2,604.83	$ 4,297.83	$ 3,892.00
Site Survey	02-00223-13-69-X	$ 2,674.00			$ 127.50	$ 820.00	$ 2,314.50	$ 4,271.60	$ 2,674.00
AWI Report	02-00223-13-70-X	$ 5,568.00			$ 67.50		$ 805.00	$ 8,417.67	$ 5,568.00
		$ 377,049.00	$ 23,834.33	$ 113,594.62	$ 74,705.01	$ 27,707.29	$ 8,895.49	$ 336,110.23	$ 377,049.00

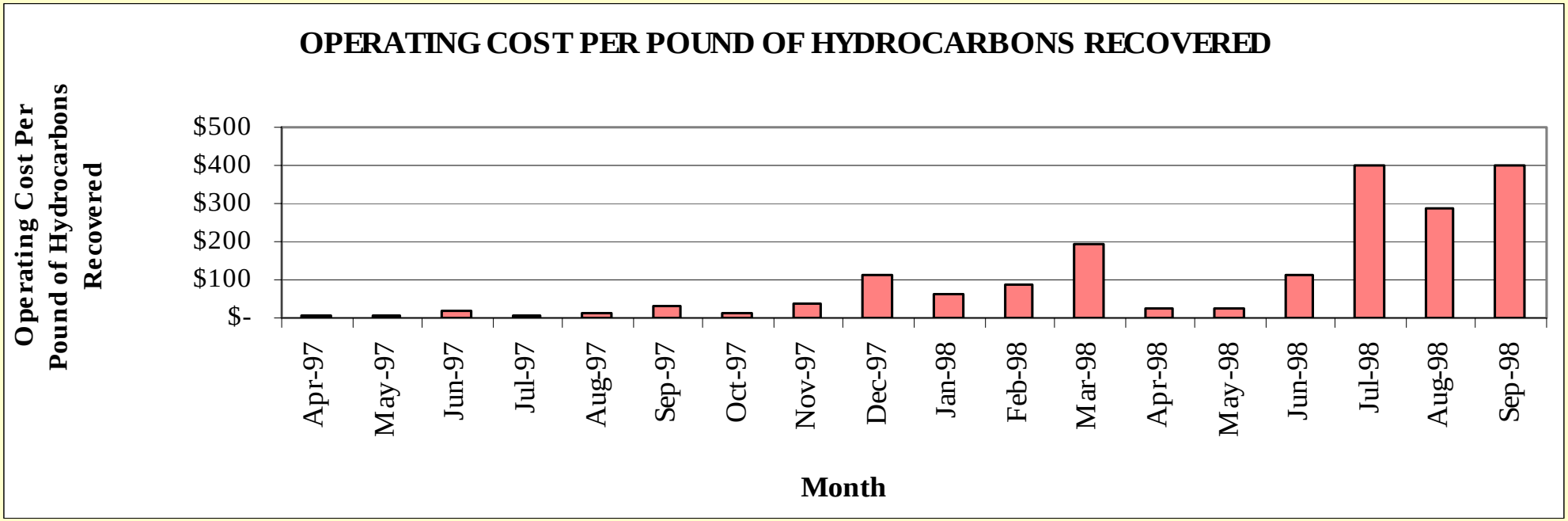
Remedy Cost Efficiency Assessment

Identify Capital Costs for Upgrades and Modifications:

- Identify upgrades/modification that can be made to improve system operation (more extraction/ injection wells, upgrade equipment, install more efficient wells, reduce pipe headloss, change recovery or treatment technologies, ect.).
- Perform a life-cycle cost evaluation to see if the modification will reduce the project life-cycle cost.
- In some instances, additional site characterization or feasibility testing can be performed to identify if upgrades and modifications are beneficial.
- Modeling may be performed to help justify if upgrades are needed.

Remedy Cost Efficiency Assessment

Mass recovery data and system cost information should be used to determine operating cost per pound (or gallon) of contaminant recovered. If system optimization adjustments are effective, the graph of cost per pound of contaminant over time should show frequent fluctuations (as efficiencies are realized following adjustments).



Life-Cycle Costing

- According to EPA and Army Corps of Engineers (2002) *A Guide to Developing and Documenting Cost Estimates during the Feasibility Study* EPA 540-R-00-002. July 2002), the term "life-cycle cost" refers to the total project cost across the lifespan of a project, including design, construction, O&M, and closeout activities.

- The cost estimate developed during the RPO is a projection of the life-cycle cost of an RA from design through response completion.

Life-Cycle Costing

- Present-value analysis is a method to evaluate expenditures—either capital or O&M—that occur over different time periods.
  - Define the period of analysis.
  - Calculate the cash outflows.
  - Select a discount rate.
  - Calculate net present value.

Life-Cycle Costing

Cost-estimating summaries should address the following:

- The key cost components/elements for both RA and O&M activities.
- The major sources of uncertainty in the cost estimate.
- Either discount rates or scale-up factors.
- The time expected to achieve RA objectives.
- Periodic capital or O&M costs anticipated in future years of the project (e.g., remedy replacement or rebuilt).
- The methods and resources used for preparing the cost estimate (e.g., estimating guides, vendor quotes, computer cost models).
- Treatability study costs, when applicable.

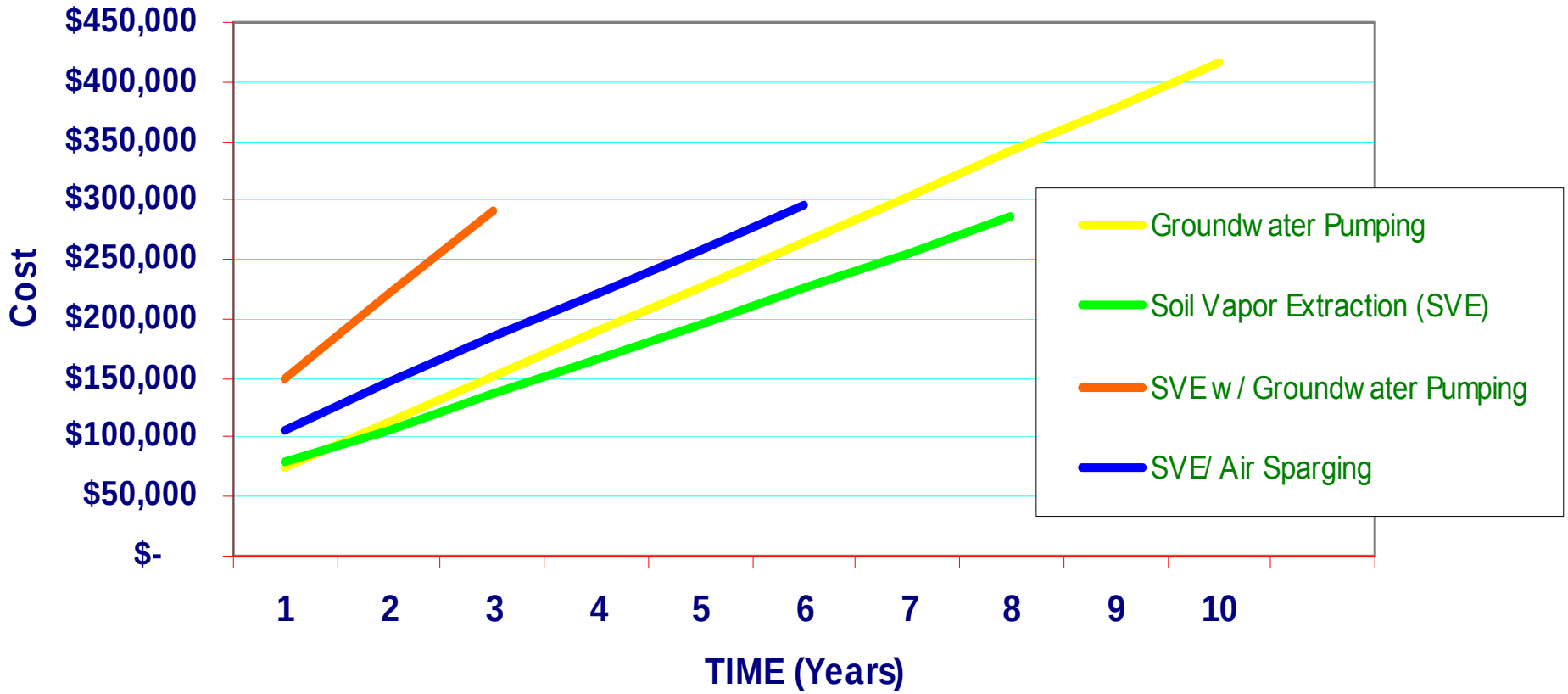
Life-Cycle Costing

Tools that can be used to develop life-cycle costs:

- Site Characterization Data.
- Pilot Test Data.
- Life Cycle Costing Spreadsheets/Software.
- Predictive Models to Access Remedial Duration.

Life-Cycle Costing

REMEDIATION COST OPTIONS OVER TIME



Implementing the Optimization Strategy

- Create an implementation strategy to facilitate optimization recommendations.
- Some recommendations may be contingent on results of implementation of other recommendations.
- Consider a sequencing strategy that will maximize the desired improvements.
- Base strategy largely on the potential for each recommendation to improve performance and reduce time and costs

Implementation Tracking

- RPO findings and recommendations should be monitored and tracked by senior management.
- RPO review report should include: probable future actions and schedule for such actions.
- Minimum tracking requirements include:
  - Who is responsible for implementation.
  - What the recommendations are to be implemented.
  - How implementation will occur.
  - Time frame for implementation.
  - Cost and time savings.
  - Expected outcome.

Challenges in the RPO Process and Possible Solutions

- Several hurdles may exist for implementing RPO activities:
  - Technical.
  - Institutional.
  - Contractual.
  - Regulatory.
- Technical issues:
  - Uncertainties and heterogeneities.
  - Dynamic nature of remediation – things change.
  - Consider alternative technologies if appropriate.
  - Conduct reliability assessment, stochastic modeling.

Challenges in the RPO Process and Possible Solutions

- Institutional issues:
  - "Inertia" of project team, no motivation to change, admit "failure"
  - No formal policies or tracking system for optimization.
  - Skeptical stakeholders – balance between protectiveness, cost
  - Staff turnover.
  - Need to publicize successes, provide guidance.

- Contractual Challenges
  - Contractors view of optimization: reduced income.
  - Tie payment to cost-effective progress toward achieving goals.
  - Metrics include: discharge violations or treatment efficiency, maintaining plume capture, plant up-time, reduction in plume size or concentrations.
  - Fixed-price contract with some cost reimbursable expendable items.

Challenges in the RPO Process and Possible Solutions

- Regulatory Challenges:
  - Multiple regulatory frameworks applied to the facility.
  - Multiple regulatory agencies or branches of the same agency with different perspectives.
  - Changing regulations, new contaminants of concern.
  - Credible guidance on optimization approaches, education would help acceptance.
  - Integrate optimization and performance reviews in regulatory requirements.

Stakeholder Considerations

- Stakeholder participation is highly recommended by the ITRC in all phases of cleanup.
- Outreach to stakeholders, at a minimum must address regulatory and policy requirements for community involvement.
- Stakeholders should be educated about the purpose of an RPO and notified of the review findings.
- Evidence has shown optimization process can be enhanced by active stakeholder participation.

Overview of Federal RPO Programs

- Department of Defense:
  - Air Force.
  - Army.
  - Navy.
  - Defense Logistics Agency (DLA).

  A common driver for the RPO initiatives within these DOD components has been the 2001 DoD Management Guidance for the Environmental Restoration Program.
- Department of Energy.
- Environmental Protection Agency.

Air Force RPO Programs

- Two consistent but separate programs have been developed for the active and BRAC programs

  For cleanups at active installations:

  - *Environmental Restoration Program Management Guidance* directing annual optimization reviews at sites that have achieved remedy in place.
  - Created an RPO Outreach Office to assist MAJCOMs:
    - Provides standardized approach
    - Builds inventory/develop baseline
  - RIPS software tracks performance over time.

Air Force RPO Programs

Cleanup under BRAC or closing installations:

- The Air Force Real Property Agency (AFRPA) implements both system and process-level optimization with the goal to reduce risk and get to property transfer.
- Started conducting RPOs in FY02 and will have completed 15 installations this year.
  - Recommended termination of 6-10 treatment systems, accelerated OPS documentation and improved property transfer strategies.
  - Tracking system captures recommendations and cost savings.
  - Recommendations will result in $8 million in cost avoidance FY08
- Goal is to complete the remaining 15 BRAC installations within the next five years.

Army RPO Programs

- Remediation System Evaluation (RSE) Process developed by the US Army Corps of Engineers Hazardous, Toxic, and Radioactive Waste Center of Expertise (HTRW CX).
- RSEs have four primary purposes:
  - Identify performance and remedy effectiveness problems.
  - Reduce operating costs.
  - Confirm the project team has clear and appropriate exit strategy.
  - Verify proper maintenance of government-owned equipment.

Army RPO Programs

RSEs process consists of:

- Pre-Visit Activities:
  - Coordination of all parties and all relevant documents are assembled.
- Site Visit:
  - Involves explanation and tour of operations.
- Data Analysis:
  - Following the site visit, technical evaluation of existing site information is performed and alternatives are evaluated.
- Report Preparation.

Navy RPO Programs

- Navy/Marine Corps Optimization Policy
  - Outlines efforts to ensure all remedies are continually optimized through evaluation of all available data at each phase of the project.
  - Requires semi-annual tracking of optimization efforts and progress.
  - Minimize or eliminates the use of pump and treat.
- Navy established a workgroup to focus on optimization and site closeout called the Remedial Action Operations/Long Term Management (RAO/LTMgt) Optimization Workgroup
- Guidance documents developed by the workgroup include:
  - *Guidance for Optimizing Remedy Evaluation, Selection, and Design, 2004*
  - *Guidance for Optimizing Remedial Action Operations, 2001*
  - *Guide to Optimal Groundwater Monitoring, 2000*

DLA RPO Programs

- Similar approach to Air Force BRAC program due to co-authoring the 2001 Remedial Process Optimization Handbook.
- Conducted Phase 1/2 RPOs at four sites resulting in millions of dollars saved and one site moving towards deletion from NPL.
- DLA is currently expanding on the RPO Handbook by developing a Performance-Based Environmental Restoration Management Assessment (PERMA) guide.
- PERMA Guide will focus on:
  - Re-assessment of the basis of the response action decisions.
  - Utilization of specific tests of performance and metrics to assess progress.
- All remediation sites required to undergo PERMA within the next fiscal year.

DOE RPO Programs

- RPOs being conducted by Office of Environmental Management.
- Recently completed two RPOs at Hanford with an emphasis on restoration of contaminated groundwater.
- Developed set of "Environmental Restoration Principles" that are followed during an RPO.
- Developed a *Technical Guidance for Optimizing Ground water Response Actions at Department of Energy Sites (April 2002).*

EPA RPO Efforts

EPA's optimization efforts began late 1990s with the use of groundwater optimization tools and continued to expand through the efforts of the Technology Innovation (OSRTI).

Focus has been on:

- Establishing programs/initiatives to encourage optimization.
- Assisting in the development and application of optimization