

Attainment Monitoring and Planning for Site Closure

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Performance Monitoring for Optimization
of In Situ Remediation Technologies
FRTR Meeting
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Providing Environmental and
Engineering Services Worldwide

Attainment Monitoring



- ▼ Background
- ▼ EPA Guidance and Tools for Demonstrating Attainment
- ▼ Case Study: Fort Ord
- ▼ Monitoring Strategies for Attainment Demonstrations



Background: Monitoring Framework

▼ Site Characterization

- *Sampling provides basis for remedy design*

▼ Remedy Performance

- *Demonstrate remedy performs as designed*

▼ Remedy Effectiveness

- *Demonstrate remedy is reducing concentrations, mass, containing plume and progress to attainment*

▼ Attainment Monitoring

- *Demonstrate that remedy has attained cleanup goals*
 - Move to passive or MNA remedy
 - Site closure



EPA Guidance



- May 2014- OSWER 9355.0-129: *The Guidance for Evaluating Completion of Groundwater Restoration Remedial Actions*
- ▼ July 2014 - OSWER 9283.1-46: *Groundwater Statistics Tool User's Guide* and *Excel Spreadsheet Tool* download at:

http://www2.epa.gov/sites/production/files/2015-11/gw_stats_tool_08112014.final_xlsm

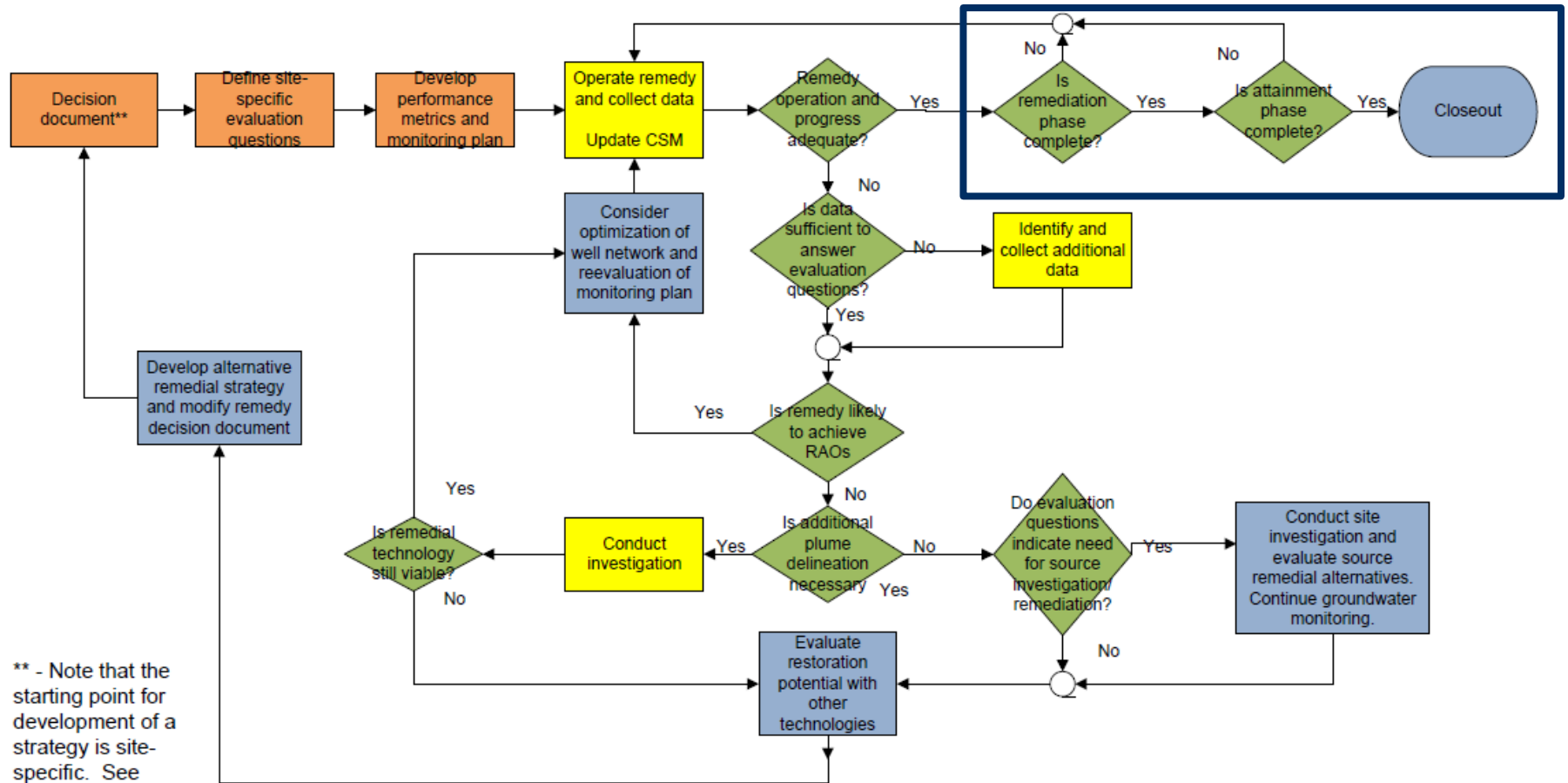
Site Completion



Groundwater restoration remedial actions should generally be considered complete when **well-specific monitoring data**, provide a **scientific basis** to conclude that the groundwater **has met and will continue to meet cleanup levels** for all COCs in the future, in accordance with the decision document.

Groundwater Remedy Completion Strategy: OSWER 9200.2-144

Figure 2: Groundwater Remedy Completion Strategy Implementation



** - Note that the starting point for development of a strategy is site-specific. See also Section 1.

← Five-Year Reviews →



EPA Guidance: Framework



Two Phases of Monitoring

- ▼ Remediation Monitoring – results compared to remedy performance expectations
- ▼ Attainment – results compared to remedial goals, background or non-detect

Key Point: The decision point or trigger between the two monitoring phases is not always obvious

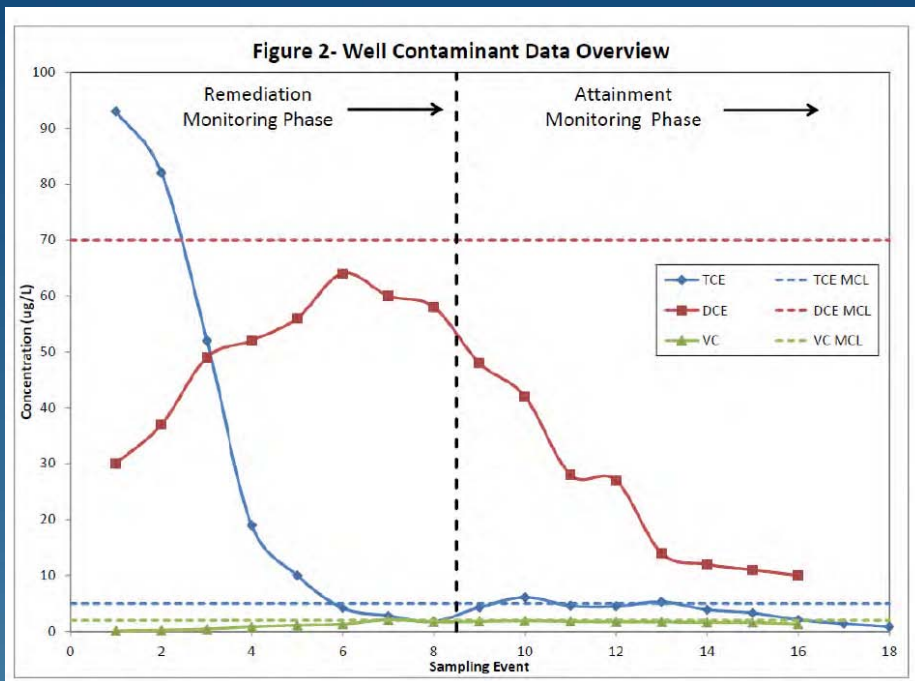
EPA Guidance: Framework



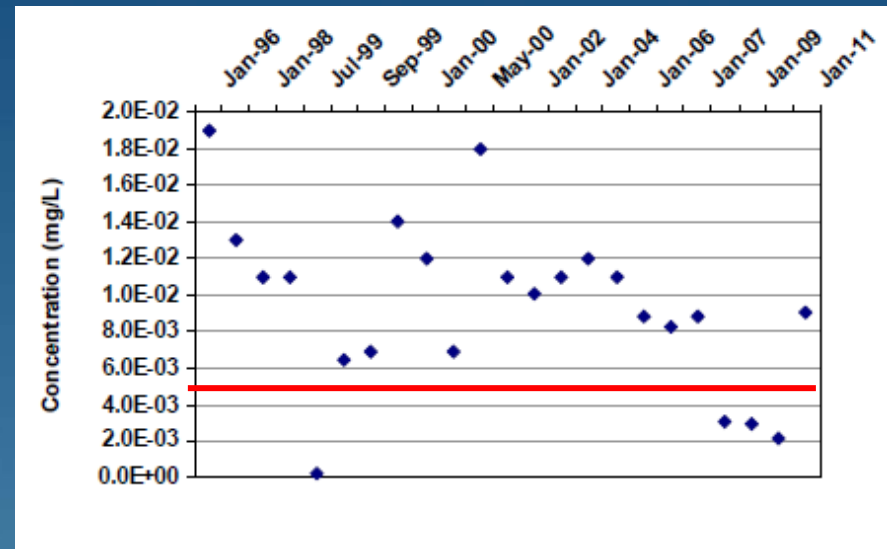
- ▼ The Remediation Phase of monitoring is complete when:
 - All remaining wells/COCs below remedial goals (mostly)
 - Post-Remediation “Steady State” (not defined) is demonstrated – Pre-approval by regulatory agency
- ▼ Transition from Remediation to Attainment
 - Minimum of 4 data points
 - “Visual” review – all results ND or < MCLs – statistical review may not be necessary to begin Attainment Monitoring

EPA Guidance: Reality Check

Ideal



Real



EPA Guidance: Framework



Transition from Remediation to Attainment Monitoring

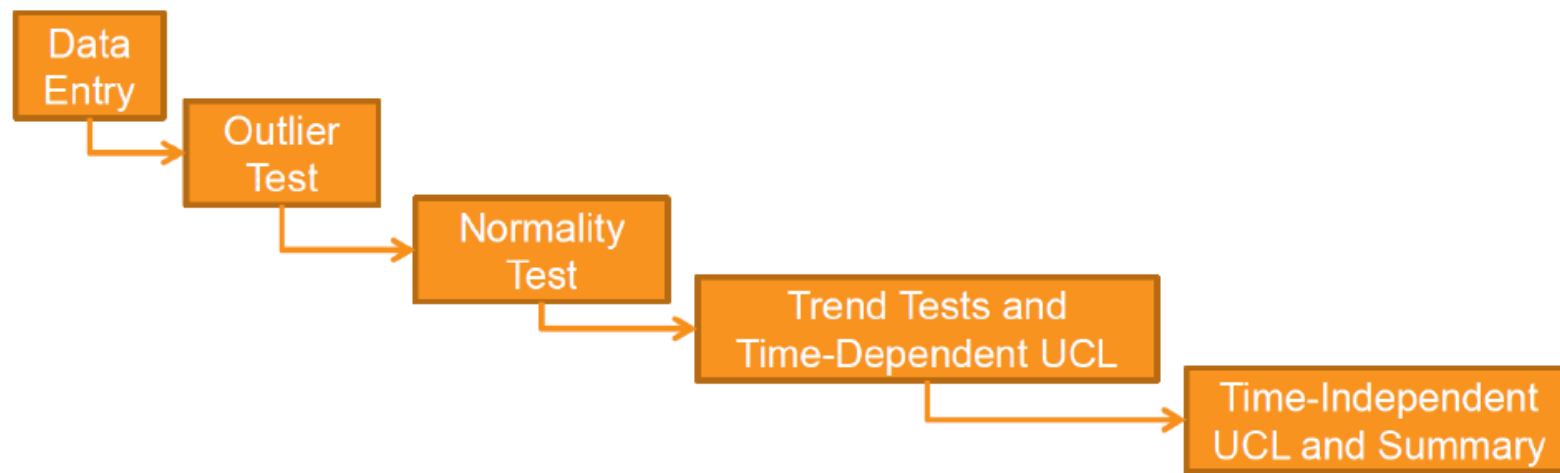
- Statistical Review – if “visual” review inconclusive
- Mean Test
 - 95% Upper Confidence Limit (UCL) – if $< \text{MCL}$, begin Attainment Monitoring phase
- Trend Test
 - 95% UCL on a trend line (Theil-Sen)
 - 95% UCL $< \text{MCL}$
 - Trend ‘not increasing’

EPA Guidance: Framework

- ▼ Attainment Monitoring Phase
 - Minimum of 8 data points
 - Two Lines of Evidence
 - “Visual” -All data ND or $<$ MCL
 - Mean test to demonstrate GW at or below cleanup goal
 - Trend test to support conclusion of future attainment
- ▼ Request regulator for ‘Completion’ status

EPA Excel Tool

Situation	Decision	Criteria
Attainment	Has action level been attained?	Time-dependent UCL < Action level AND Trend is not increasing AND Time-independent UCL < Action level
Site Cleanup	Is site cleaned up?	Time-independent UCL < Action level

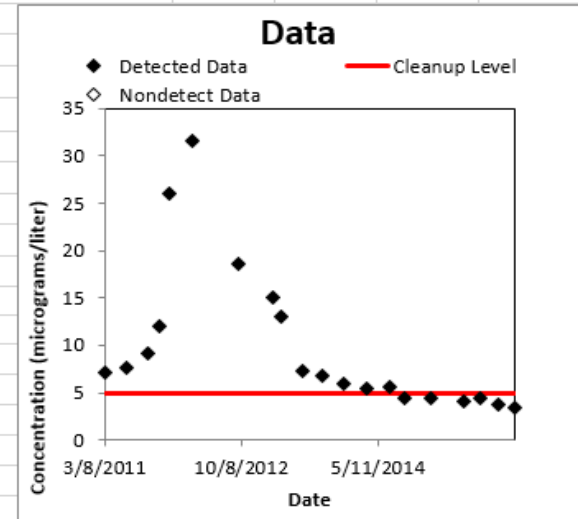


Key Point: The statistical standard set by EPA tool is very high.

EPA Excel Tool



1 Groundwater Statistics Tool					
2 Data input worksheet					
4 Site Name	Former Fort Ord	Date (Date)	Concentration (micrograms/liter)	Data Qualifier	Detected? (Yes or No)
5 Operating Unit (OU)	OU-1	3/8/2011	7.1		Yes
6 Type of Evaluation	Attainment	6/7/2011	7.6		Yes
7 Date of Evaluation	1/25/2016	9/8/2011	9.1		Yes
8 Person performing analysis		10/24/2011	12		Yes
10 Chemical of Concern	TCE	12/7/2011	26		Yes
11 Well Name/Number	MW-OU1-61-A	3/15/2012	31.5		Yes
12 Date Units	Date	9/27/2012	18.5		Yes
13 Concentration Units	micrograms/liter	2/19/2013	15		Yes
15 Confidence Level Desired	95%	3/27/2013	13		Yes
16 Cleanup Level	5	6/26/2013	7.25		Yes
17 Source of cleanup level (e.g. MCL or risk-based concentration)	MCL	9/18/2013	6.7		Yes
18 Risk of False Outlier Rejection	1%	12/17/2013	5.95		Yes
19 Random Seed (may be left blank)		3/27/2014	5.4		Yes
20 Significant figures to use	3	6/27/2014	5.55		Yes
		9/2/2014	4.35		Yes
		12/22/2014	4.4		Yes
23 Number of data points:	20	5/7/2015	4.15		Yes
24 Number of detected results:	20	7/17/2015	4.35		Yes
25 Number of nondetect results:	0	10/2/2015	3.7		Yes
26 Detection frequency:	1	12/11/2015	3.45		Yes



Axis Values			
Time		Concentration	
Min	Max	Min	Max
Auto	Auto	Auto	Auto

Reset Concentration Axis

28 Data Review		28 Recommendations
29 Are all necessary data fields entered, and in proper format?	Yes	None
30 Are at least 4 data points present for statistical analysis?	Yes	None
31 Are detection limits for nondetects \leq maximum detected value?	Yes	None
32 Are all data within chart axis limits?	Yes	None

35 Pressing the "Check for Outliers" button to the right will open a worksheet that shows the results of a Dixon's test for outliers.

Next Step: Check for Outliers

Attainment for In Situ Remedies



- ▼ *Why don't I have an example of attainment demonstrations at In Situ Remediation Sites?*
 - Poor site characterization –
 - Remedy not installed in correct location
 - Failure to identify primary source(s)
 - Source under building
 - Fractured bedrock
 - Back-diffusion – remedy did not address low-K zones, long-term, low-level discharge

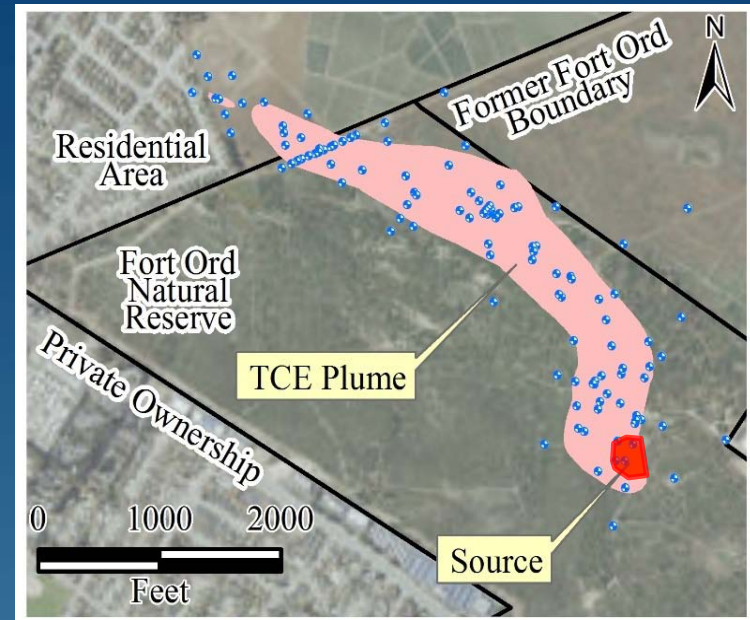
Attainment for In Situ Remedies



- ▼ *Why don't I have an example of attainment demonstrations at In Situ Remediation Sites?*
 - Remedy failure – formation plugged, incomplete treatment etc.
 - Monitoring wells – premature or wrong wells P&A
 - Concentration variability – data do not meet statistical standards

Attainment Case Study: Fort Ord, California PBR

- ▼ Client: US Army Corps
- ▼ Location: Former Fort Ord, California, EPA R10
 - OU-1 former fire training area
 - TCE is the only COC remaining above cleanup goal
 - P&T remedy, sandy aquifer
 - PBR Contract – *size of plume was larger than portrayed in site characterization documents*



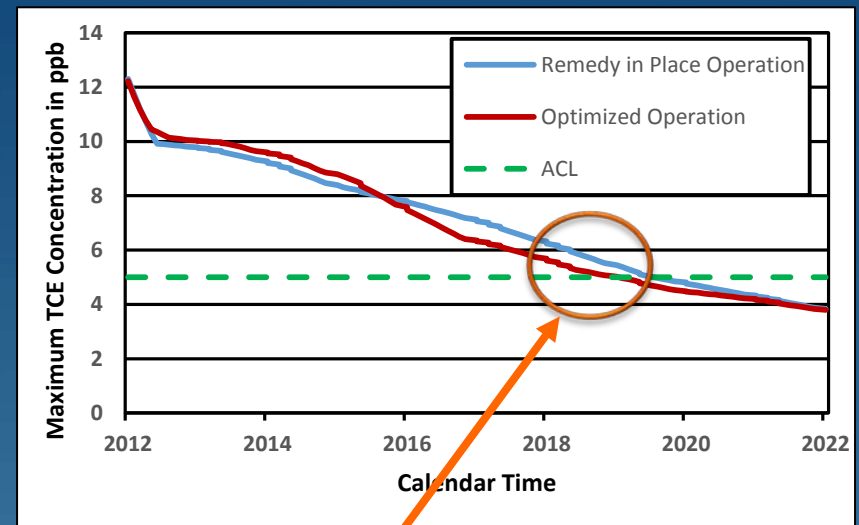
Optimized Exit Strategy

Optimized Pumping Rates

Well No.	RIP Pumping Rates (gpm)	PBMO™ Optimized Pumping Rates (gpm)
62	0.0	0.9
60	1.4	0.1
66	12.3	1.2
10	21.2	1.4
87	7.3	1.3
46	0.0	1.7
85	14.3	3.4
71	0.0	0.7
Total:	56.5	10.7

Use of groundwater model and formal mathematical optimization using PBMO

Time to Attainment of Goals



Time to think about monitoring to demonstrate attainment

Ft. Ord Monitoring Framework



- ▼ Remedy performance data collected 2006 through 2014
- ▼ 2014 Data showed no exceedance of MCLs for TCE
- ▼ P&T terminated in October 2014
- ▼ Agreement with stakeholders that 2014 data sufficient to trigger Attainment Monitoring phase
- ▼ 8 Attainment monitoring locations – along the main axis of plume
- ▼ 4 Samples collected in 2015 for Attainment Demonstration
- ▼ Well and COC-specific statistical evaluation
 - No exceedance of MCL at any of the 8 wells during Attainment phase
 - 4 wells with statistically *Decreasing* trends
 - No wells have *Increasing* trend

Qualitative Considerations



▼ Complete CSM

- ▼ Aquifer parameters understood
- ▼ No significant data gaps
- ▼ No complete human or ecological exposure pathways

▼ Weight of Evidence

- ▼ Historical sampling results below MCLs for wells not in Attainment program
- ▼ Documented history of P&T remedy optimization success
- ▼ Sampling plan included PFOS/PFOA even though not specified in the ROD
- ▼ Good relationship between stakeholders

Fort Ord – Closure Letter

Receipt of Site Closure Letter
from EPA and State Regulators

CPAR Rating

Project Title:

FT Ord OU1 GWTP Operations and GWM



UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION IX
75 Hawthorne Street
San Francisco, CA 94105

March 28, 2016

Mr. William Collins
BRAC Environmental Coordinator
Fort Ord Base Realignment and Closure Office
P.O. Box 5008
Monterey, CA 93944-5008

Subject: Remedial Action Completion: Operable Unit 1, Former Fort Ord,
California

Mr. Collins:

EPA reviewed the "Final Remedial Action Completion Report/Technical Memorandum Operable Unit 1 Attainment Monitoring Results Sampling Events #1 through #4, Former Fort Ord, California", dated March 16, 2016. Based on our review of the report and relevant supporting documentation, EPA concurs with the Army's finding that all remedial actions have been implemented and completed at this site. Please initiate appropriate decommissioning of the OU-1 Remediation facilities and monitoring well network.

If you have any questions, please do not hesitate to call my staff Judy Huang at (415) 972-3681 or e-mail her at huang.judy@epa.gov.

Sincerely,

Angeles Herrera
Assistant Director, Superfund Division
Federal Facilities and Site Cleanup
Branch

cc: Min Wu
California Department of Toxic Substance Control
8800 Cal Center Drive
Sacramento, CA 95826

Grant Himebaugh
California Regional Water Quality Control Board
895 Aerovista Place, Suite 101
San Luis Obispo, CA 95826

Evaluation Areas	Past Rating	Rating
Quality:	N/A	Exceptional
Schedule:	N/A	Exceptional
Cost Control:	N/A	Exceptional
Management:	N/A	Exceptional

Attainment: Reality Check



- ▼ Most sites will not meet all standards for all wells and COCs for either ‘visual’ or statistical methods – *Do not despair*
- ▼ “Guidance” is not set in stone
- ▼ Discretion of regulatory agency
- ▼ Pursue “weight of evidence” approach

Recommendations



- ▼ Identify monitoring wells that reliably demonstrate remedy performance
 - Screened in relevant interval
 - Located on GW flow lines
 - Data show low variance
 - Have a long sampling history
 - Have not been adversely affected by remedial action
 - Do not P&A

Recommendations



- ▼ Data Sufficiency
 - If site has reduced monitoring frequency – insufficient data for demonstration?
 - Think about increasing frequency prior to attainment demonstration – reduce impact of outliers or variability
 - Think about re-sampling – as done for Detection Monitoring programs

Recommendations

- ▼ For wells close to cleanup goals – after each sampling event
 - Mann-Kendall Statistical Trend – document *Decreasing or Stable* trends
 - Calculate 95% UCL on recent results – compare with MCLs
 - Review all outliers for laboratory or sampling errors

Recommendations



- ▼ Communicate with regulators and stakeholders – early in the process
 - Confirm consensus on CSM
 - Articulate remedy performance metrics
 - Cultivate ‘culture of optimization’
 - Outline exit strategy and requirements for site closure