Headquarters Pacific Air Forces

Integrity - Service - Excellence

RPO Management at PACAF Installations: Program Strategies and Lessons Learned

Presented by

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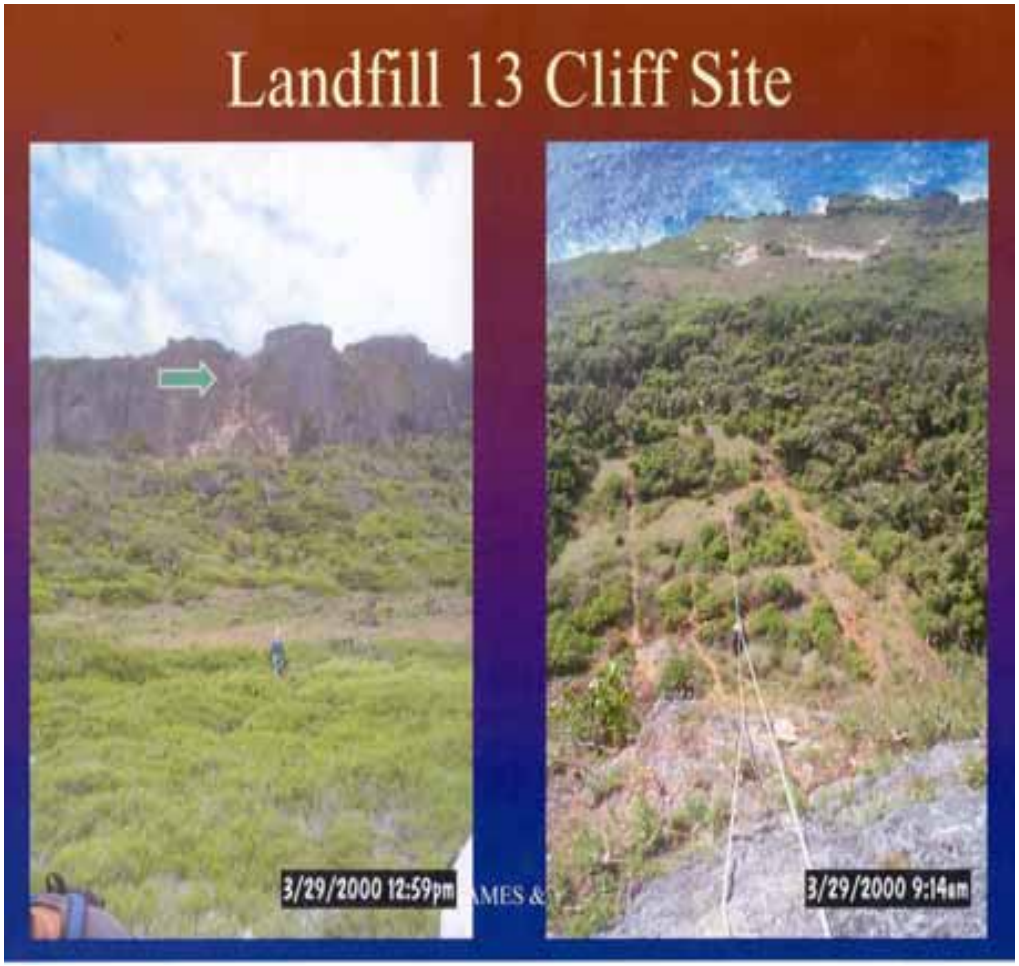
Overview

- Remedial Process Optimization (RPO) at PACAF
- Program Strategies
- Lessons Learned
- Case Study: Eielson Air Force Base
  Event Driven Monitoring
- Case Study: Johnston Atoll
  Risk Based TPH Criteria
- Conclusions

PACAF: Unique Sites

Murphy Dome, Alaska

Johnston Atoll, USA

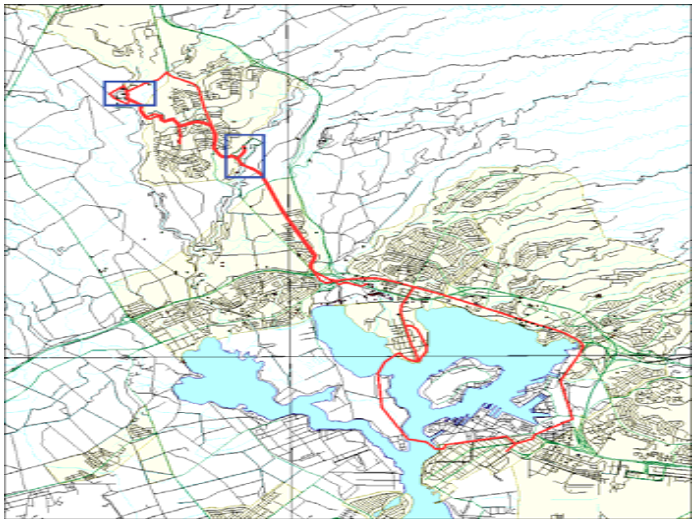


Andersen AFB, Guam,

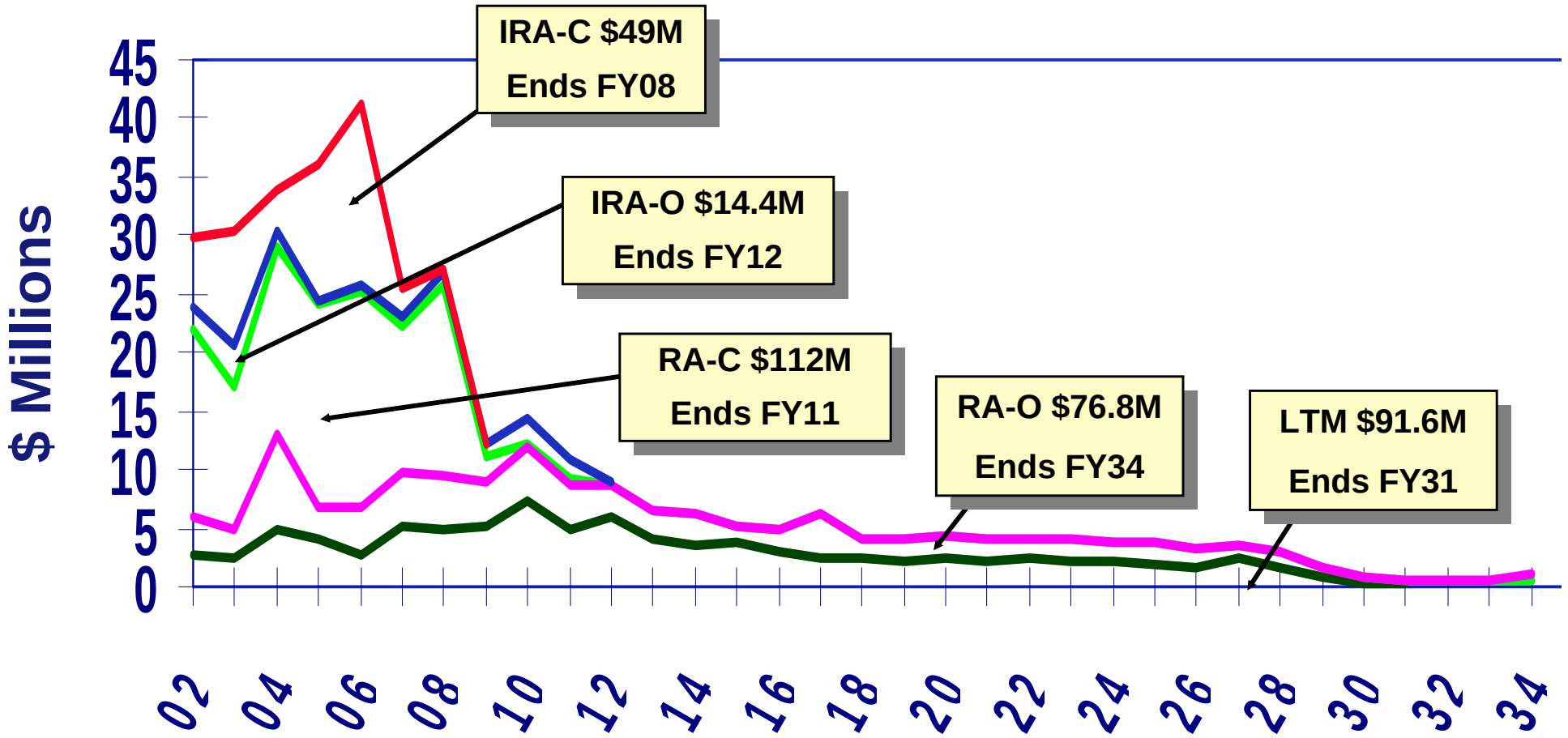
Cliff Side Landfill

RPO at PACAF

- **Significant cost savings potential**
  - **Many PACAF bioventing and nat. attenuation sites**
  - **RPM focus: program management vice technical**
  - **Long term monitoring ($91M) + remedy operation costs ($77M) = savings opportunity**
- **Peer review experiences**
  - **Limited *pre decision* quality check**
  - **Good PACAF success**
    - **Significant savings and quality improvement**
    - **RPMs have solicited voluntary reviews**
- **RPO provides**
  - **Extensive *post decision* quality check w/efficacy data**
  - **Opportunity for enhanced consultation**
  - **Chance to thoroughly review the entire study and cleanup program**



PACAF ERA Cleanup Costs to Completion



PACAF RPO Implementation History

- 1999 PACAF invited AFCEE RPO training
  - Offered to all base RPMs command-wide
  - Exposed concept to most RPMs using their data
  - Sparked interest at Eielson AFB
- 2000 Eielson AFB initiated RPO support
  - Optimize long-term monitoring program
- 2001 PACAF offered RPO as peer review waiver alternative
- 2002 RPO Tracking Matrix Established
- 2003 All PACAF bases *voluntarily* completed RPOs
- 2004 and beyond
  - Follow through on recommendations
  - Specialized/focused RPOs
  - Review feasibility of small remote facility RPOs

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Making RPO Fit

- **Base RPMs have identified RPO as:**
  - **A flexible process tailored to specific needs of the site, stakeholders and regulatory climate**
  - **Technical support and consultation that provides new experiences, options and solutions**
  - **Not an audit or inspection imposed by management**
  - **Comprehensive assessment of restoration projects**
  - **Opportunity to cross-feed and learn how to improve program management**
- **Management: Facilitate, support and promote RPO assessments and follow-through**

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RPO Experience

- 2001 Eielson RPO Phase I & II
  - Provided supporting data to close three soil sites
  - Eliminating the need to rebuild and operate Vapor Extraction System
    - Site E 7 & ST 48 = $ 860K
    - Site E 9 = $ 375K
- 2002 King Salmon RPO Phase 1 & II
  - Switch from SVE to bioventing: $2.8M initial
  - O&M savings $890K

RPO Experience

- 2003 Galena AFS, Alaska RPO Phase I
  - Revitalization of entire program: no immediate savings
  - Hugh potential cost avoidance
- 2003 Elmendorf, Alaska, RPO Phase I & II
  - Phase I – Optimize 13 bioventing wells, 1 bioventing system, 1 SVE system:
  - Phase I cost avoidance: None – Poor Planning
  - In-house Phase II – 30% monitoring reduction $150K annual
- 2003 Andersen AFB RPO Phase I & II
  - No savings, strategic reorganization of program

Galena AFS, Alaska

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RPO Experience

- 2004 Hickam Duel Phase Extraction Systems
  - Quality: shift to focus on gas phase vs liquid
  - Portable well slurper: $50K
  - Smaller extraction wells: $50K
  - Use more hand held instrumentation: $20K
- 2004 Hickam POL Pipeline and Fuel Storage Annex
  - Optimize bioventing $50K
  - Optimize LTM: $120K immediate savings
    - Annual savings for each year we close earlier
    - 4 rounds saved minimum

Hickam AFB, Hawaii

"Ms Pig" (Mobile Recovery System for Pumping Insitu-Gasoline)

PACAF RPO Lessons Learned

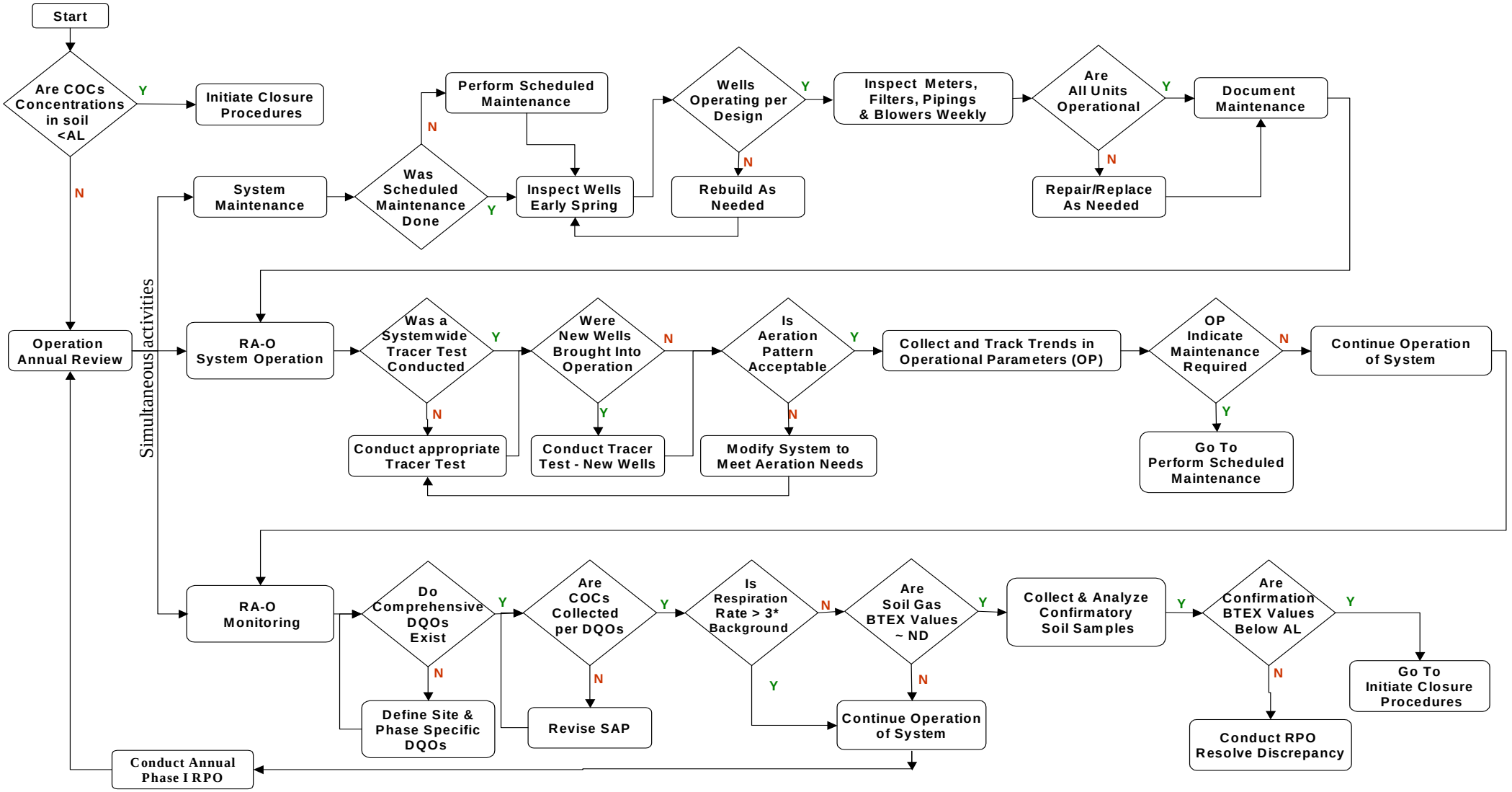
- Remedial systems require more maintenance and efficacy evaluation
  - Maintenance failure = remedy failure
    - Major Alaska POL remedy challenge
    - Same tech fixes often needed at different sites
  - Evaluate remedy effectiveness
    - Site may already be “clean”
    - Remedy may not be effective any more
    - May need to refocus on “stubborn” parts of a site
- Cleanup goals may need to be updated
  - Early RODs may have been too conservative
  - Regulators are now more sophisticated and flexible
  - Impracticabilities may now be apparent

PACAF RPO Lessons Learned

- **Programs require explicit decision rules:**
  - **Conditions which trigger an alternate remedy or optimization of present cleanup technology**
  - **Monitoring well management and decommissioning**
  - **Remedial system operation and maintenance**
  - **Sampling frequency, sampling locations, and analytes/parameters**
  - **Ultimate close out/exit strategy**

Example of Decision Tree Developed in an RPO Scoping Visit

King Salmon Airport Bioventing Systems Operation and Site-Closure Decision Tree



Program Strategies

- **Wholistic approach: Look at entire installation all sites, all phases**
- **Carefully select team and process to meet special needs of installation**
- **Identify immediate firm time/cost savings**
- **Meticulously track fate of recommendations with RPO tracking matrix**
- **Ensure appropriate recommendations are implemented before funding future actions**
- **Use RPO to prepare for 5 Year reviews**

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Tracking Matrix

	2002 Phase 2 RPO Report	Site	Recommendation Type	Status of Recommendation	OPR	Estimated Implementation Date	Risk Evaluation
1a	Base-wide inorganic background studies. 3.1.1. Obtain results of previous background metals study	Basewide	Data analysis	Ongoing	ET	Jun-03	No impact to site risks
1b	Base-wide inorganic background studies. 2.1.2. Review B-aquifer ground water inorganic data with regard to its use as an inorganic background data set. Evaluate the appropriateness of utilizing B-aquifer data as background for the A-aquifer	Basewide	Data analysis	Ongoing	RPO team, ET	Jun-03	No impact to site risks
1c	Basewide inorganic background studies. 3.1.3. Review the USGS gound water quality monitoring data	Basewide	Data analysis	Ongoing	RPO team, ET	Jun-03	No impact to site risks
2a	CERCLA 5-year review strategies. 4.1.1. Develop an overall strategy to prepare for and efficiently execute CERCLA 5-year reviews to include a list of critical parameters and criteria that can be used to validate effectiveness, protectiveness, etc.	Basewide	Data analysis	Ongoing	MTS, ET, RPO	Aug-03	Will ensure risk protectiveness of selected remedies
2b	CERCLA 5-year review strategies. 4.1.2. Customize a checklist for King Salmon Air Station, AK.	Basewide	Data analysis	Ongoing	MTS, ET, RPO	Aug-03	
2c	CERCLA 5-year review strategies. 4.4.3. Prototype strategy on Zone 4	Basewide	Data analysis	Ongoing	MTS, ET, RPO	Aug-03	
3a	Groundwater Zone 1 (OT027) Cleanup Strategy. 5.1.1. Postpone the design and implementation of Zone 1 free product recovery (bioslurping) and bioventing systems until data collection is completed.	Zone 1	Action Item	Completed	RPO Team, 611	Nov 02	No impact to site risks
3b	Groundwater Zone 1 (OT027) Cleanup Strategy. 5.1.2 Continue the operation of the Eskimo Creek Treatment system.	Zone 1	Action Item	Completed	611th CES/CEVR	Nov 02	Risk protectiveness will be ensured
3c	Groundwater Zone 1 (OT027) Cleanup Strategy. 5.1.3. Identify and evaluate remedial alternatives for Zone 1 (e.g. bioventing near wetlands to reduce hydrocarbon concentration in soil below LNAPL mobility values, aeration trench, etc)	Zone 1	Action Item	Completed	MTS, ET, RPO	Dec 02	Site risks will be improved
4	Groundwater Zone 1 (OT027) Cleanup Strategy. 5.2.1. Verify that the elevation of seep collection system results in the collection of upgradient ground water, but does not result in the drainage or collection of water from the downgradient wetland area.	Zone 1	Data analysis	Completed	611 CES/CEVR	Dec 02	Risk protectiveness will be ensured

Case Studies

- **Event Driven Monitoring, Eielson AFB**
  - **Mr Mike Raabe, Eielson Restoration Program Manager**
- **Risk Based TPH Criteria, Johnston Atoll**

EVENT-DRIVEN MONITORING
EIELSON AFB AK

EVENT-DRIVEN MONITORING
EIELSON AFB AK

EVENT-DRIVEN MONITORING
EIELSON AFB AK

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GOALS

- **Comply with ROD monitoring requirements**
  - **Remain protective of human health and the environment**
- **Optimize ERA funded LTM events**
  - **verify statistical site closure criteria only**
  - **Monitor impact of changing site conditions, when necessary**

Statistical Evaluation Method

- **Mann-Kendall Test and Sen's Slope Estimate (The Excel Template - MAKESENS)**
  - **Mann-Kendall Test – Used to detect and estimate increasing or decreasing trends in time series**
  - **Sens' Slope Estimate – Used to estimate the slope of a linear trend**

- **Reference**
  - **http://www.fmi.fi/kuvat/MAKESENS_MANUAL.pdf**

Site Qualifiers

- **Applied to Sites Having:**
  - **Isolated Exposure Pathway(s)**
  - **Source Term ID**
  - **Demonstrated Stable/Attenuating Plume**
  - **Controlled Site Access**
- **Other Considerations**
  - **Plume Location**
  - **Efficient Management of LUC's Controls**

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SITE DP44-02

TsNumber	1
Name	38M01
Years	1992 - 2002
n	4
Test S	-4
Test Z	
Signific.	
Q	-1.00E-01
Qmin99	
Qmax99	
Qmin95	
Qmax95	
B	1.53E+00
Bmin99	
Bmax99	
Bmin95	
Bmax95	

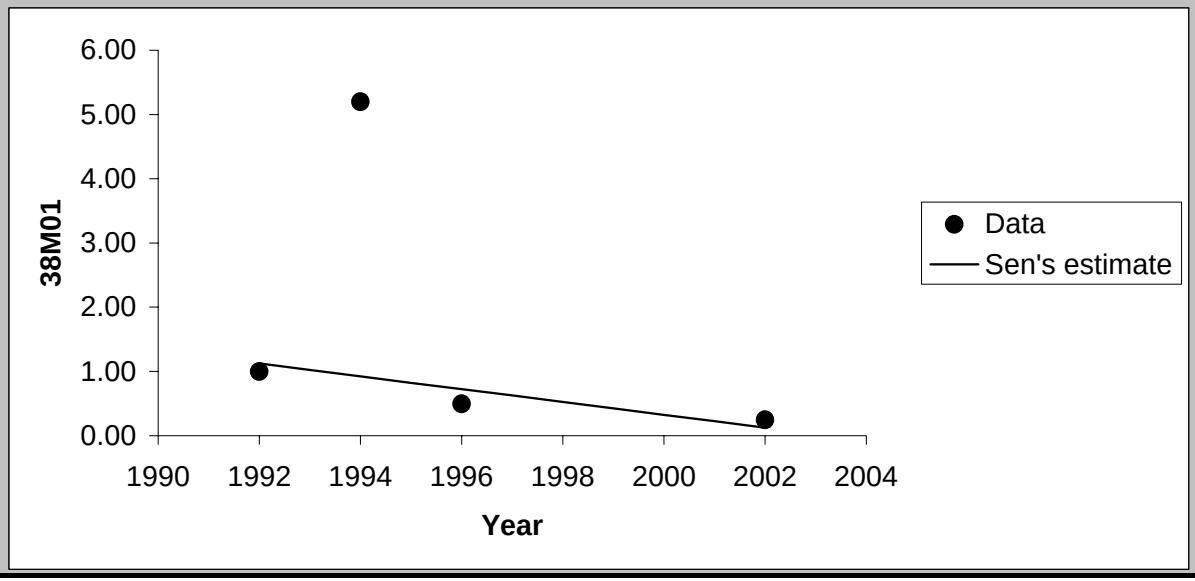


Chart options

- ☐ show 99 % confidence interval
- ☐ show 95 % confidence interval
- ☐ show residuals

Update chart outlook

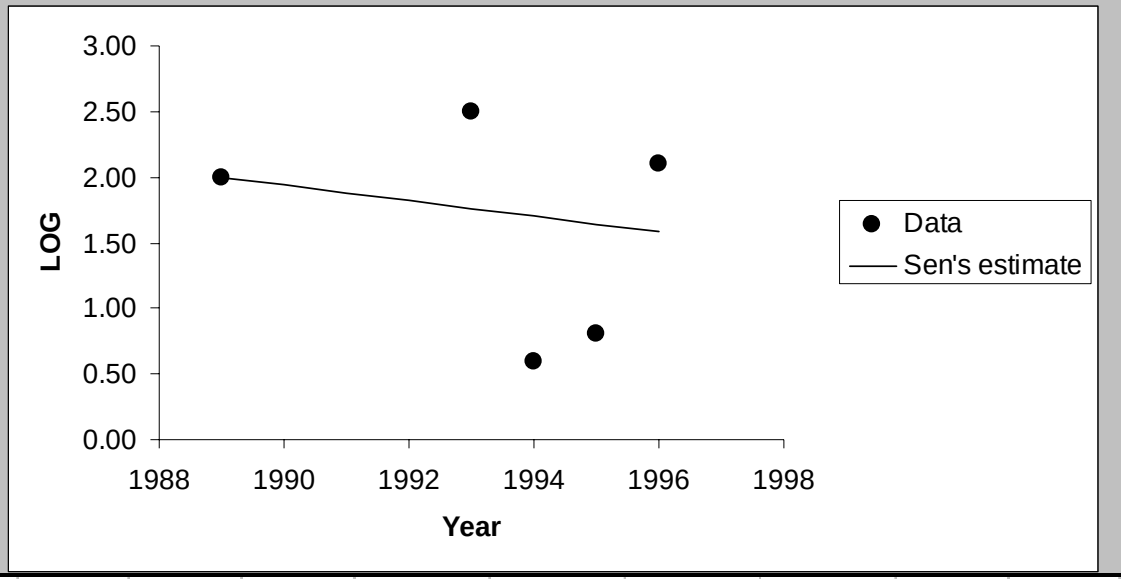
Equation of the lines:
f(year) = Q*(year-firstDataYear) + B
FirstDataYear= 1988

Point values for the chart

Year	Data	Sen's estim	99 % conf. m	99 % conf. m	95 % conf. m	95 % conf. m	Residual
1992	1.00	1.13	0.00	0.00	0.00	0.00	-0.13
1993		1.03	0.00	0.00	0.00	0.00	
1994	5.20	0.93	0.00	0.00	0.00	0.00	4.28
1995		0.83	0.00	0.00	0.00	0.00	
1996	0.50	0.73	0.00	0.00	0.00	0.00	-0.23
1997		0.63	0.00	0.00	0.00	0.00	
1998		0.53	0.00	0.00	0.00	0.00	
1999		0.43	0.00	0.00	0.00	0.00	
2000		0.33	0.00	0.00	0.00	0.00	
2001		0.23	0.00	0.00	0.00	0.00	
2002	0.25	0.13	0.00	0.00	0.00	0.00	0.13

SITE SS50-02

TsNumber	2
Name	LOG
Years	1989 - 1996
n	5
Test S	0
Test Z	
Signific.	
Q	-5.95E-02
Qmin99	
Qmax99	
Qmin95	
Qmax95	
B	2.06E+00
Bmin99	
Bmax99	
Bmin95	
Bmax95	



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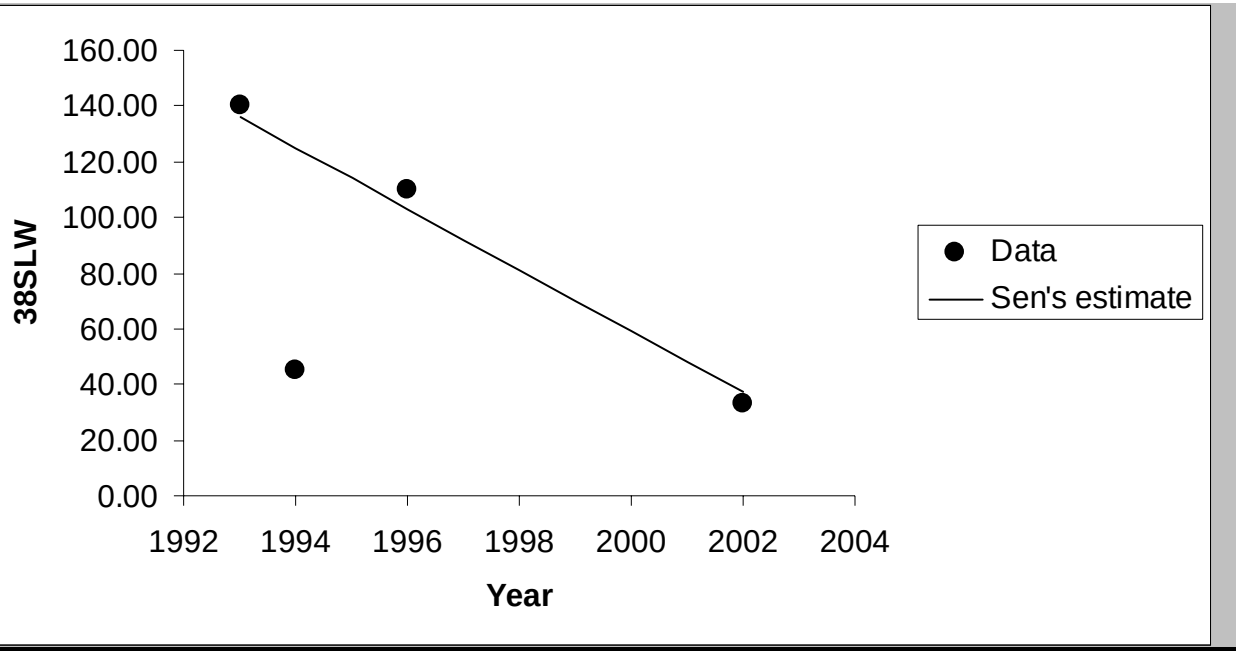
f(year) = Q*(year-firstDataYear) + B
FirstDataYear= 1988

Point values for the chart

Year	Data	Sen's estir	99 % conf. m	99 % conf. m	95 % conf. m	95 % conf. m	Residual
1989	2.00	2.00	0.00	0.00	0.00	0.00	0.00
1990		1.94	0.00	0.00	0.00	0.00	
1991		1.88	0.00	0.00	0.00	0.00	
1992		1.82	0.00	0.00	0.00	0.00	
1993	2.50	1.76	0.00	0.00	0.00	0.00	0.74
1994	0.60	1.70	0.00	0.00	0.00	0.00	-1.10
1995	0.80	1.64	0.00	0.00	0.00	0.00	-0.84
1996	2.10	1.58	0.00	0.00	0.00	0.00	0.52

TsNumber	2
Name	38SLW
Years	1993 - 2002
n	4
Test S	-4
Test Z	
Signific.	
Q	-1.09E+01
Qmin99	
Qmax99	
Qmin95	
Qmax95	
B	1.90E+02
Bmin99	
Bmax99	
Bmin95	
Bmax95	



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Update chart outlook

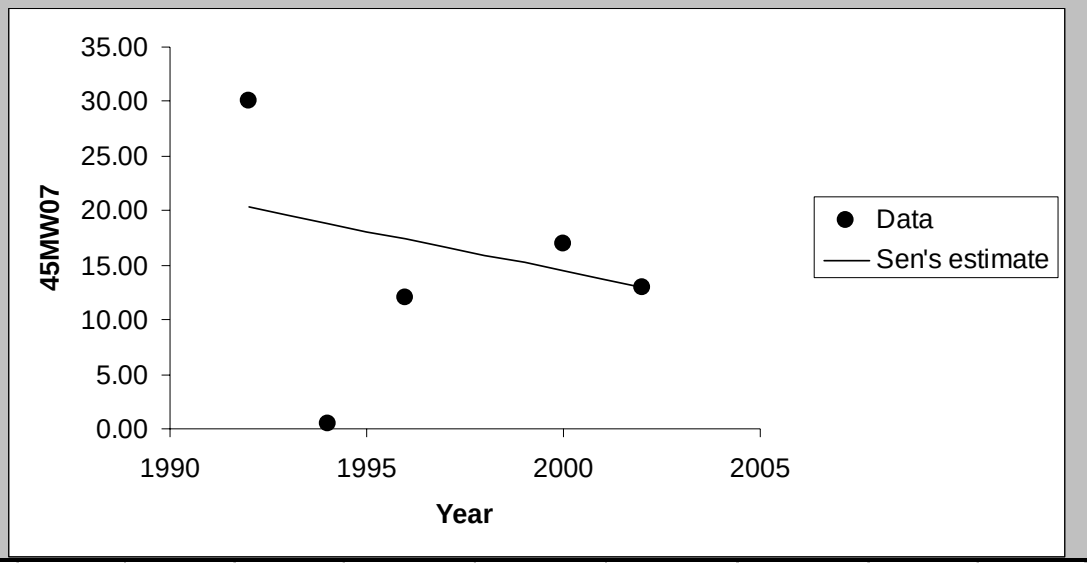
Equation of the lines:
f(year) = Q*(year-firstDataYear) + B
FirstDataYear= 1988

Point values for the chart

Year	Data	Sen's estir	99 % conf. m	99 % conf. m	95 % conf. m	95 % conf. m	Residual
1993	140.00	135.75	0.00	0.00	0.00	0.00	4.25
1994	45.00	124.81	0.00	0.00	0.00	0.00	-79.81
1995		113.86	0.00	0.00	0.00	0.00	
1996	110.00	102.92	0.00	0.00	0.00	0.00	7.08
1997		91.97	0.00	0.00	0.00	0.00	
1998		81.03	0.00	0.00	0.00	0.00	
1999		70.08	0.00	0.00	0.00	0.00	
2000		59.14	0.00	0.00	0.00	0.00	
2001		48.19	0.00	0.00	0.00	0.00	
2002	33.00	37.25	0.00	0.00	0.00	0.00	-4.25

SITE WP45-00-02

TsNumber	2
Name	45MW07
Years	1992 - 2002
n	5
Test S	0
Test Z	
Signific.	
Q	-7.29E-01
Qmin99	
Qmax99	
Qmin95	
Qmax95	
B	2.03E+01
Bmin99	
Bmax99	
Bmin95	
Bmax95	



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- ☐ show 95 % confidence interval
- ☐ show residuals

Update chart outlook

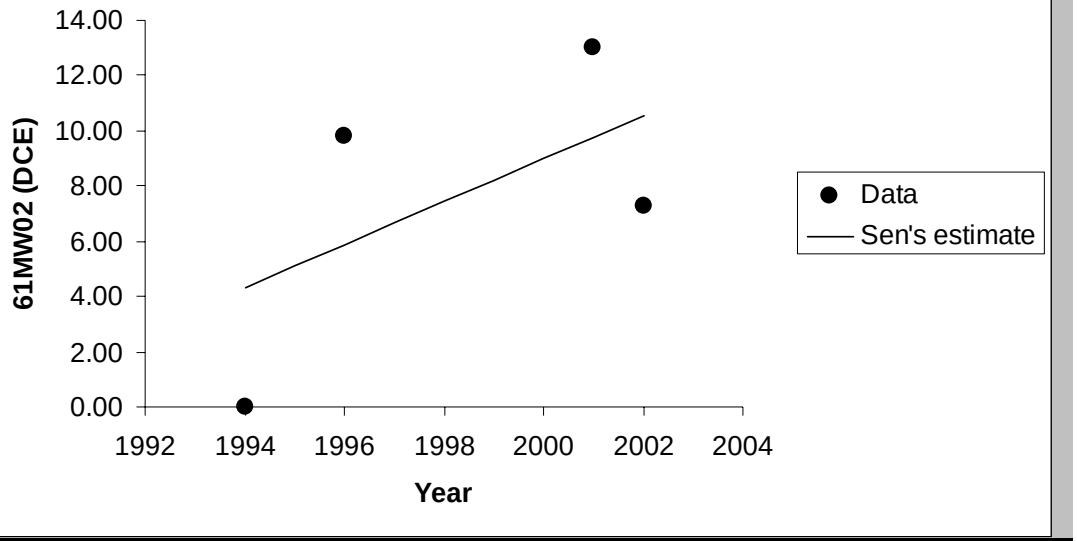
Equation of the lines:
f(year) = Q*(year-firstDataYear) + B
FirstDataYear= 1992

Point values for the chart

Year	Data	Sen's estir	99 % conf. m	99 % conf. m	95 % conf. m	95 % conf. m	Residual
1992	30.00	20.29	0.00	0.00	0.00	0.00	9.71
1993		19.56	0.00	0.00	0.00	0.00	
1994	0.50	18.83	0.00	0.00	0.00	0.00	-18.33
1995		18.10	0.00	0.00	0.00	0.00	
1996	12.00	17.38	0.00	0.00	0.00	0.00	-5.38
1997		16.65	0.00	0.00	0.00	0.00	
1998		15.92	0.00	0.00	0.00	0.00	
1999		15.19	0.00	0.00	0.00	0.00	
2000	17.00	14.46	0.00	0.00	0.00	0.00	2.54
2001		13.73	0.00	0.00	0.00	0.00	
2002	13.00	13.00	0.00	0.00	0.00	0.00	0.00

SITE SS61-01-02

TsNumber	2
Name	61MW02 (DCE)
Years	1994 - 2002
n	4
Test S	2
Test Z	
Signific.	
Q	7.76E-01
Qmin99	
Qmax99	
Qmin95	
Qmax95	
B	-3.29E-01
Bmin99	
Bmax99	
Bmin95	
Bmax95	



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FirstDataYear= 1988

Point values for the chart

Year	Data	Sen's estir	99 % conf. m	99 % conf. m	95 % conf. m	95 % conf. m	Residual
1994	0.00	4.33	0.00	0.00	0.00	0.00	-4.33
1995		5.10	0.00	0.00	0.00	0.00	
1996	9.80	5.88	0.00	0.00	0.00	0.00	3.92
1997		6.66	0.00	0.00	0.00	0.00	
1998		7.43	0.00	0.00	0.00	0.00	
1999		8.21	0.00	0.00	0.00	0.00	
2000		8.99	0.00	0.00	0.00	0.00	
2001	13.00	9.76	0.00	0.00	0.00	0.00	3.24
2002	7.30	10.54	0.00	0.00	0.00	0.00	-3.24

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SITE: DP25						Has COC crossed MCL?
WELL NO.	EQUATION OF LINE	Q	B	YEAR-FIRST-DATE	DATE TO MCL	(prior to predicted date) ^
B-1	f(year) = Q*(year - firstDataYear) + B	-18.5	242	1988	2001	YES
B-15		-22	146	1988	1994	NO
B-18		-790	7590	1988	1998	No Verification
53M01		-69.4	608	1988	1997	No Verification
SITE: WP38-01-02						Has COC crossed MCL?
WELL NO.	EQUATION OF LINE	Q	B	YEAR-FIRST-DATE	DATE TO MCL	(prior to predicted date) ^
38SLW	f(year) = Q*(year - firstDataYear) + B	-10.9	190	1993	2010	No Verification
SITE: ST13 2003						Has COC crossed MCL?
WELL NO.	EQUATION OF LINE	Q	B	YEAR-FIRST-DATE	DATE TO MCL	(prior to predicted date) ^
13MW07	f(year) = Q*(year - firstDataYear) + B	-50	806	1995	2011	No Verification
26-1	f(year) = Q*(year - firstDataYear) + B	-61.7	704	1991	2002	NO
26-12	f(year) = Q*(year - firstDataYear) + B	-8.42	77.7	1991	2000	No Verification
SITE: ST10-1-02						Has COC crossed MCL?
WELL NO.	EQUATION OF LINE	Q	B	YEAR-FIRST-DATE	DATE TO MCL	(prior to predicted date) ^
W-1	f(year) = Q*(year - firstDataYear) + B	-11.6	184	1991	2006	No Verification
10-1	f(year) = Q*(year - firstDataYear) + B	-154	861	1991	1997	YES
SITE: ST20-02 (E7)						Has COC crossed MCL?
WELL NO.	EQUATION OF LINE	Q	B	YEAR-FIRST-DATE	DATE TO MCL	(prior to predicted date) ^
20M03	f(year) = Q*(year - firstDataYear) + B	-46.1	463.4	1989	1999	NO
20M04	f(year) = Q*(year - firstDataYear) + B	-646.4	8078.3	1989	2001	NO
20M09	f(year) = Q*(year - firstDataYear) + B	-100	940	1989	1998	NO
53M04	f(year) = Q*(year - firstDataYear) + B	-466.3	6896.3	1989	2004	No Verification
SITE: ST20-02 (E9)						Has COC crossed MCL?
WELL NO.	EQUATION OF LINE	Q	B	YEAR-FIRST-DATE	DATE TO MCL	(prior to predicted date) ^
20M07	f(year) = Q*(year - firstDataYear) + B	-160	1340	1989	1997	No Verification
20M08	f(year) = Q*(year - firstDataYear) + B	-17.5	177	1989	1999	YES
SITE: WP-45-00-02						Has COC crossed MCL?
WELL NO.	EQUATION OF LINE	Q	B	YEAR-FIRST-DATE	DATE TO MCL	(prior to predicted date) ^
45MW08	f(year) = Q*(year - firstDataYear) + B	-0.8	10.8	1992	1999	YES
45MW07	f(year) = Q*(year - firstDataYear) + B	-0.73	20.3	1992	2013	No Verification
SITE: SS50-02						Has COC crossed MCL?
WELL NO.	EQUATION OF LINE	Q	B	YEAR-FIRST-DATE	DATE TO MCL	(prior to predicted date) ^
50M05	f(year) = Q*(year - firstDataYear) + B	-7.66	116	1989	2003	No Verification
SITE: LF03 2003						Has COC crossed MCL?
WELL NO.	EQUATION OF LINE	Q	B	YEAR-FIRST-DATE	DATE TO MCL	(prior to predicted date) ^
03M13	f(year) = Q*(year - firstDataYear) + B	-1.56	41.2	1988	2011	NO
03M08	f(year) = Q*(year - firstDataYear) + B	-2	28	1988	2000	YES
09M02	f(year) = Q*(year - firstDataYear) + B	-0.9	19	1988	2004	No Verification
SITE: ST48-02						Has COC crossed MCL?
WELL NO.	EQUATION OF LINE	Q	B	YEAR-FIRST-DATE	DATE TO MCL	(prior to predicted date) ^
50M03	f(year) = Q*(year - firstDataYear) + B	-25.7	385	1989	2004	No Verification

* sites compared to EPA MCL for benzene (MCL = 5 ug/L)

^ comparison between measured sample data and predicted statistical date

Conclusions
Event-Driven Monitoring

- **Optimize a Shrinking ERA Budget**
  - **Reduce out-year CTC for site closure**
  - **Apply LTM savings toward site cleanup**
    - **Drive the program schedule to the left**


1340
YIELD
10 10:38 AM

EVENT-DRIVEN MONITORING
EIELSON AFB AK

Contact Information

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DSN 317-377-1164

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Case Study: Johnston Atoll Aerial View

Case Study: Johnston Atoll TPH

Case Study: Johnston Atoll TPH

- Thermal desorption cost overruns force review of final corrective action
- 5,000 ppm TPH c/u criteria drives excessive soil volumes
- RPO team called in to help brainstorm a fix
- Risk based approach selected
  - TPH fractionation
  - Silica gel scrub removes non polar compounds
  - Synthetic precipitation leaching procedure (SPLP)
- Result:
  - 17,000 vice 5,000 ppm TPH c/u criteria
  - SPLP passes 640 ppb leachability for groundwater
  - Soil volume drops from 20,000 to 3,000 yards
  - Land farming selected
  - $3M saved

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Conclusions

- Train all RPMs on RPO concept
  - Management of monitoring and remedial systems is becoming the “bread and butter” of our business
  - RPO = technical cross-feed
- Seek out appropriate installation for first RPO
  - Multiple sites in remedial action-operation and long term management phases
  - Progressive, open-minded RPM
  - Reasonable regulatory over site
- RPM referral is the best form of promotion

Conclusions

- Management participation and support
  - Promote through peer review waiver option
  - RPO team participation-lessons applied to validation
  - Assist support for less desirable recommendation
  - Let program “keep” the savings
  - Tailor process to sites & regulatory climate
    - Poor planning can lead to failure
  - Wholistic vice focused: use both

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Conclusions

- Monitor follow-through of RPO recommendations
  - Track recommendations before funding: Matrix
- Positive PACAF RPO experience
  - Doing the job smarter + faster = $ savings
  - Improves technical knowledge of RPM
  - Knowledge broadly applied
  - RPMs take it to the next level: innovation
- 10% cumulative savings = $17M + protective, early closure
  - $5.3M in firm cost avoidance in 5 years
    - Does not include Johnston Atoll ($3M) or projections
  - $800K invested in RPOs
  - Follow through will yield greater benefits
  - 20% savings easily conceivable

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