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Automated Data Analysis and Decision Making to Support Pump and Treat Shutdown Evaluation

Background:

- At a former industrial facility in the Caribbean, a pump and treat (P&T) system was operated to address a contaminated groundwater plume associated with a petroleum-based DNAPL (petroDNAPL) body for ~30 years. P&T system was aging, diminishing in effectiveness, and required off-island disposal of a hazardous waste
- Regulator granted approval to shut down P&T system for a year to evaluate stability of petroDNAPL body and associated groundwater plume under ambient conditions • Monthly monitoring events performed to assess petroDNAPL thickness, groundwater
- elevations, and groundwater concentrations trends during P&T shutdown
- Monitoring data compared with rigorous stability criteria to assess plume stability (**Table 1**) • If primary stability criteria were met, the P&T system would be reactivated per conditional approval with regulator
- Large amounts of data were generated that needed to be evaluated at a high frequency to support decision making throughout shutdown

	aute	e i – Stability Chiena					
		Unacceptable Condition	Criteria				
petroDNAPL	Primary	Offsite petroDNAPL migration (lateral)	New petroDNAPL observation in wells without prior in-well petro "clean" soil boring logs				
		Offsite petroDNAPL migration (vertical)	New petroDNAPL observation in well screens that appear vertical observed petroDNAPL in soil boring logs and without prior in-wel				
		Onsite petroDNAPL migration (laterally distal)	New petroDNAPL observation in distal, downgradient wells witho petroDNAPL detection and "clean" soil boring logs				
		Onsite petroDNAPL mobility (potentially non- migrating)	New petroDNAPL observation in wells previously noted as contain				
	Seconda	Onsite petroDNAPL migration (vertical)	New petroDNAPL observation in well screens that appear vertical observed petroDNAPL in soil boring logs and without prior in-wel				
	Primary	Offsite migration of multiple COCs	Exceedance in well without prior exceedances and "clean" soil bor				
ISe	Prin	Onsite migration of multiple COCs (distal)	Exceedance in south perimeter well				
l-Phase		Onsite dissolved COC migration	Exceedance in downgradient wells without prior exceedances and				
Dissolved-F	dary	Onsite dissolved COC migration	Exceedance AND statistically significant increasing trends by MK i petroDNAPL footprint without prior exceedances				
Disse	econ	Onsite dissolved COC migration	Thiessen polygons and plume moment analysis show: - a statistically significant increase (i.e., p-value < 0.05) in Unit - a consistently, downgradient advancing center of mass that h 30% the baseline and post-earthquake plume length				

Table 1 – Stability Criteria



Objective:

oDNAPL detection and ally disconnected from ell petroDNAPL detection out prior in-well aining petroDNAPL ally disconnected from ell petroDNAPL detection oring logs nd "clean" soil boring logs K in wells proximal to it 2 plume mass, AND has traveled greater than

• Automate data flows, data analysis, and decision criteria evaluation to support P&T system shutdown

Approach

- Data flows were completely digitized from field to database including DNAPL thickness, water levels, water quality parameters, groundwater analytical data, daily rainfall data, earthquake frequency
- Inventory scripts were developed to inventory and QA/QC data flows • Evaluation of all stability decision criteria in **Table 1** were automated using logic scripts, and hosted in web-based dashboard which also automatically updated visuals, data plots, plume maps, etc.
- Dashboard access granted to regulators to streamline data review • Dashboard referenced in reports for figures, plume maps, data analysis

A marked mark	PSE Overview	Dissolved-Phase Condition Su Status of Dissolved-Phase Contingency Response Action /	Assessment	Date	PSE Overview DNAPL Thickness Resul	5	DNAPL Condition Su Status of DNAPL Contingency Response Ac	
	ent Select all 2018-12 Baseline Groun 2019-11 Baseline Groun 2020-05 Inital Stewide 2020-06 Month 1 Groun 2020-08 Month 2 Groun 2020-09 Month 2 Groun 20	As None N	2018-12 Baseline 2019-11 Baseline 2020-05 Initial Sit 2020-06 Month 1 2020-09 Month 2 2020-09 Month 4 2020-10 Month 5 2020-10 Month 5 2020-10 Month 5 2020-10 Month 8 2020-10 Month 8 2020-10 Month 9 2021-01 Month 8 2021-01 Month 9 2021-02 M	Secondary we	Event Select all 2020-05 Initial Sitewid 2020-05 Initial Sitewid 2020-06 Minth 4 Gau 2020-01 Minth 7 Gau 2021-01 Minth 8 Gau 2021-03 Minth 10 Gau 2021-03 Minth 11 G	Well List →<	None None None None None None None None None None None None None None	2018-12 Baseline Gauging 2018-12 Baseline Gauging 2020-05 Initial Stewide Gau 2020-07 Biweekly 6 Gauging 2020-08 Wieekly 6 Gauging 2020-09 Month 4 Gauging 2020-10 Month 5 Gauging 2020-11 Month 6 Gauging 2020-12 Month 7 Gauging 2020-12 Month 7 Gauging 2021-01 Month 7 Gauging 2021-01 Month 9 Gauging 2021-02 Month 9 Gauging
			5 -0.5			New observation	ation of DNAPL (>0.03-foot thickne	ess) in wells without
	olved Condition Summary	Dissolved-Phase Monitoring	-1.0 Jul 2020 Sep 2020 Nov 2020 Dissolved-Phase Plume 2-Dimensional Krig 2-Methylnaphthale \$45.0 ug/l	Contouring	2	prior in-well 28A, MW-28	DNAPL detection and "clean" soil B, and P-2A). DNAPL Monitoring	boring logs (e.g. MW-

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Summarv



Figure 1 Decision criteria data flow

Figures 2-5

- Dashboard screen grabs: Decision criteria summary for
- dissolved-phase Decision criteria summary for
- petroDNAPL 4. Dissolved-Phase results
- 5. PetroDNAPL thickness results



Results/Lessons Learned

- Data analysis and decision making were successfully automated
- Dashboard was an effective reporting interface and holds promise for use as an administrative record
- Project hours for data analysis and reporting decreased by 25% following decision criteria automation. Potential for additional savings through generating reports using machine learning
- The first year of the shutdown evaluation supported the stability hypothesis
- Regulator approved 2-year extension to continue stability evaluation
- \$1M saved in O&M costs for each year the P&T system remained off

grabs of: 6. Groundwater Level Monitoring

Dashboard screen

Figures 6-9

- 7. Mann-Kendall **Trend Analysis**
- 8. Thiessen Polygor Center of Mass 9. Thiessen Polygor
- **Total Mass**

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