

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

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### 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

### Objective:

- 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

- Figures 6-9 Dashboard screen grabs of:
- Groundwater Level Monitoring
  - Mann-Kendall Trend Analysis
  - Thiessen Polygon Center of Mass
  - Thiessen Polygon Total Mass

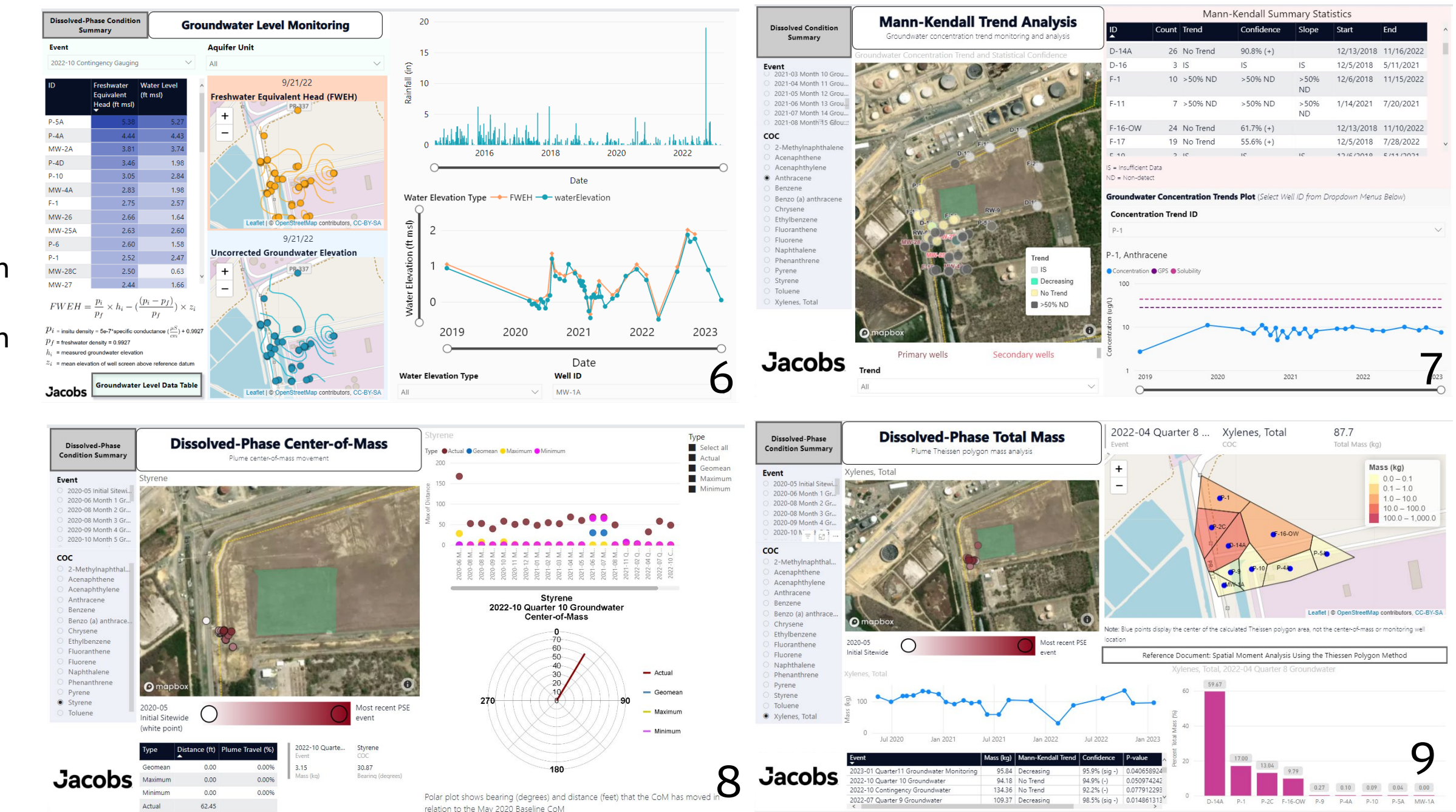


Table 1 – Stability Criteria

	Unacceptable Condition	Criteria
petroDNAPL Primary	Offsite petroDNAPL migration (lateral)	New petroDNAPL observation in wells without prior in-well petroDNAPL detection and "clean" soil boring logs
	Offsite petroDNAPL migration (vertical)	New petroDNAPL observation in well screens that appear vertically disconnected from observed petroDNAPL in soil boring logs and without prior in-well petroDNAPL detection
	Onsite petroDNAPL migration (laterally distal)	New petroDNAPL observation in distal, downgradient wells without prior in-well petroDNAPL detection and "clean" soil boring logs
petroDNAPL Secondary	Onsite petroDNAPL mobility (potentially non-migrating)	New petroDNAPL observation in wells previously noted as containing petroDNAPL
	Onsite petroDNAPL migration (vertical)	New petroDNAPL observation in well screens that appear vertically disconnected from observed petroDNAPL in soil boring logs and without prior in-well petroDNAPL detection
Dissolved-Phase Primary	Offsite migration of multiple COCs	Exceedance in well without prior exceedances and "clean" soil boring logs
	Onsite migration of multiple COCs (distal)	Exceedance in south perimeter well
	Onsite dissolved COC migration	Exceedance in downgradient wells without prior exceedances and "clean" soil boring logs
	Onsite dissolved COC migration	Exceedance AND statistically significant increasing trends by MK in wells proximal to petroDNAPL footprint without prior exceedances
Dissolved-Phase Secondary	Onsite dissolved COC migration	Thiessen polygons and plume moment analysis show: - a statistically significant increase (i.e., p-value < 0.05) in Unit 2 plume mass, AND - a consistently, downgradient advancing center of mass that has traveled greater than 30% the baseline and post-earthquake plume length

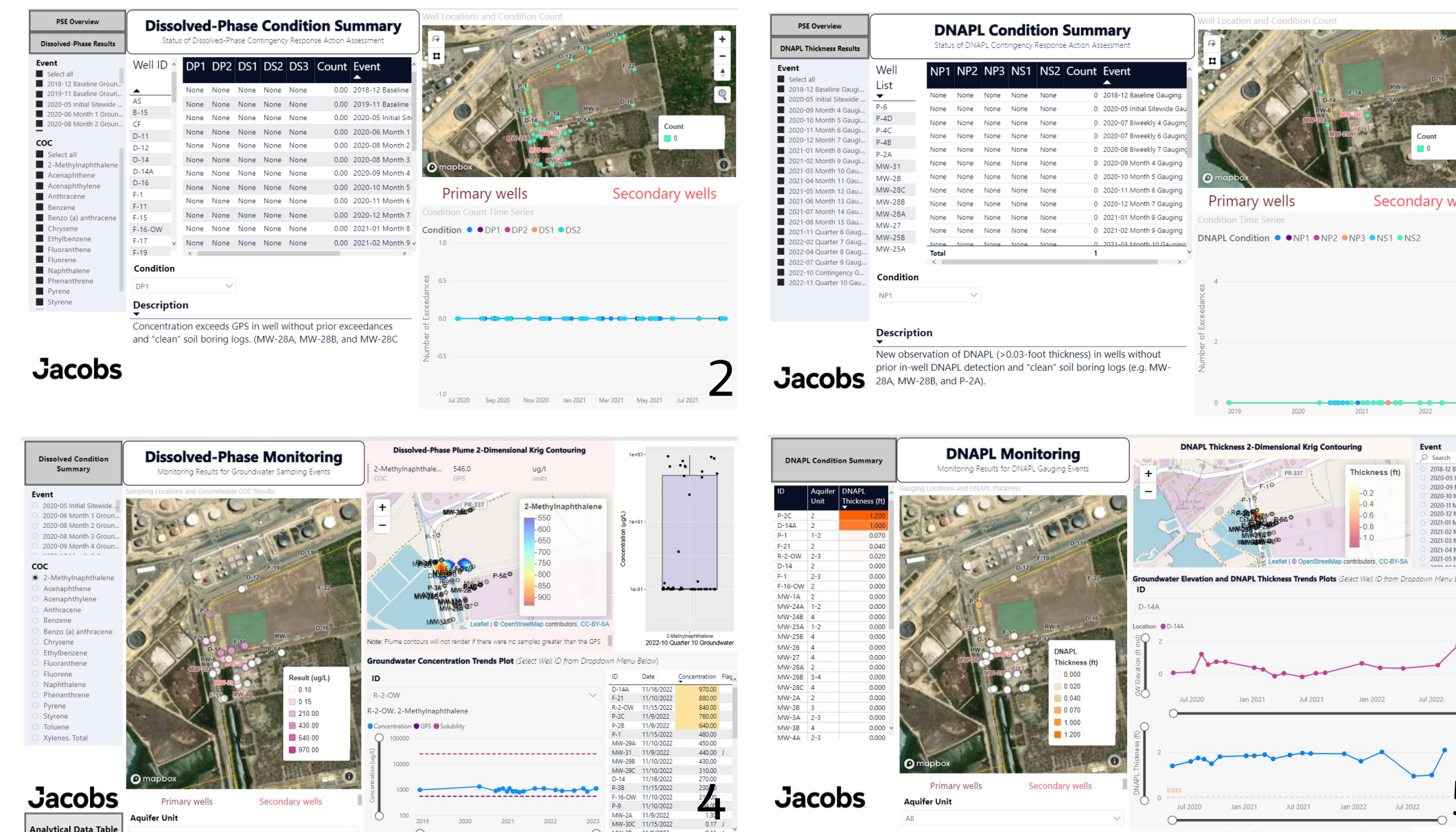


Figure 1 Decision criteria data flow

- Figures 2-5 Dashboard screen grabs:
- Decision criteria summary for dissolved-phase
  - Decision criteria summary for petroDNAPL
  - Dissolved-Phase results
  - 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