How to Avoid “Kick the Can” – Get More Out of Your Annual Performance Assessments

Subtitle

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Topics

- What does “kick the can” mean?
- Three Questions for Performance Reviews
- Making data presentations easier to interpret
- Estimating trends examples (wells, polygons, kriging)
- Assessing progress in life-cycle cost reduction

Origins of “Kick the Can (Down the Road)”

Merriam-Webster

- In the 1980’s, critical new way of referring to putting off work on an issue for a later date
- It caught the attention of William Safire (New York Times) as “effectively summarizes desultory but definite progress”
  - *Desultory – lacking a plan, purpose, or enthusiasm*
- Others thought it something akin to you walking down the street and kicking a can, and when you get bored, you leave it for someone else to kick further down the road
- Externalizing - kick the can to your neighbors property to make it their problem

Do these phrases look familiar to you?

- “Reductive dichlorination daughter products have been detected, indicating that natural attenuation is occurring”
- “The last ten years of data at wells MW-X, MW-Y, and MW-Z show a decreasing trend in TCE concentrations (not noting what is happening to DCE and VC)
- “The plume area has decreased by 50% since the remedy was initiated in 2009”
- “Average plume concentrations have decreased by 40% since 2012”
- These observations may, individually, provide WoE that “good things are happening!” but they are palliative phrases only
- Will not provide information for decision making

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Three Key Questions for Performance Reviews We Rarely Address

- We complete performance reviews on projects every year but generally do not ask these important questions:
  1. How much additional mass (contaminant or concentration [as a proxy]) removal is required to achieve remediation goals?
  2. What is the timeline for reaching contaminant reduction milestones leading to a transition point and achieving cleanup goals?
  3. What is the ratio of annual operations and maintenance spending to annual change in the life cycle project forecast?

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Barriers to estimating the 3-key questions

- We will never know how much mass we have
  - Use concentration as a proxy
  - Estimate sorbed mass based on groundwater concentrations
  - Develop an “envelope” – even if 1 OoM
- There is too much uncertainty in estimating TOR
  - Come up with different scenarios (best, worse, best estimate)
  - At least you have a basis for evaluating performance
- There is too much uncertainty in estimating life-cycle costs
  - Most project management organizations have some kind of estimate
  - Why not put some more effort in coming up with an estimate/range to help decision making, and then continue to refine as you calibrate progress and spend?

Examples of Cognitive Biases Impact Our Performance Reviews

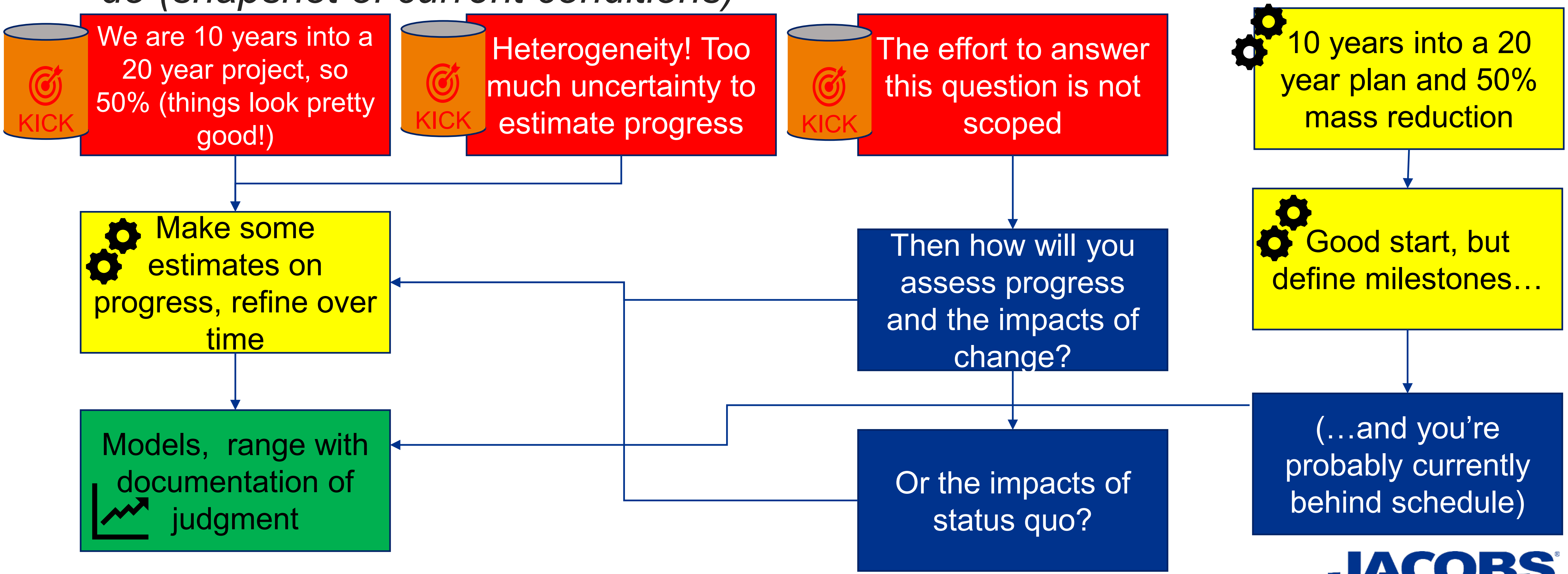
Planning fallacy	Incorrect belief that a decision alternative is more likely to succeed exactly as planned, if accompanied by a high level of planning
Confirmation bias	Excessive weighting of information that is supportive of a belief held by the individual, often reinforced by in-group or herd behavior, and often discounting of contradictory information
Neglect of probability	Failure to recognize, on a probabilistic basis, the numerous possible outcomes of a decision, including secondary and tertiary outcomes
Availability bias	Preferential weighting of information that is easier to recall or more recently or frequently heard

Loss aversion	Over-weighting of potential losses relative to potential gains
Anchoring effect	The undue weighting of the first decision alternative posed
Overconfidence effect	The expectation of a greater likelihood of individual success than would be predicted by a statistically representative success rate
Intuition bias	The instinctual human tendency to favor fast, intuitive thinking and avoid slower, more complex thinking and detailed analysis, in order to conserve cognitive resources needed for survival

From: Clayton, W. *Remediation Decision-Making and Behavioral Economics: Results of an Industry Survey.* Groundwater Monitoring & Remediation. 2017

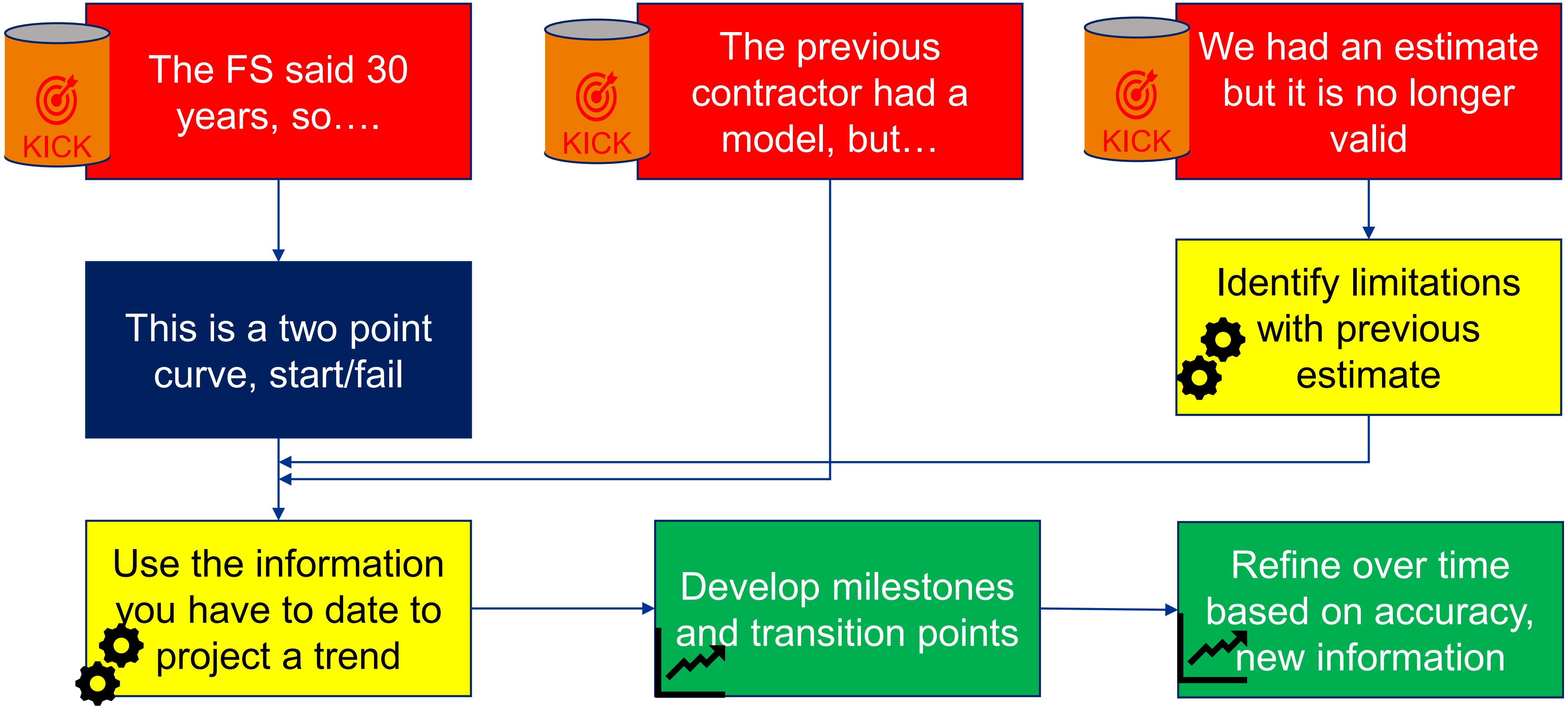
Q1: How much additional mass (contaminant or concentration) removal is required to achieve remediation goals?

- *Identify how much progress has been made and how much is left to do (snapshot of current conditions)*



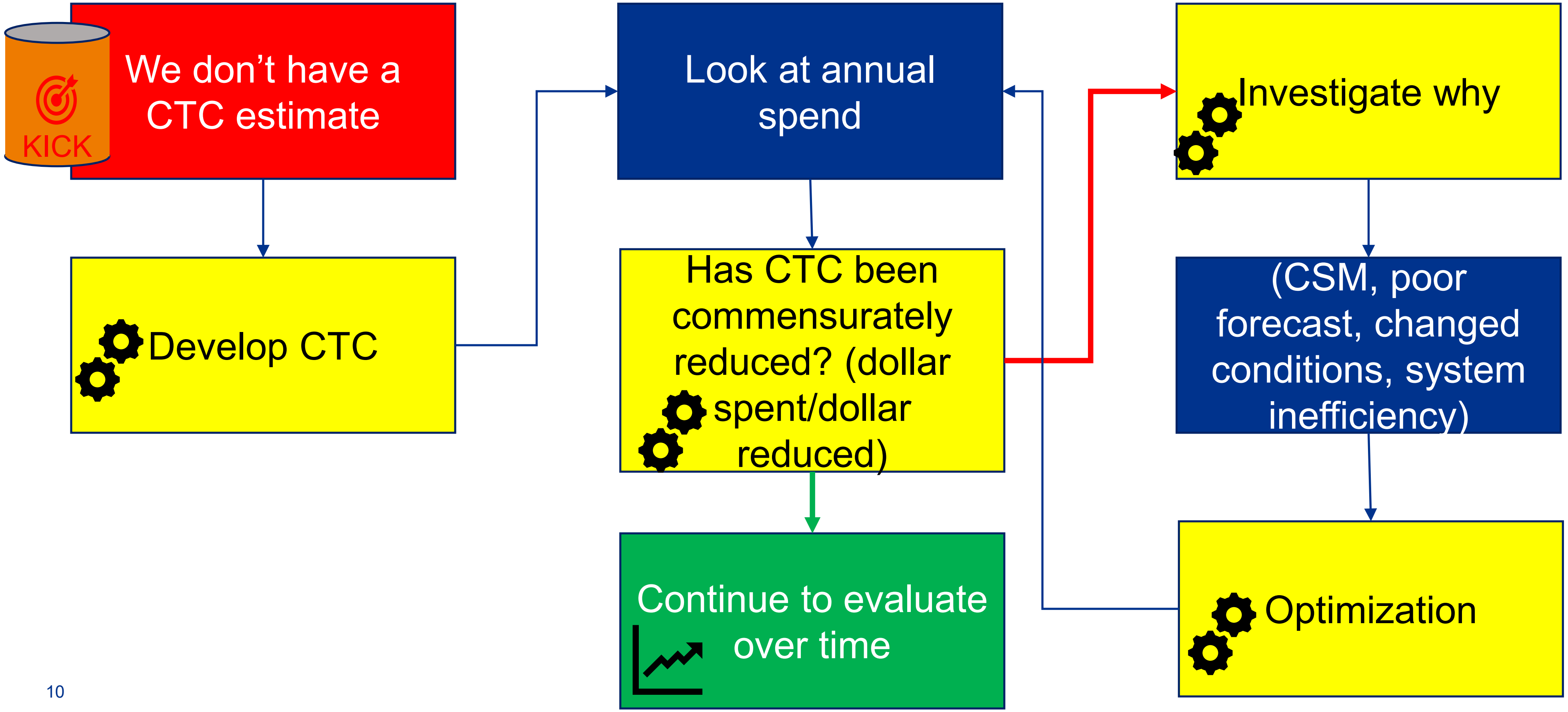
Q2: What is the timeline for reaching contaminant reduction milestones leading to a transition point and achieving cleanup goals?

- *Surprisingly, this information is rarely updated after the FS*



Q3: What is the ratio of annual operations and maintenance spending to annual change in the life cycle project forecast?

- *This requires a cost-to-complete estimate and will provide insight into if your spending in bringing down CTC in an effective way*



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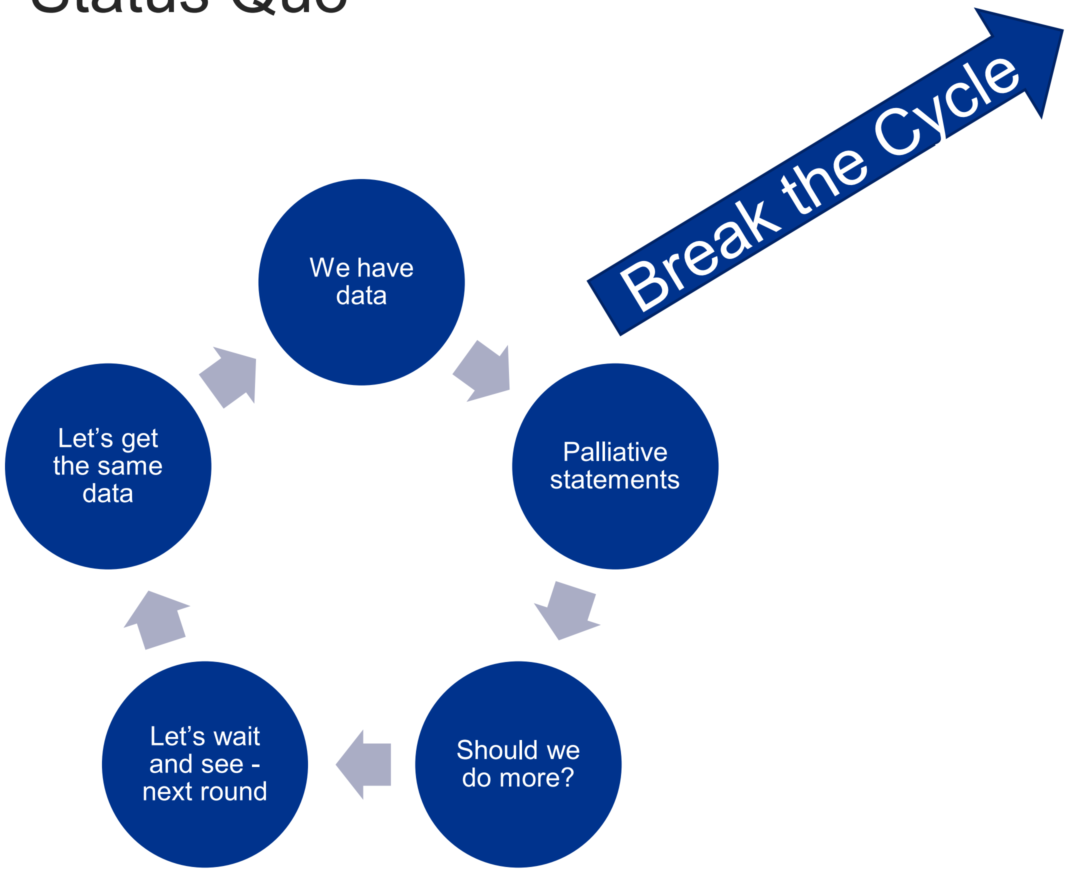
Is your annual performance review data limiting your confidence in progress?

- Status Quo



- Mine the data that you have
- Get information to (start) estimating the three key questions
- Collect additional data
  - Threshold varies by problem owner

Understand Site Data

- Review data for applicability of different data evaluation techniques:
  - Single well analytics
    - Summary statistics and Mann-Kendall trend analysis
    - Time-series (molar) concentration plots
    - First-order decay rates
  - Spatial moment analysis (developed by Aris, 1956)
    - Integrated plume mass and center-of-mass changes over time
    - Kriging versus Thiessen (Voronoi) polygons
- Identify which analyses may be appropriate for continued use and at which project stage
  - Iterative approach
  - Support regulator and or public understanding of plume stability at the site
  - Support site decision-making

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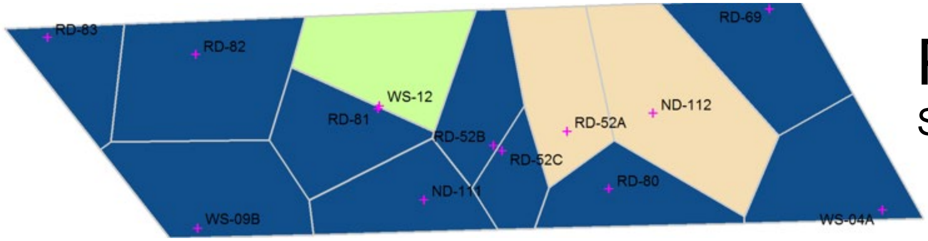
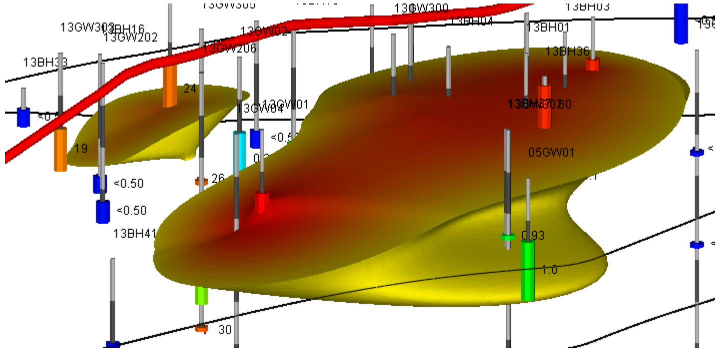
Estimating site wide changes over time



Polygons

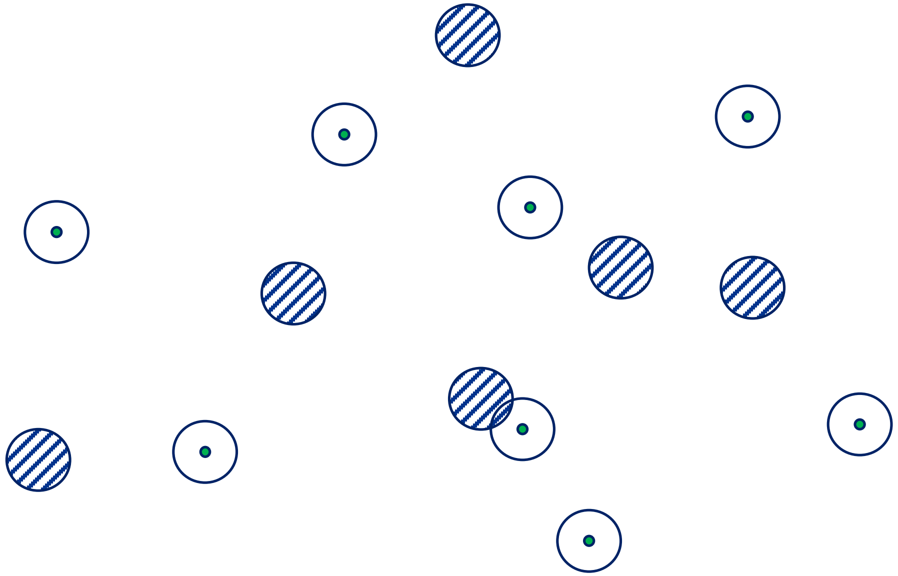
Sometime single well dominates



Kriging

Defining borders takes effort

Singe wells representing large area dominates



MCL Equivalents

Focus on wells that are driving exceedances

(but need to avoid “remediate well” mentality)

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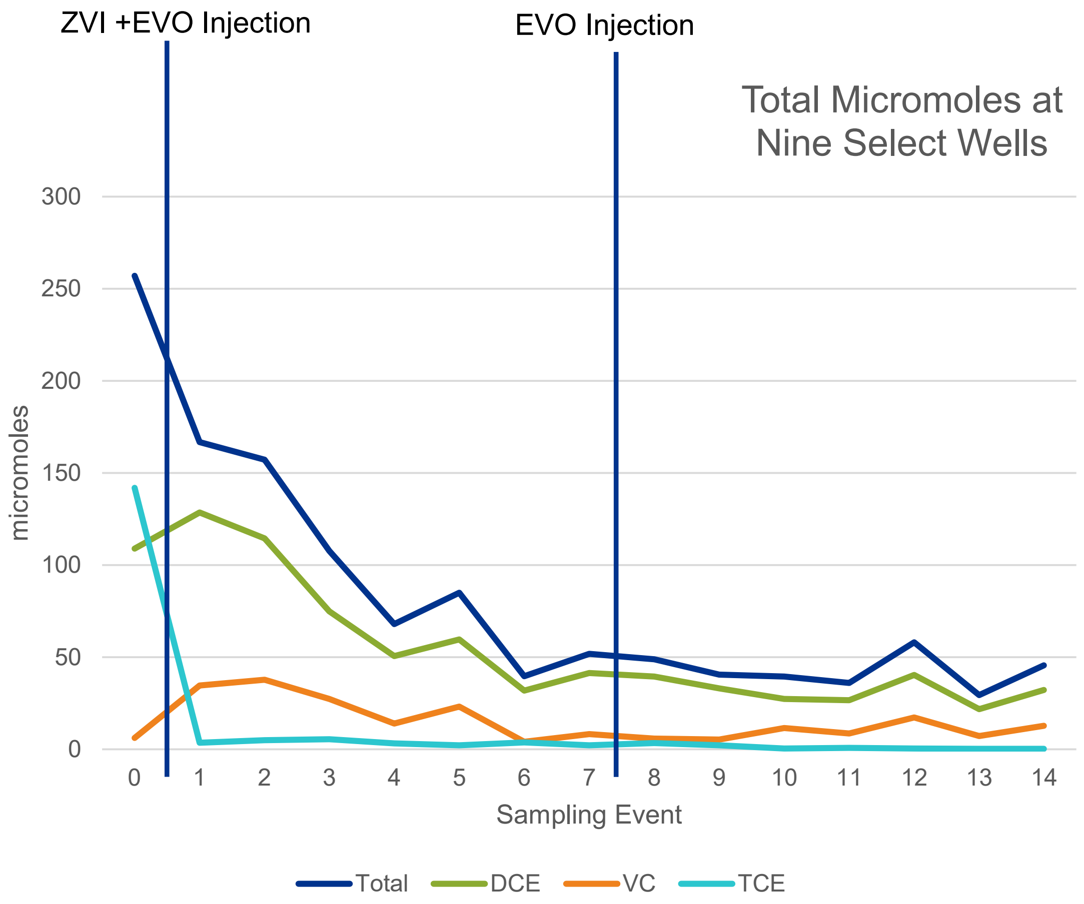
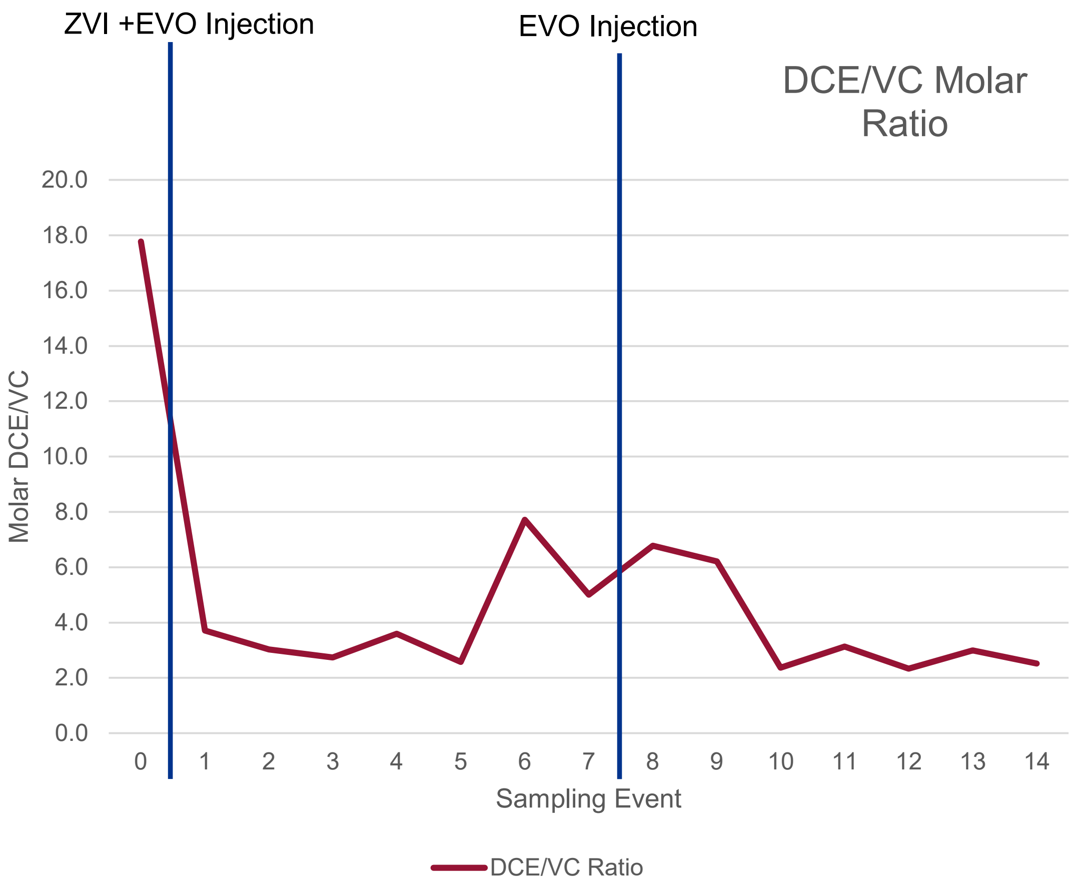
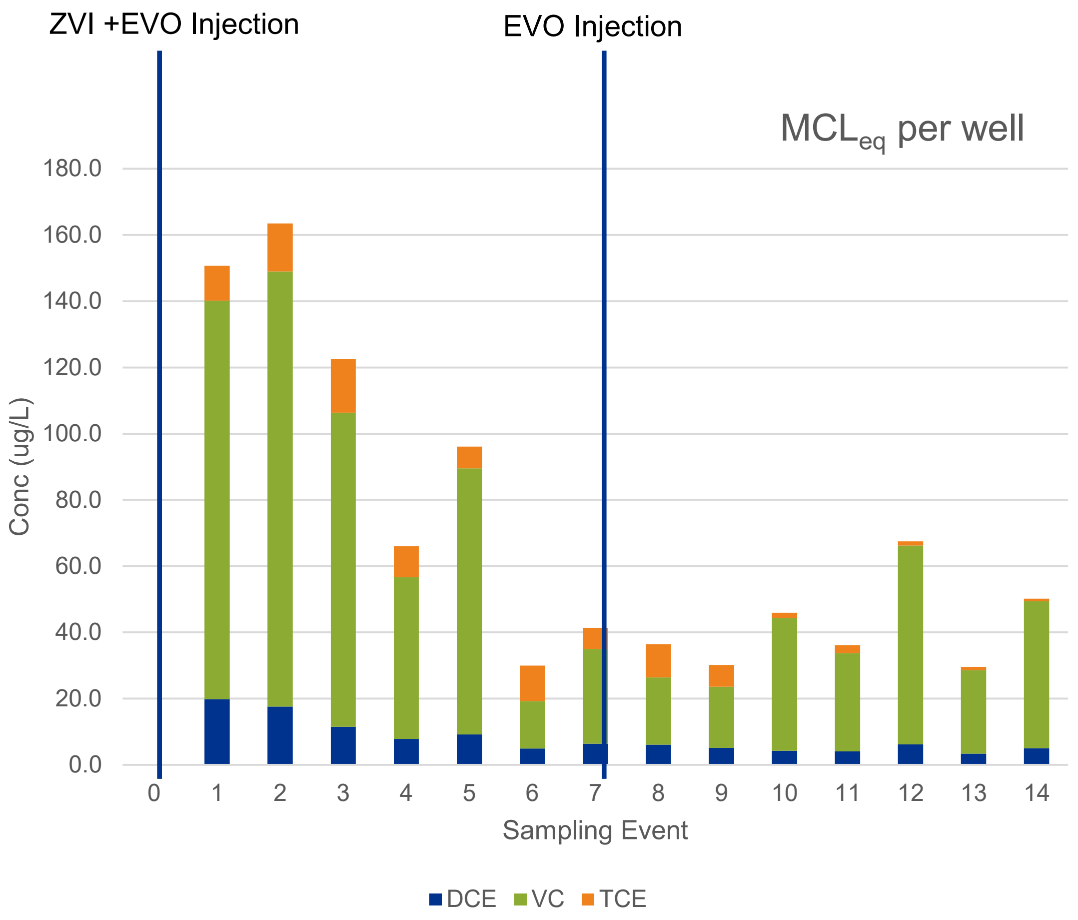
Focus on Nine "Stubborn" Wells
(when not estimating mass, use total concentration as a proxy)





MCL_{eq} provides a different perspective, compared to total molar or concentration approach



- Focused on “stubborn” wells rather than estimating mass or areas
- Approach shows a flattening trend since second injection
- Majority of MCLeq is related to VC
- The ratio of DCE to VC and lack of decreasing concentrations indicate a DCE stall
- 1 MCL_{eq} DCE = 22.6 MCL_{eq} VC
- Per well, currently 44 MCL_{eq} VC plus an additional 110 MCL_{eq} VC from DCE deg
- Trend analysis showed 25 years to DCE MCL and indeterminable for VC due to increasing trends
- Will complete optimization study

Example:
MCL_{eq} = conc/MCL: (100/5) ug/L TCE + (100/70) ug/L C12DCE + (100/2) ug/L VC = 71.4 MCL_{eq}
$VC_{pot\text{-}eq}$ = 106 (based on total moles of TCE, DCE, VC)

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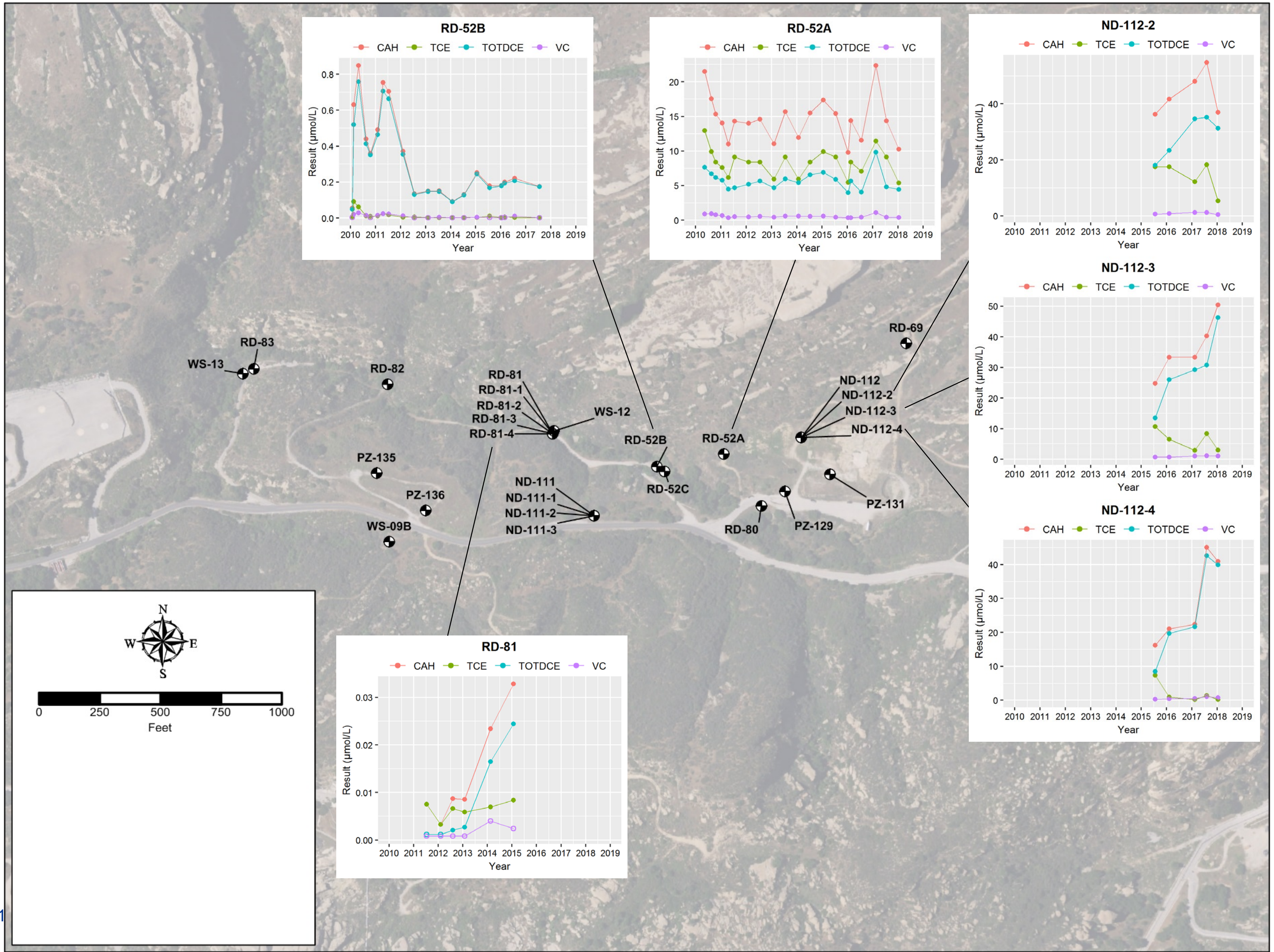
Mining Data – placing trend plots on maps

Site B – Deep CVOC plume in fractured sand-stone



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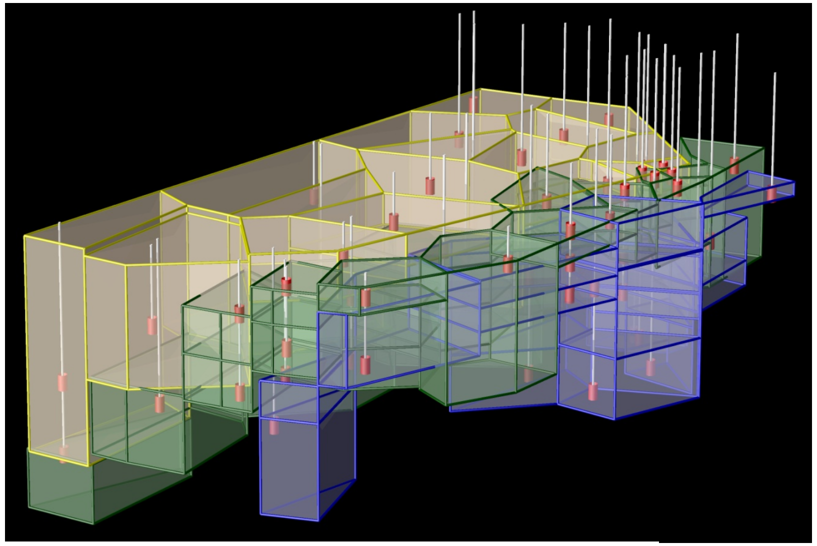
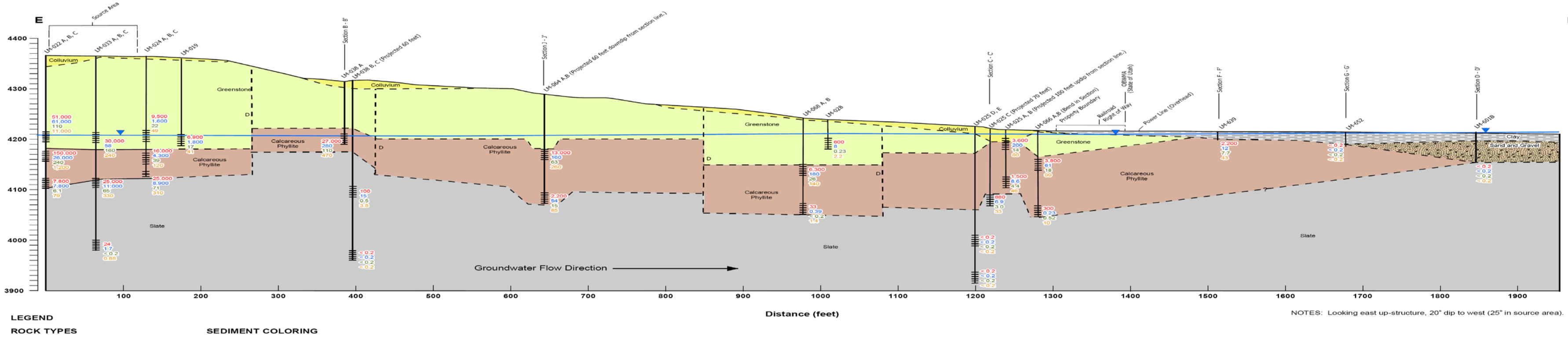
Example of Stacked Thiessen Polygons for Mass Estimation

Chlorinated Solvent Plume in Fractured Bedrock

- 3 distinct rock types
- polygon network for each unit
- Mass calculations used to document plume stability





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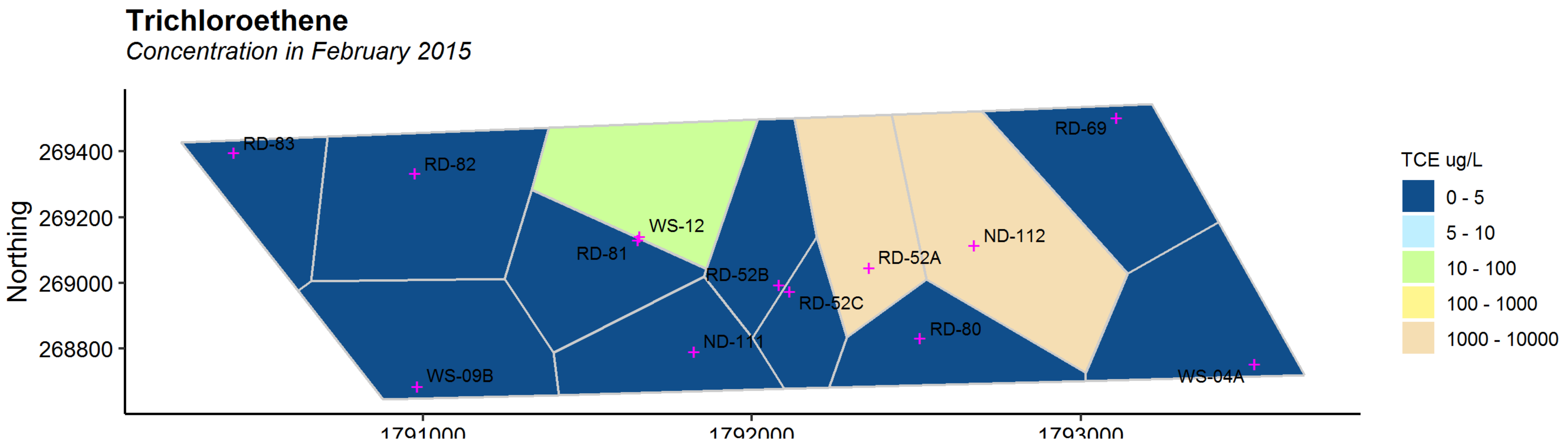
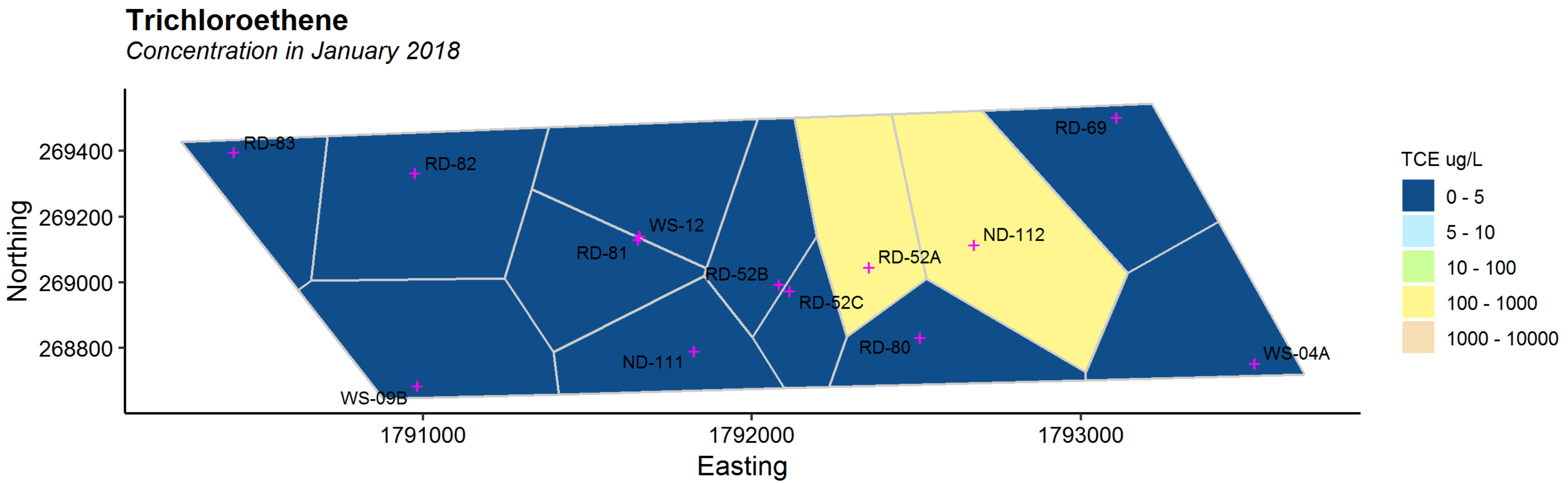
Plume Moment Analysis - Thiessen Polygon Network





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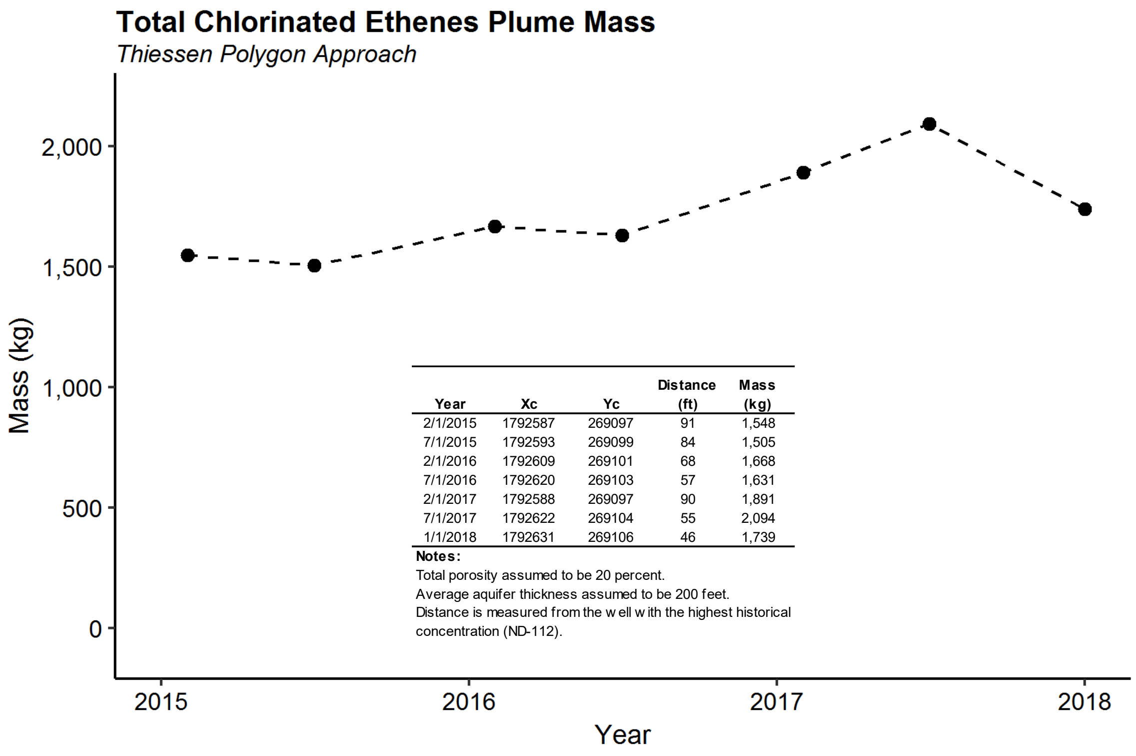
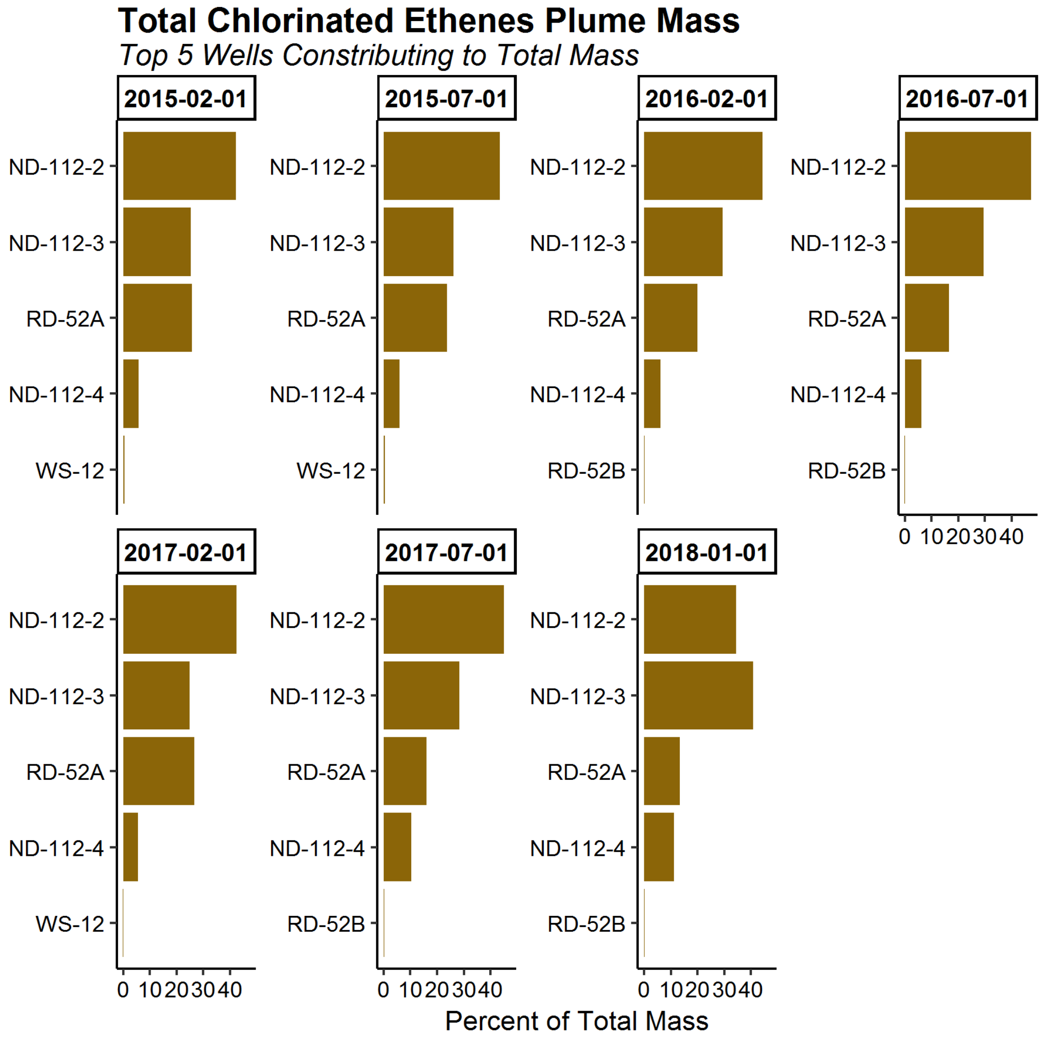
Thiessen Polygon Approach
Total CVOC Mass and CoM



Year	Xc	Yc	Distance (ft)	Mass (kg)
2/1/2015	1792587	269097	91	1,548
7/1/2015	1792593	269099	84	1,505
2/1/2016	1792609	269101	68	1,668
7/1/2016	1792620	269103	57	1,631
2/1/2017	1792588	269097	90	1,891
7/1/2017	1792622	269104	55	2,094
1/1/2018	1792631	269106	46	1,739

Notes:
Total porosity assumed to be 20 percent.
Average aquifer thickness assumed to be 200 feet.
Distance is measured from the w ell w ith the highest historical concentration (ND-112).



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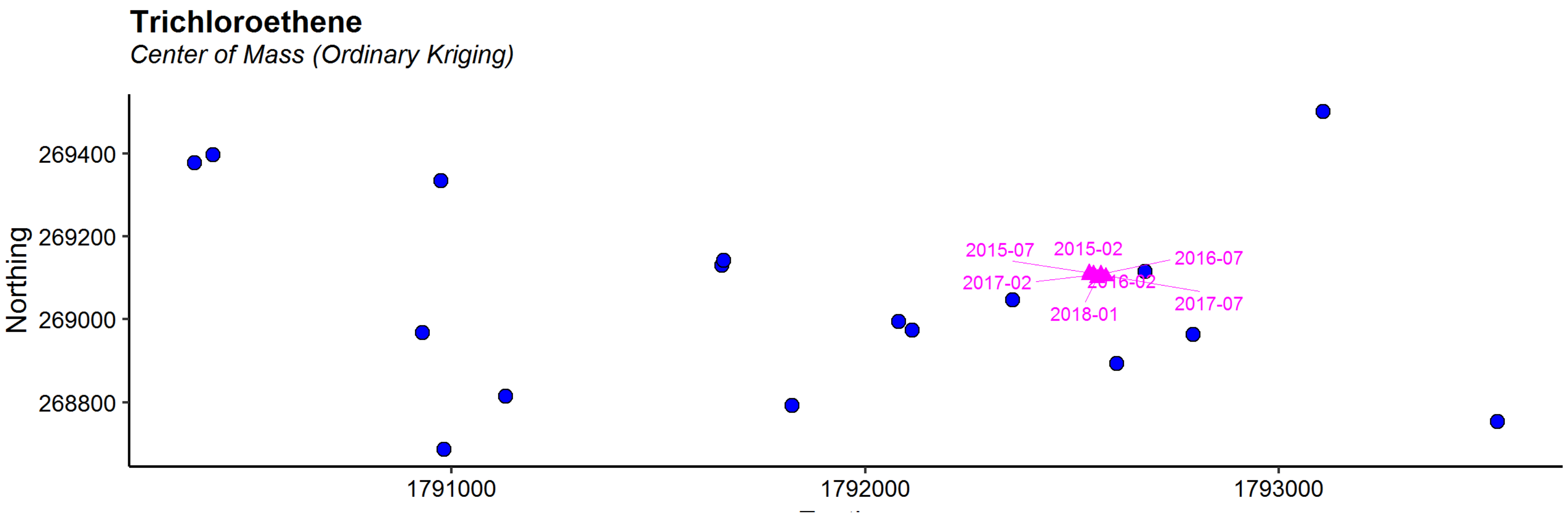
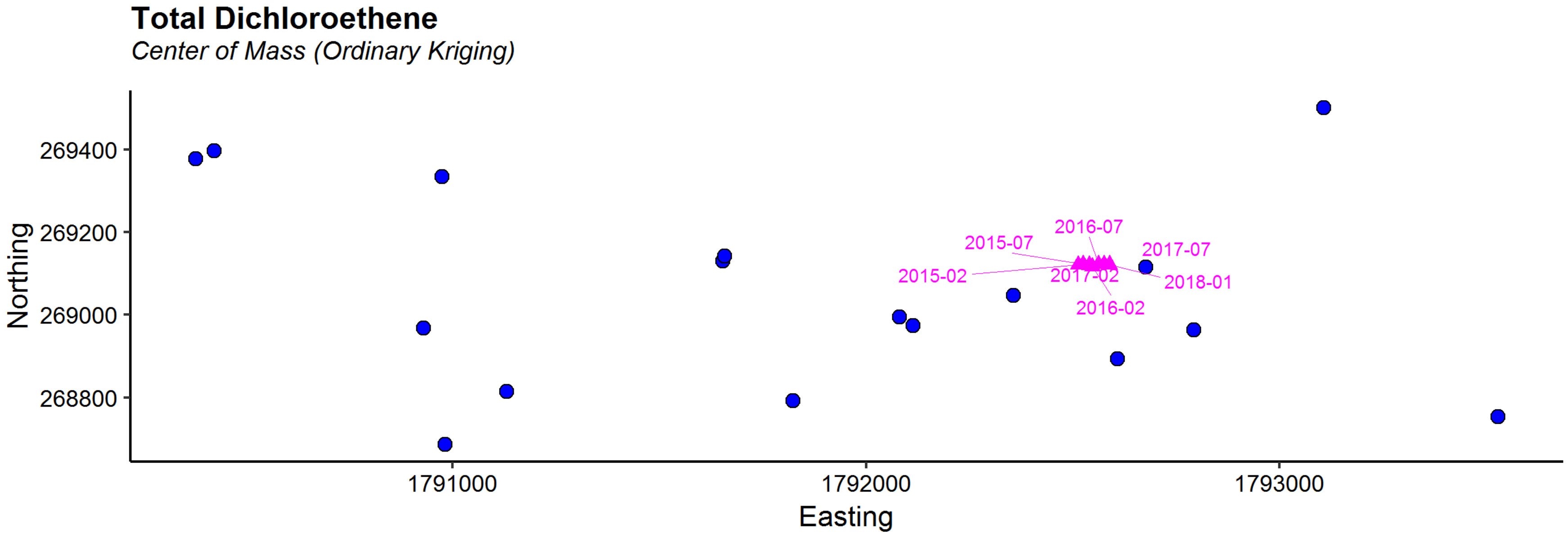
Ordinary Kriging, Center-of-Mass (CoM)



CoM relatively stable



CoM relatively stable

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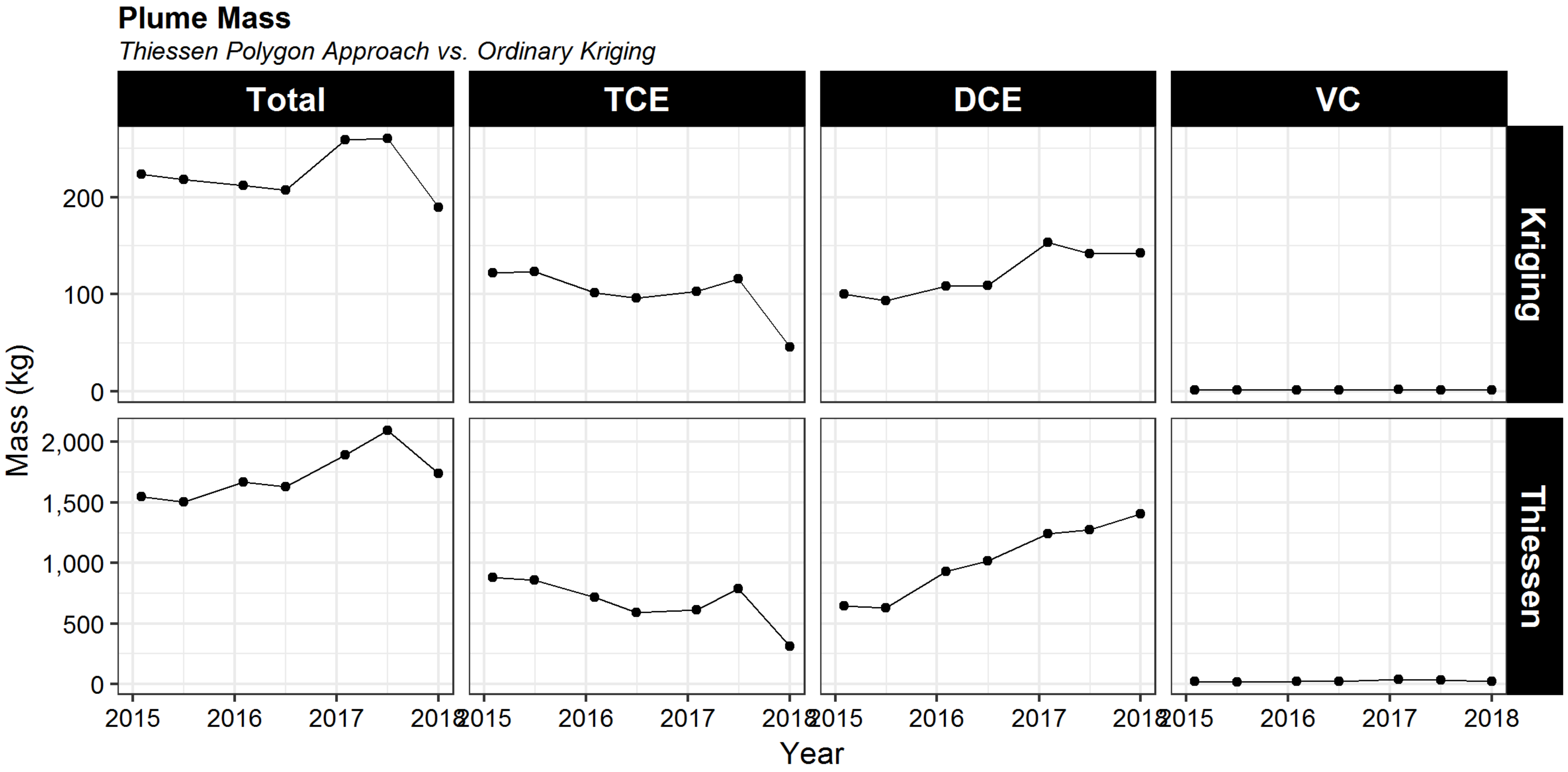
Method Comparison CVOC Mass



Screening level solute transport model for adjacent similar site estimates TOR as 35 years under natural attenuation - we have a basis for the start of decision making and refining

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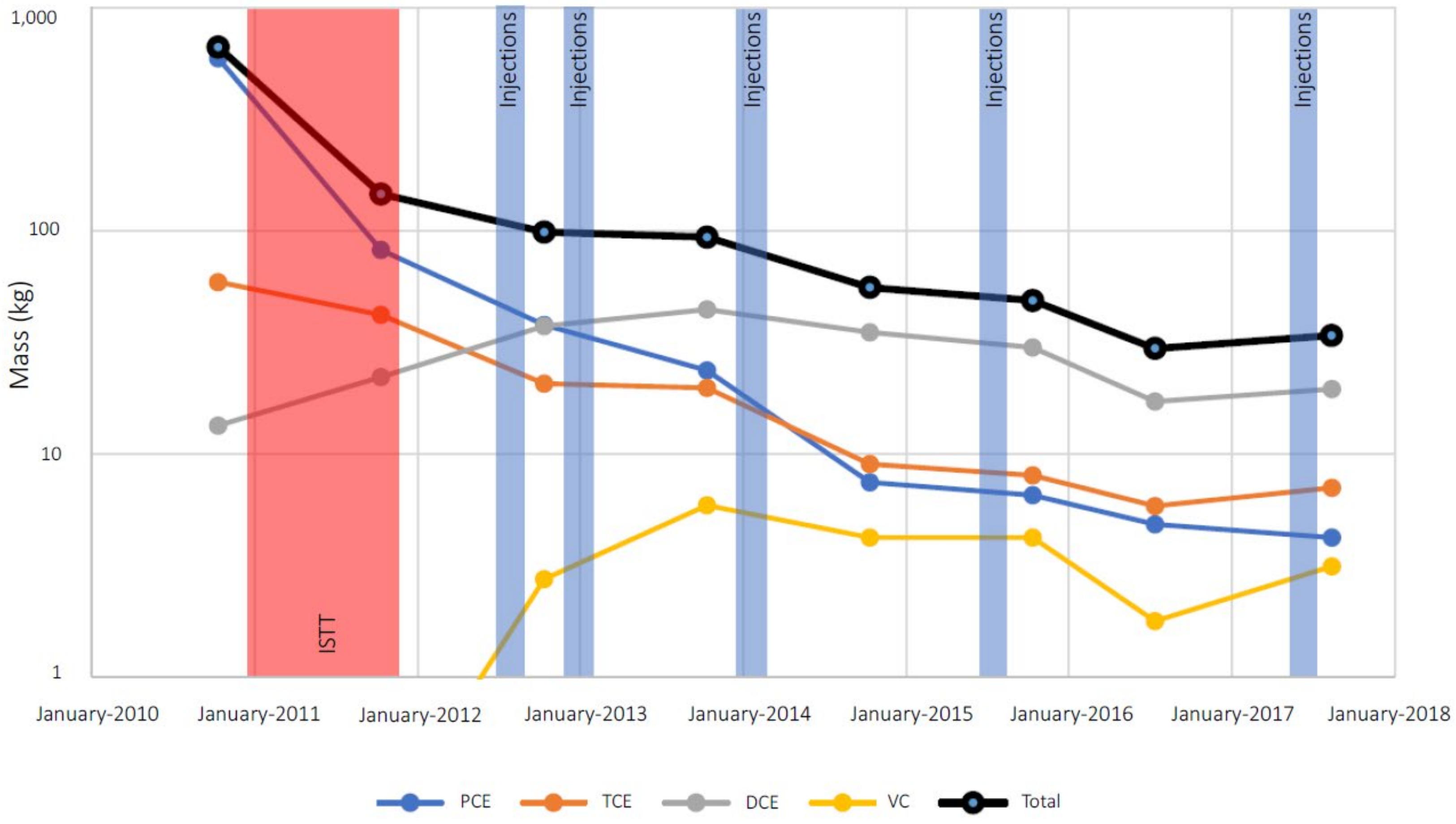
Mass Removal Over Time
Site C – moderately deep groundwater plume in silty-sand and clayey soils



- 8.5 years into 20 year active remediation program
- 95% mass removed
- 13 total injection cycles planned
- 5 completed
- 5 remaining
- 3 eliminated due to optimization activity

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Evaluation of Site Progress: Hypothetical (typically client sensitive data)

- Focus on annual spend for given year vs. reduction in life-cycle cost (LCC), or progress toward transition point
  - Akin to a loan where LCC = principal
  - LCC reduction/spend = amount of principal paid down
- Example 1:
  - Spent $1.2 million in 2018
  - Forecasted (@ end of 2018) LCC Reduction = $1 million
  - 2018 LCC Reduction/Spend = 83%, (paying down the principal)
- Example 2:
  - Spent $1.2 million in 2018
  - Forecasted (@ end of 2018) LCC Reduction = $0.1 million
  - 2018 LCC Reduction/Spend = 8%, (not paying down principal)

Site Summaries

- Site A – site well data mapped over time, trend graphs plotted, effort to estimate TOR, concluded in need for optimization study (Q1, Q2 addressed, optimization will help address Q3)
- Site B – initial estimates for site mass, compared to screening level model for TOR, starting point for assessing potential for MNA (Q1 and Q2 addressed, design or remedy and Adaptive Management will be used answer Q3)
- Site C – substantive mass removal with ample additional treatment planned and optimization to refine activity moving forward (Q1 and Q2 addressed, Q3 indirectly addressed through compliance with project anticipated spend)
- Site Hypothetical – contrasts two scenarios to evaluate if progress is being made (Q3 addressed)

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Cost/Benefit is the key to effective decision making

- To make any spending decision, cost/benefit need to be considered
- Answering the three key questions will help us determine cost/benefit of:
  - Stay the course
  - Optimize the remedy
  - Change the remedy

- If you don't know what you have left to do (mass or proxy for mass), how do you know your work is beneficial?
- If you don't know how much longer you have to go, how can you make a cost-to-complete estimate?
- If you don't evaluate your change in time of remediation, how do you know if you are making good progress with your annual spend?
- …or if you are making the right decisions

Thank You!

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