

Optimization Techniques for Aging SVE Systems



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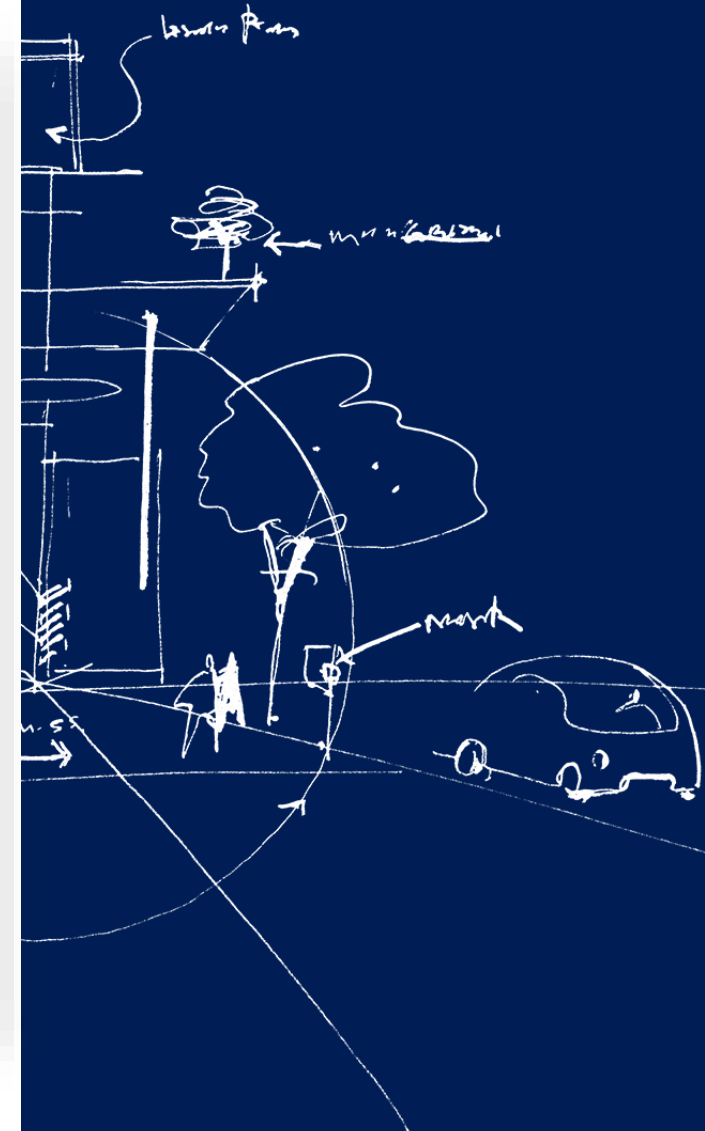
Todd Kremmin, PG

Agenda

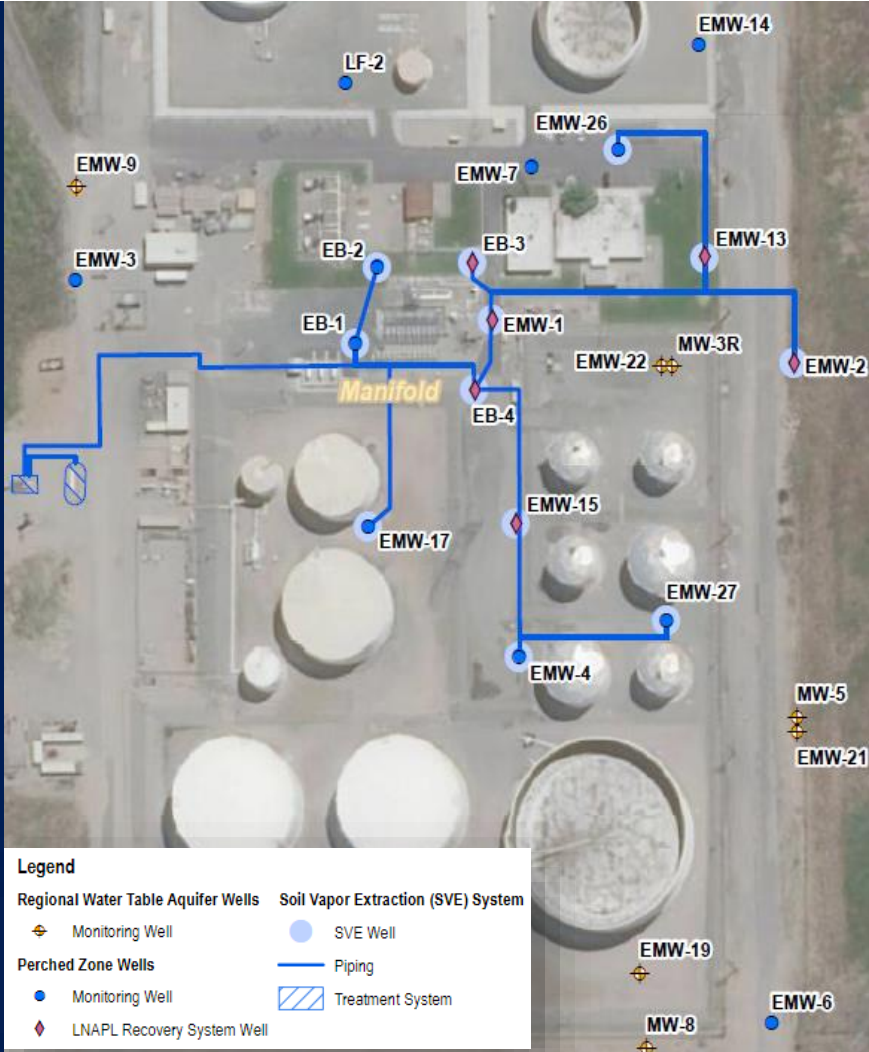
- Site & System Overview
- SVE Pitfalls
- SVE Lifecycle and Optimization Opportunities
 - System performance
 - Biodegradation enhancement
- Importance of Optimization



SVE Wellhead (Newly Installed)



Site Overview



- Active oil terminal with historical gasoline spills
- Impacted soils are relatively fine grained with large smear zone (>100 ft bgs)
- SVE system primary remediation technique
 - 22 extraction wells with mix of nested and non-nested wells
 - 200 scfm blower capacity
 - ~300 lb TPH/VOCs per day RTO capacity
- SVE optimization studies performed in 2014, 2018 and 2021-present
 - Focus on soil gas chemistry and decline curves of VOC removal and biodegradation rates

Common Pitfalls of SVE Remediation



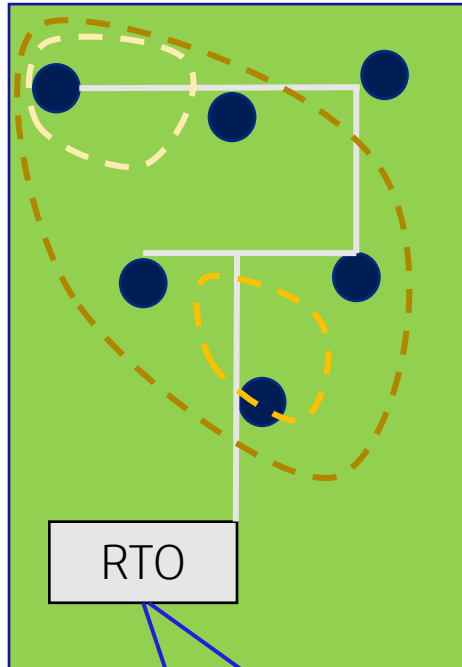
- Biodegradation commonly not accounted for in mass removal
 - Maybe qualitatively evaluated, maybe CO₂ and O₂ data not collected at all
- SVE well placement and installation depths create complex flow pathways
 - Wells may fight against each other or remediate areas at different rates
- Poor understanding of phase change
 - Aging SVE systems must overcome heavier hydrocarbon ranges as time passes
- Changing regulatory environment
 - What seemed like sufficient mass removal 10 years ago, may no longer be acceptable for site closure

SVE Lifecycle and Optimization Opportunities

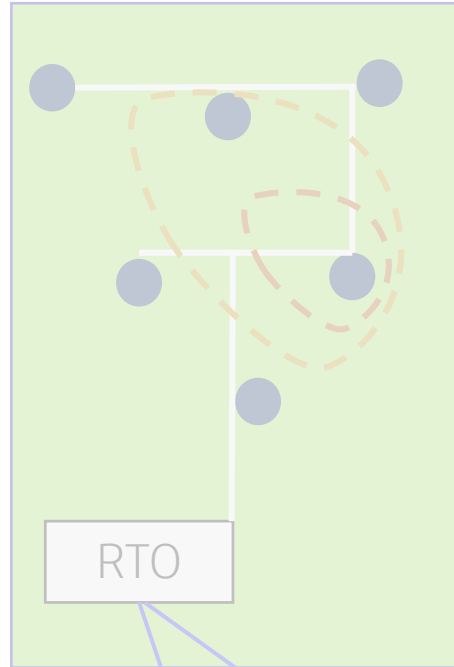


TIME

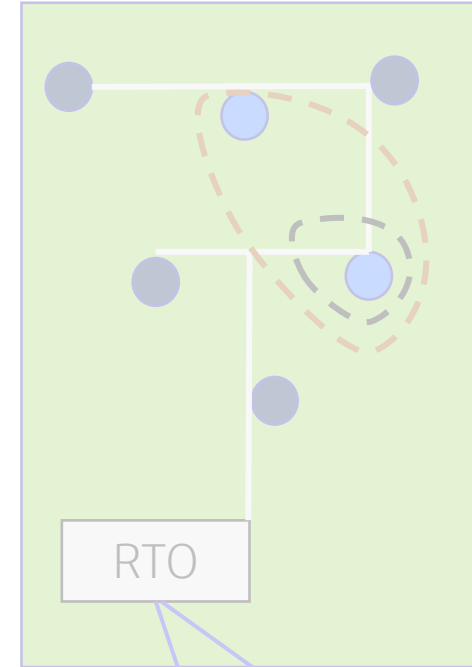
Newly installed system



Asymptotic/Trench Flow removal rates

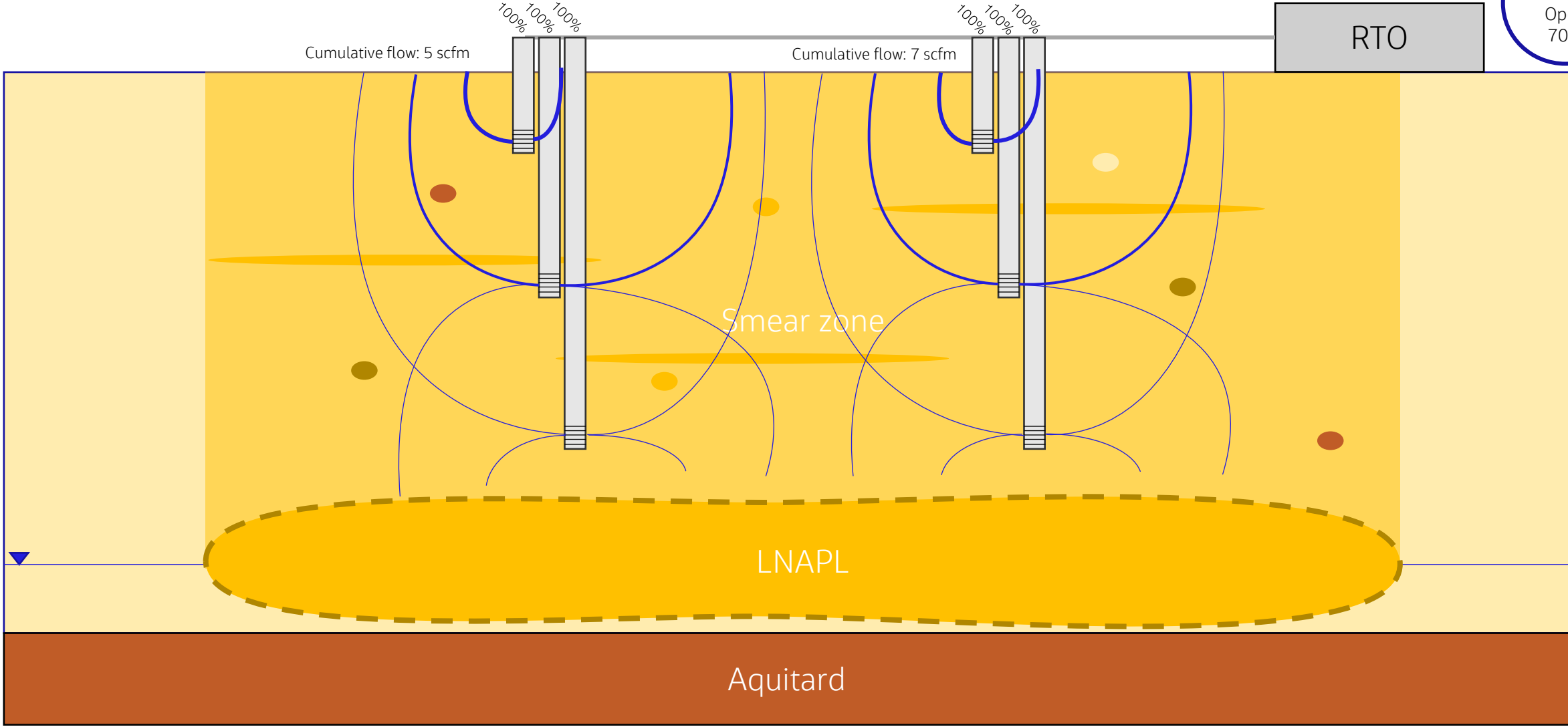


Optimized Setup



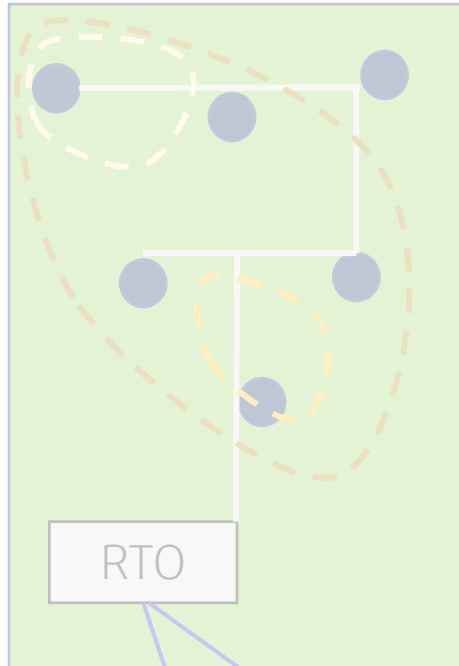
Conceptual Visualization of Default SVE System

Dilution Valve Open 70%



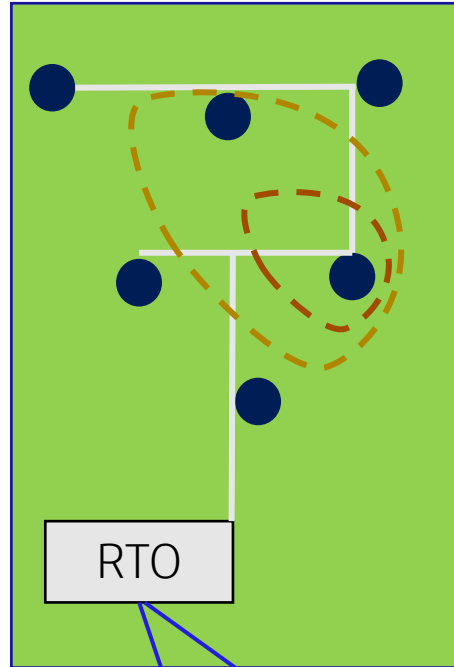
TIME

Newly installed system



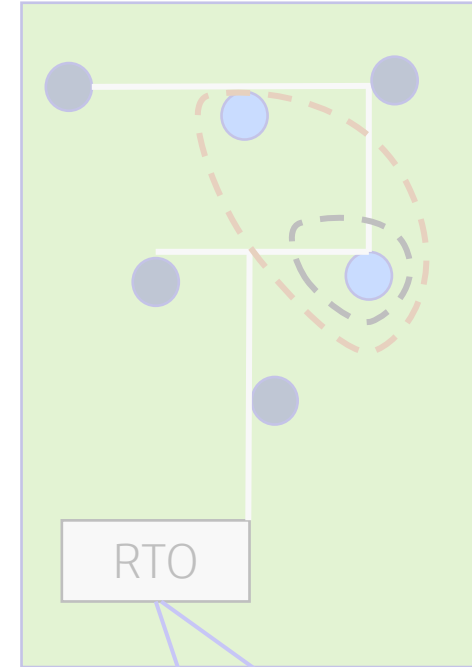
Dilution Valve Open 70%

Asymptotic/Trench Flow removal rates



Dilution Valve Open 50%

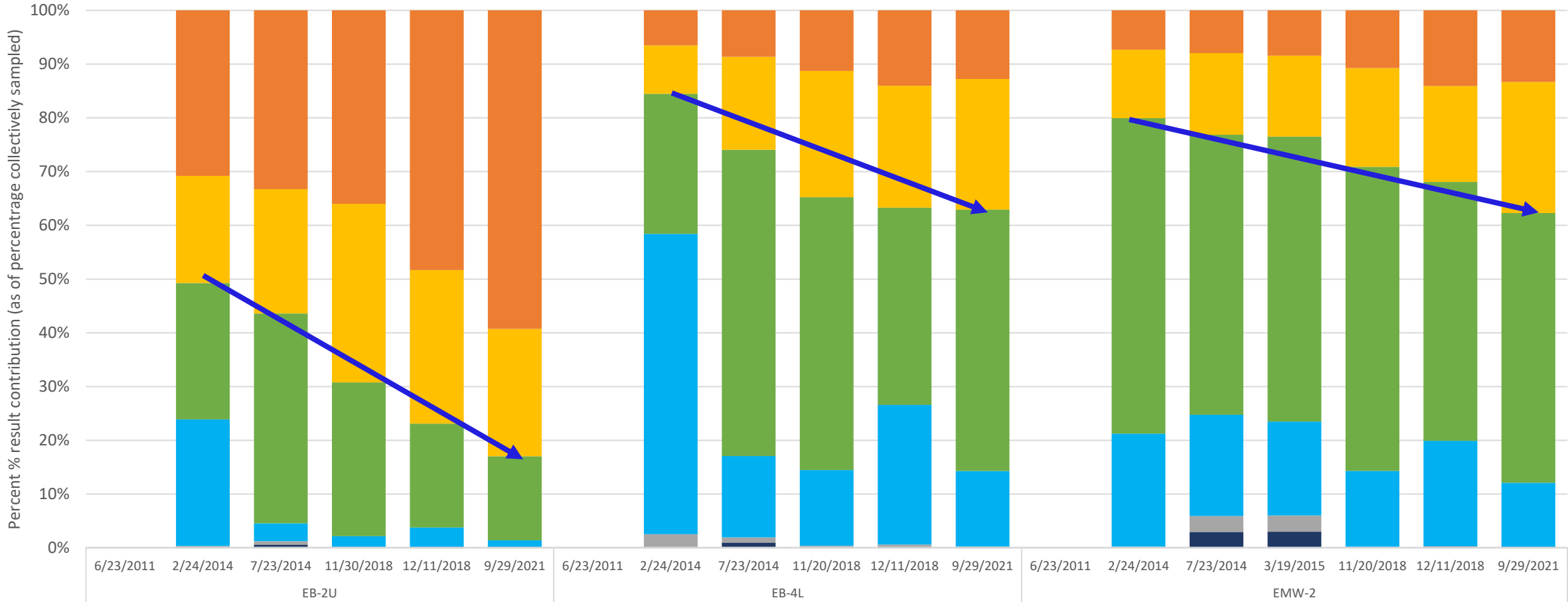
Optimized Setup



Dilution Valve Open 20%

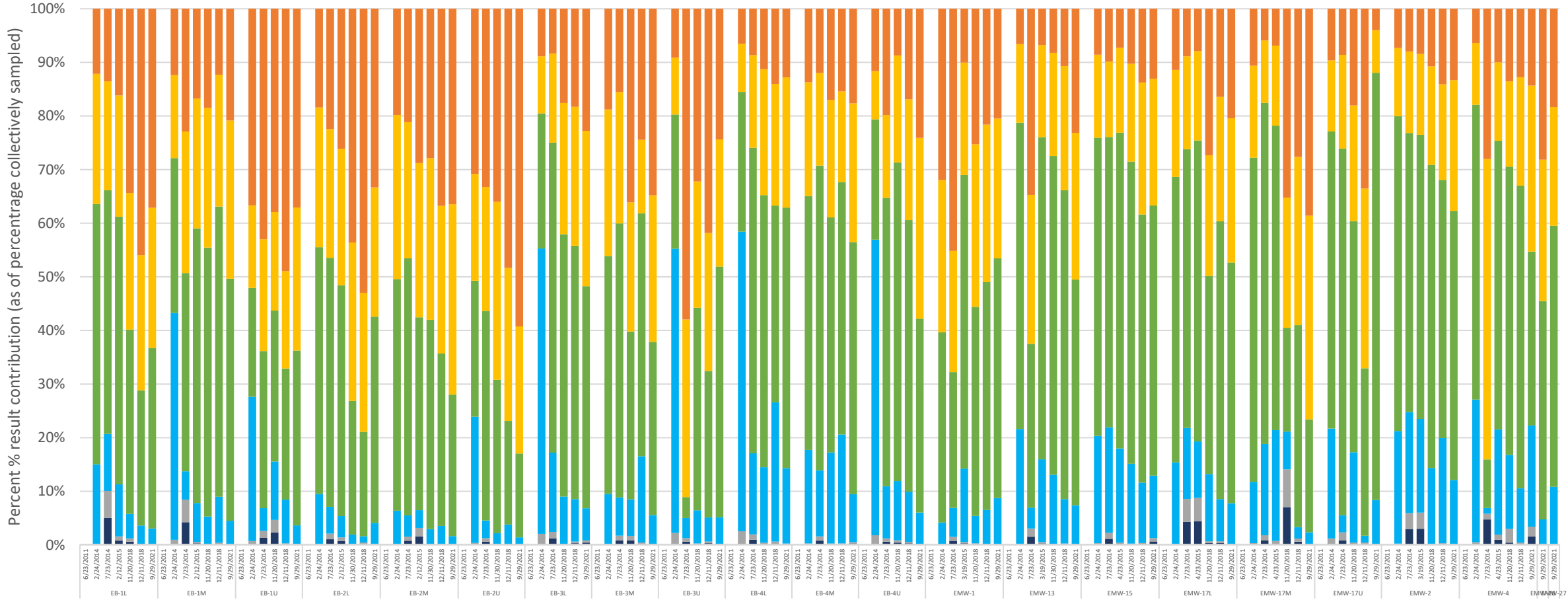
Compositional Changes Over Time

■ C2 ■ C3 ■ C4 ■ C5 ■ C6 ■ C7



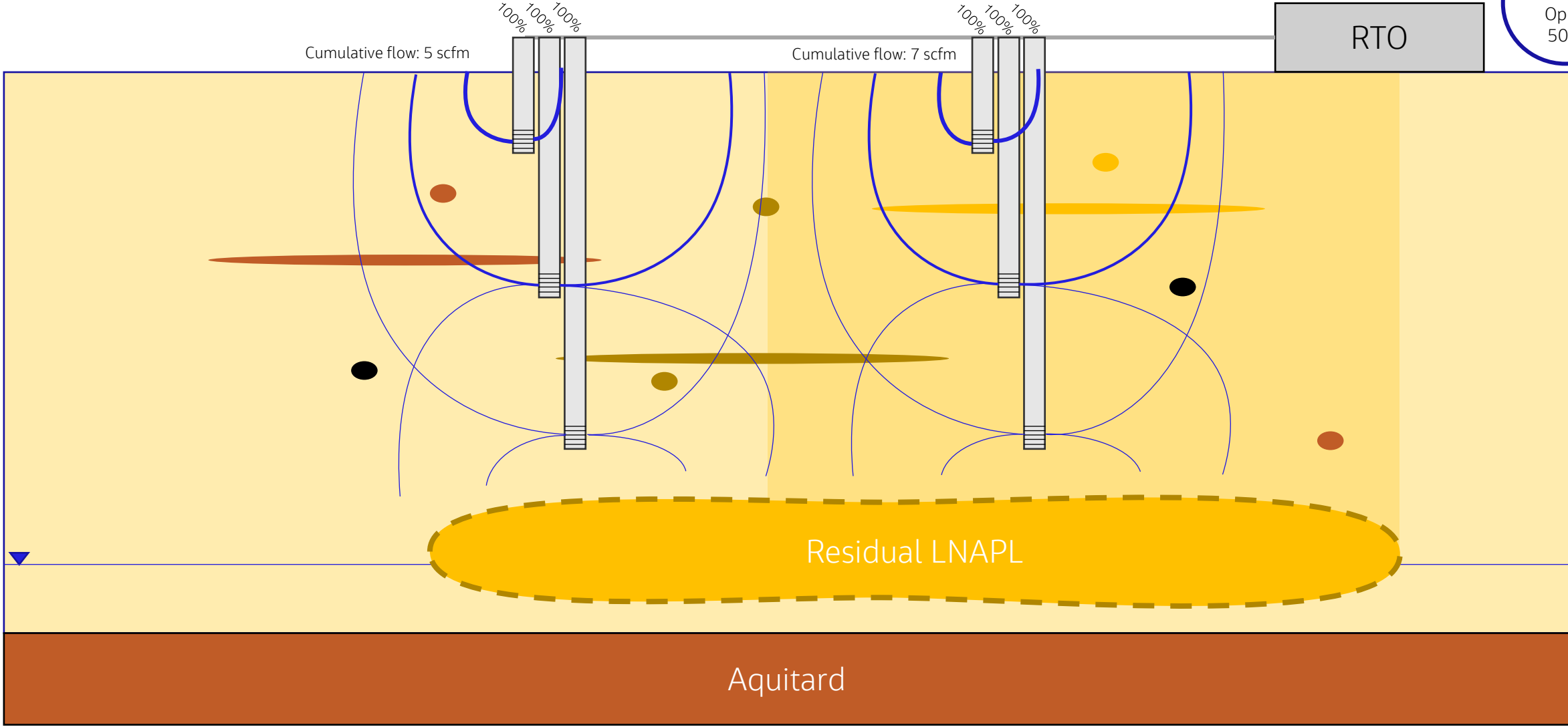
Compositional Changes Over Time

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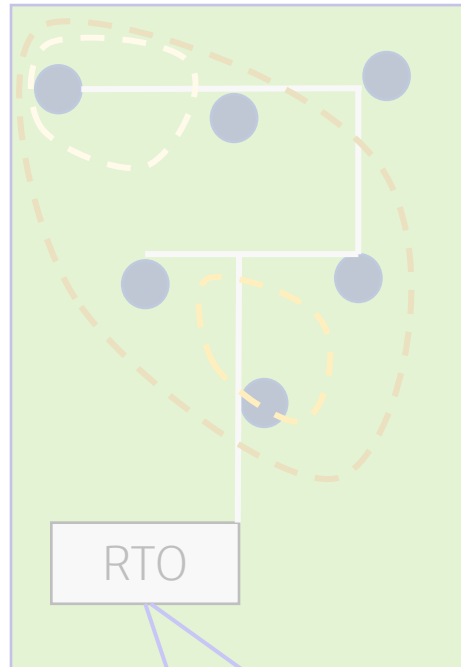
Conceptual Visualization of Aging SVE System

Dilution Valve Open 50%



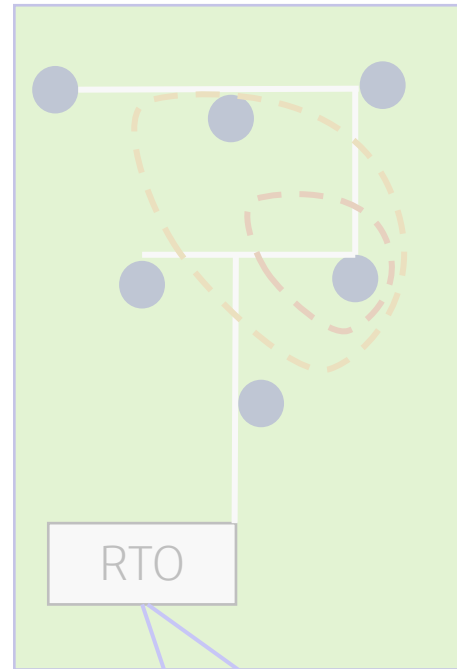


Newly installed system



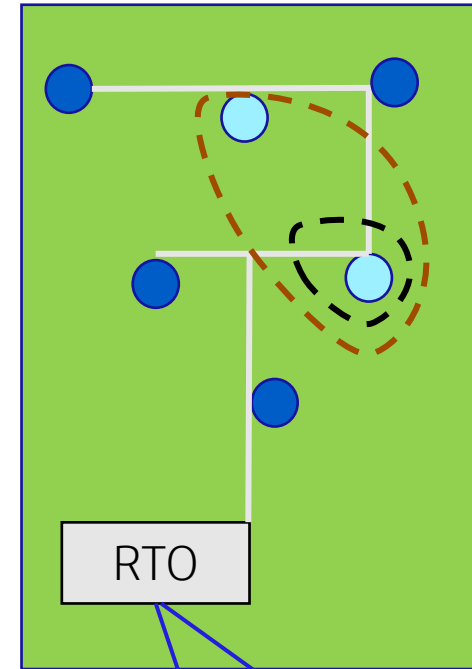
Dilution Valve Open 70%

Asymptotic/Trench Flow removal rates



Dilution Valve Open 50%

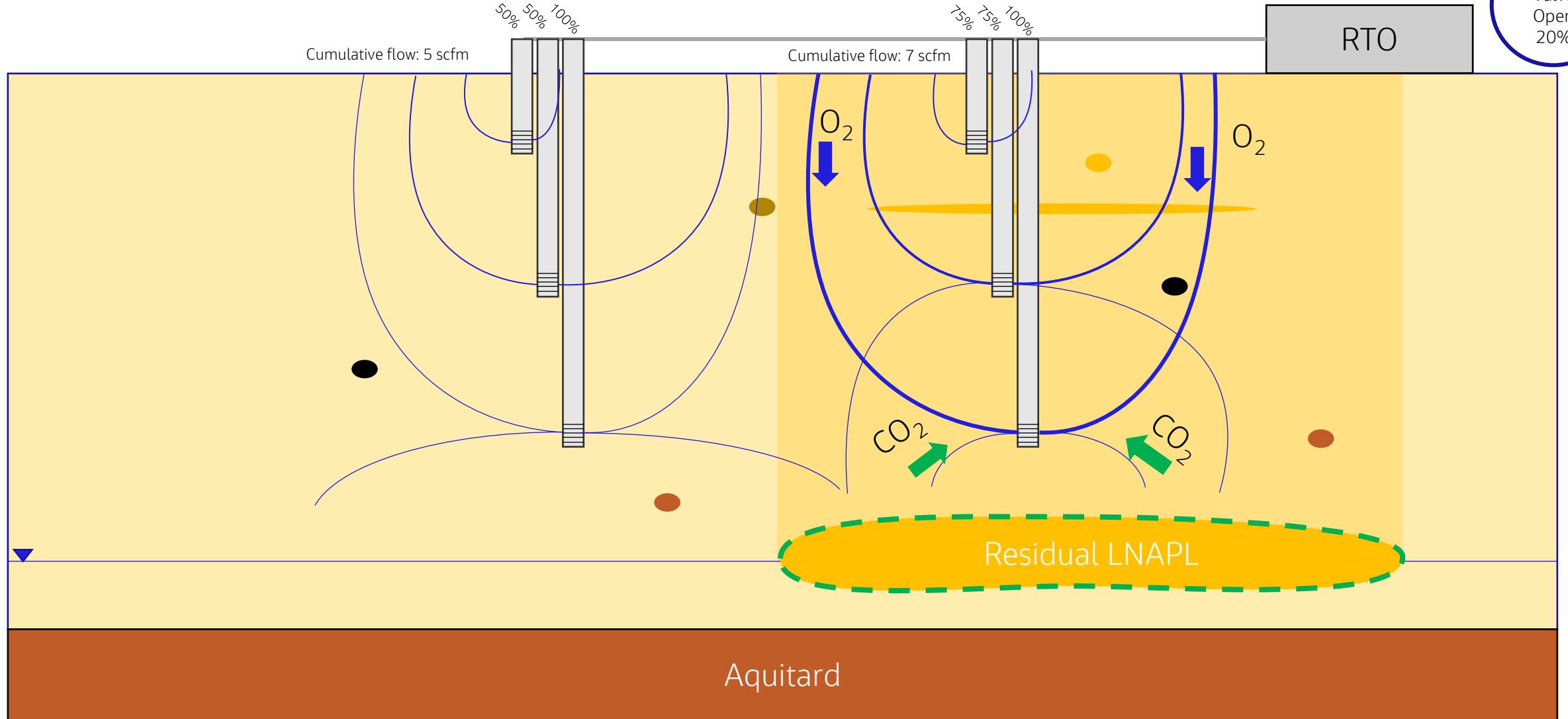
Optimized Setup



Dilution Valve Open 20%

Conceptual Visualization of Optimized Setup

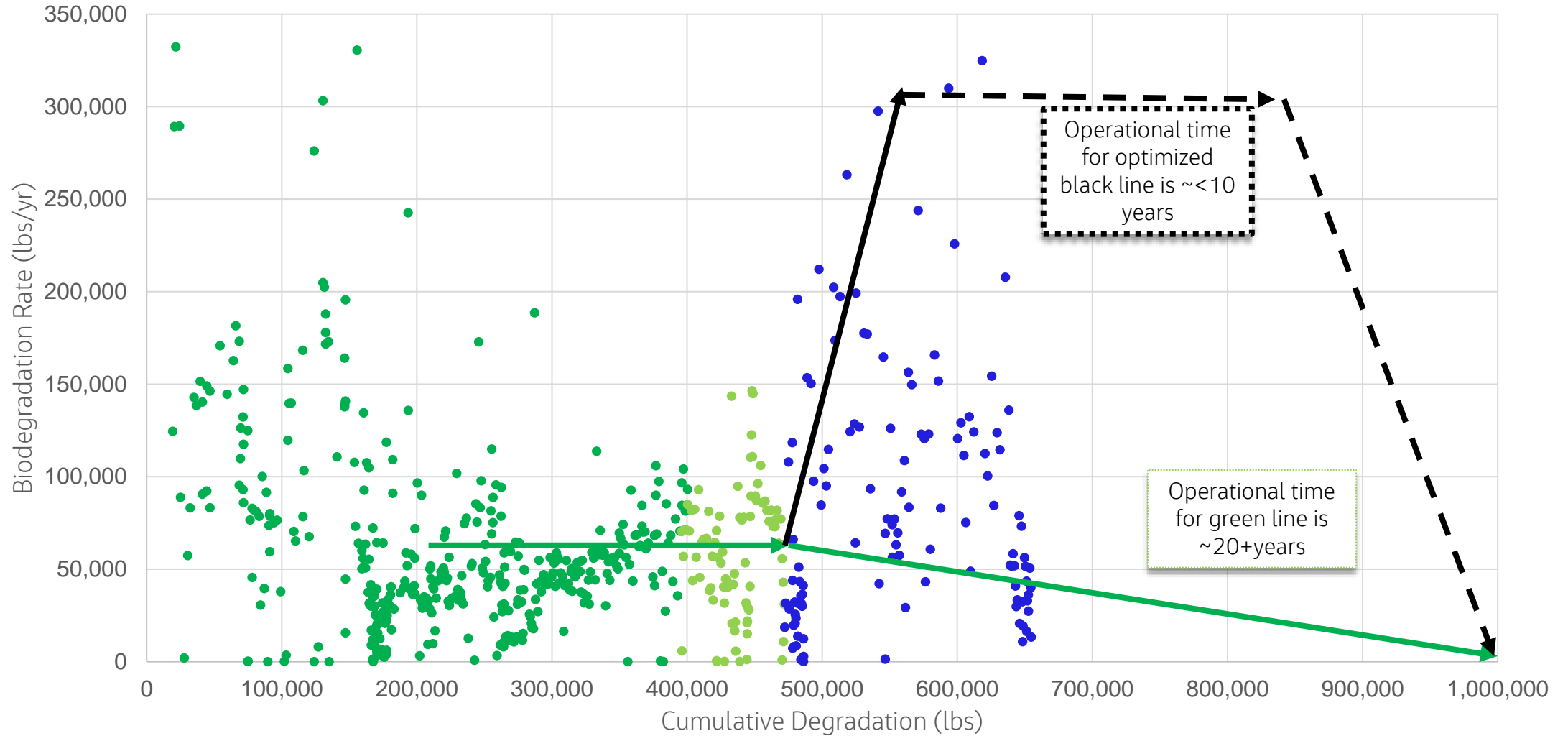
Dilution Valve Open 20%



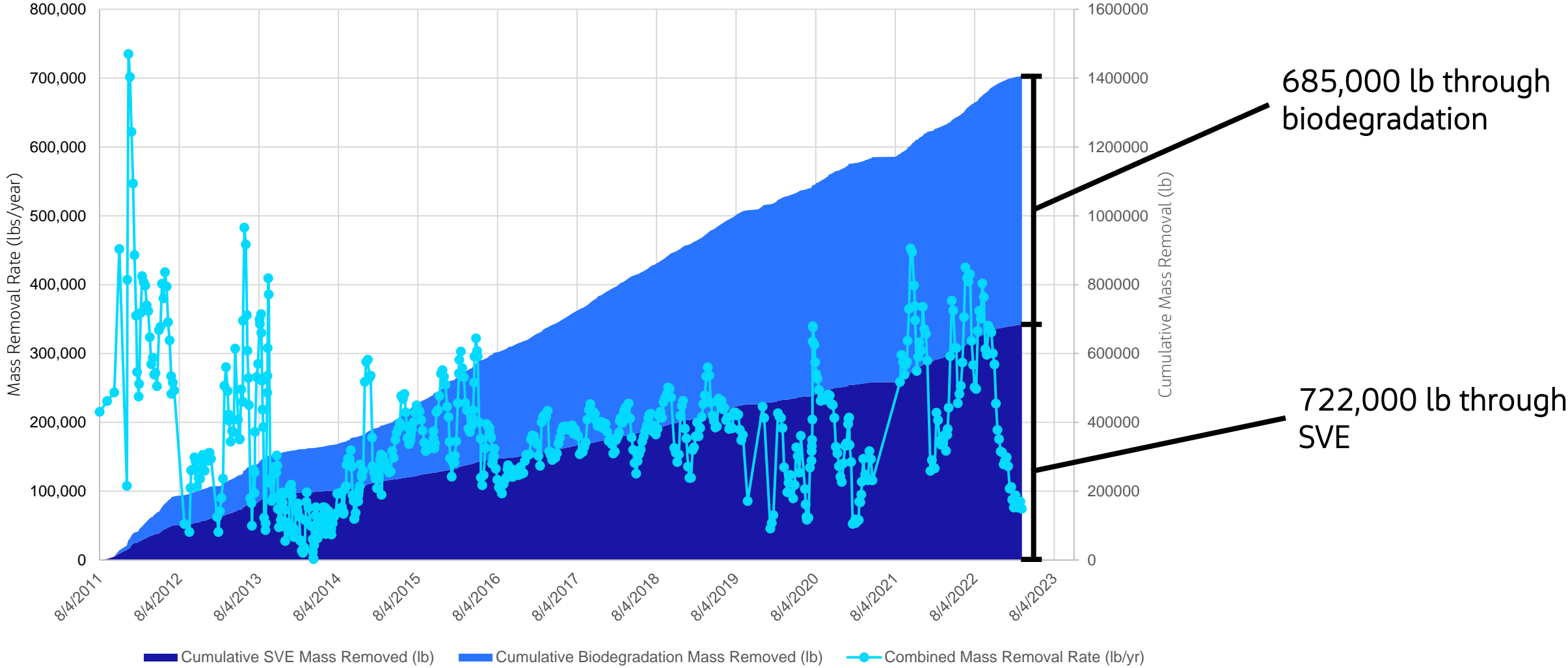
Historical Biodegradation Decline Curve

SVE Decline Curve Analysis (12/2011 – 03/2023)

- 2011 to 2019
- 2019 to 2021
- 2021 to Present (Optimization Period)

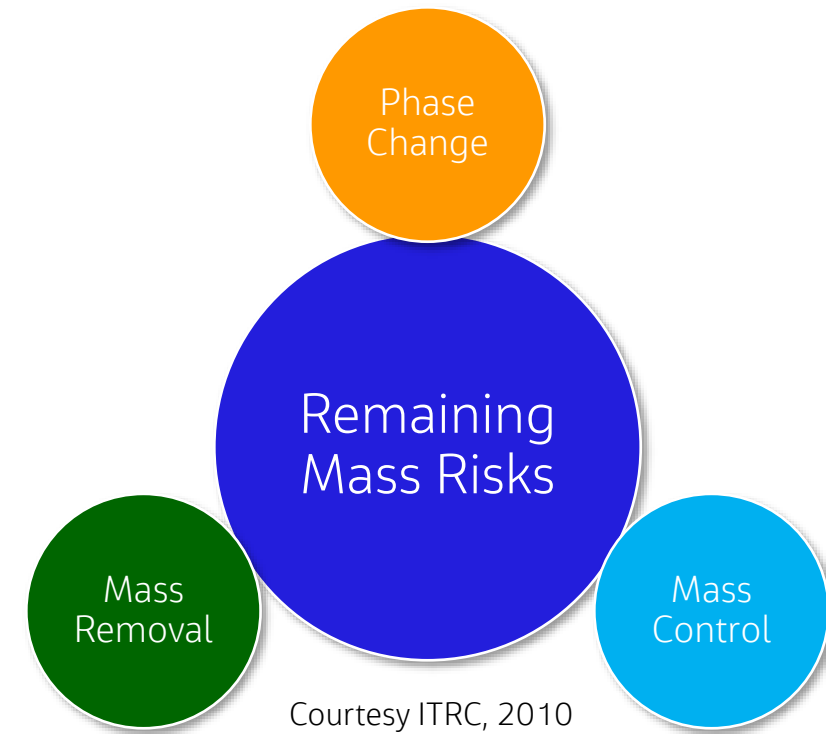


Mass Removal by SVE and Biodegradation (Over Time)



Why is SVE optimization important?

- *Don't forget about biodegradation*
 - Biodegradation can be as important as SVE removal itself
 - May be the only way to remove remaining heavier fractions
 - May be the only way to decrease remediation time
- *Study the relationship between plume and SVE system geometry*
 - SVE systems are dynamic and need constant adjustment
 - Rainfall can influence fluid buildup in piping
 - Spatial and vertical profile variations cause heterogeneity in flow
- *Keep an eye on phase changes*
 - Although mass removal and containment occur with SVE, these are only temporary
 - Phase change may be the only way site closure can be obtained
- *Changing metrics of performance*
 - Regulatory requirements may have been met under old assumptions, closure of the site may be another question
 - Even though SVE system has reached asymptotic removal, biodegradation enhanced because of system operation



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