



REGENESIS[®]

**Assessment, Planning, and Execution of Passive Methods
to Measure Mass Flux and Groundwater Velocity**

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Presentation Overview

- Introduction to Flux
- Importance to Remedial Process
- Methods and Practice of Collection
- Application Examples
- Final Thoughts



Introduction: Mass Flux

Mass Flux

Rate of flow through
unit cross-section

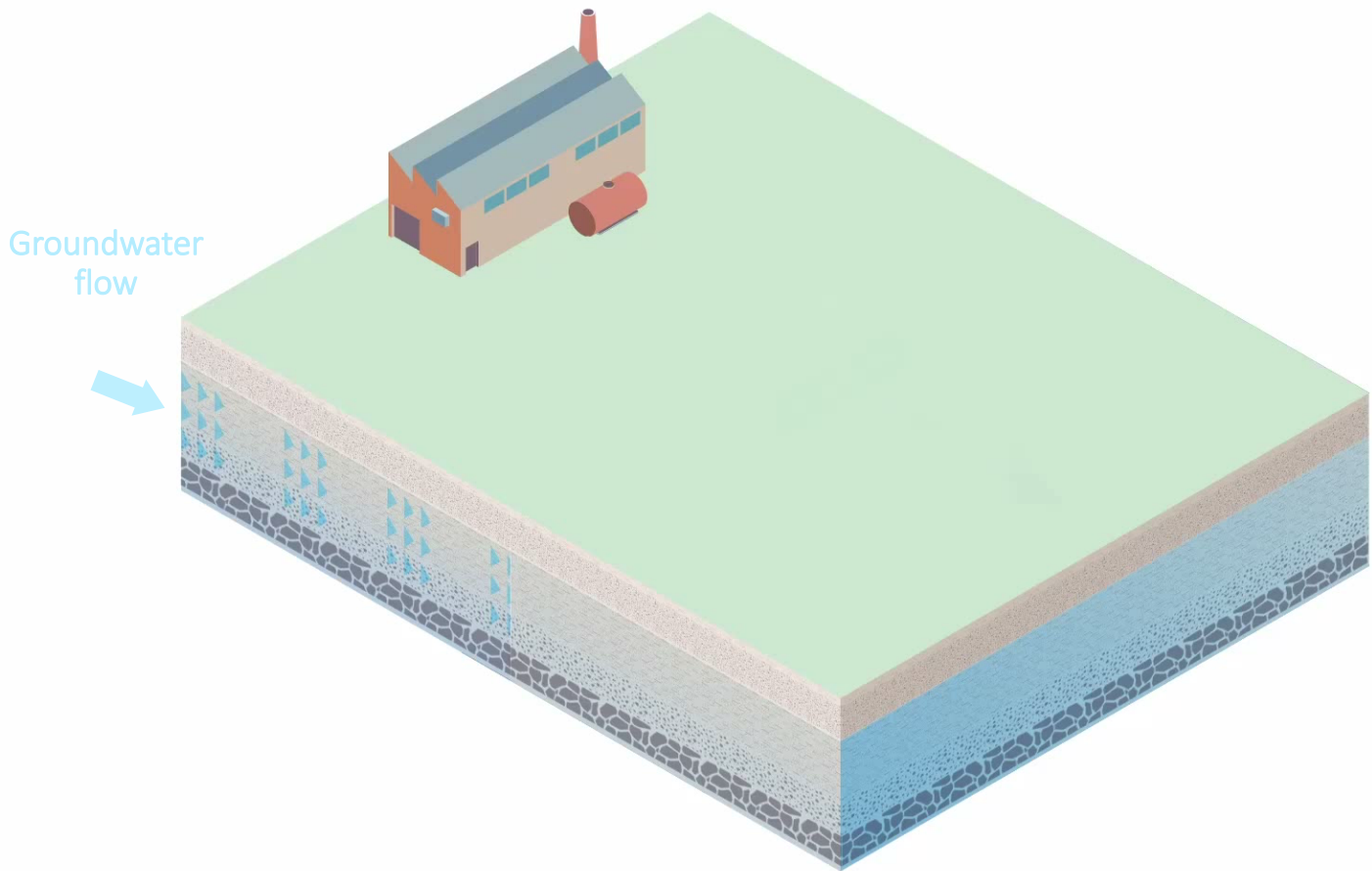
Mass Discharge

Rate of flow through
transect

Units

Darcy flux
(cm/d)

Mass flux
(mg/m²/d)



Darcy velocity (cm/d)	Seepage* (ft/yr)	Mass flux** (mg/m ² /d)
2	96	100
4	192	200
6	287	300
8	383	400
10	479	500
20	958	1000

*Porosity = 0.25

**GW concentration = 5 mg/L

Finding the Balance

- Effective, Efficient Remediation Design:

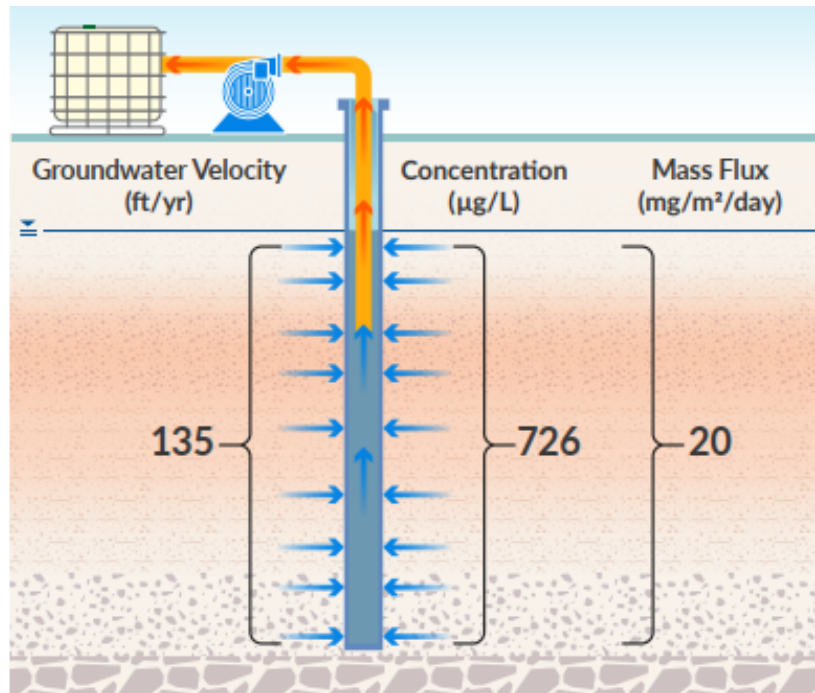


Ideally, these are also vertically delineated

Comparing Conventional and Passive Methods

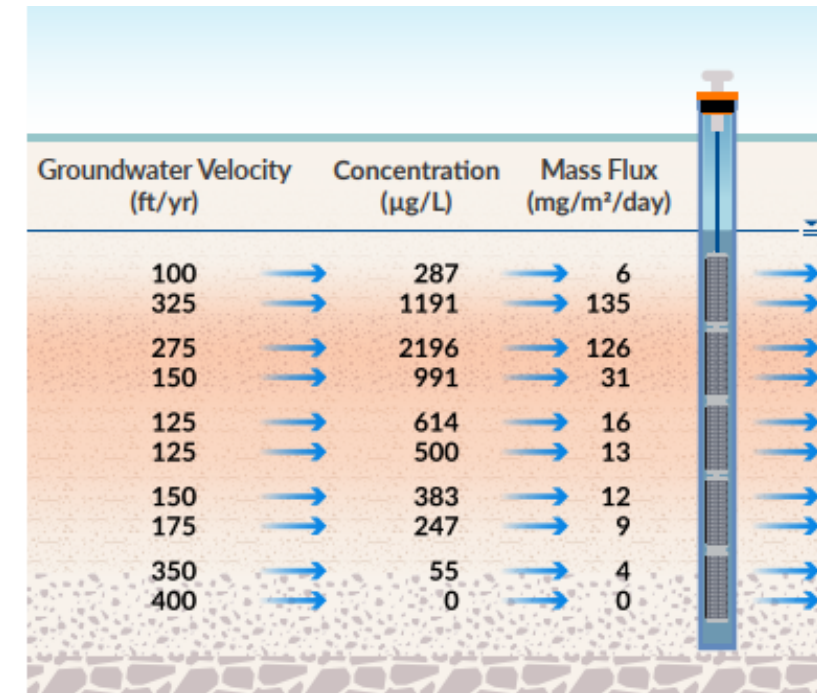
Bulk Average Methods (Pump/Slug Test)

- Does not delineate velocity and mass flux
- No data resolution
- Not ideal for in-situ remediation designs



Passive Methods

- Identify zones with highest GW/mass flux
- Design remediation to optimize product placement



Passive Determination of Mass Flux

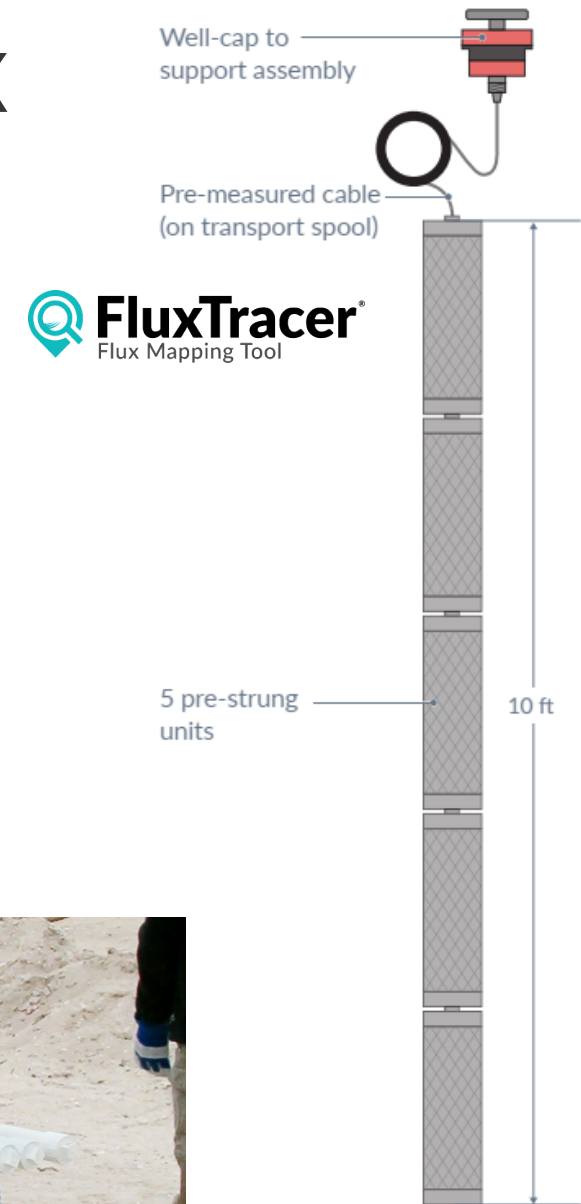
Technology at-a-glance

Commercial options in US:

- FluxTracer® (Regenesis)
- Passive Flux Meters® (EnviroFlux)
- Placed in existing monitoring wells

Key benefits:

- Collect GW and mass flux in tandem
- High data resolution and accuracy
- Allow for discharge characterization



Enviroflux.com

Determining Mass Flux

- Traditional concentration-based sampling
 - Established, well known, accepted



- Typically low resolution, limiting, incomplete

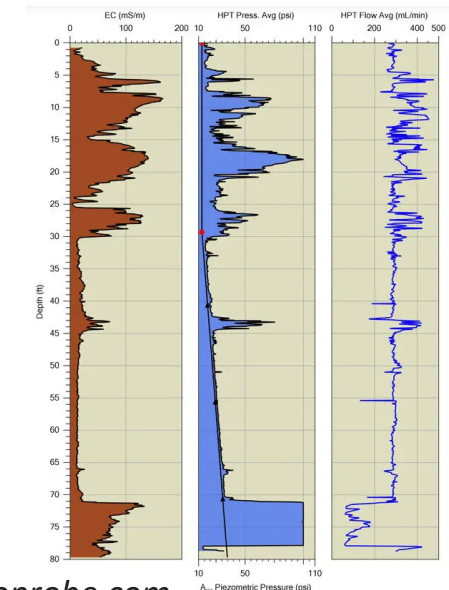
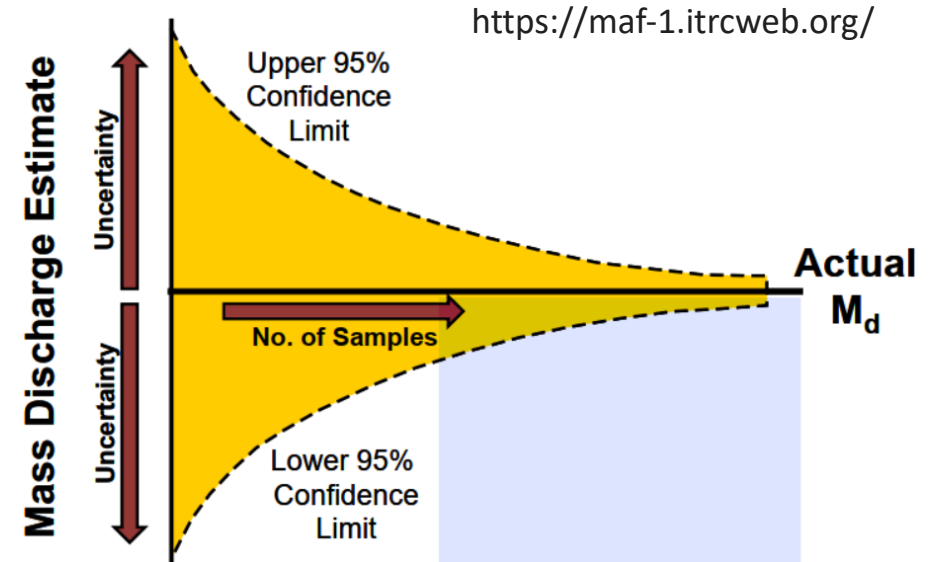
- Passive method-based sampling
 - More comprehensive, detailed



- Not established, well known or accepted

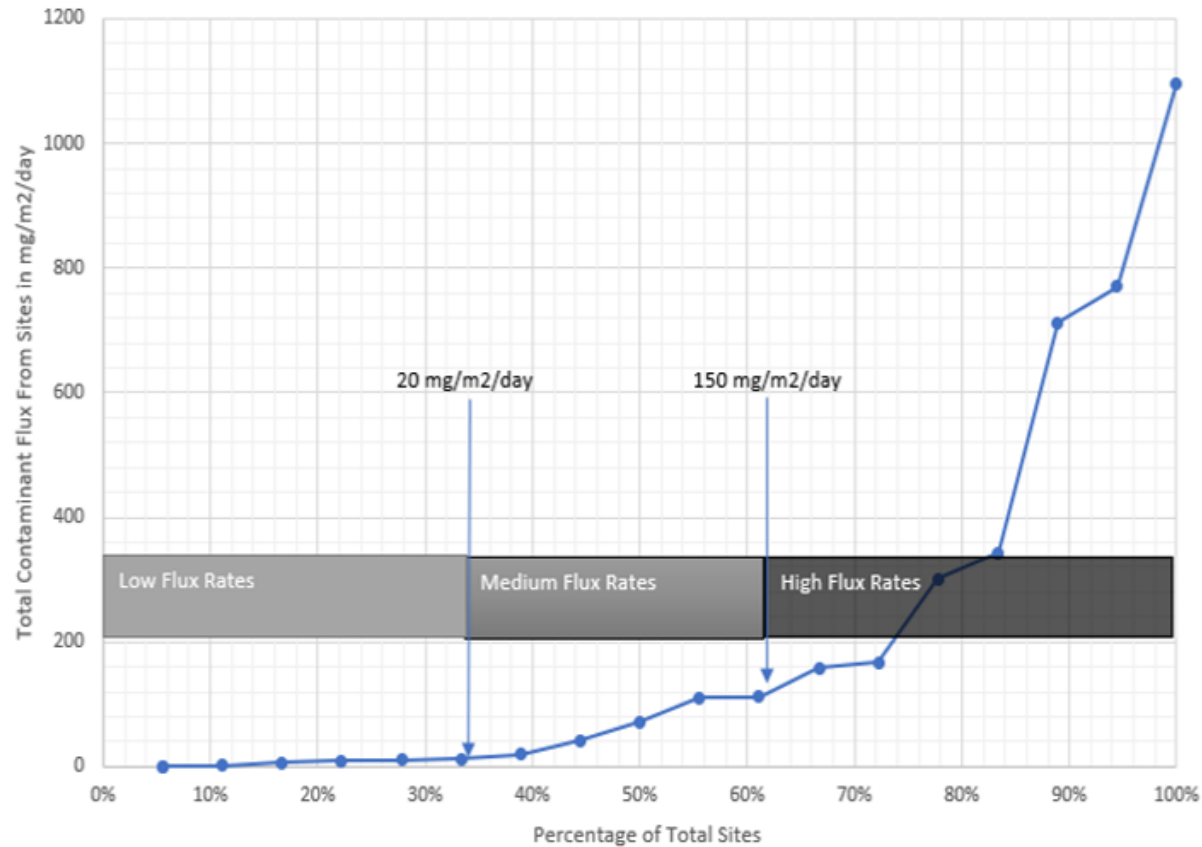
Determining Mass Flux

- Collect flux data close to:
 - Plume center
 - Planned treatment area(s)
 - Potential anomalous areas
- Sampling frequency:
 - As dense as budget allows!
- Check results against other available data
 - Agreement with boring logs or HPT profile?



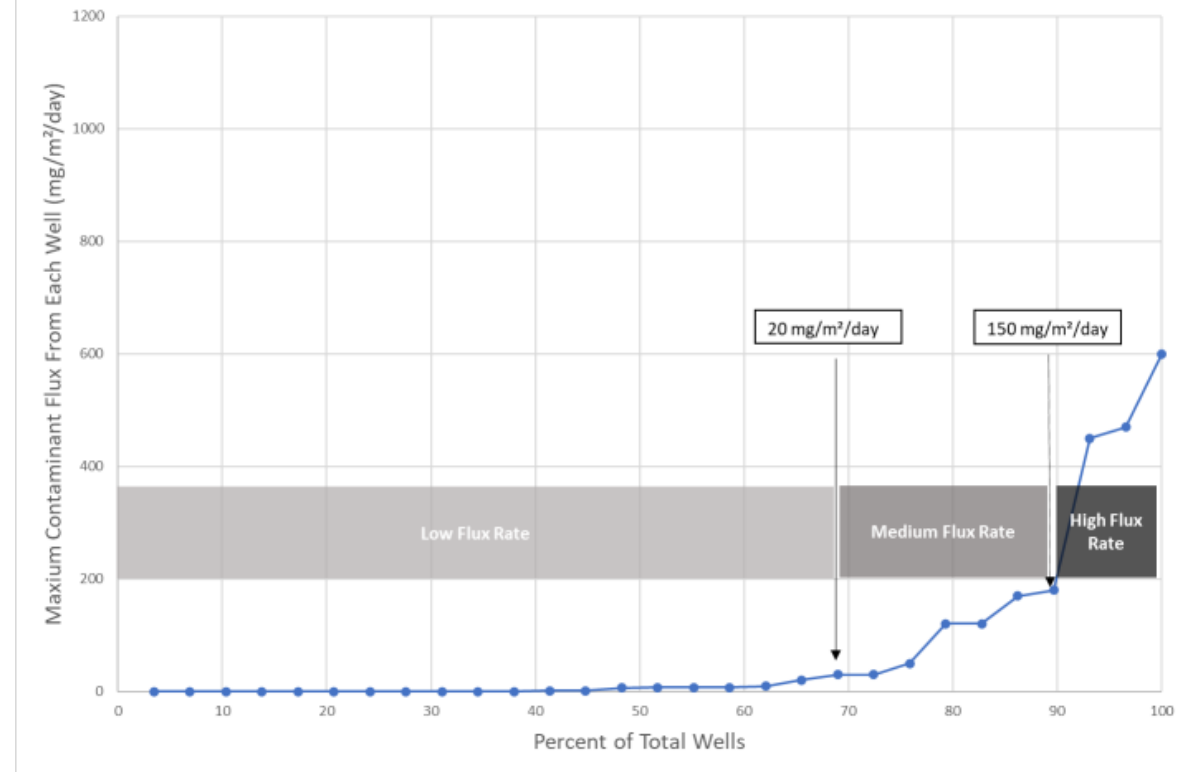
Expected/past

Total Contaminant Flux vs Percentage of Sites



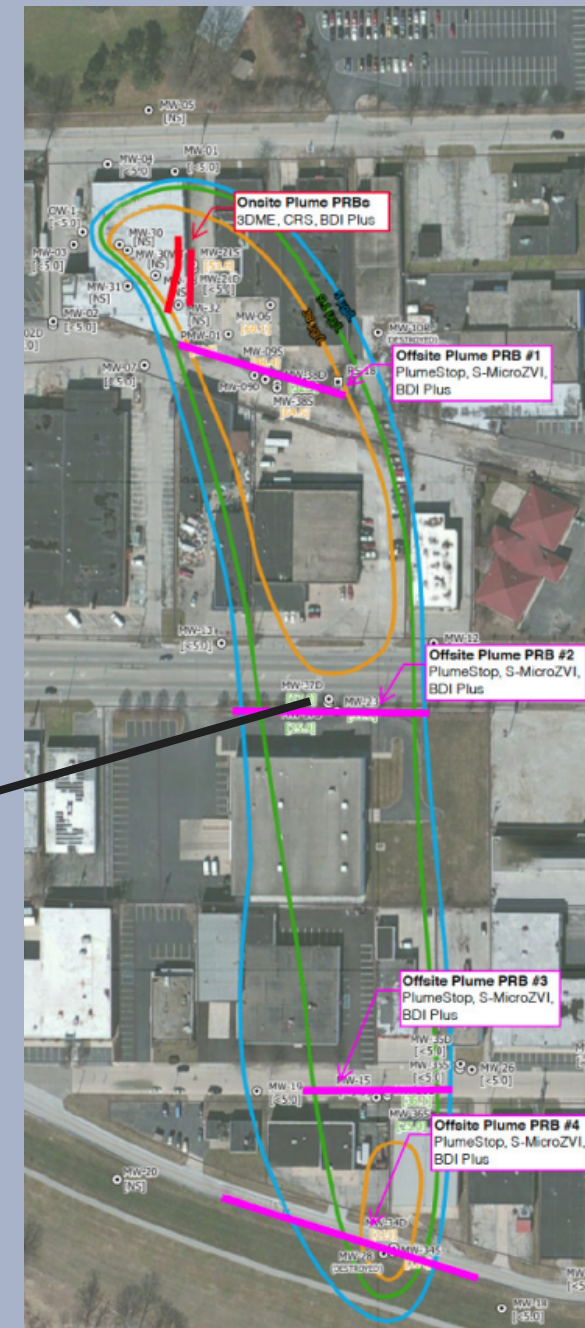
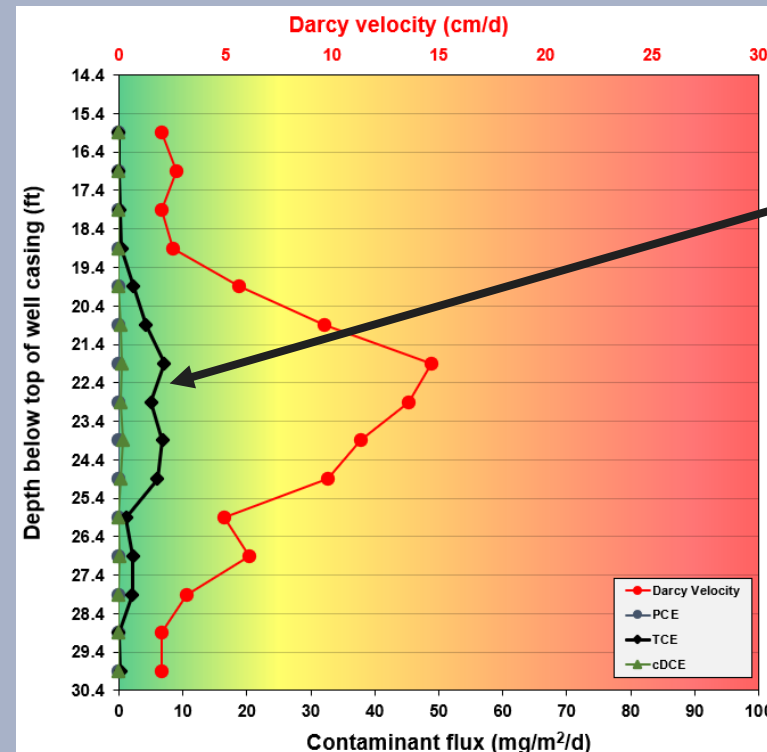
Observed

Flux Measurements n=29



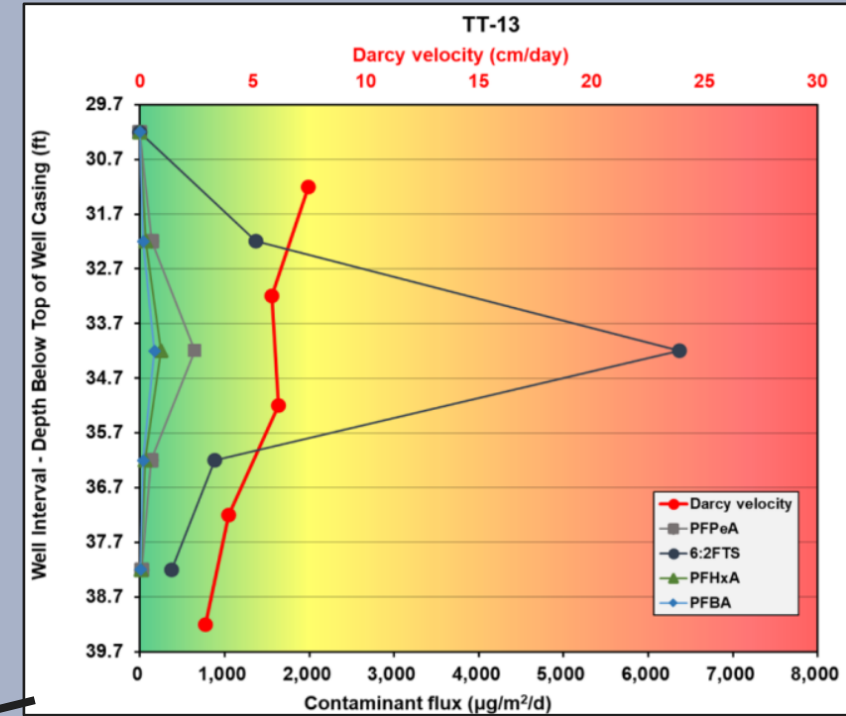
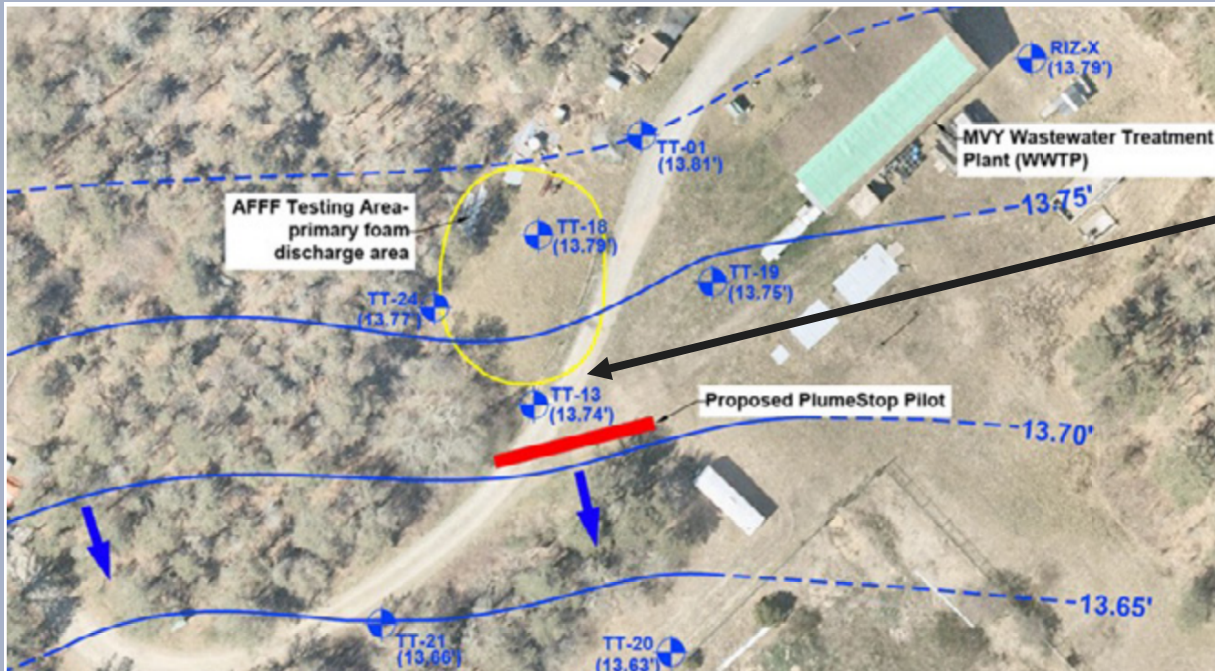
Application Example # 1

- CVOC site in Indianapolis, IN
- High flux zone defined, better targeted with design
- Project savings of \$380,000



Application Example # 2

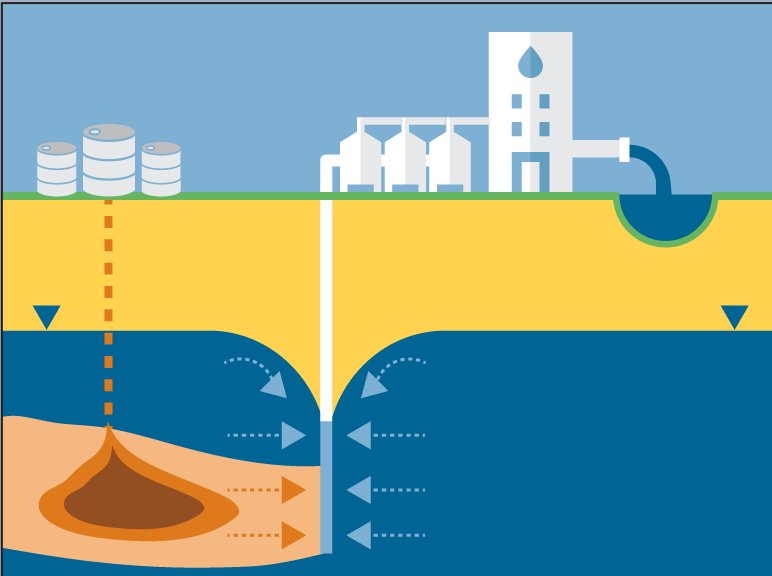
- Martha's Vineyard, MA
- Significant mass flux variation in small interval
- Lacked an obvious (hydro)geological explanation



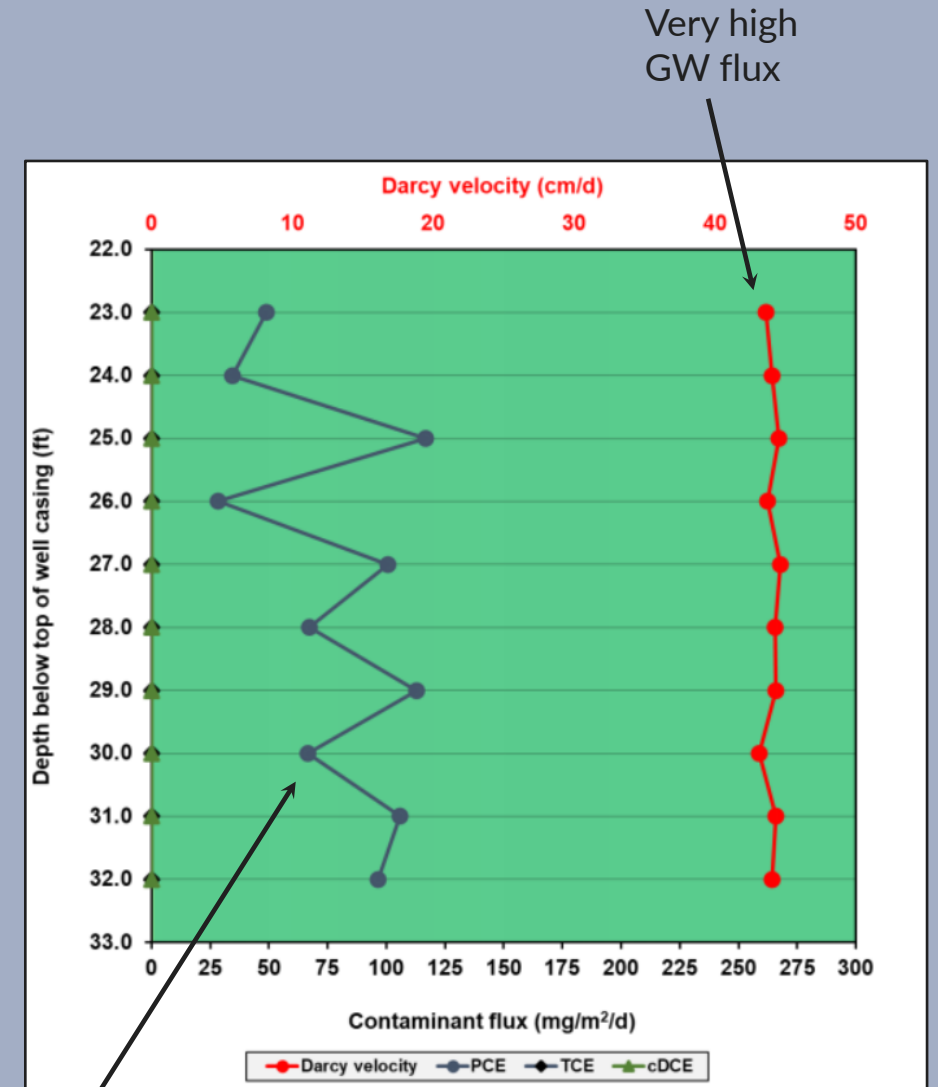
Results drove dose and CAC placement

Application Example # 3

- Local groundwater flow anomalies
- Velocity **did not** match expectations
- Remedial pumping in vicinity confirmed
- CAC grid injections not affected- mass flux still low



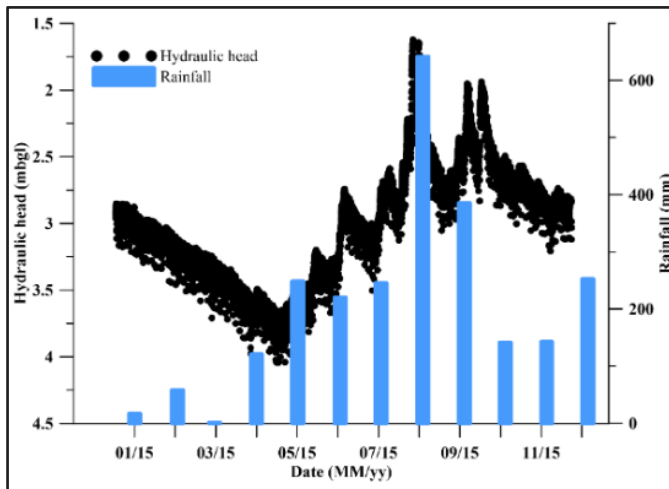
<https://itrcweb.org/teams/training/pt>



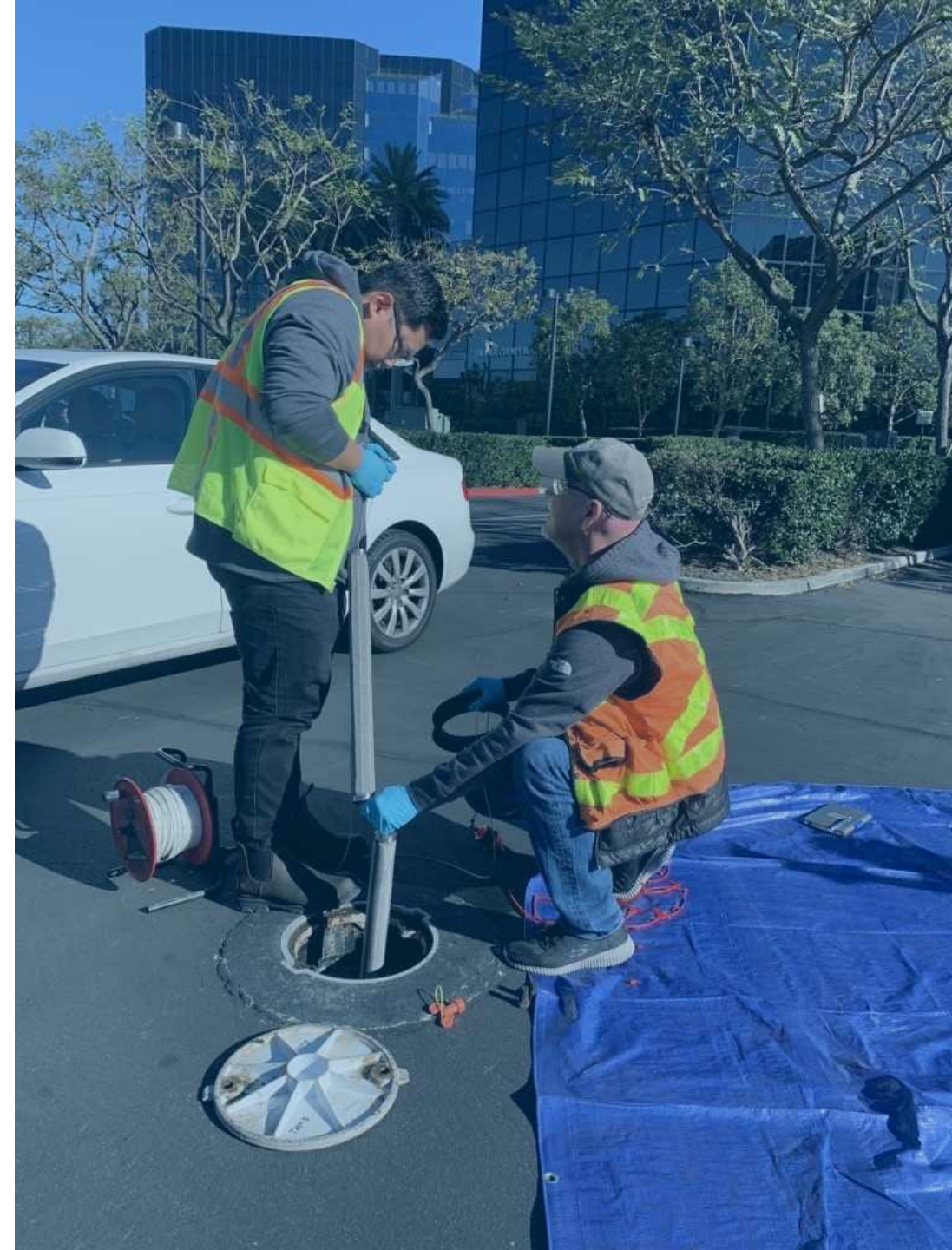
Low/mod
mass flux

Final Thoughts

- Powerful way to plan remediation
- Data depends on well integrity
 - Usually the case, but more important for flux
- Give thought to the data context
 - Confounding event during collection?



Hydrology 2019, 6(2), 36;
<https://doi.org/10.3390/hydrology6020036>



Thank you!

Questions?



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