Montana Department of Environmental Quality

Petroleum Tank Cleanup Section (PTCS)

Low Flow Sampling

Overview

Reed Miner
Petroleum Tank Cleanup Section

Consultants Day Meeting, February 2020

Goal of Sampling Groundwater

- Assess the safety of groundwater.
- Collect representative groundwater samples for laboratory analysis and compare the results to human health standards/ risk-based screening levels.
- To achieve representative samples, we need to understand potential biases and accept them or reduce them.

Potential Biases

- Well Installation. – screen interval, lithology, submerged screen
- Stagnant water in well column
- Purge method – volume, rate, affects to aquifer
- Pump type
- Field conditions – rain, refueling vehicle, etc.

Potential Biases

Separate Discussion

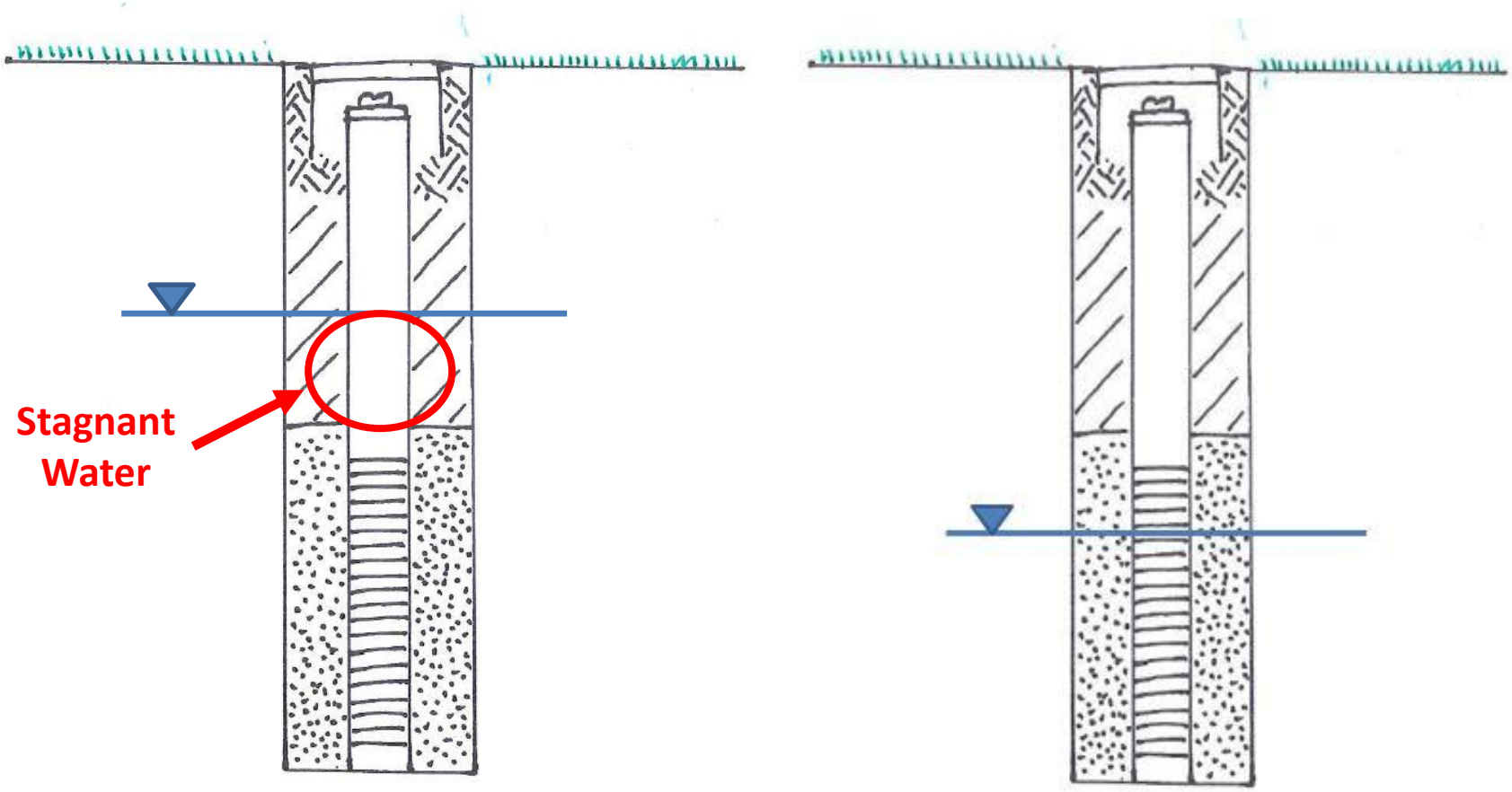
- Well Installation. – screen interval, lithology, submerged screen
- Stagnant water in well column
- Purge method – volume, rate, affects to aquifer

Reason for Low-Flow Sampling

- Pump Type ← Subject of DEQ PTCS Assessment
- Field conditions – rain, refueling vehicle, etc.

Assessed w/ Field Blanks, etc.

Stagnant Water
(Potential Biases)



Potential Biases

- Well Installation. – screen interval, lithology, submerged screen
- Stagnant water in well column
- Purge method – volume, rate, affects to aquifer
- Pump
- Tubing
- Field conditions – rain, refueling vehicle, etc.

Subject of this Presentation

Well Purging
(Potential Biases)

Methods of Well Purging

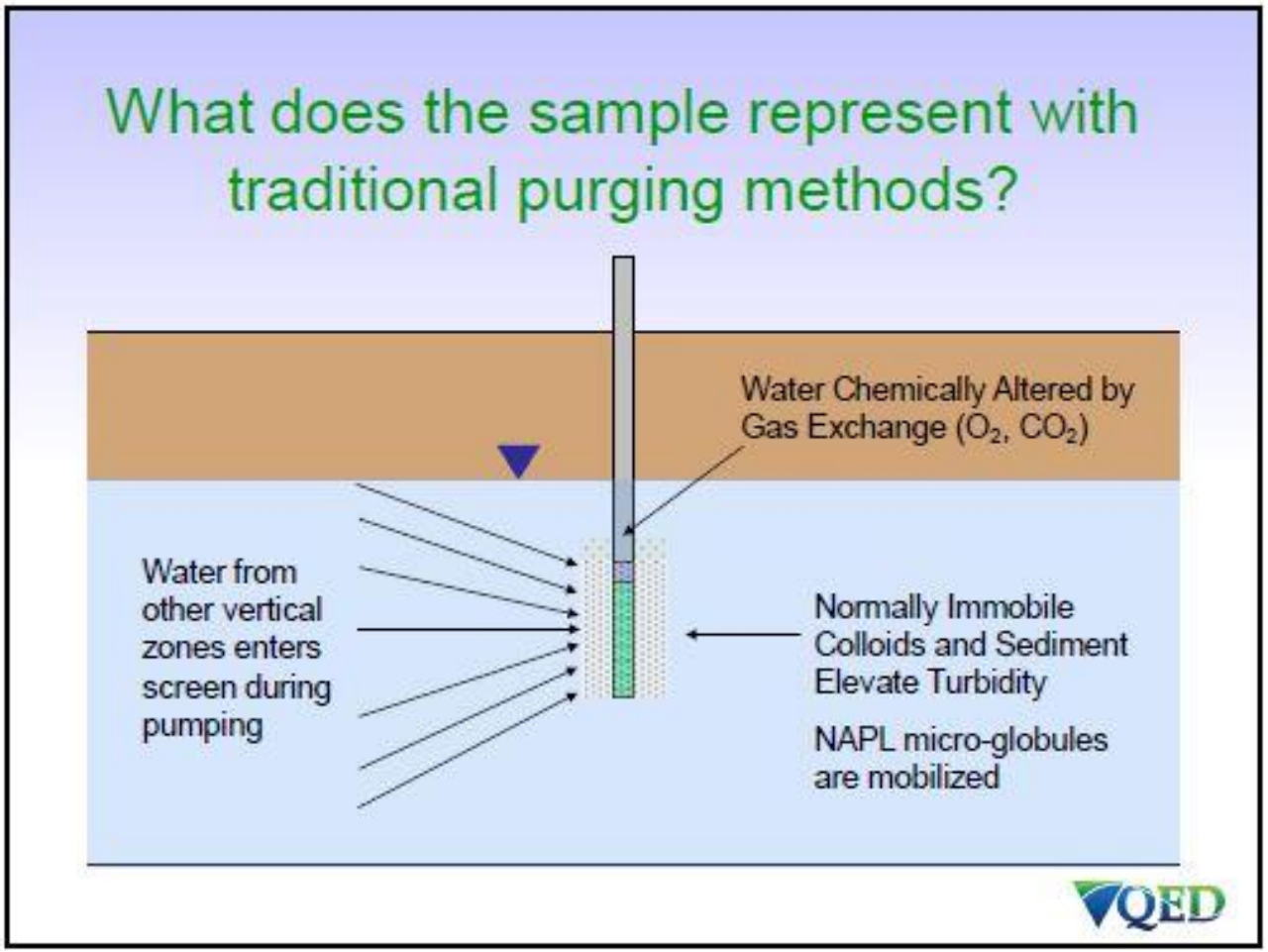
- Traditional well-volume purging
- Purge to stabilization of indicator parameters
- Low-flow purging and sampling
- Passive and no-purge sampling

Well Purging
(Potential Biases)

Traditional Well-Volume Purging

- 3 – 5 well volumes purged (by bailer or pump)
- Low-yield wells evacuated, sampled after recovery
- High volumes of purge water
- High variability between events: purge rate, method, etc.

Well Purging
(Potential Biases)



Source: QED Webinar, Trends in Groundwater Sampling: A Comparison of Groundwater Sampling Methods.

Well Purging
(Potential Biases)

Traditional Well-Volume Purging

- Purging with a Bailer magnifies effects:
  - Stagnant water mixed, increases purge volume
  - Surging action increases turbidity
  - Causes aeration, can offgas VOCs
  - Low reproducibility – imprecision and inaccuracy

Well Purging
(Potential Biases)

Purge to Stabilization of Indicator Parameters

- Purging with a Pump while monitoring indicator parameters
- Flow rate is not always a concern, drawdown not assessed
- Overpumping can lead to same biases as well-volume purge
  - Pulls from above and below screen interval
  - Can mobilize constituents

Well Purging
(Potential Biases)

Purge to Stabilization of Indicator Parameters

Well Information:

Well Diameter (in.)	2	Free Product? [ ] Yes [X] No	
Depth to Bottom (ft.)	19.44	Depth to FP (ft.)	—
Depth to Water (ft.)	8.25	Thickness (ft.)	—
Length of Water Column (ft.)	11.19	Volume (gal.)	—
1 Casing Volumes (gal.)	1.03		
3 Casing Volumes (gal.)	3.09		

Purge Information:

Purge Method: [ ] Submersible Pump [X] Peristaltic Pump
[ ] Bladder Pump [ ] Other: _____
Total Gallons Purged: 4 Purge Rate: 0.2 gpm
Date of Last Well Development:
Recharge Rate: [ ] Rapid [X] Moderate [ ] Slow [ ] None

Time	Gallons	Conductivity	pH	Salinity	DO (mg/L)	DO%	Temperature	ORP
11:50								
11:55	1	1703	7.49	0.87	3.58	34.1	13.37	85.7
12:00	2	1695	7.46	0.86	2.34	22.9	14.58	83.6
12:05	3	1703	7.43	0.87	1.98	19.6	14.71	82.2

Parameters Immediately Prior to Sample Collection:

Time	Gallons	Conductivity	pH	Salinity	DO (mg/L)	DO%	Temperature	ORP
12:10	4	1694	7.40	0.86	2.24	23.4	14.88	80.4

Well Purging - (Potential Biases)

Low-Flow Sampling

- Preferred method of groundwater sampling by Montana DEQ Contaminated Site Cleanup Bureau (Groundwater Sampling Guidance, March 6, 2018).
- Method published in EPA Groundwater Issue April 1996 by Puls and Barcelona under title “Low-Flow (Minimal Drawdown) Ground-Water Sampling Procedures.”
- Common method used by state agencies, national consulting companies.

Well Purging - (Potential Biases)

Low-Flow Sampling

- Low-flow Sampling is a method, not a pump type
- Pump type is selected based on water depth, flow rate, well diameter, etc.
- In response to your questions, DEQ is evaluating potential biases based on pump type (bladder pump vs. peristaltic)

Well Purging - (Potential Biases)

Low-Flow Sampling

United States Environmental Protection Agency | Office of Research and Development | Office of Solid Waste and Emergency Response | EPA/540/S-95/504 April 1996

EPA **Ground Water Issue**

LOW-FLOW (MINIMAL DRAWDOWN) GROUND-WATER SAMPLING PROCEDURES

by Robert W. Puls[1] and Michael J. Barcelona[2]

A. Low-Flow Purging and Sampling

Low-flow refers to the velocity with which water enters the pump intake and that is imparted to the formation pore water in the immediate vicinity of the well screen. It does not necessarily refer to the flow rate of water discharged at the surface which can be affected by flow regulators or restrictions. Water level drawdown provides the best indication of the stress imparted by a given flow-rate for a given hydrological situation. The objective is to pump in a manner that minimizes stress (drawdown) to the system to the extent practical taking into account established site sampling objectives. Typically, flow rates on the order of 0.1 - 0.5 L/min are used, however this is dependent on site-specific hydrogeology. Some extremely coarse-textured formations

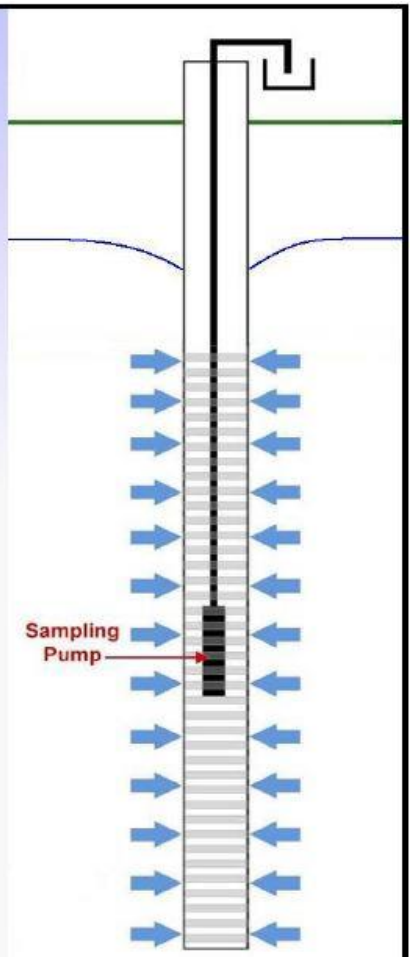
Well Purging - (Potential Biases)

Low-Flow Sampling

Low-flow purging and sampling can solve problems seen with traditional well purging methods

- Low pumping rate minimizes drawdown, in-well mixing and formation stress, isolates stagnant water above screen
- Low stress = low turbidity, improved sample accuracy, reduced purge volume
- Samples represent naturally mobile contaminants, not stagnant water in the well or mobilized contaminants
- Purge volume is based on stabilization of water quality indicator parameters, NOT a minimum purge volume or purge time

QED



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Well Purging
(Potential Biases)

Low-Flow Sampling

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Free Product? [ ] Yes [X] No

Depth to FP (ft.) —

Thickness (ft.) —

Volume (gal.) —

Purge Information:

Purge Method: [ ] Submersible Pump [X] Peristaltic Pump

[ ] Bladder Pump [ ] Other: ____

Total Gallons Purged: 4 Purge Rate: 0.2 gpm

Date of Last Well Development:

Recharge Rate: [ ] Rapid [X] Moderate [ ] Slow [ ] None

DTW ?

Turb ?

Time	Gallons	Conductivity	pH	Salinity	DO (mg/L)	DO%	Temperature	ORP
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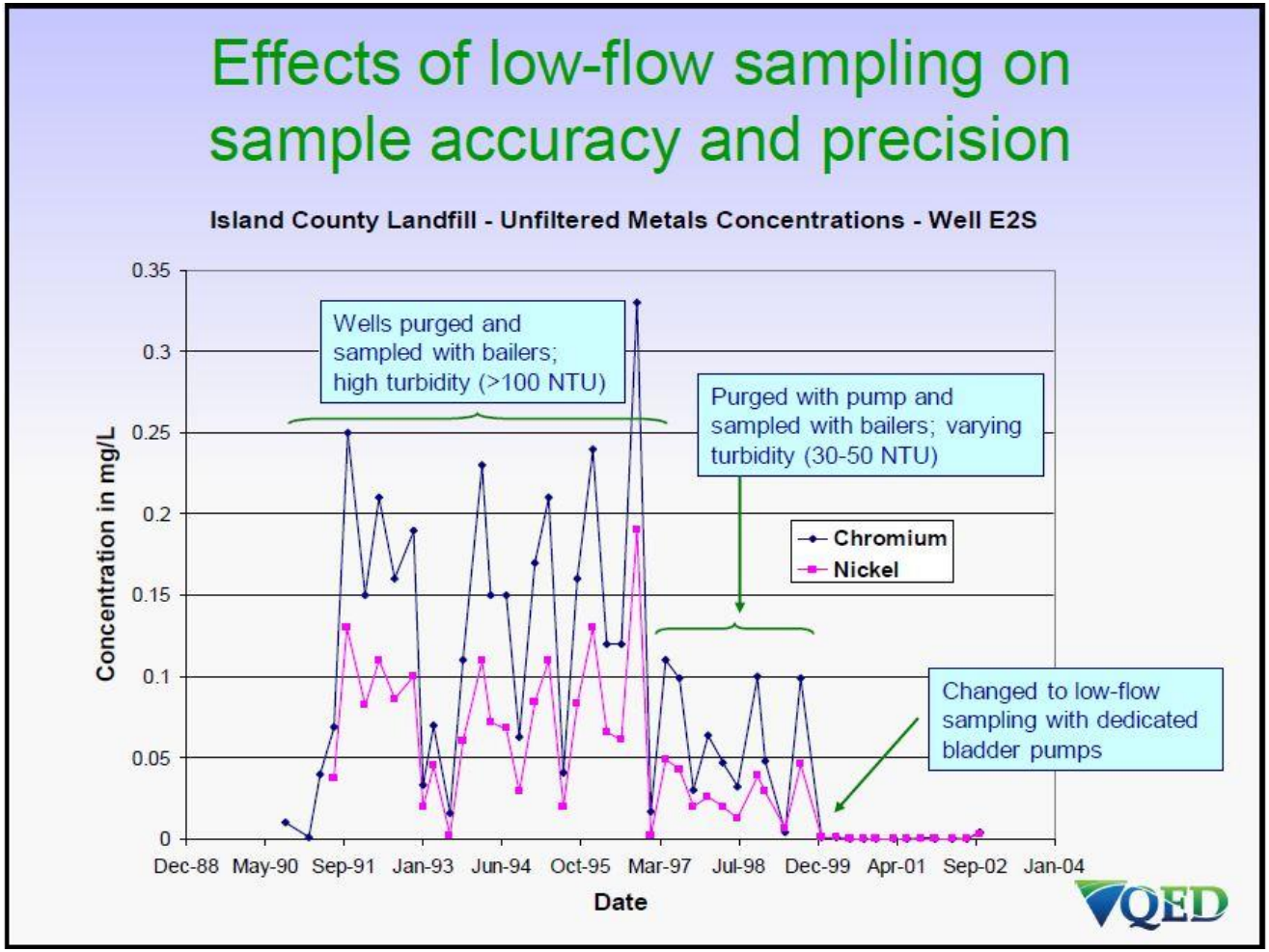
Well Purging - (Potential Biases)

Effects of Purge Method on Accuracy



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Well Purging - (Potential Biases)

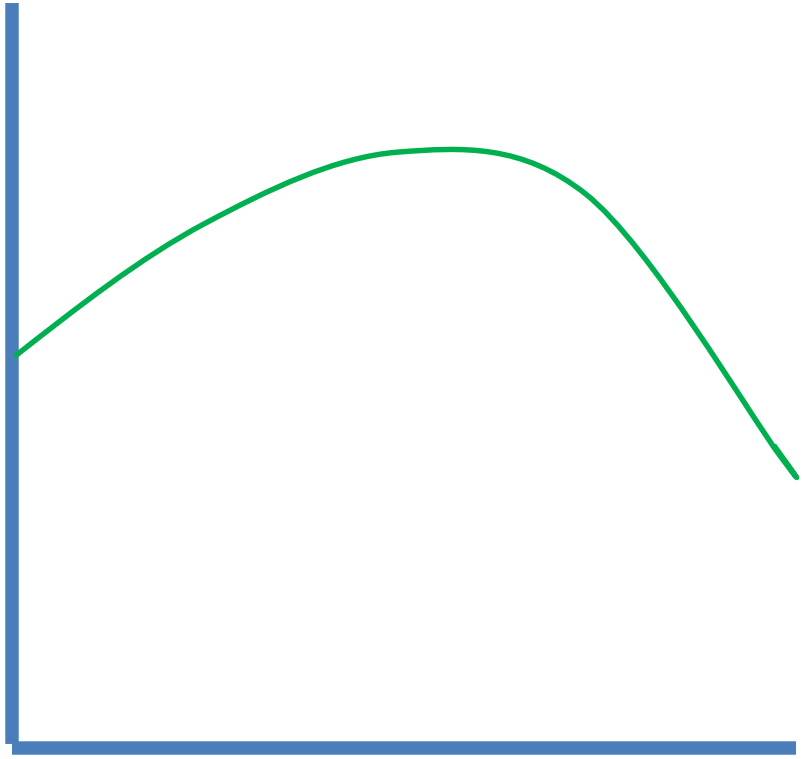
Summary

- Low-flow sampling is preferred method of Bureau
- Increase repeatability and accuracy
- More representative of natural conditions
- Limits uncertainties introduced by other methods

Low-Flow Sampling

What About Reimbursement?

ANALOGY: NOT BASED ON ACTUAL DATA



Low-Flow Sampling

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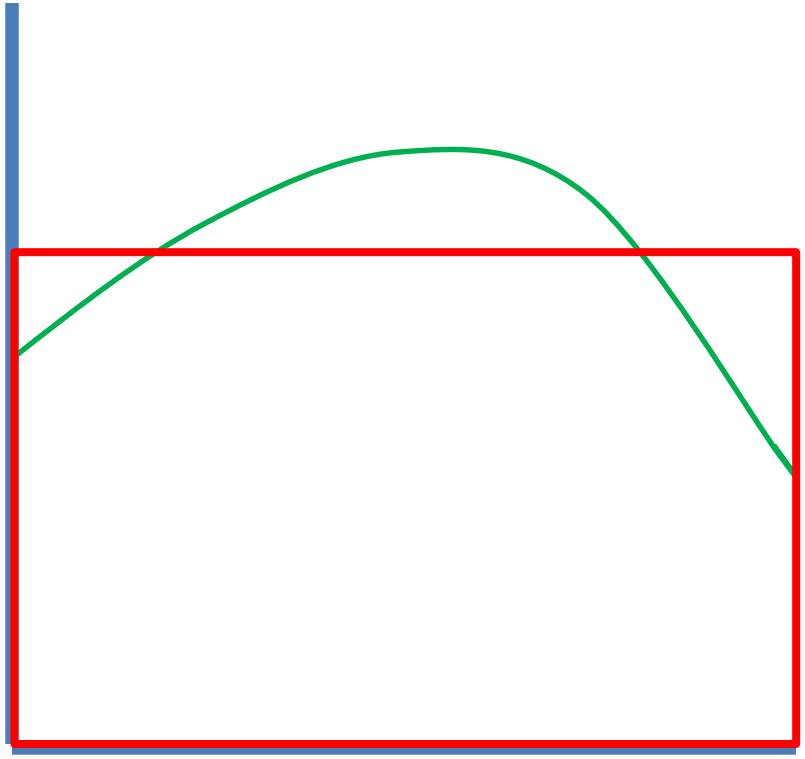

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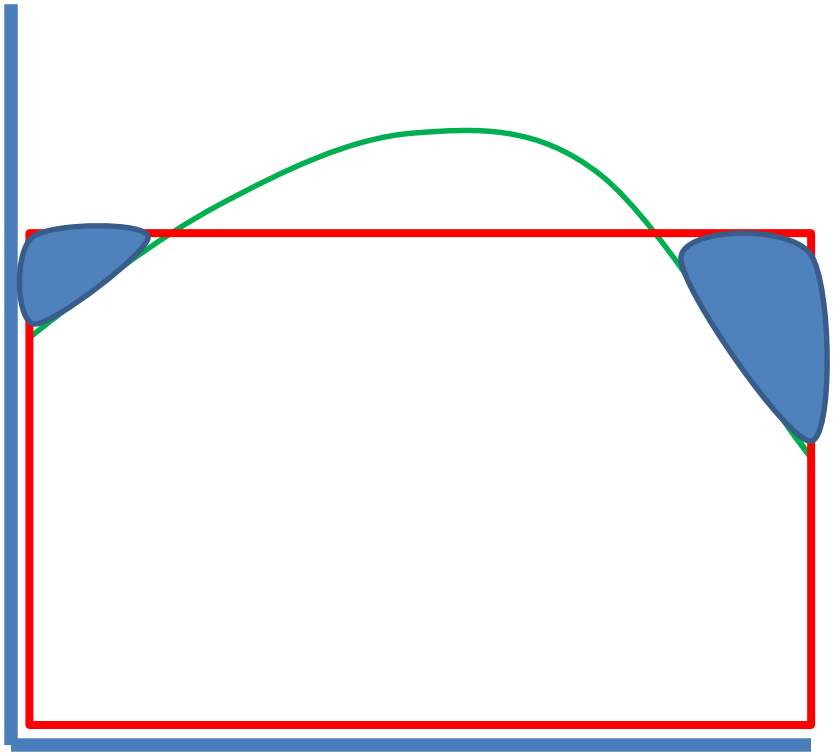

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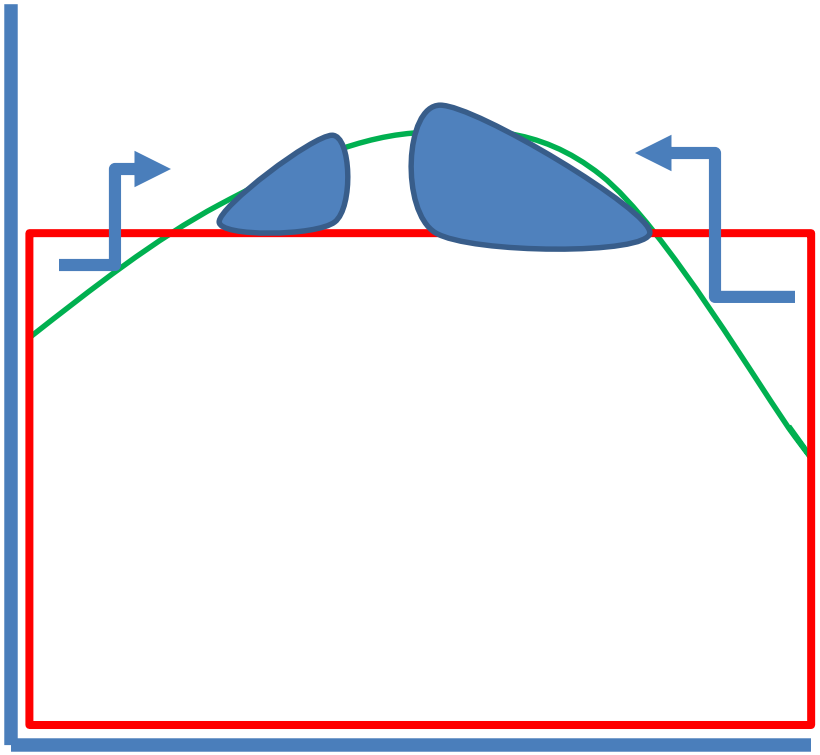

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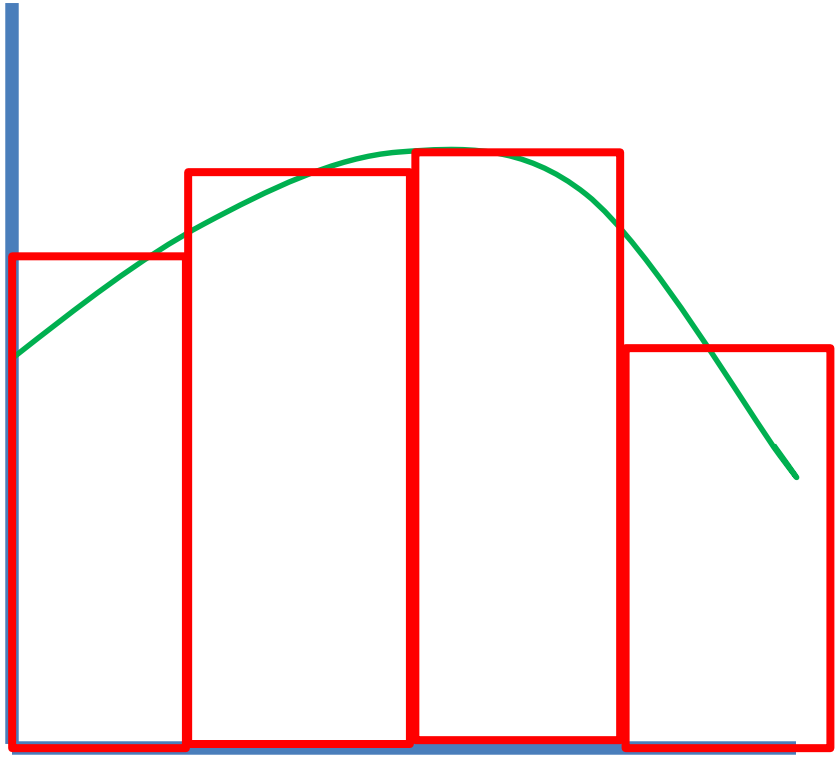

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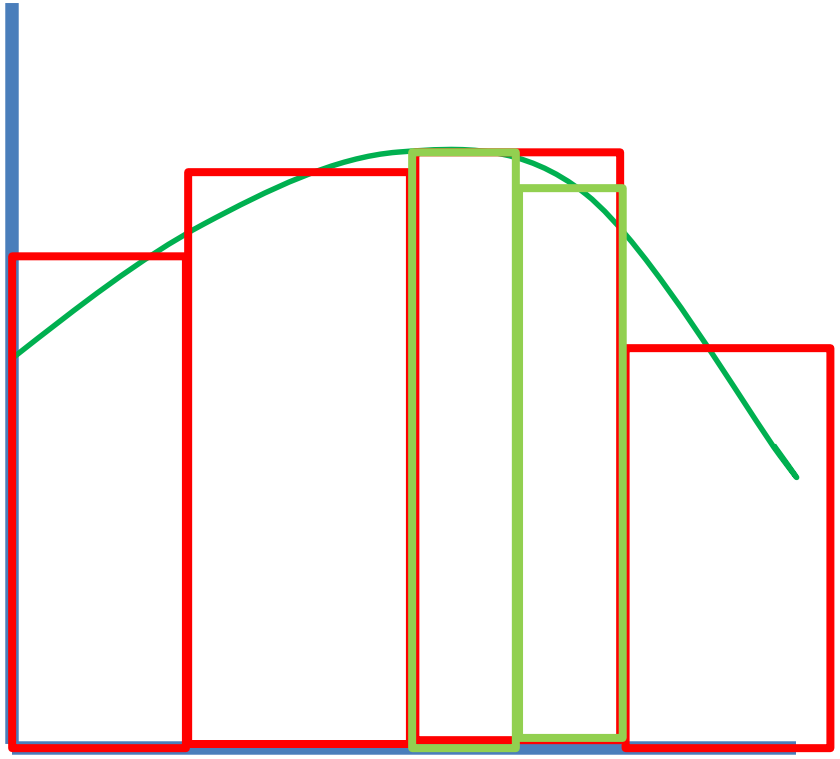

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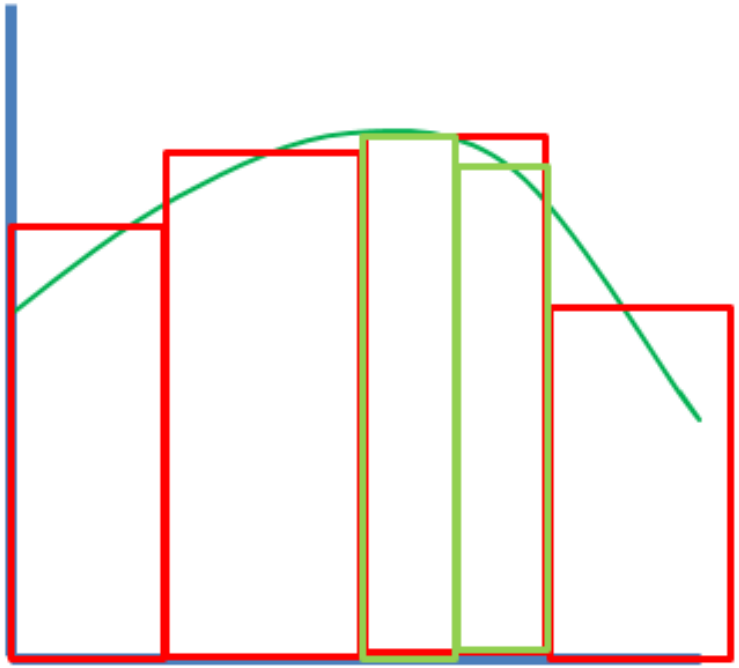

1. Low-Flow Shallow

2. Low-Flow Deep

3. No Purge

4. Separate Category or Add-on: Low Yield or IBI