



# Status of Groundwater Monitoring and Corrective Action

Under the CCR Rule

[woodplc.com](http://woodplc.com)



# Timeline Interpretations and Actual Implementation

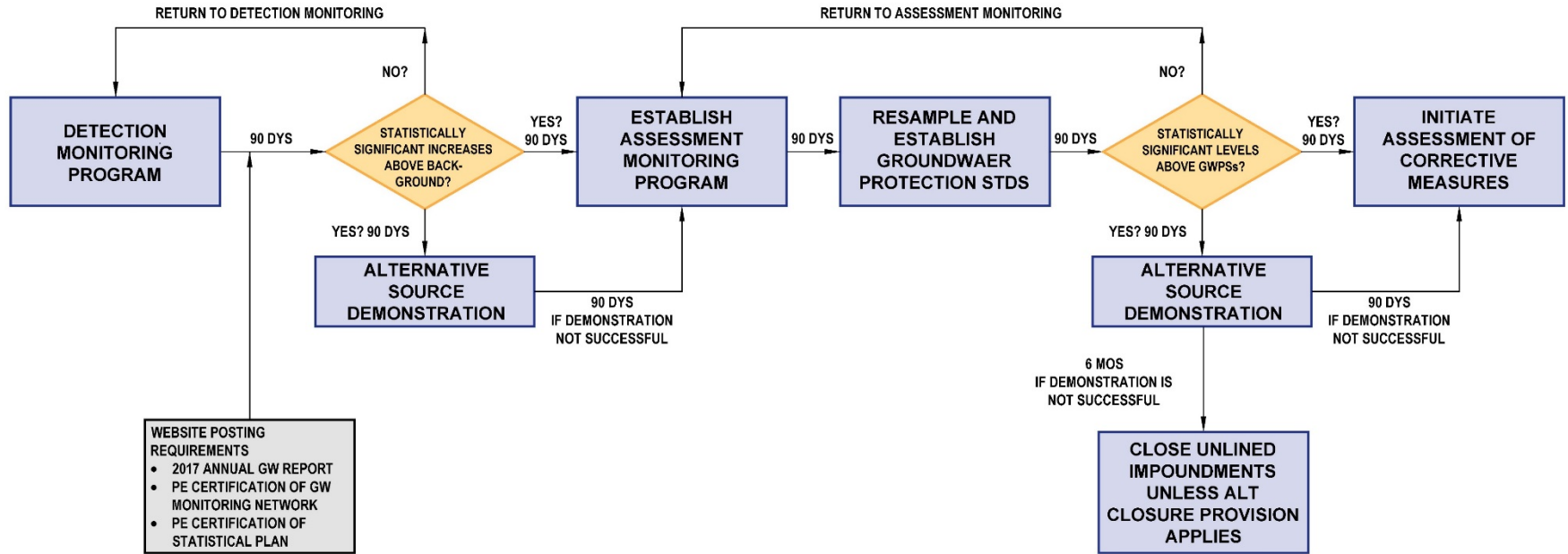
*What's happening now*

# Groundwater Monitoring Timeline

2017

2018

2019



*Adapted from USWAG, 27 November 2017*



# What's Been Posted to the Internet?

A survey of the 20 largest utilities regulated under the CCR Rule.\*

Utility	Groundwater Monitoring Network Certification	Statistical Method Certification	2017 Annual Report (2 March 2018)	Detection Monitoring Statistical Report
Utility 1	◆	◆	◆	◆
Utility 2	◆	◆	◆	
Utility 3	◆	◆	◆	◆
Utility 4	◆	◆	◆	◆
Utility 5	◆	◆	◆	◆
Utility 6	◆	◆	◆	
Utility 7	◆	◆	◆	
Utility 8	◆	◆	◆	◆
Utility 9	◆	◆	◆	
Utility 10	◆	◆	◆	◆

\*Based on number of coal-burning stations, data as of 13 March 2018.

Utility	Groundwater Monitoring Network Certification	Statistical Method Certification	2017 Annual Report (2 March 2018)	Detection Monitoring Statistical Report
Utility 11	◆	◆	◆	◆
Utility 12	◆	◆	◆	
Utility 13	◆	◆	◆	
Utility 14	◆	◆	◆	
Utility 15	◆	◆	◆	
Utility 16	◆	◆	◆	
Utility 17	◆	◆	◆	◆
Utility 18	◆	◆	◆	
Utility 19	◆	◆	◆	◆
Utility 20	◆	◆	◆	
<b>Totals</b>	<b>20</b>	<b>20</b>	<b>20</b>	<b>9</b>



# Statistical Analysis

---

## What happened to the 15 January 2018 deadline?

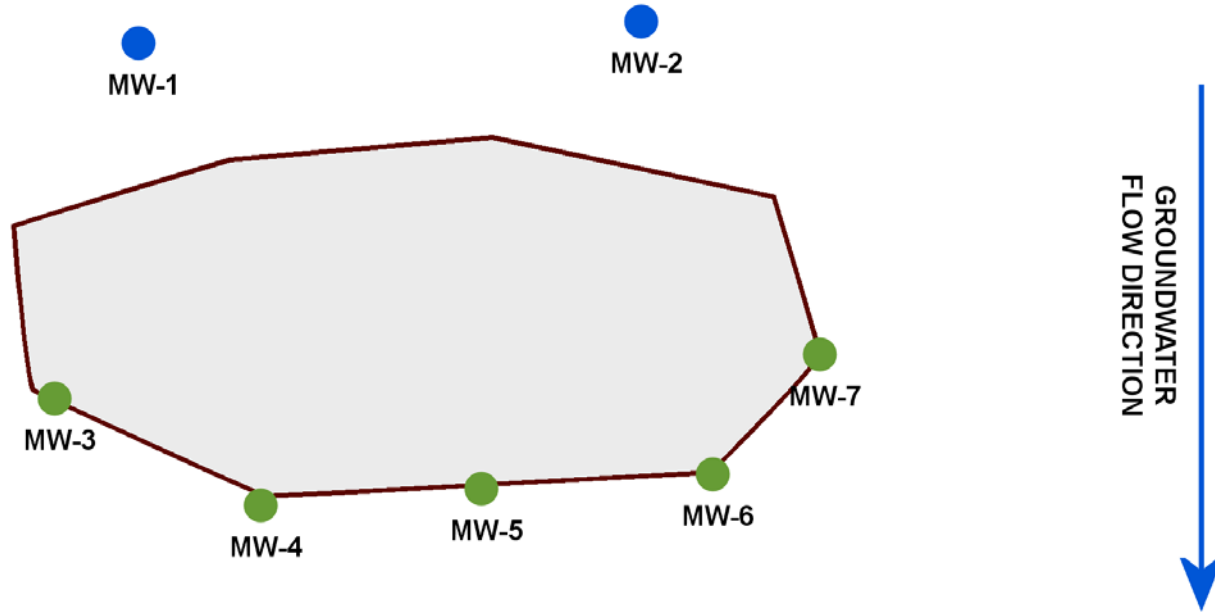
- Results not required in 2017 Annual Report
- Interim posting (outside the Annual Report) not required
- Additional detection monitoring event required after first 8
  - Before end of 2017, to meet the 15 January 2018 deadline; or
  - As the first semi-annual detection round in 2018
- Some statistical plans require one or more confirmations rounds before declaring a SSI
- Problems with baseline data (discussed below) have complicated statistical interpretations



# Statistical Evaluations

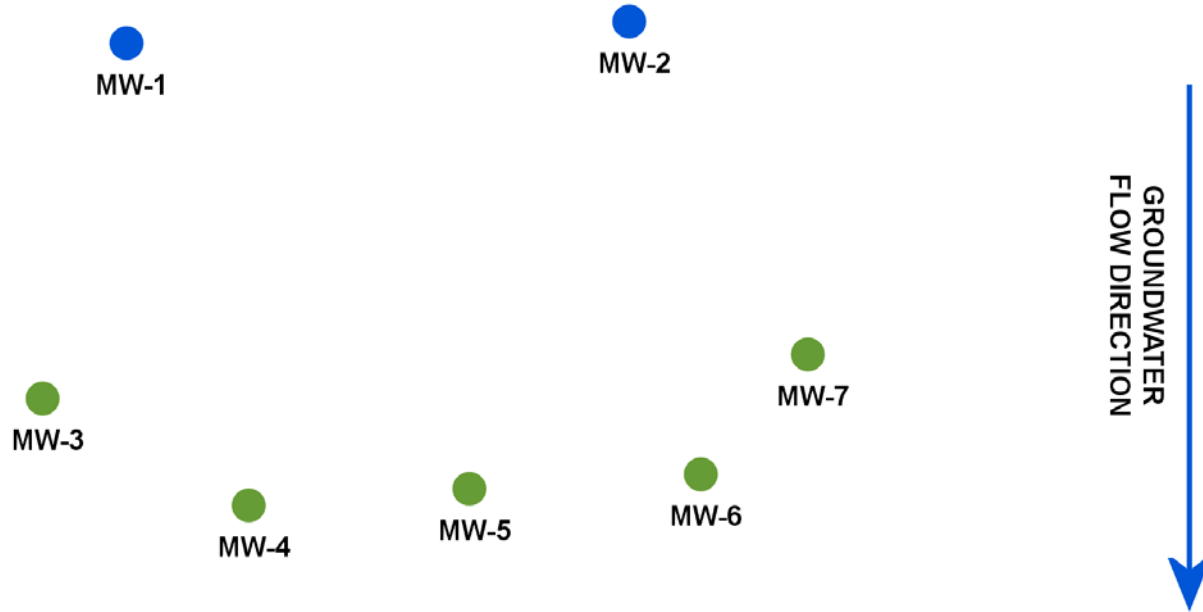
# Why do we do statistical evaluations?

---



# Why do we do statistical evaluations?

---





# Statistical Methods

---

- Generally falling into UPL or UTL
- Limited use of ANOVA or non-parametric ANOVA
- Generally not enough data for control charts
- Usually interwell (between wells) comparisons are used
- Intrawell (same well) comparisons are used for some constituents when:
  - Background data have spatial variability; and
  - Baseline data can be assumed to be unimpacted by CCR unit



# Data Problems Affecting Statistics

---

- Background well results not representative
- Data collected in compressed timeframe
- False positive exceedances – the Russian Roulette problem
- Address by using:
  - Re-sampling, or
  - Intrawell (same well) comparisons



# Statistical Evaluation (Hypothetical Appendix III)

Resolving the grey areas only gets you so far in detection monitoring

Constituent	MW-1	MW-2	MW-3	MW-4	MW-5	MW-6	MW-7
Boron				◆	◆		
Calcium			◆	◆			
Chloride			◆	◆	◆	◆	
Fluoride				◆	◆		
Sulfate			◆	◆	◆		◆
pH (std)							



# Statistical Evaluation (Hypothetical Appendix IV)

Resolving the grey areas will be critical in assessment monitoring

Constituent	MW-1	MW-2	MW-3	MW-4	MW-5	MW-6	MW-7
Selenium				◆	◆		
Lithium			◆	◆			
Arsenic			◆	◆	◆	◆	
Fluoride				◆	◆		
Molybdenum			◆	◆	◆		◆
Radium 226/228							



# Statistical Evaluation - Bottom Line

---

- In detection monitoring:
  - SSIs over background are likely to occur, especially at unlined impoundments
  - Results for landfills tend to be more in the “grey areas”
  - Statistics have limited ability to change the outcome if proven SSIs exist
- Look ahead at Appendix IV data:
  - Failing detection monitoring will lead to ASD and possibly assessment monitoring, but not necessarily to corrective action
  - Statistics will be even more important in assessment monitoring, to limit and focus corrective action



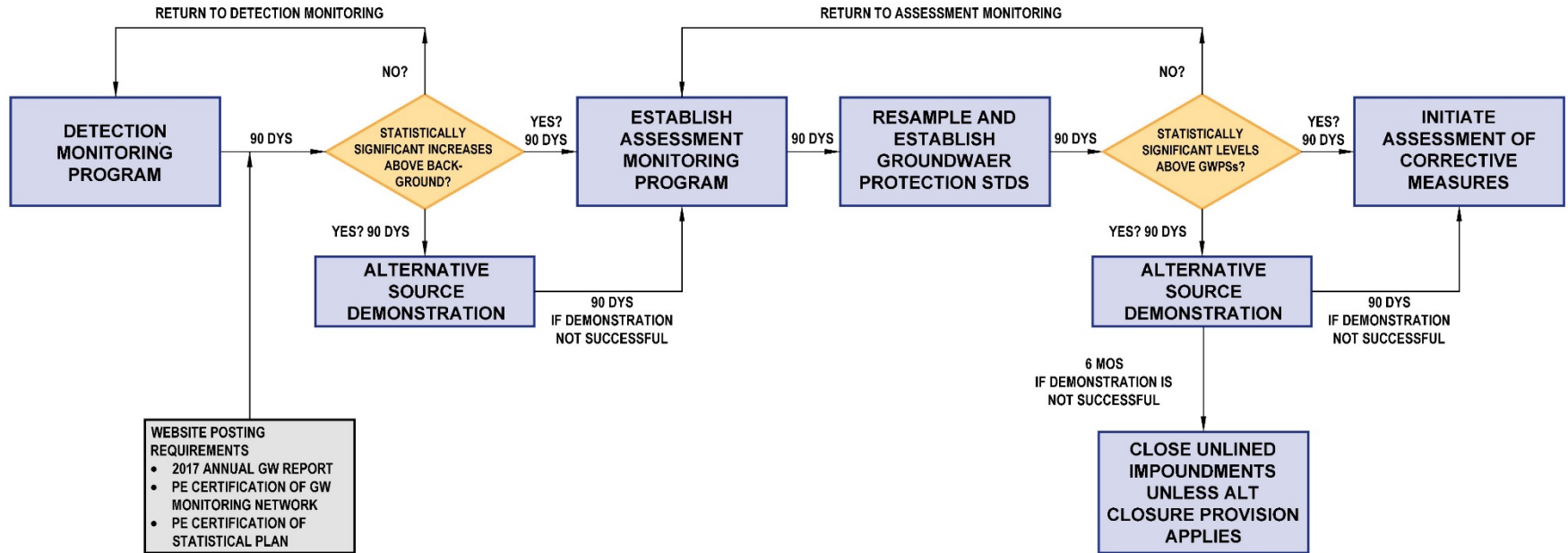
# Groundwater Corrective Action

# Groundwater Monitoring Timeline

2017

2018

2019

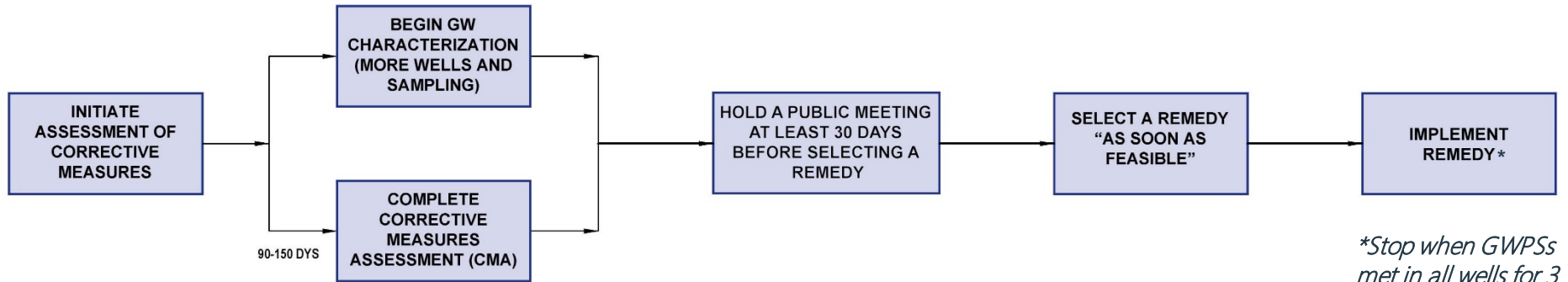


*Adapted from USWAG, 27 November 2017*



# Corrective Action Timeline

---



*\*Stop when GWPSs met in all wells for 3 years*





# Triggers for Corrective Action

---

- Appendix IV constituents at SSLs above GWPSs
    - Maximum Contaminant Level (if established)
    - Background (if no MCL)
  - Persistent MCL exceedances are already apparent from baseline data
  - Often only 2-5 times MCL, not orders-of-magnitude higher
  - Most frequently observed constituents with exceedances\*:
    - Primary: arsenic
    - Others: molybdenum, antimony, barium, radium, lithium, selenium, fluoride...
- \*Based on results from selected utilities only



# General Treatment Options

## Treatability of the Appendix IV constituents

Applicability by Constituent	MCL?	Monitored Natural Attenuation	In-Situ Treatment					Above-Ground Treatment			
			ZVI	Activated Carbon	Zeolites and other adsorbents	Other Reagents	Biological	Granular Activated Carbon	Physical/ Chemical (Precipitation)	Selective Ion Exchange/Adsorption Media	Reverse Osmosis
Arsenic	Y	■	■	■	■	□	■	■	■	■	
Chromium	Y	■	■	■	■	□	■	■	■	■	
Antimony	Y	■	■	■	■	□	■	■	□	■	
Selenium	Y	■	■	■	■	□	■	■	□	■	
Thallium	Y	■	■	■	■	■	□	■	■	□	
Mercury	Y	■	■	■	■	□	□	■	■	□	
Cadmium	Y	■	☒	■	■	□	□	■	■	□	
Fluoride	Y	■	☒	□	■	■	■	□	■	□	
Molybdenum	N	■	■	■	☒	□	□	■	■	□	
Radium 226+228	Y	■	□	■	☒	□	■	■	□	■	
Beryllium	Y	■	□	☒	☒	□	□	☒	■	■	
Cobalt	N	■	□	☒	■	☒	□	☒	■	□	
Lead	N	■	■	□	■	□	□	□	■	□	
Barium	Y	■	□	□	☒	■	□	□	■	□	
Boron	N	■	□	□	□	□	□	□	□	■	
Lithium	N	■	□	□	□	□	□	□	□	□	

□ Technology not effective

☒ Technology possibly effective, limited data

■ Technology demonstrated effective



# Potential Game Changers

---

EPA's proposed CCR rule amendments (published in FR on 15 March 2018)

- Timeframe for CCR rule amendments:
  - Just published in Federal Register, comment period to end of April
  - At least some Phase One amendments finalized this year (required by June 2019)
  - Phase Two would be proposed in September 2018 (required to be finalized by December 2019)
- Allow states more flexibility than federal CCR Rule
- Encourages state CCR programs to align where possible with municipal solid waste landfill regulations



# Potential Game Changers

---

EPA's proposed CCR rule amendments (published in FR on 15 March 2018)

Amendments will allow:

- Alternative risk-based groundwater protection standards
- Site-by-site flexibility to:
  - Establish alternate time period for a corrective action demonstration
  - Modify or waive groundwater monitoring requirements
  - Modify or waive the corrective action remedy



# Potential Game Changers

---

EPA's proposed CCR rule amendments (published in FR on 15 March 2018)

## Modification to corrective action remedy:

- On a site-specific basis, groundwater remediation could be waived under a state program if:
  - Groundwater is contaminated from other source(s) in addition to CCR unit
  - Groundwater is not a source of drinking water
  - Groundwater is not hydraulically connected to impacted receptors
  - Remediation is technically infeasible
  - Remediation would result in unacceptable cross-media impacts (making no action the lower-risk alternative)
- Source control and other mitigating measures still required, however.



# Potential Game Changers

---

EPA's proposed CCR rule amendments (published in FR on 15 March 2018)

## Return of boron to Appendix IV

- Frequently found above background concentrations → frequent SSIs
- In Appendix IV, what will the GWPS be?
  - No MCL established
  - Existing risk-based screening levels
    - EPA RSL tapwater 4 mg/L
    - Five states have drinking water limits 0.6 to 1 mg/L
    - Aquatic toxicity values not well established
- Depending on where GWPSs are set, SSLs are less likely



# Summary

---

- Published SSIs – half of large utilities included in 2017 annual report
- Statistical evaluations
  - Detection monitoring: at unlined surface impoundments, there are usually one or more SSIs inarguably above background
  - Assessment monitoring: limiting SSLs can reduce footprint and number of constituents to be addressed by corrective action
- Consider beginning groundwater characterization beyond waste boundary
- Changes proposed in Phase One Amendments may not be finalized before corrective action is required



# Other Topics

---

So many topics, so little time...

- Alternative Source Demonstrations (ASDs)
- Status of state programs (only Oklahoma final so far)
- Clean Water Act groundwater liability





# Questions?

## *Contacts:*

*Kathleen Regan*

[kathleen.regan@woodplc.com](mailto:kathleen.regan@woodplc.com)

*Brian Owens*

[brian.owens@woodplc.com](mailto:brian.owens@woodplc.com)