

Nutrient Data Management - Best Practices

May 10, 2017

ICEDM



Chris Neumiller, L.Hg.

WA State Dept. of Ecology



Nutrient best practices workgroup

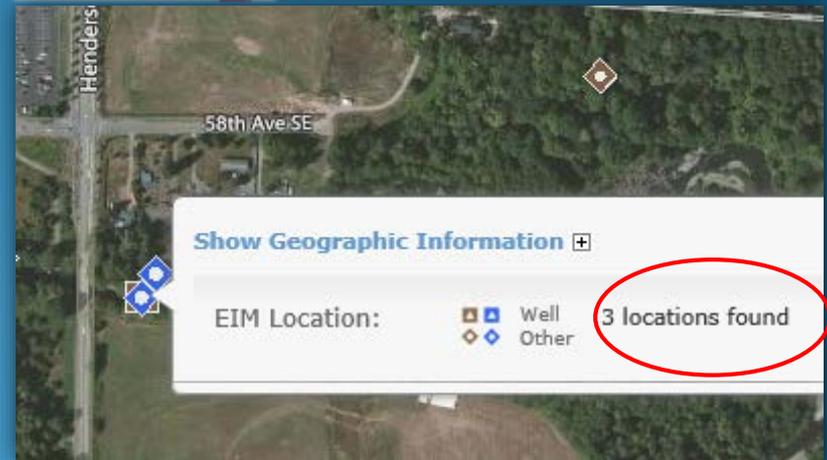
- Address challenges EPA & USGS had assimilating nutrient data from Water Quality Portal.
- EPA Office of Water (lead), USGS & several states.
- January 2016-April 2017, monthly calls.

Biggest Challenges

1. Multiple locations in system for same sampling point
2. Inconsistent use of parameter names
3. Confusion around sample fraction & term “Total”
4. Lack of speciation info
5. Missing/incorrectly document censored data
6. Ambiguous analytical methods

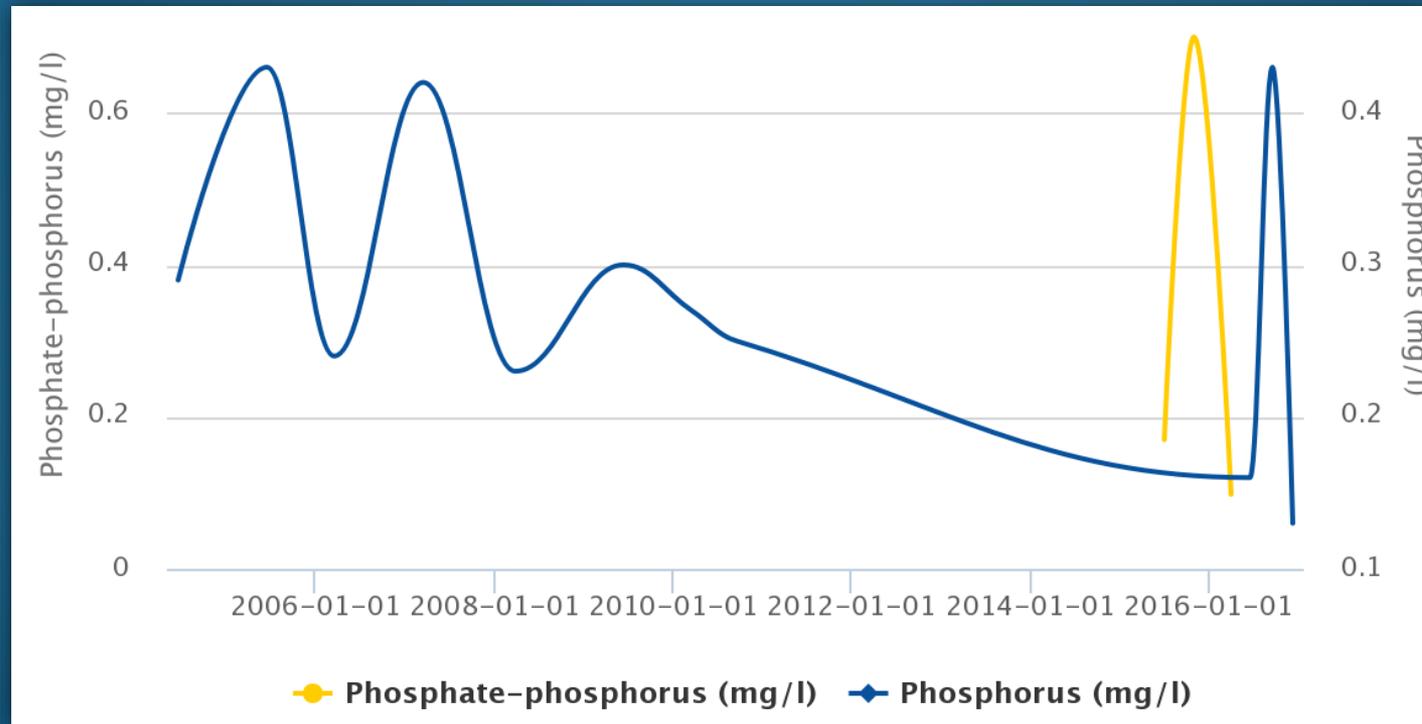
1. Multiple locations - same sampling point

- Develop process for establishing new monitoring locations.
- Use available tools to manage.
 - *Ex: GPS – store locations*
- Before submitting data to systems like WQX, look for existing locations you can use.



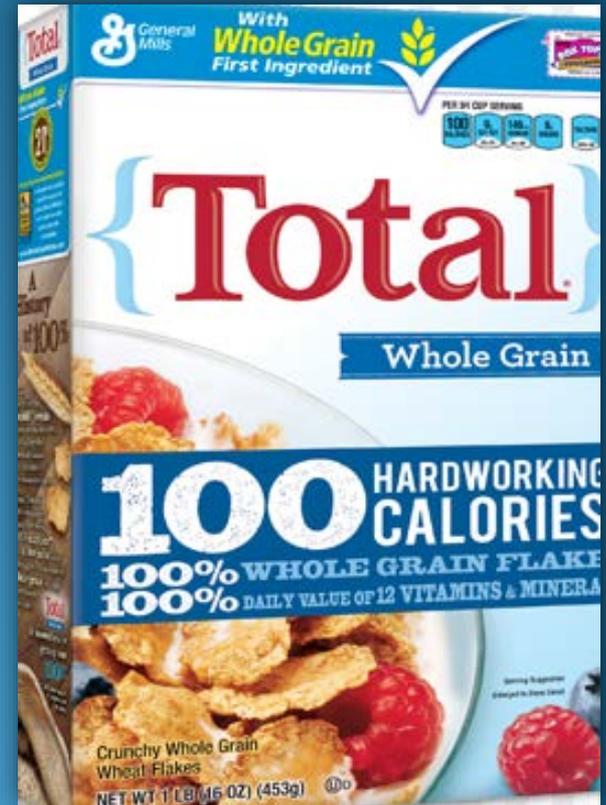
2. Inconsistent use of parameter names

- Same parameter in system under multiple names!
- Difficult to assimilate & assess data, especially from multi-stakeholder systems.
- Solutions - system parameter cleanup; synonyms.



3. Sample fraction & Total

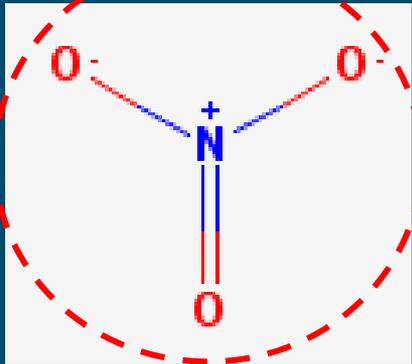
- What does *Total* mean?
- Unfiltered? Sum of forms?
- For WQX, *Total* = sum of all forms
 - Ex: Total Nitrogen = $\text{NO}_3 + \text{NO}_2 + \text{NH}_3 + \text{Organic N}$
- *Sample Fraction* = filtration state



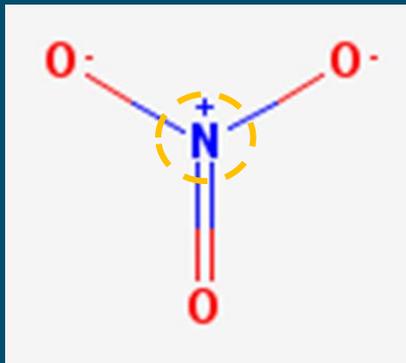
Media	Parameter	Speciation	Result Value	Result Units	Sample Fraction	Analytical Method
Water	Total Nitrogen, mixed forms	as N	2.0	mg/L	Filtered, field	USEPA 351.1
Water	Total Phosphorus, mixed forms	as PO4	1.8	mg/L	Unfiltered	USEPA 365.1

4. Lack of speciation info

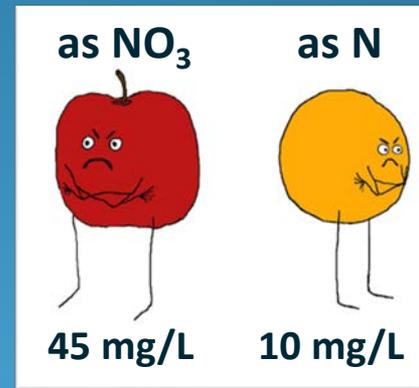
Nitrate as NO₃



Nitrate as N



- Speciation = chemical form of analyte
- Why is it important?
 - Affects the result value
 - Ex: MCL for *Nitrate*



- Without speciation info, data can't be used reliably.
- Independent of analytical method!

5. Missing/incorrectly documented censored data

- Data below lower quantitation limit (non-detects).
- Censored data important for data analyses!
- Bad - symbols in Result Value: < > ~ ND *
- Different systems have different solutions (WQX, below).

Characteristic Name	Result Detection Condition	Result Value	Result Unit	Result Detection/Quantitation Limit Type	Result Detection/Quantitation Limit Measure	Result Detection/Quantitation Limit Unit
Nitrite		4.46	mg/l	Method Detection Level	0.001	mg/l
Nitrogen-15		11.3	mg/l			
Ammonia-nitrogen		0.8022	mg/l			
Nitrate		6.2	mg/l			
Nitrite	Present Below Quantification Limit			Lower Quantitation Limit	0.50	mg/l
Nitrogen-15		10.3	mg/l			
Ammonia-nitrogen		1.0022	mg/l			
Nitrate	Not Detected			Method Detection Level	0.001	mg/l
Nitrite		5.46	mg/l			
Nitrogen-15		12.3	mg/l			

6. Ambiguous analytical methods



- Use standardized, published methods when possible.
- *Ex: Ammonia*
 - EPA-350.1
 - SM4500-NH3-C
 - ASTM-D6919-03
- More trustworthy data.
- More easily assimilated with other data.

Help for documenting nutrient data

- Best practices document addresses issues.
- Table with common metadata combos for complete nutrient results:
 - Speciation ✓
 - Sample Fraction ✓
 - Top-reported standard methods ✓
 - Synonyms ✓
- Goal – the most usable data!!



Table 4 Nutrient Result Guidance at a Glance

Preferred WQX Characteristic Name	Former WQX Characteristic Name(s) (Synonyms)	Method Speciation	Result Sample Fraction	Top-Reported Methods for Preferred Characteristic
Ammonia	<ul style="list-style-type: none"> ○ Ammonia Nitrogen ○ Nitrogen, ammonia (NH₃) 	as N or as NH ₃	<ul style="list-style-type: none"> ○ Filtered, Lab ○ Filtered, Field ○ Unfiltered ○ Non-Filterable (Particle) 	USEPA: 350.1 APHA: 4500-NH ₃ (C), 4500-NH ₃ (E) HACH: 8155, 10023 ASTM: D6919-03, D6919-09 LACHAT: 10-107-06-3-D
Ammonium	NA	as N or as NH ₄	<ul style="list-style-type: none"> ○ Filtered, Lab ○ Filtered, Field ○ Unfiltered ○ Non-Filterable (Particle) 	APHA: 4500-NH ₃ (F), NH ₃ (H) ASTM: D6919-03
Inorganic nitrogen (NO₂, NO₃, & NH₃)	<ul style="list-style-type: none"> ○ Inorganic nitrogen (ammonia, nitrate and nitrite) 	as N	<ul style="list-style-type: none"> ○ Filtered, Lab ○ Filtered, Field ○ Unfiltered ○ Non-Filterable (Particle) 	USEPA: 300.0, 353.1, 353.2, 353.4, 354.1 APHA: 4500-NO ₃ (E), 4500-NO ₃ (F), 4500-NO ₃ (H) ASTM: D3867-04, USDOIS/USGS: I-4545 LACHAT: 10-107-04-1-J
Nitrate + Nitrite	<ul style="list-style-type: none"> ○ Inorganic nitrogen (nitrate and nitrite) 	as N	<ul style="list-style-type: none"> ○ Filtered, Lab ○ Filtered, Field ○ Unfiltered ○ Non-Filterable (Particle) 	USEPA: 353.2, 353.1, 353.4, 300.0, 300.1, 300.6, 354.1 APHA: 4500-NO ₃ (F), 4500-NO ₃ (I), 4110-C, 4110B, 4500-NO ₃ (B), 4500-NO ₃ (E) ASTM: D3867-04 LACHAT: 10-107-04-1-C
Total Kjeldahl nitrogen (Organic N & NH₃)	<ul style="list-style-type: none"> ○ Kjeldahl nitrogen 	as N	<ul style="list-style-type: none"> ○ Filtered, Lab ○ Filtered, Field ○ Unfiltered ○ Non-Filterable (Particle) 	USEPA: 351.2, 351.3(A), 351.3(B), 351.3(C), 351.1, 351.4, 350.1, 350.2, 350.3 APHA: 4500-NORG(B), 4500-NORG C, 4500 NORG D, 4500-NH ₃ (C), 4500-NH ₃ (D), 4500-NH ₃ (G) HACH: 10242 ASTM: D3590(A) LACHAT: 10-107-06-2-M
Nitrate	NA	as N or as NO ₃	<ul style="list-style-type: none"> ○ Filtered, Lab ○ Filtered, Field ○ Unfiltered ○ Non-Filterable (Particle) 	USEPA: 353.2, 353.1, 352.1, 300.1, 300.0 APHA: 4500-NO ₃ (D), 4500-NO ₃ (E), 4500-NO ₃ (F), 4500-NO ₃ (H), 4110-B HACH: 10020 ASTM: D3867-04, D3867-16 USDOI/USGS: I4545
Nitrite	NA	as N or as NO ₂	<ul style="list-style-type: none"> ○ Filtered, Lab ○ Filtered, Field ○ Unfiltered ○ Non-Filterable (Particle) 	USEPA: 353.2, 300, 300.1, 354.1 APHA: 4500-NO ₃ (E), 4500-NO ₃ (F), 4500-NO ₂ (B) ASTM: D3867-04, D3867-16 USDOI/USGS: I-4545

Preferred WQX Characteristic Name	Former WQX Characteristic Name(s) (Synonyms)	Method Speciation	Result Sample Fraction	Top-Reported Methods for Preferred Characteristic
Total Nitrogen, mixed forms	<ul style="list-style-type: none"> ○ Nitrogen ○ Nitrogen, mixed forms (NH₃), (NH₄), organic, (NO₂) and (NO₃) ○ Nutrient-nitrogen Total Particulate Nitrogen (capture with "Total Nitrogen, mixed forms with sample fraction "Suspended") 	as N	<ul style="list-style-type: none"> ○ Filtered, Lab ○ Filtered, Field ○ Unfiltered ○ Non-Filterable (Particle) 	USEPA: 353.1, 353.2, 353.3, 440(S), 440(W) APHA: 4500-NORG(C), 4500-P(J), 4500-NO3(D), 4500-NO3(E) LACHAT: 10-107-04-1-C
Organic Nitrogen	<ul style="list-style-type: none"> ○ NA 	as N	<ul style="list-style-type: none"> ○ Filtered, Lab ○ Filtered, Field ○ Unfiltered ○ Non-Filterable (Particle) 	USEPA: 351.2, APHA 4500-NORG(B) LACHAT: 10-107-06-2E
Organic Phosphorus	<ul style="list-style-type: none"> ○ Phosphorus, Particulate Organic (capture as "Organic Phosphorus" with sample fraction "Suspended") 	as P	<ul style="list-style-type: none"> ○ Filtered, Lab ○ Filtered, Field ○ Unfiltered ○ Non-Filterable (Particle) 	USEPA: 365.2 APHA: 4500-P(E)
Orthophosphate	<ul style="list-style-type: none"> ○ Inorganic Phosphorus 	as P or as PO ₄	<ul style="list-style-type: none"> ○ Filtered, Lab ○ Filtered, Field ○ Unfiltered ○ Non-Filterable (Particle) 	USEPA: 365.1, 365.3, 365.2, 365.4, 300.1, 3,365.5 APHA: 4500-P(E) HACH: 8048 LACHAT: 10-115-01-1-A
Total Phosphorus, mixed forms	<ul style="list-style-type: none"> ○ Phosphate-phosphorus ○ Phosphorus Phosphorus (Total: PO₄ & Organic Phosphorus) 	as P or as PO ₄	<ul style="list-style-type: none"> ○ Filtered, Lab ○ Filtered, Field ○ Unfiltered ○ Non-Filterable (Particle) 	USEPA: 365.1, 365.4, 365.3, 365.2 APHA: 4500-P(E) HACH: 10210, 8190 ASTM: D515(B) USDOI/USGS: I-4650-03 LACHAT: 10-115-01-1-F
Soluble Reactive Phosphorus	<ul style="list-style-type: none"> ○ NA 	as P or as PO ₄	<ul style="list-style-type: none"> ○ Filtered, Lab ○ Filtered, Field 	USEPA: 365.1 APHA: 4500-P(E)

Table 4: The table above shows each of the recommended characteristics to be reported to WQX, the previous WQX allowable values that are synonyms of the recommended characteristic, the method speciations and sample fractions which can be reported for those characteristics, and the most commonly reported national methods for those characteristics.

Wrap-up

- Collaborative effort went extremely well!
- Final product - *Best Practices for Submitting Nutrient Data to the Water Quality eXchange (WQX)*. Available soon on WQX website.
- Focus on WQX, but principles pertain to any EDMS.



Questions?

Chris Neumiller, L.Hg.
WA State Dept. of Ecology
www.eim.wa.gov
Chris.Neumiller@ecy.wa.gov

Laura Shumway
U.S. EPA, Office of Water
Shumway.Laura@epa.gov