Portland Water Bureau's One-Year *Cryptosporidium* Study in the Bull Run Watershed

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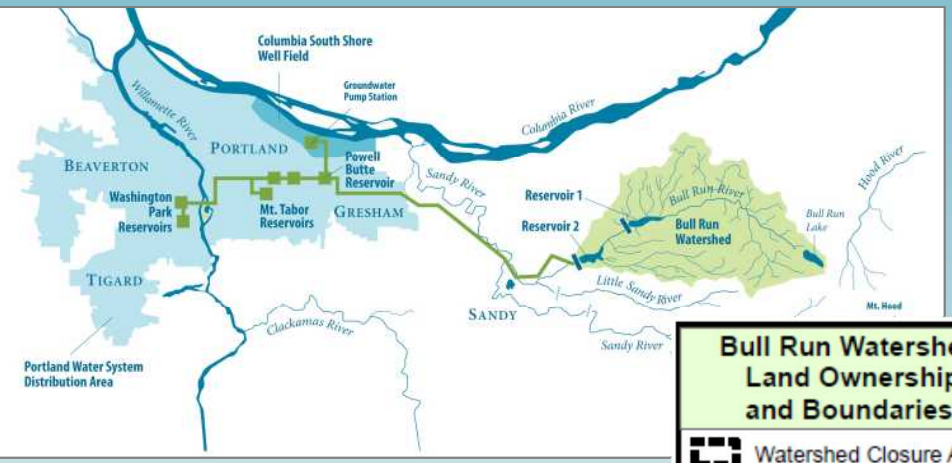
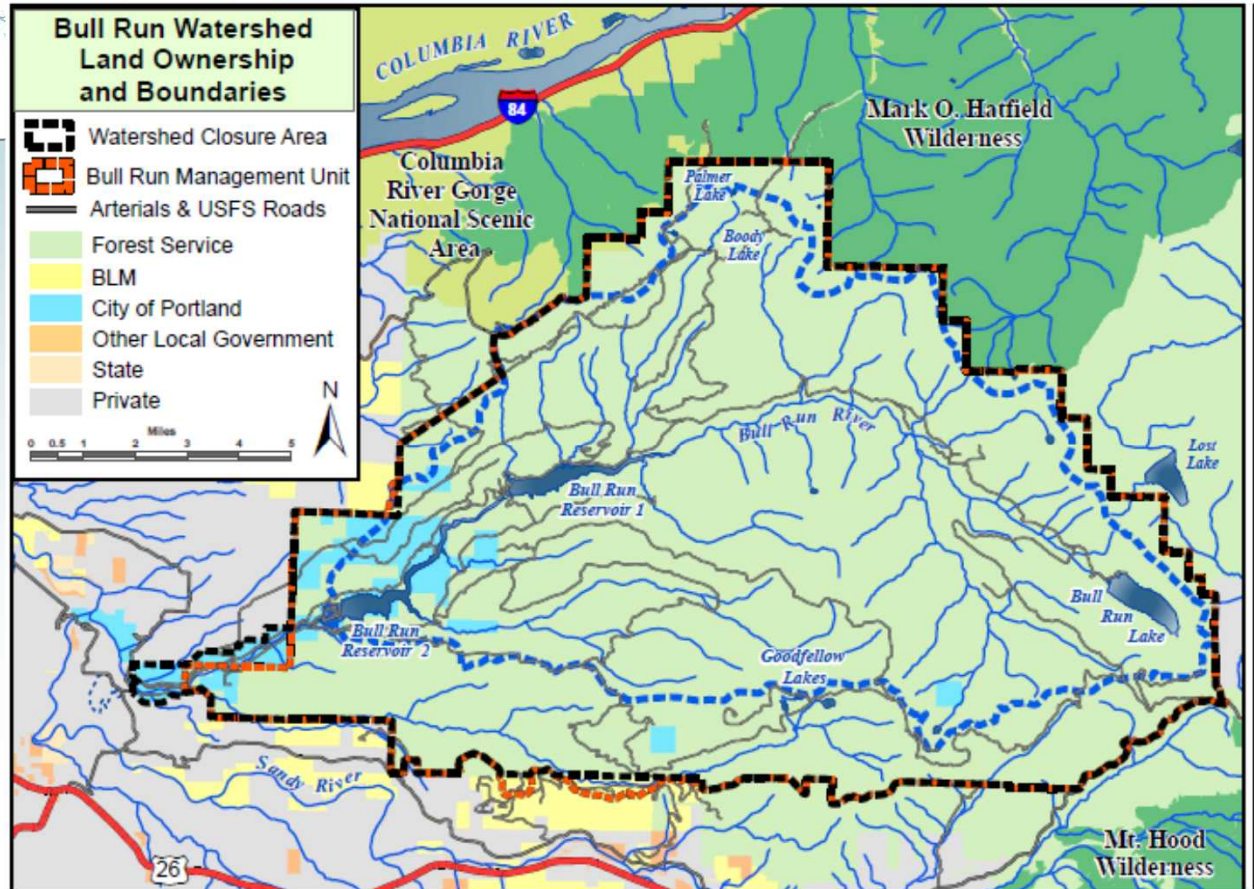
Long Term 2 Enhanced Surface Water Treatment Rule

- EPA LT2 Rule mandates removal or inactivation of the pathogenic protozoan *Cryptosporidium* (2006)
- Level of additional treatment based on average *Cryptosporidium* concentration calculated from 24 months of source water monitoring
- Unfiltered water systems must add treatment equivalent to filtered systems- minimum of 2-log removal regardless of monitoring results

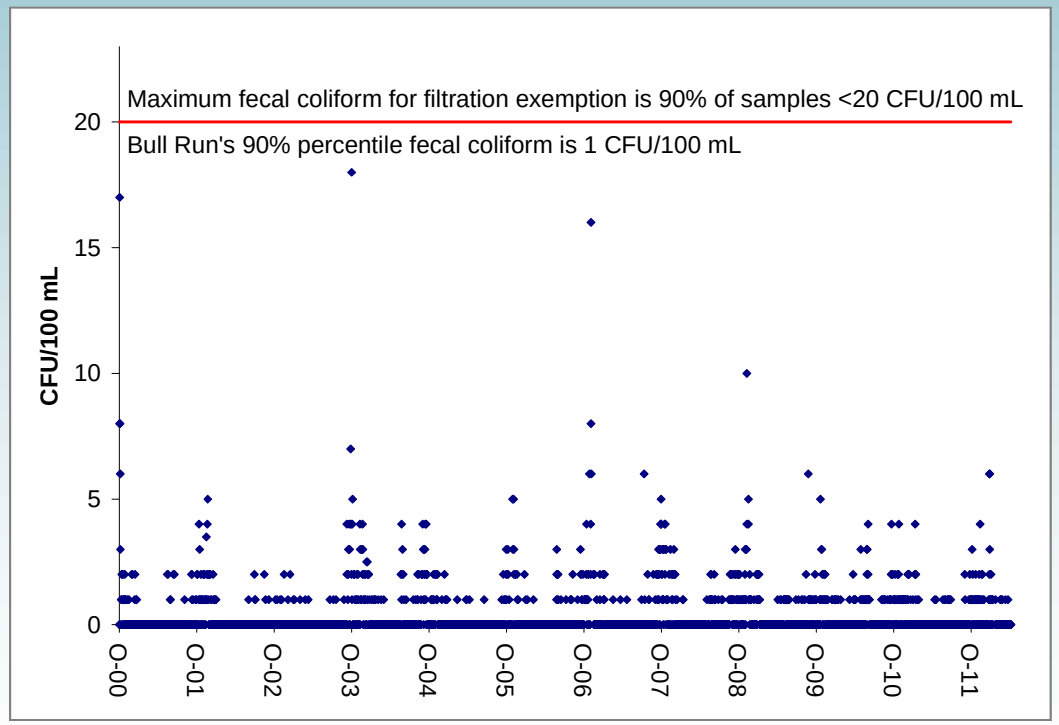
Bull Run Watershed



- Long history of source water protection
- BRWMU/Closure area
- No public entry
- No recreational use
- No development
- No timber harvest



Portland's Rationale for a Variance from LT2 Rule Requirements



- Very good source water quality
- No *Cryptosporidium* had been detected since 2002
- Extremely low risk for human infectious *Cryptosporidium*
- No evidence in the community of cryptosporidiosis related to drinking water

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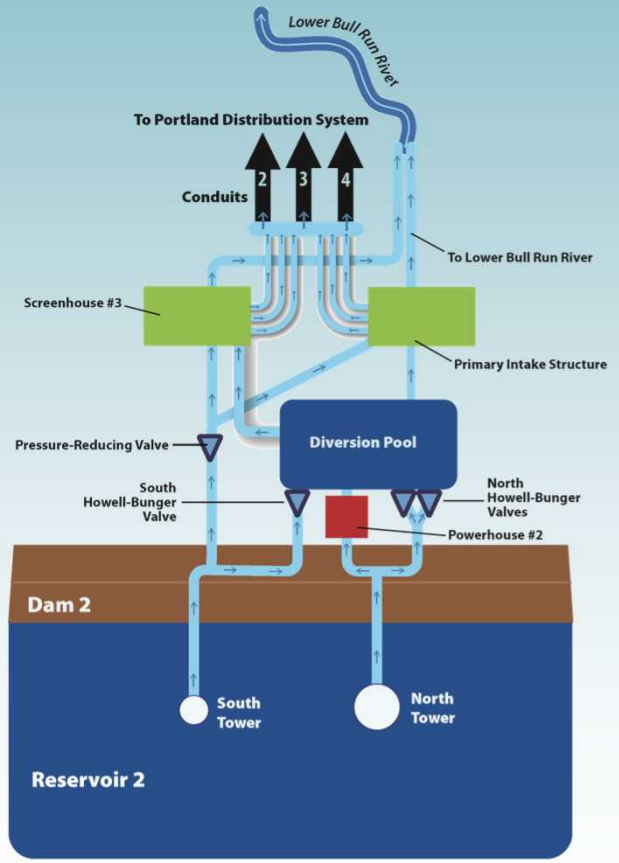
LT2 Variance Request Sampling Plan and Study

- SDWA variance provision requires water quality data and other information on the quality of the source water
- Portland had to demonstrate a *Cryptosporidium* concentration statistically equivalent to filtered systems under the LT2 Rule (<0.075 oocyst/1000 L)
- Sampling plan and study developed in consultation with EPA
- Must demonstrate that due to the nature of the Bull Run source water additional treatment is not needed

One Year Intensive Monitoring at the Raw Water Intake

- Dec. 14, 2009- Dec. 6, 2010
- 10,250 L with zero oocysts detected
- 50 L samples 4x/week
- EPA Method 1623 for *Cryptosporidium and Giardia*
- Method modification during seasonal low recovery
- QA matrix spike samples at minimum frequency of 1 per 20 field samples



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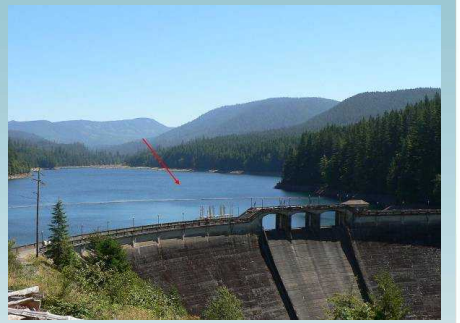
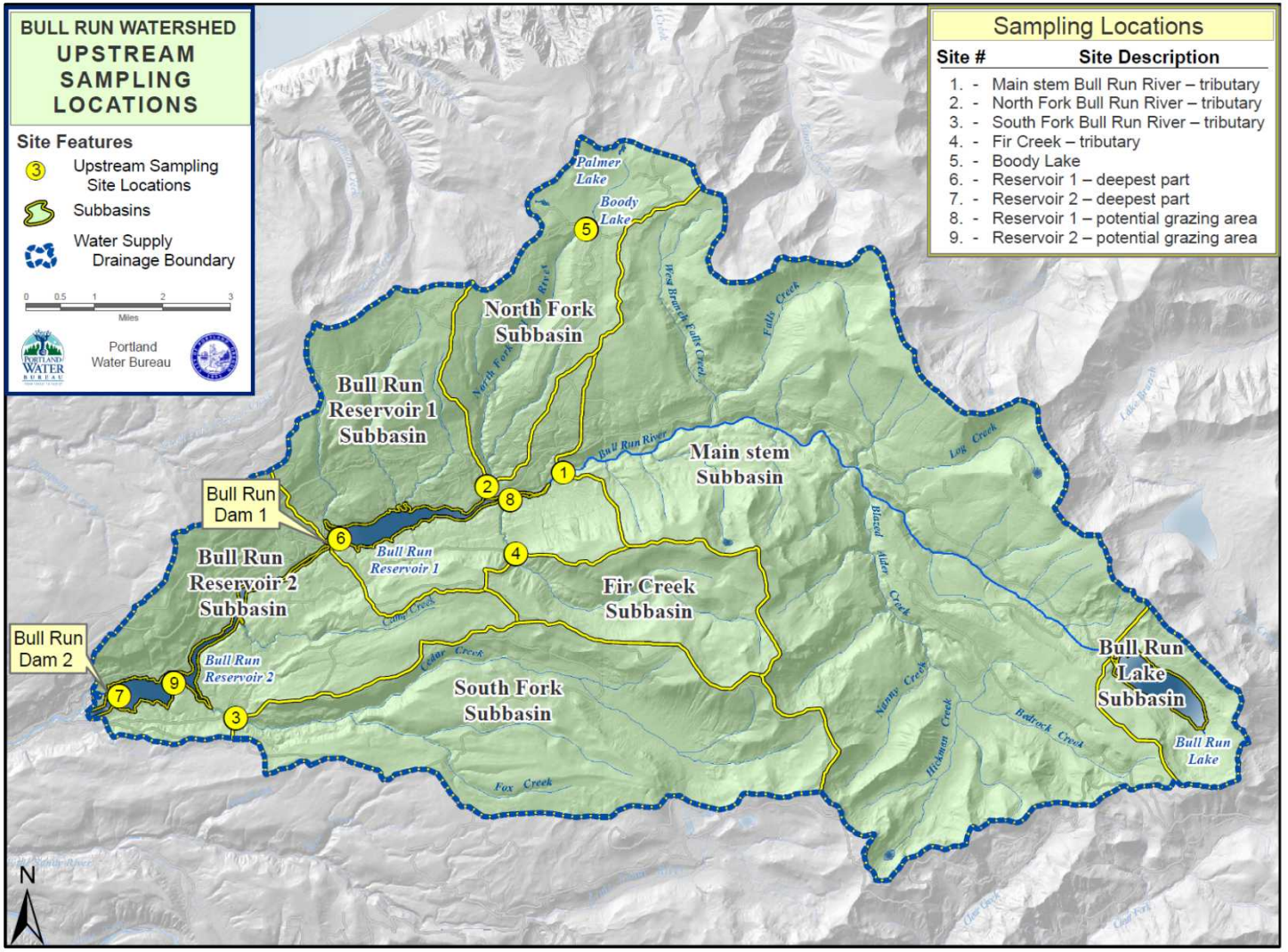
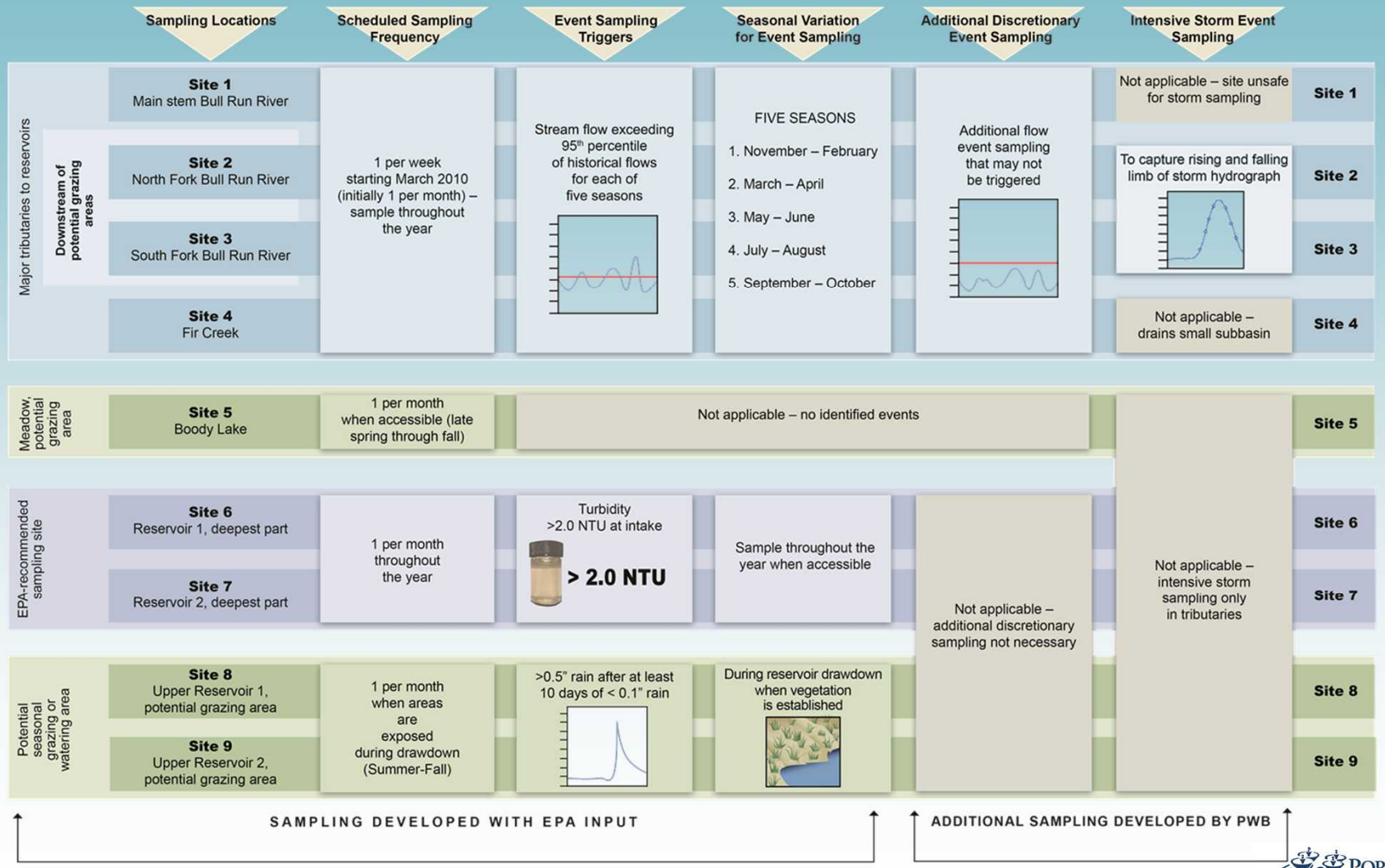
Scheduled and Event-Based Upstream Monitoring at Potential *Cryptosporidium* Hotspots





Sampling Frequency & Triggers



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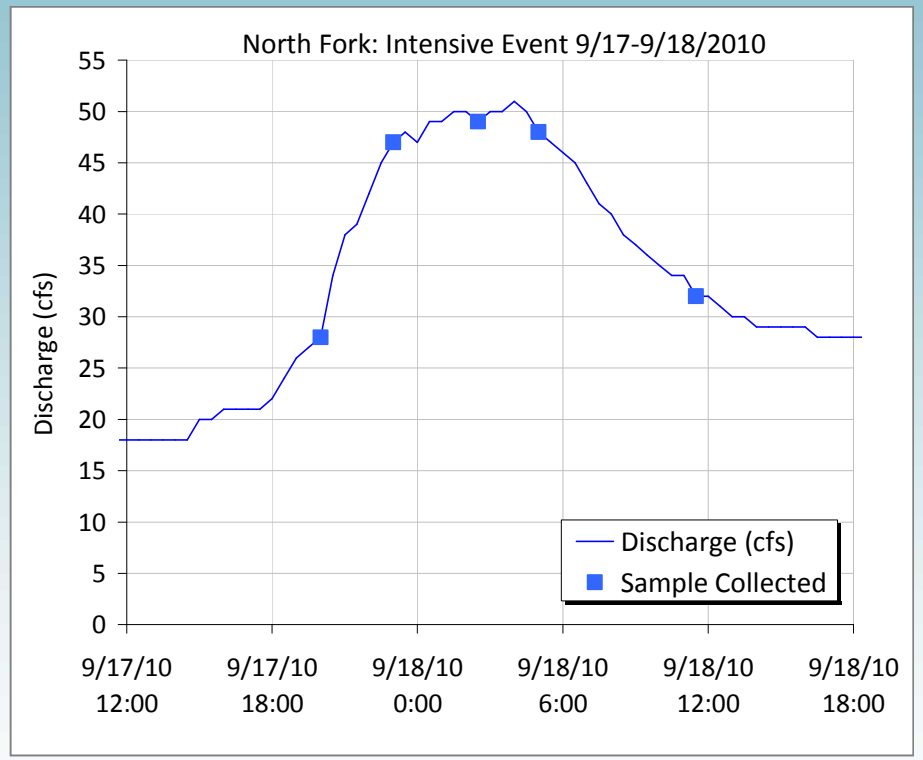
Intensive Storm-Event Sampling at Reservoir Tributary Site #1 & #3

- Bull Run dry period from approximately June through October
- First flush storms can mobilize pathogens accumulated over the dry period
- Multiple samples collected throughout the hydrograph



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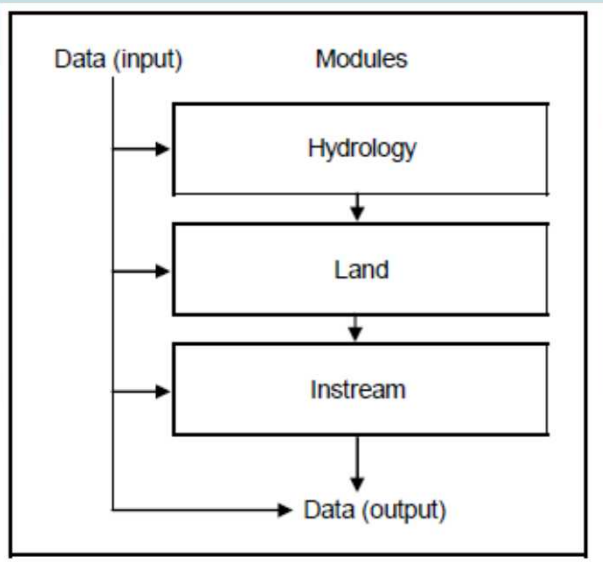
Wildlife Investigations

- Pathogen Catchment Budget Model
- Identified wildlife that are most abundant, produce largest fecal loads, and use aquatic & riparian habitats
- Scat monitoring for *Cryptosporidium* and Giardia
- Genotyping and DNA sequencing of positive samples



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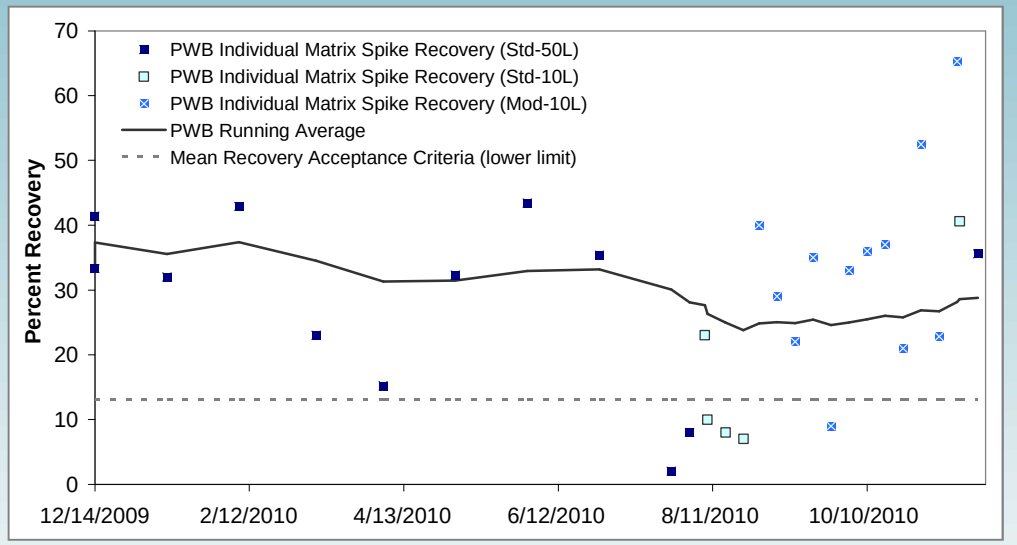
Intake *Cryptosporidium* Results

Number of field samples collected and analyzed	**449**
Volume of raw water collected and analyzed	**10,271 L**
Number of *Cryptosporidium* oocysts detected	**0**
Mean *Cryptosporidium* concentration	**0 oocysts/L**



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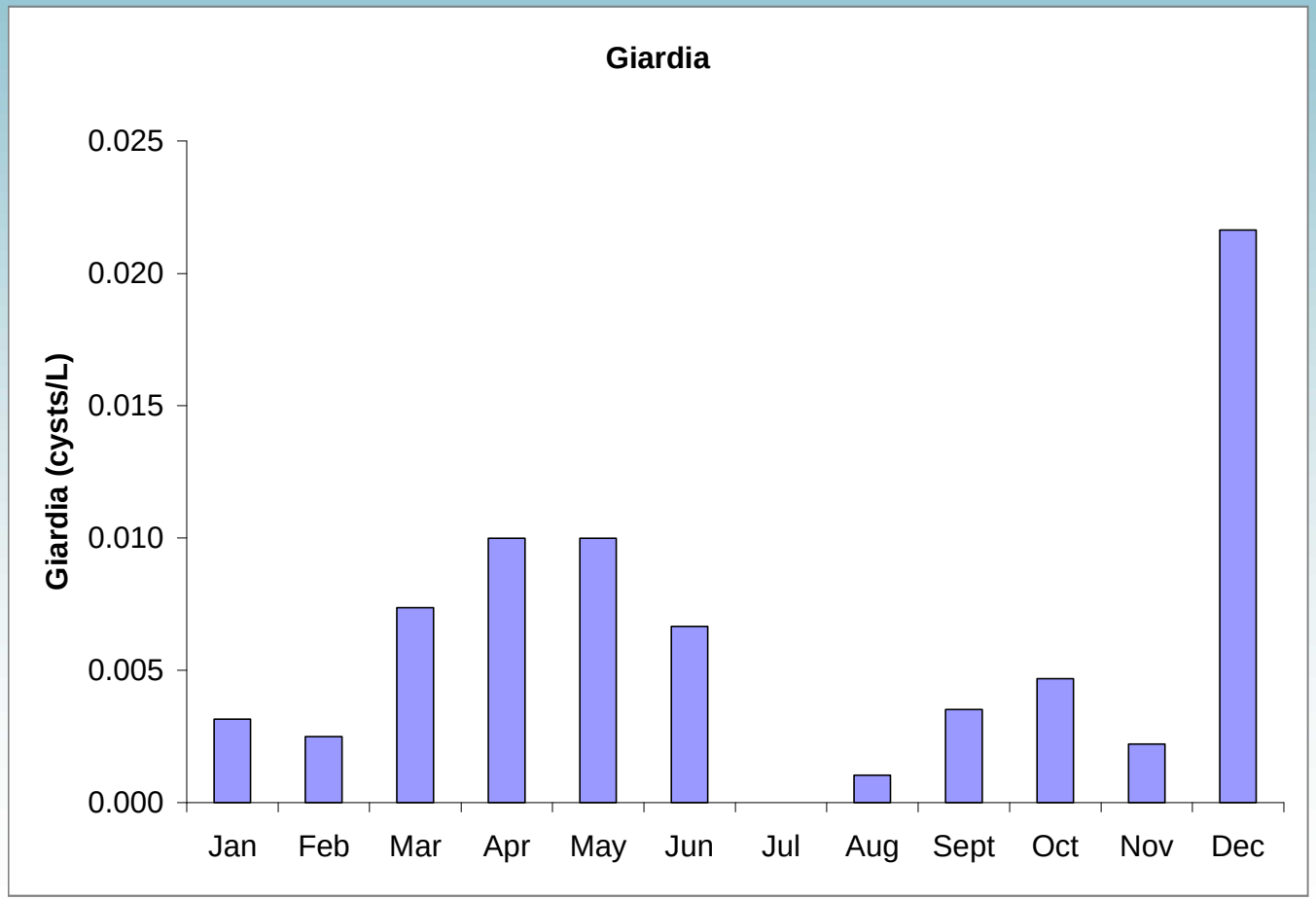
Intake *Giardia* Results



Month	Volume (L)	Cyst Count
Jan	951.2	3
Feb	800.8	2
Mar	950.9	7
Apr	801.1	8
May	900.9	9
Jun	900.9	6
Jul	800.1	0
Aug	956.6	1
Sept	852.2	3
Oct	853.1	4
Nov	903.6	2
Dec	600.9	13

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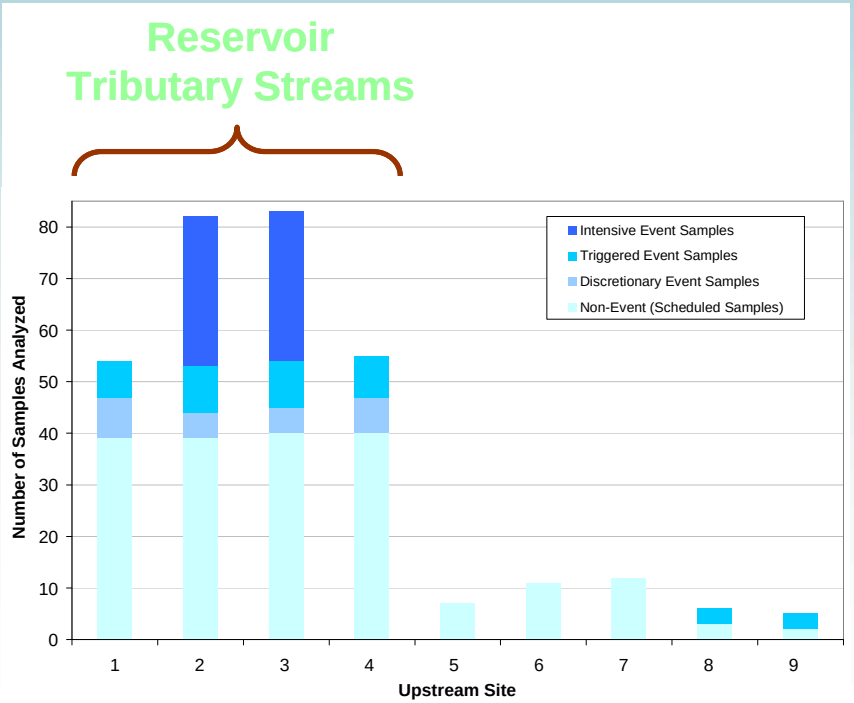
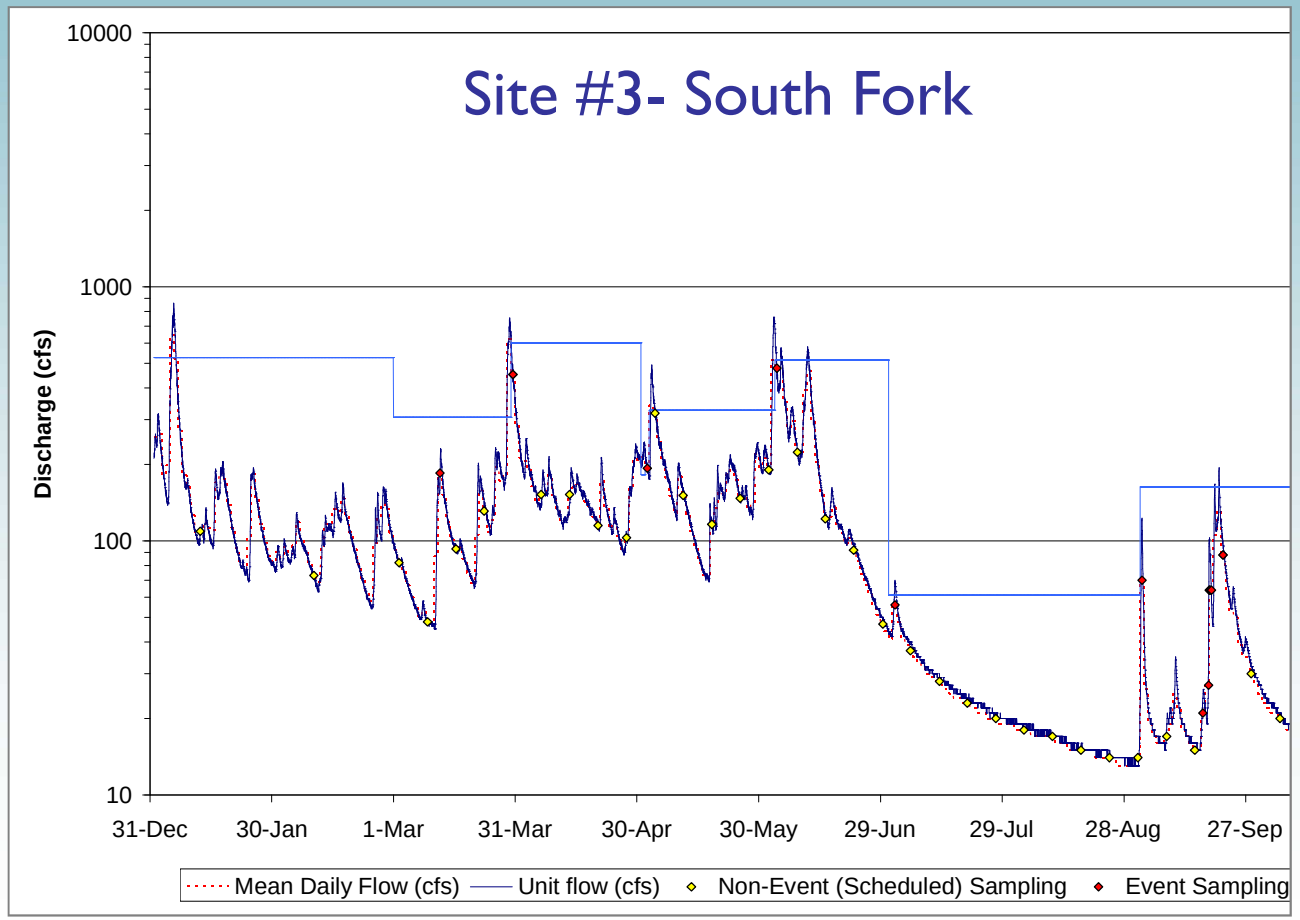
Upstream *Cryptosporidium* Results

- No detections in 315 samples (3384 L)
- 39% of samples collected during event-based conditions

Site and Description	# of Field Samples	Volume (L)	*Cryptosporidium* Concentration (#oocysts/L)
1. Main stem Bull Run River	54	585.4	0
2. North Fork Bull Run River	82	883.4	0
3. South Fork Bull Run River	83	881.5	0
4. Fir Creek	55	592.3	0
5. Boody Lake	7	73.9	0
6. Reservoir 1, deepest part	11	120.5	0
7. Reservoir 2, deepest part	12	129.4	0
8. Upper Bull Run Reservoir 1, potential grazing area	6	65	0
9. Upper Bull Run Reservoir 2, potential grazing area	5	52.9	0



A Variety of Flow Conditions Captured at Reservoir Tributary Streams



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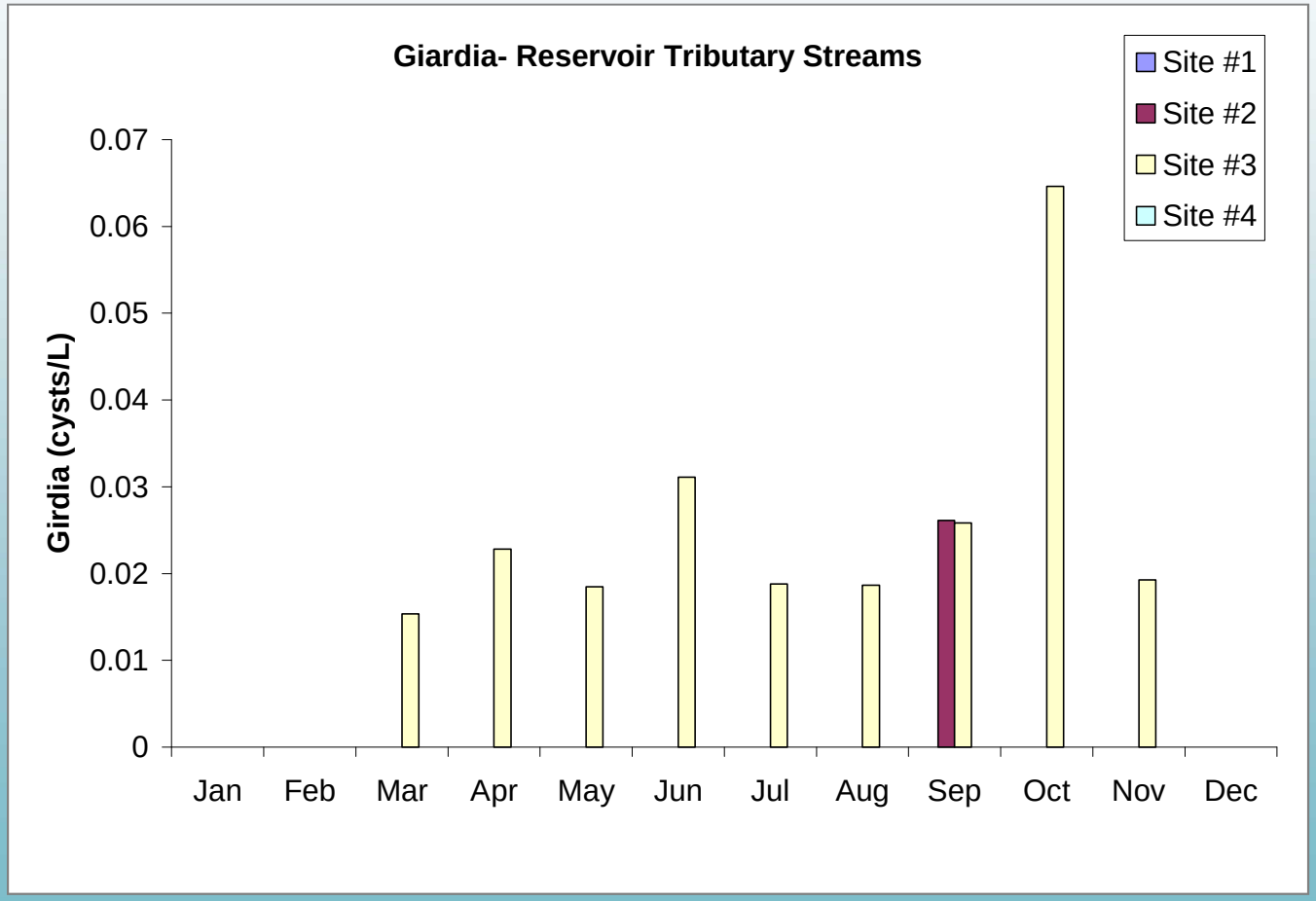
Giardia Results- Reservoir Tributary Streams



Volume (L)				
Month	Site #1	Site #2	Site #3	Site #4
Jan	11.2	11.2	10.8	10.8
Feb	9.4	10.9	10.5	10.8
Mar	66.4	66.0	65.1	65.3
Apr	43.8	42.8	43.8	43.2
May	43.4	43.8	54.1	43.9
Jun	65.8	66.0	64.3	65.7
Jul	54.7	54.1	53.1	53.6
Aug	54.4	54.5	53.6	54.0
Sep	119.1	76.5	116.1	74.8
Oct	267.6	64.2	263.1	63.9
Nov	52.8	42.3	51.9	53.5
Dec	94.6	52.8	95.1	52.7

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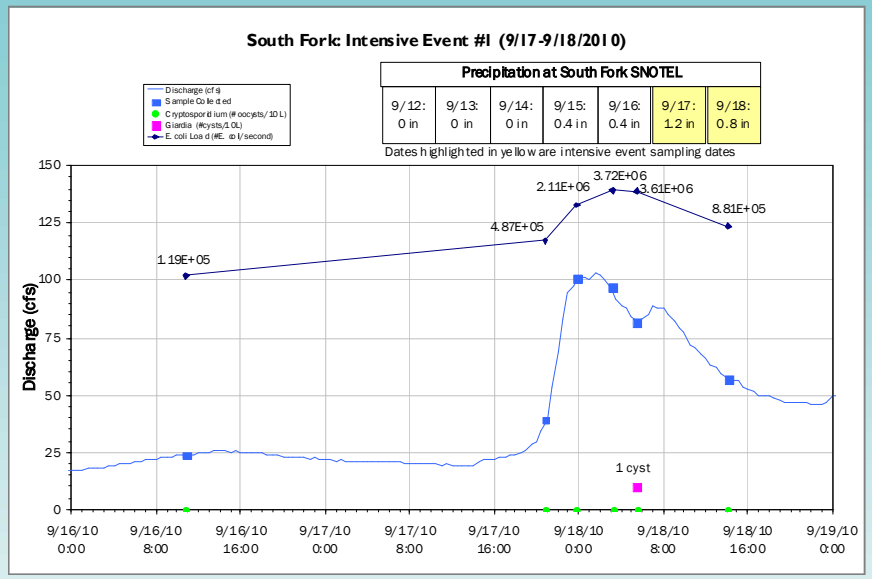
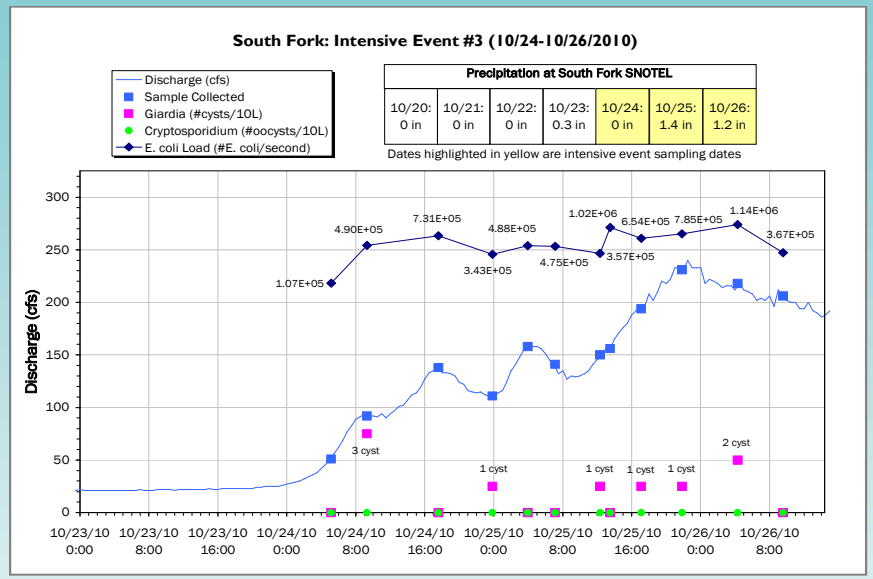
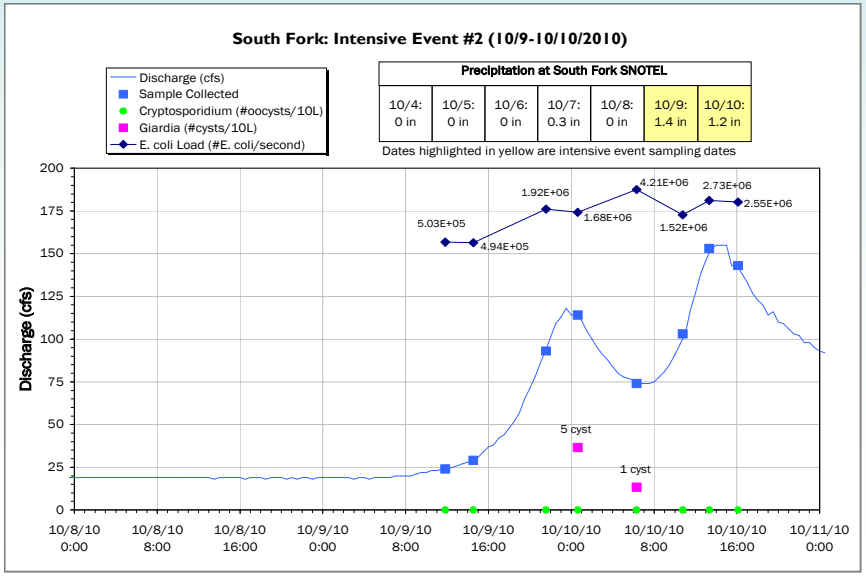
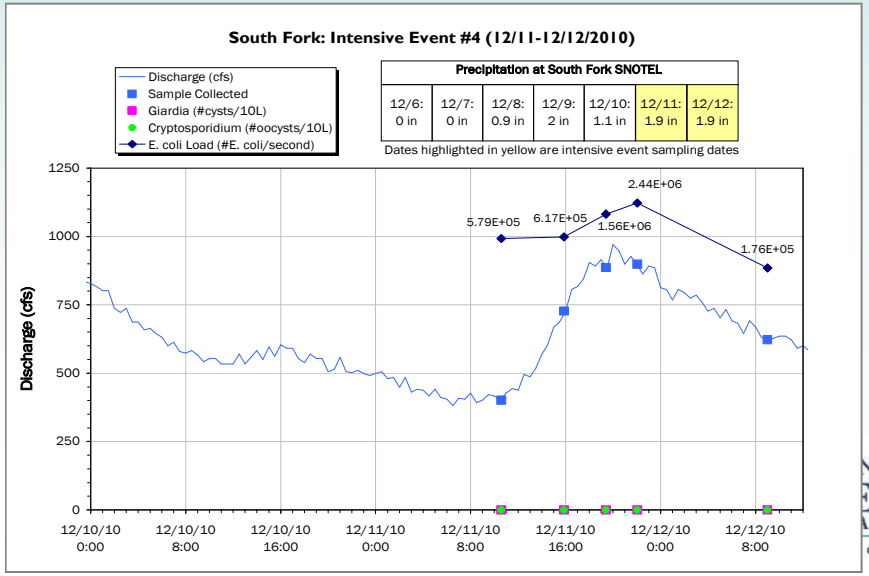
Intensive Storm-Event Sampling Results

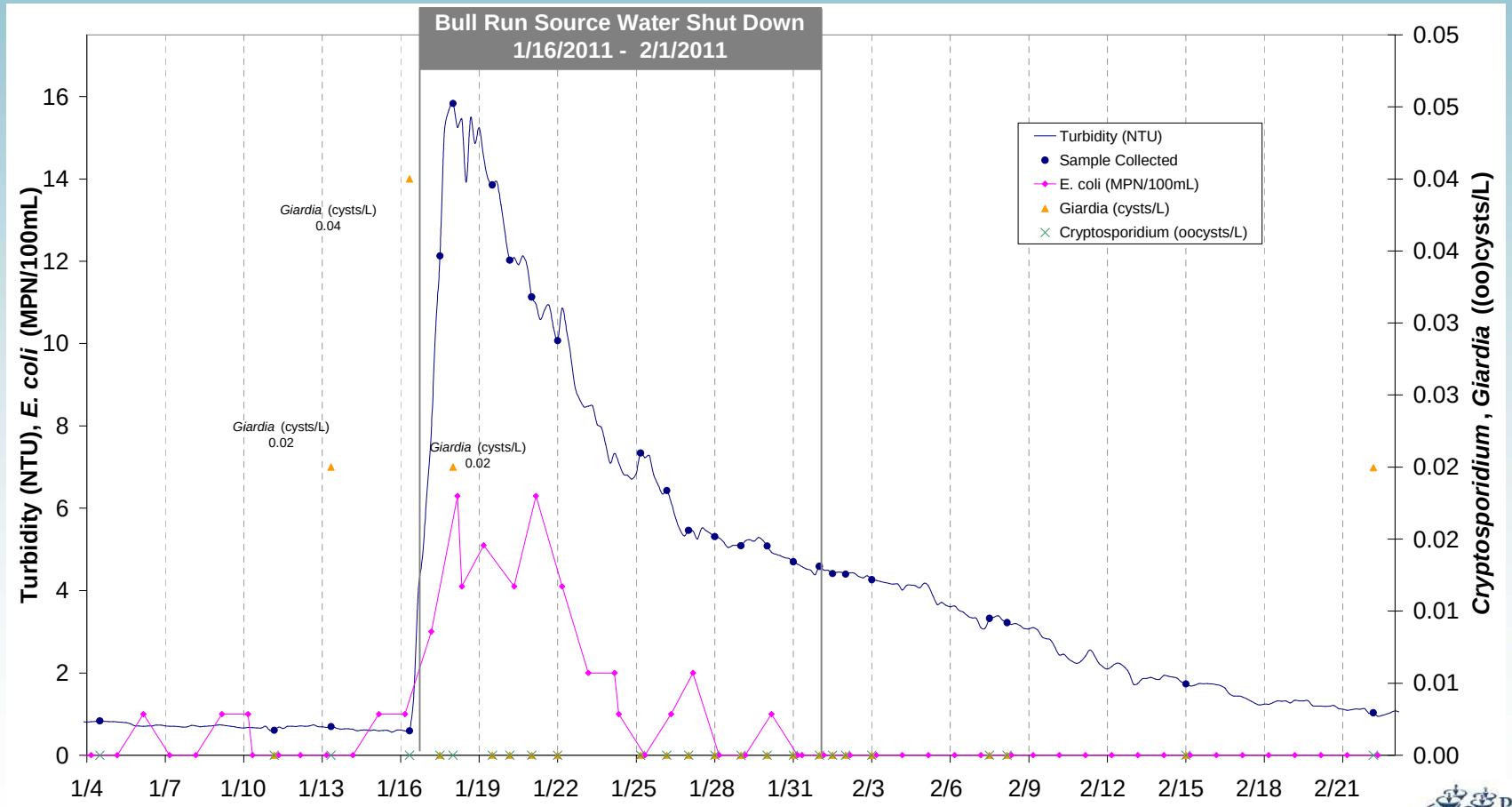








Interim Monitoring- Turbidity Event



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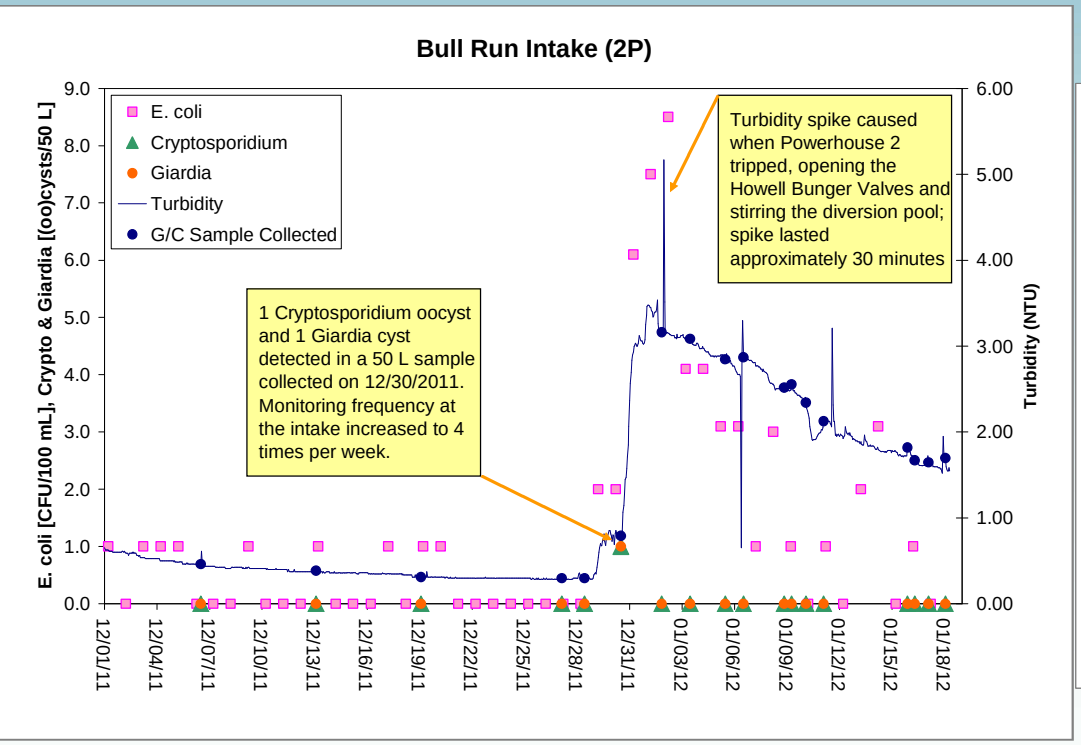
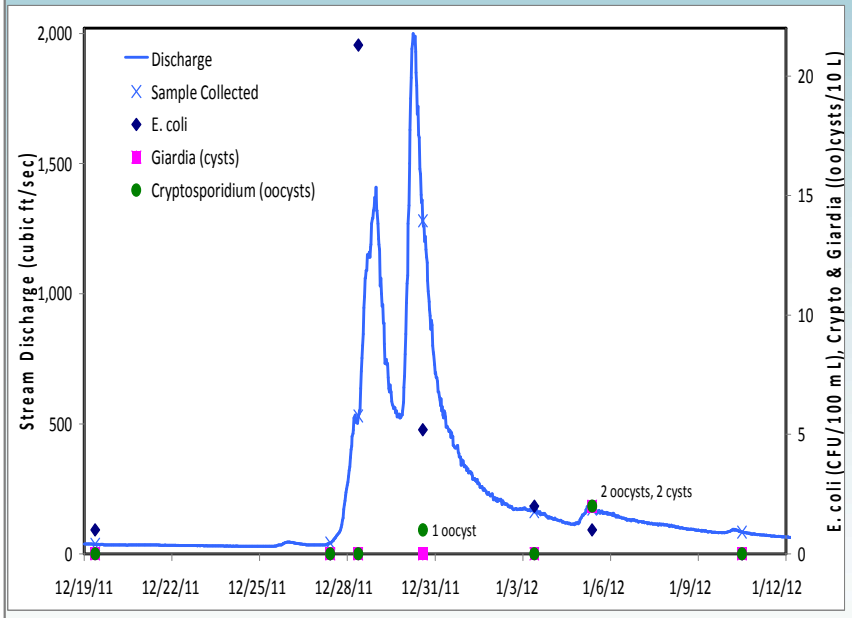
Interim Monitoring- *Cryptosporidium* Detections at Intake and Upstream Site #3





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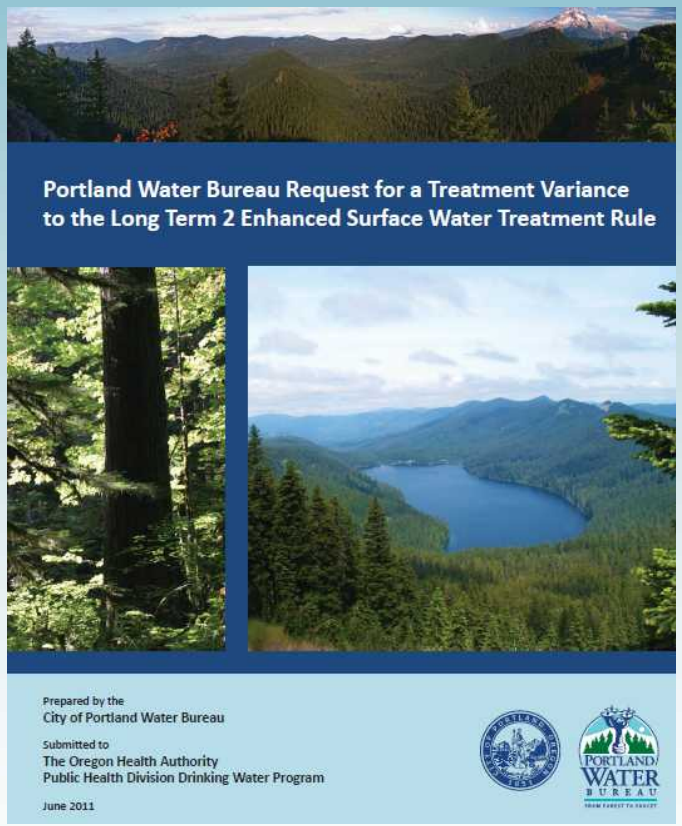
OHA Grants Portland's LT2 Variance Request

- LT2 Variance Request submitted to OHA June 6, 2011
- On November 29, 2011 OHA issued intent to grant the variance
- Public comment period
- Second public comment period in response to *Cryptosporidium* detections
- Final Order granting Portland a variance issued March 14, 2012
- Variance subject to specific conditions



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