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Passive No-Purge Samplers – Cheaper Solution?

Passive Sampler Experience

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- **WCG has deployed 49 Passive Samplers at 3 Sites**
  - Sites range from High Volume – High Flow to Low Volume – Low Flow, & Moderate to Deep Monitoring Well Sites
- **Two years of Snap Sampler Use**
- **Review Setup, Use, & Issues**
- **Completed a direct comparison study of results from Low-Flow sampling pumps compared to Snap Samplers**

What is a Snap sampler?

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- Equilibrated-grab sampler
- Grab sampler left in well for a period prior to sample collection
- Allows well to recover from disturbance caused by placing sampler in well
- Collects sample from discrete interval in well screen
- Collects samples in “real time”
- Cost is less than a low flow pump
- First landfill study using snap samplers
- Pilot study in MO and KS

Components of the Snap Sampler

- **Sampler body with trigger mechanism**
- **Snap Sampler bottles**
- **Openings on 2 ends with spring-activated caps**
  - Teflon caps
  - Teflon-coated spring
  - 40-mL VOA vials
  - 125 ml to 250-mL PP bottles
- **Trigger line**
- **Teflon-coated wireline cable inside PE tube**
- **Docking station**

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Snap Sampler Key Points

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- A non purge device
- Perfect for most wells - as low as 7 feet (2.1 m) to over 2000 feet (600 m)
- No limitations on analyte testing
- Enhanced sampling consistency
- Samples are collected inside the well
- No-pump, no-pour passive sampling
- Reduced time to collect each sample
- Repeatable use of equipment
- Green technology
- Easy to use

Field Setup

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Down Well Deployment

- **Lowering 5 trigger line with 5 bottles per line in 2-in wells**
- **Used 125-nL PP Snap sampler bottles**

Field test

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- **6 sampling locations**
  - Each well tested twice
  - Deployed at same depth as bladder pump
  - Deeper wells had bottle weights
  - Pneumatic pump was used on deeper wells
  - Decanting into lab containers
  - All samples were tested for Appendix I analyses

Snap Sampler System Experience

- **Time Comparison** – 15 min vs 30 min
- **Cost Comparison** - $1,200/unit vs $1,250/unit
- **Deep Well Issues with Schedule 80 PVC wells** - Working with QED on modifying bottle design (250ml) to accommodate deep 2-inch wells
- **Harsh pH conditions** - (QED modification to change from stainless steel connector to nylon)
- **Snap Bottle Replacement Frequency**
- **Lab Coordination for Low Volume Bottles**

Comparison Sample Results

Six Well Study

Test Well "A" Inorganic Data

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Parameter	Units	TW-A 11/8/2019	TW-A (SNAP) 11/26/2019	TW-A (SNAP) 5/19/2020	TW-A 5/27/2020
Missouri Indicator Parameters					
Chemical Oxygen Demand	mg/L	<10	<10	<10	<10
Chloride	mg/L	18.8	19.3	19.7	34.6
Total Dissolved Solids	mg/L	231	258	277	273
Missouri Appendix I Inorganics					
Ammonia	mg/L	<0.10	<0.1	<0.1	<0.10
Antimony	ug/L	<5.0	2.3		<5.0
Arsenic	ug/L	<5.0	4.2		<5.0
Barium	ug/L	173	454		144
Beryllium	ug/L	<4.0	<10		<4.0
Boron	ug/L	<50	<100		<50
Cadmium	ug/L	<1	2.7		<1
Calcium	ug/L	55,300	41,800		39,700
Chromium	ug/L	24.4	<20		<10
Cobalt	ug/L	<10	<20		<10
Copper	ug/L	<20	<10		<20
Fluoride	mg/L	0.11	<0.1	0.18	<0.1
Hardness	ug/L	227,000	166,000		160,000
Lead	ug/L	<5.0	<1		<5.0
Magnesium	ug/L	21,700	15,000		14,800
Manganese	ug/L	144	8190		158
Nickel	ug/L	<10	151		<10
Nitrate/Nitrite	mg/L	1.74	2.4	1.5	2.1
Phosphorus	mg/L	0.25	0.58	0.80	0.23
Selenium	ug/L	<5.0	1.1		<5.0
Silver	ug/L	<10	<10		<10
Sodium	ug/L	13,800	13,800		13,500
Sulfate as SO4	mg/L	35.7	34.1	33.5	26.7
Thallium	ug/L	<2.0	<1		<2.0
Total Organic Carbon	mg/L	<1.0	<10	1.0	<1.0
Vanadium	ug/L	<10	9.7		<10
Zinc	ug/L	<20	20.9		<20

Sample data within historical range of data.

Test Well "B" Inorganic Data

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Parameter	Units	TW-B (SNAP) 2/26/2020	TW-B 2/26/2020	TW-B (SNAP) 5/19/2020	TW-B 5/27/2020
Missouri Indicator Parameters					
Chemical Oxygen Demand	mg/L	26.2	11.6	25	<10
Chloride	mg/L	42.6	44.6	45.2	44
Total Dissolved Solids	mg/L	520	554	560	563
Missouri Appendix I Inorganics					
Ammonia	mg/L	<0.1	<0.1	<0.1	<0.10
Antimony	ug/L	<5	<5	<5	<5.0
Arsenic	ug/L	26.9	14	29.1	17.1
Barium	ug/L	260	241	228	215
Beryllium	ug/L	<4	<4	<4	<4.0
Boron	ug/L	<50	<50	<50	<50
Cadmium	ug/L	<1	<1	<1	<1.0
Calcium	ug/L	122,000	115,000	106,000	106,000
Chromium	ug/L	<10	<10	<10	<10
Cobalt	ug/L	18.4	17.5	17	17.3
Copper	ug/L	367	23	243	<20
Fluoride	mg/L	<0.1	<0.1	0.13	<0.1
Hardness	ug/L	631,000	580,000	545,000	539,000
Lead	ug/L	12.3	<5	9.9	<5.0
Magnesium	ug/L	79,200	71,000	67,800	66,600
Manganese	ug/L	600	556	526	522
Nickel	ug/L	75.8	68.1	66.3	71.1
Nitrate/Nitrite	mg/L	0.034	<0.02	<0.02	0.032
Phosphorus	mg/L	0.089	<0.05	0.051	<0.05
Selenium	ug/L	<5	<5	<5	<5.0
Silver	ug/L	<10	<10	<10	<10
Sodium	ug/L	23,000	22,800	21,300	21,600
Sulfate as SO4	mg/L	17.1	17	18	15.8
Thallium	ug/L	<2	<2	<2	<2.0
Total Organic Carbon	mg/L	1.1	1.8	1.5	1.4
Vanadium	ug/L	<10	<10	<10	<10
Zinc	ug/L	97.3	<20	72.2	31.6

Generally good correlation with low-flow pump data.

Sample collected after replacing dedicated sampling pump and purging in February.

Test Well "C" Inorganic Data

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Parameter	Units	TW-C (SNAP) 2/26/2020	TW-C 2/26/2020	TW-C (SNAP) 5/19/2020	TW-C 5/27/2020
Missouri Indicator Parameters					
Chemical Oxygen Demand	mg/L	41.1	21.8	39.6	<10
Chloride	mg/L	7.4	6.9	7.2	6.6
Total Dissolved Solids	mg/L	120	316	340	312
Missouri Appendix I Inorganics					
Ammonia	mg/L	<0.10	<0.10	<0.10	<0.10
Antimony	ug/L	<5	<5.0	<5	<5.0
Arsenic	ug/L	19	45.4	25.3	<5.0
Barium	ug/L	466	695	790	239
Beryllium	ug/L	<4.0	<4.0	<4	<4.0
Boron	ug/L	<50	63.9	80.9	<50
Cadmium	ug/L	<1	1.4	2.2	<1.0
Calcium	ug/L	178,000	474,000	545,000	98,900
Chromium	ug/L	48.3	93.3	121	<10
Cobalt	ug/L	13.7	25.9	34	<10
Copper	ug/L	33.3	63.7	88.8	<20
Fluoride	mg/L	0.13	0.12	0.15	<0.1
Hardness	ug/L	883,000	2,210,000	2,730,000	468,000
Lead	ug/L	36.2	74.6	103	6.2
Magnesium	ug/L	107,000	250,000	332,000	53,600
Manganese	ug/L	683	1510	1620	153
Nickel	ug/L	38.2	70.2	86.9	<10
Nitrate/Nitrite	mg/L	<0.02	<0.02	<0.02	0.033
Phosphorus	mg/L	2.7	1.5	3	0.18
Selenium	ug/L	<5	<25	<5	<5.0
Silver	ug/L	<10	<10		<10
Sodium	ug/L	7,880	7,980	7,320	6,480
Sulfate as SO4	mg/L	12.6	10.8	13.9	12.7
Thallium	ug/L	<2	<2.0	<2	<2.0
Total Organic Carbon	mg/L	<1	1.3	<1	<1.0
Vanadium	ug/L	69.2	134	143	14.2
Zinc	ug/L	128	239	320	24.4

Similar to TW-B, higher metals observed in sample collected after disturbing sediment.

Also, higher metals in May Snap sample possibly from replacing Snap sampler in well after collecting sample from pump in February.

Test Well “D” Inorganic Data

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Parameter	Units	TW-D 11/8/2019	TW-D (SNAP) 11/26/2019	TW-D (SNAP) 2/25/2020	TW-D 2/25/2020
Missouri Indicator Parameters					
Chemical Oxygen Demand	mg/L	<10	68.4	24.3	251
Chloride	mg/L	89.3	85.3	123	118
Total Dissolved Solids	mg/L	770	980	813	400
Missouri Appendix I Inorganics					
Ammonia	mg/L	0.57	0.77	0.6	0.94
Antimony	ug/L	<5.0	<1	<1	<1
Arsenic	ug/L	36.7	33.1	19.3	275
Barium	ug/L	893	1,020	1,200	2,840
Beryllium	ug/L	<4.0	<10	<10	9.7
Boron	ug/L	<50	<100	<100	152
Cadmium	ug/L	<1.0	0.73	<1	5.1
Calcium	ug/L	194,000	196,000	208,000	469,000
Chromium	ug/L	28.4	44	15.7	306
Cobalt	ug/L	18.5	22	<10	138
Copper	ug/L	29.5	38.2	<20	288
Fluoride	mg/L	0.2	0.21	0.11	<0.1
Hardness	ug/L	836,000	844,000	904,000	1,970,000
Lead	ug/L	21.7	24.3	8.4	175
Magnesium	ug/L	85,600	86,500	93,500	195,000
Manganese	ug/L	5650	5,810	6,390	12,800
Nickel	ug/L	54.8	67	38.7	391
Nitrate/Nitrite	mg/L	0.027	0.1	<0.02	<0.02
Phosphorus	mg/L	0.88	2.4	3.1	4.9
Selenium	ug/L	<10	<2	<2	<2
Silver	ug/L	<10	<10	<10	<10
Sodium	ug/L	36,400	36,900	39,800	37,600
Sulfate as SO4	mg/L	28.3	25.8	24.4	24.1
Thallium	ug/L	<2.0	<1	<1	3.1
Total Organic Carbon	mg/L	4.7	<10	3.6	5.2
Vanadium	ug/L	52.3	52.3	21	280
Zinc	ug/L	86.0	112	45	816

Similar to the other wells – good general chemistry match and higher metals after disturbing the well.

Test Well “D” Inorganic Data

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Parameter	Units	TW-D (SNAP) 5/19/2020	TW-D 5/27/2020
Missouri Indicator Parameters			
Chemical Oxygen Demand	mg/L	65.2	16.9
Chloride	mg/L	124	117
Total Dissolved Solids	mg/L	876	913
Missouri Appendix I Inorganics			
Ammonia	mg/L	0.7	0.49
Antimony	ug/L	<1	<5.0
Arsenic	ug/L	64	6.1
Barium	ug/L	1,450	736
Beryllium	ug/L	<10	<4.0
Boron	ug/L	74.7	<50
Cadmium	ug/L	1.3	<1.0
Calcium	ug/L	231,000	188,000
Chromium	ug/L	72.1	<10
Cobalt	ug/L	33.7	<10
Copper	ug/L	60.5	<20
Fluoride	mg/L	0.23	<0.1
Hardness	ug/L	1,010,000	801,000
Lead	ug/L	40.2	<5.0
Magnesium	ug/L	404,000	80,700
Manganese	ug/L	7,610	5950
Nickel	ug/L	98.5	24.4
Nitrate/Nitrite	mg/L	0.022	0.032
Phosphorus	mg/L	3.7	0.57
Selenium	ug/L	<2	<10
Silver	ug/L	<10	<10
Sodium	ug/L	35,500	36,100
Sulfate as SO4	mg/L	29.2	27.1
Thallium	ug/L	<1	<2.0
Total Organic Carbon	mg/L	3.9	3.8
Vanadium	ug/L	74.8	<10
Zinc	ug/L	191	<20

Higher metal concentrations in Snap sampler possibly from replacing in well after disturbing sediment.

Results are closer to sample collected with pump in February.

Test Well "B" Organic Data

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Parameter	Units	TW-B (SNAP) 2/26/2020	TW-B 2/26/2020	TW-B (SNAP) 5/19/2020	TW-B 5/27/2020
Missouri Appendix I Organic					
1,1-Dichloroethane	ug/L	**6.3**	**6.8**	**6.5**	**5.1**
1,4-Dichlorobenzene	ug/L	**6.2**	**10.5**	**9.9**	**8.1**
Benzene	ug/L	**1.9**	**3.2**	**3.5**	*<1.0*
Chlorobenzene	ug/L	**3.9**	**6.5**	**7.1**	**4.9**
cis-1,2-Dichloroethylene	ug/L	**12**	**13.8**	**14.2**	**6.8**
Trichloroethylene	ug/L	**1.6**	**2.7**	**3.1**	**1.9**
Vinyl chloride	ug/L	**6.2**	**8.3**	**7.1**	**3.2**

Test Well “D” Organic Data

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Parameter	Units	TW-D 11/8/2019	TW-D (SNAP) 11/26/2019	TW-D (SNAP) 2/25/2020	TW-D 2/25/2020
Missouri Appendix I Organic					
1,1,1,2-Tetrachloroethane	ug/L	*<1.0*	*<1.0*	*<1.0*	*<1.0*
1,1-Dichloroethane	ug/L	*<1.0*	*<1.0*	**1.4**	**1.3**
1,1-Dichloroethylene	ug/L	*<1.0*	*<1.0*	*<1.0*	*<1.0*
cis-1,2-Dichloroethylene	ug/L	**1.0**	*<1.0*	*<1.0*	**1.1**
Vinyl chloride	ug/L	*<2.0*	*<2.0*	*<2.0*	*<2.0*
Xylenes	ug/L	*<2.0*	*<2.0*	*<2.0*	*<2.0*

Parameter	Units	TW-D (SNAP) 5/19/2020	TW-D 5/27/2020
Missouri Appendix I Organic			
1,1,1,2-Tetrachloroethane	ug/L	*<1.0*	*<1.0*
1,1-Dichloroethane	ug/L	**1.1**	**1.5**
1,1-Dichloroethylene	ug/L	*<1.0*	*<1.0*
cis-1,2-Dichloroethylene	ug/L	*<1.0*	*<1.0*
Vinyl chloride	ug/L	*<2.0*	*<2.0*
Xylenes	ug/L	*<2.0*	*<2.0*

Test Well "E" Organic Data

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Parameter	Units	TW-E (SNAP) 2/26/2020	TW-E 2/26/2020	TW-E (SNAP) 5/19/2020	TW-E 5/27/2020
Missouri Appendix I Organic					
1,1-Dichloroethane	ug/L	**3.4**	**3.9**	**4.4**	**4.6**
1,4-Dichlorobenzene	ug/L	*<1.0*	**1.2**	**1.4**	*<1.0*
cis-1,2-Dichloroethylene	ug/L	**3.8**	**4.7**	**5.5**	**4.9**
Vinyl chloride	ug/L	*<2.0*	*<2.0*	*<2.0*	*<2.0*
Xylenes	ug/L	*<2.0*	*<2.0*	*<2.0*	*<2.0*

Chloride Graphs

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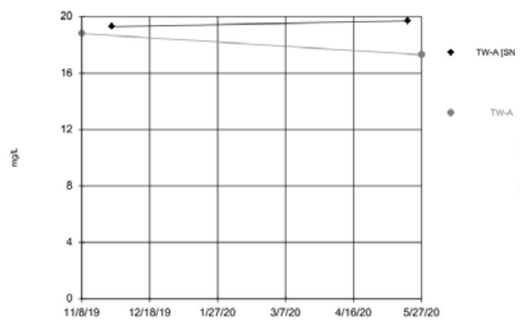

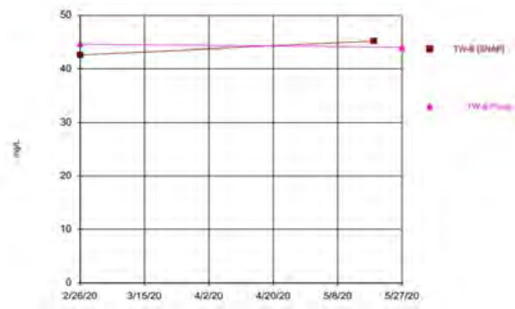

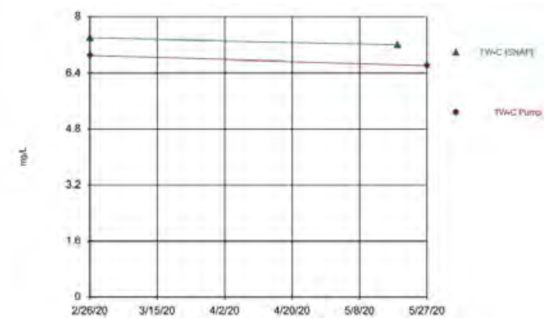

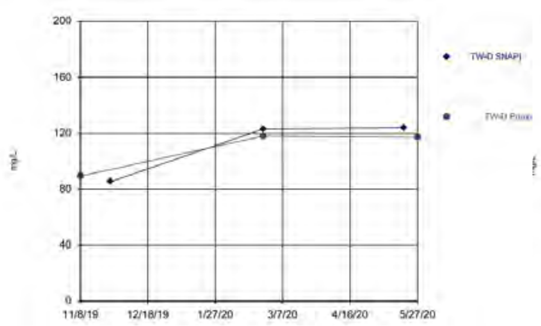

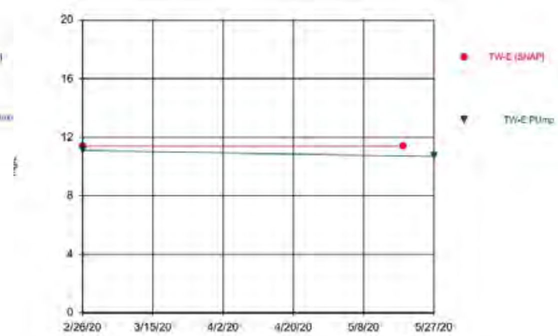

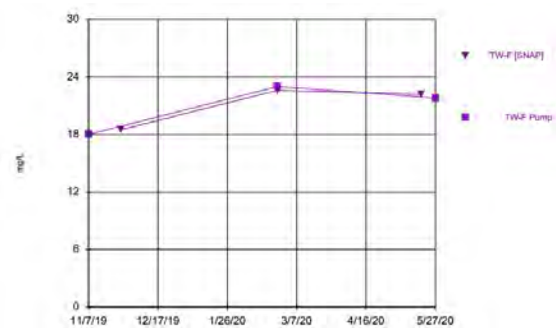

Sulfate Graphs

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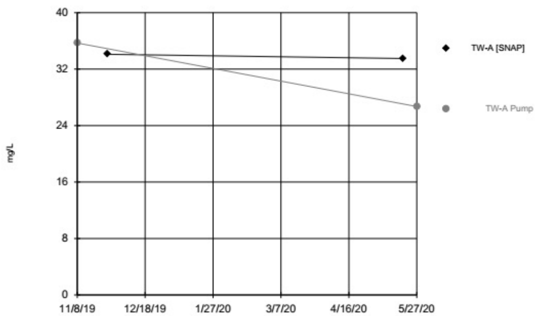

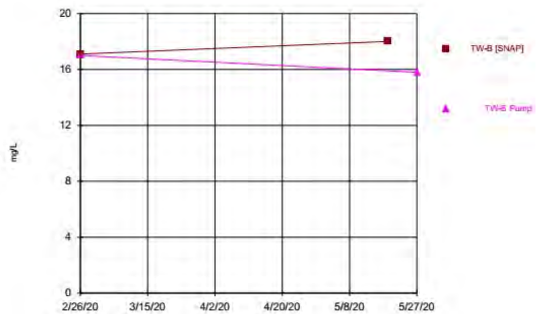

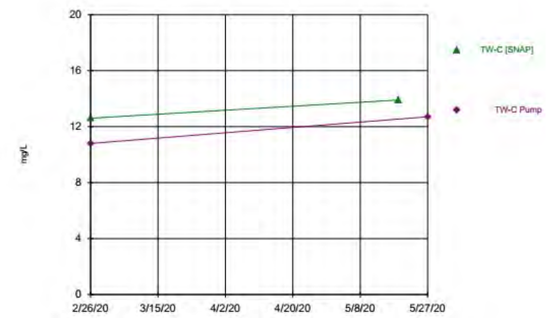

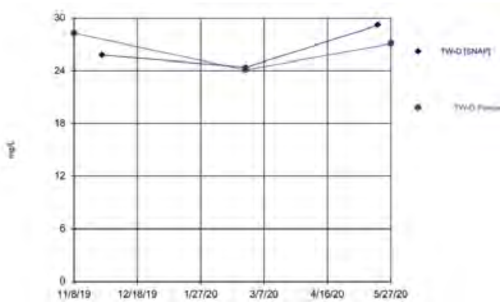

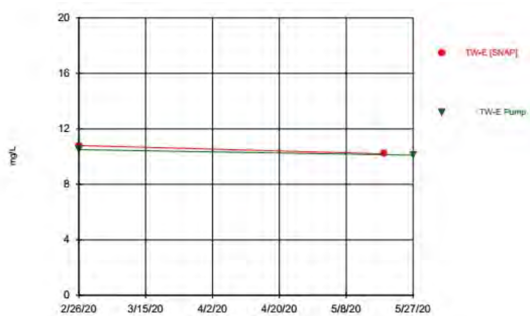

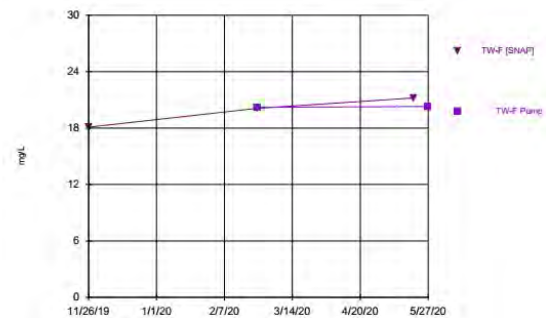

TDS Graphs

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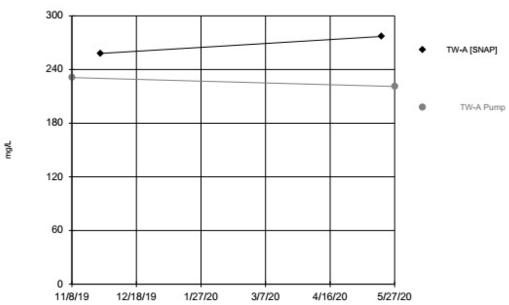
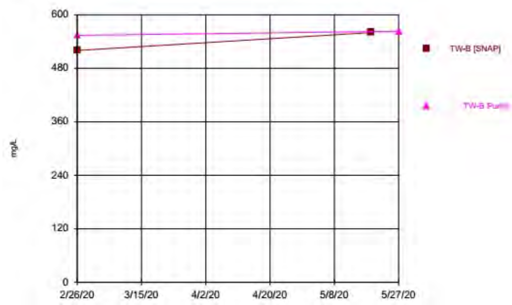
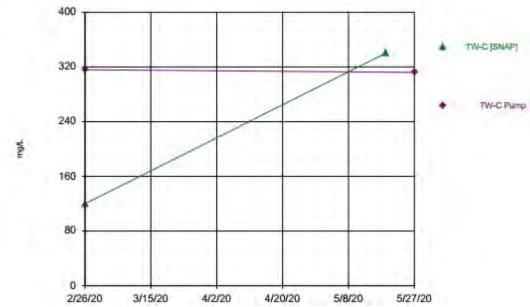
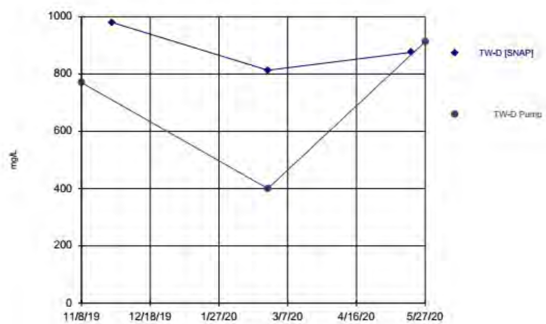
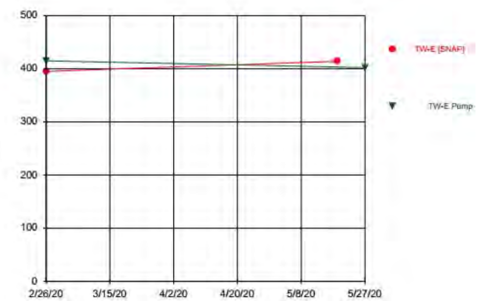
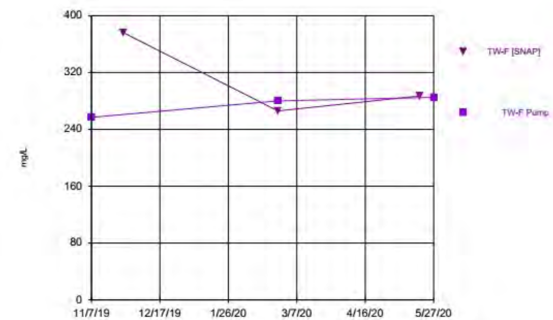




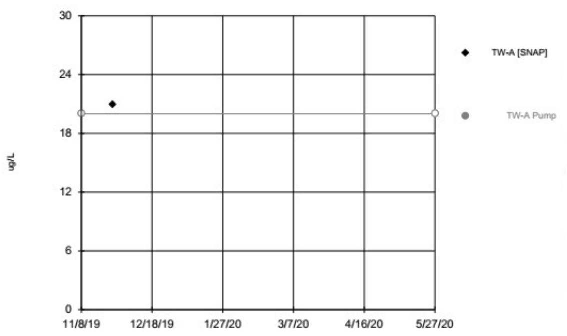








Zinc Graphs



30
24
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ug/L
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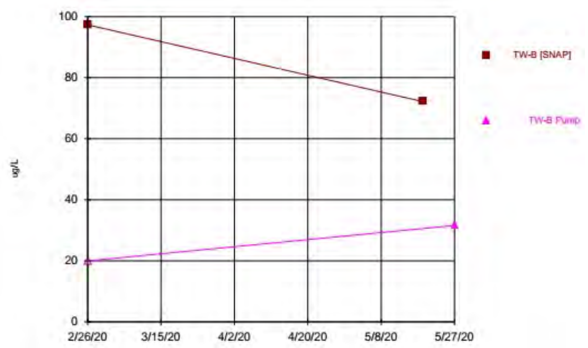
1/27/20
3/7/20
4/16/20
5/27/20
TW-A [SNAP]
TW-A Pump



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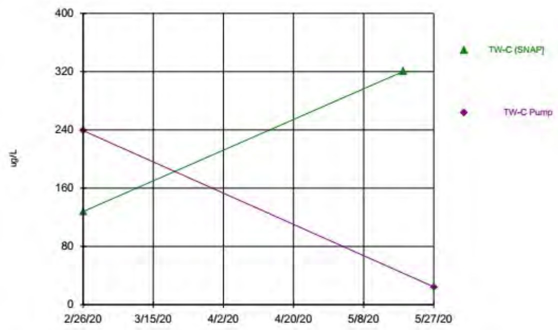
TW-B [SNAP]
TW-B Pump



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4/20/20
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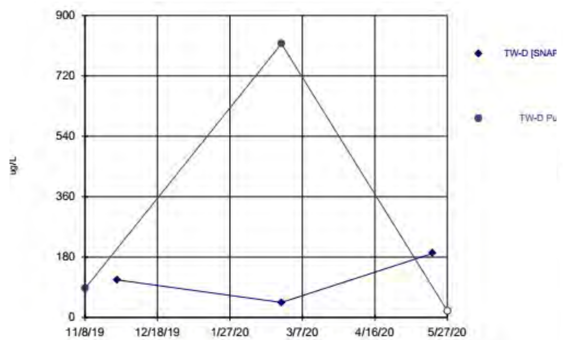
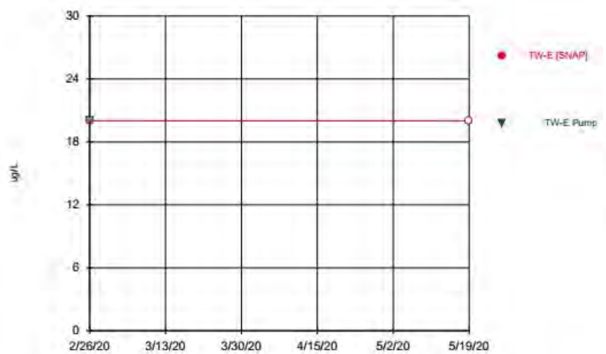
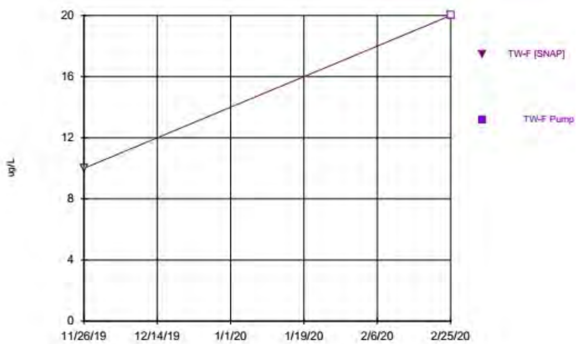
5/27/20
TW-C [SNAP]
TW-C Pump



900
720
540
360
180
0
ug/L
11/8/19
12/18/19
1/27/20
3/7/20
4/16/20
5/27/20
TW-D [SNAF
TW-D Pu



30
24
18
12
6
0
ug/L
2/26/20
3/13/20
3/30/20
4/15/20
5/2/20
5/19/20
TW-E [SNAP]
TW-E Pump



20
16
12
8
4
0
ug/L
11/26/19
12/14/19
1/1/20
1/19/20
2/6/20
2/25/20
TW-F [SNAP]
TW-F Pump

Sampler Method Matrix

Weaver Consultants Group

Snap	Snap	Bailer
Bailer	Bailer	Pump
Pump	Pump	Snap
Snap	Pump	Pump
Pump	Snap	Bailer
Bailer	Bailer	Snap
Snap	Pump	Pump
Pump	Snap	Snap
Bailer	Bailer	Bailer

Water Column: <5 feet → ≥100 feet (down the rows)

Screen Depth: Shallow (10-15 ft) → ≥100 feet (down the rows)

Groundwater Flow: Slow recharge (purge dry) → No change in water level during purge (across the columns)

Summary

- Passive Samplers can collect accurate data without purging
- Can be sensitive to disturbed sediment – similar to pumps & bailers
- Mechanical failures are possible in low pH monitored zones – similar to pump bladders
- May have to be modified to fit existing wells – inner diameter & straightness restrictions
- Request low-volume containers & analysis methods from labs
- Another sampling tool available
- Can save time & potential cost at the right sites

Questions

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