UCMR3 – What has been found in the Water? Update on Chlorate!

Detection patterns in drinking water systems in the Potomac River basin

February 24, 2015

UCMR3 – Chlorate Update

OUTLINE

- Regulatory background
- Quarterly monitoring, EP and MR points
- Analytical method and reporting
- Quarterly downloads, data reduction
- Provisional occurrence (2013-2014)
- Patterns of frequent detection (Chlorate, metals)
- Sources of chlorate

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UCMR3 – Regulatory Background

Safe Drinking Water Act

Contaminant Candidate List

- CCL 1 – 1998 (not chlorate)
- CCL 2 – 2005 (perchlorate, but not chlorate)
- CCL 3 – 2009

CCL 3 List

Chemical Contaminants

Substance Name	CASRN (Chemical Abstract Service Registration Number)	Use
Chlorate	14866-68-3	Chlorate compounds are used in agriculture as defoliants or desiccants and may occur in drinking water related to use of disinfectants such as chlorine dioxide.

Third Unregulated Contaminant Monitoring Rule

- Promulgated April 16, 2012
- PWS monitoring: all systems >10,000 (and 800 rep. PWS ≤ 10,000)
- List 1 – Assessment Monitoring (common analytical method)

UCMR 3 Contaminants and Corresponding Analytical Methods

Assessment Monitoring (List 1 Contaminants)

Contaminant	CAS Registry Number[1]	Minimum Reporting Level	Sampling Points[2]	Analytical Methods EXIT Disclaimer
One Oxyhalide Anion			EPTDS & DSMRT	EPA 300.1, ASTM D6581-08, Standard Methods 4110D (1997)
chlorate	14866-68-3	20µg/L		

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UCMR3 – Quarterly Monitoring

Sampling Schedule

- Four successive quarterly samples
- During a 12-month period between January 2013 through December 2015

Monitoring Locations

- Entry point (EP) to distribution system, normally at water treatment plant
  - Consecutive systems may use EP connections from supplier
- Maximum residence (MR) time within distribution system, normally at remote limits
- Raw water (not required), additional optional samples by WSSC

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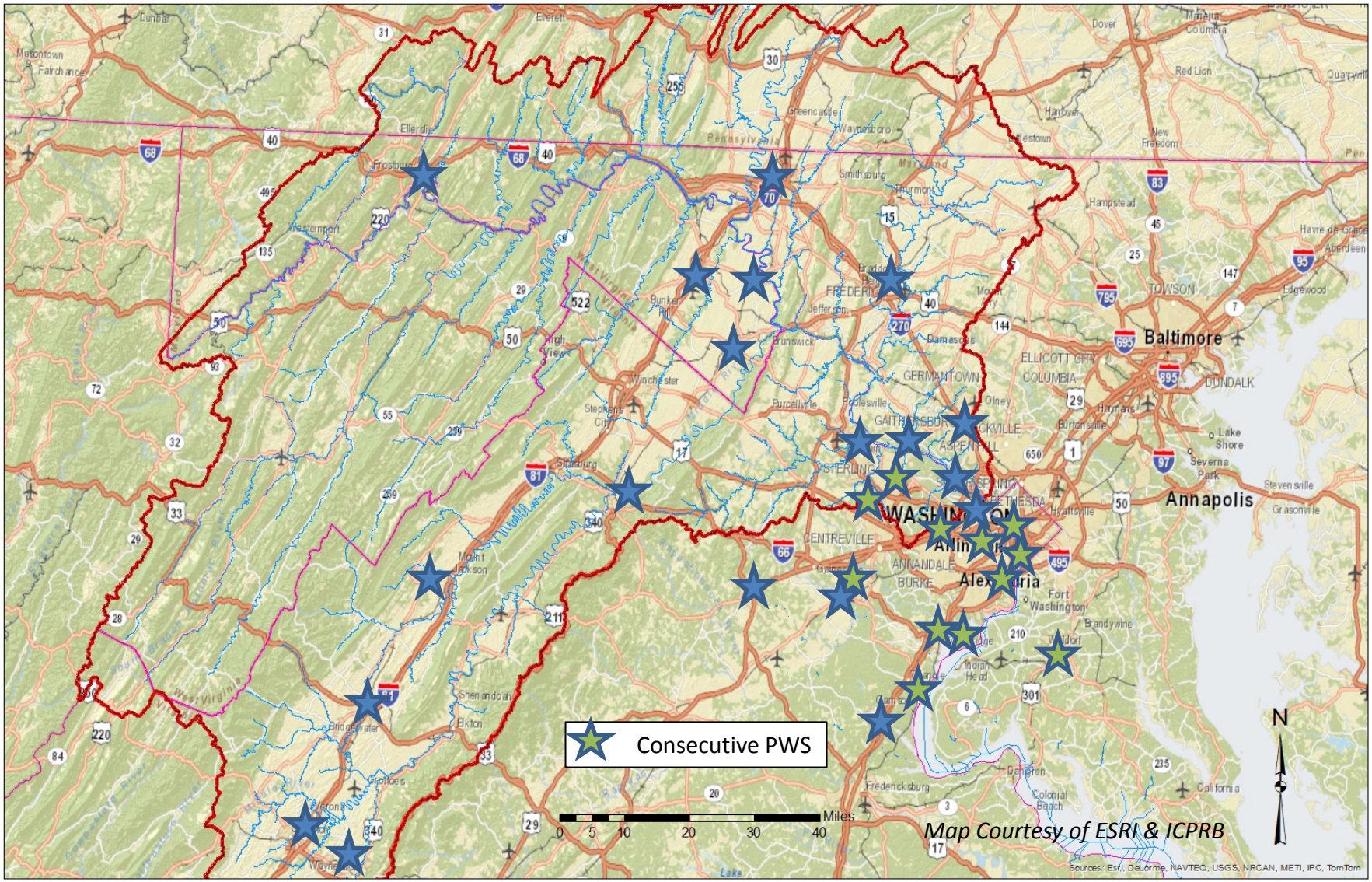
Figure Courtesy of Google Earth

UCMR3 – PWS Locations

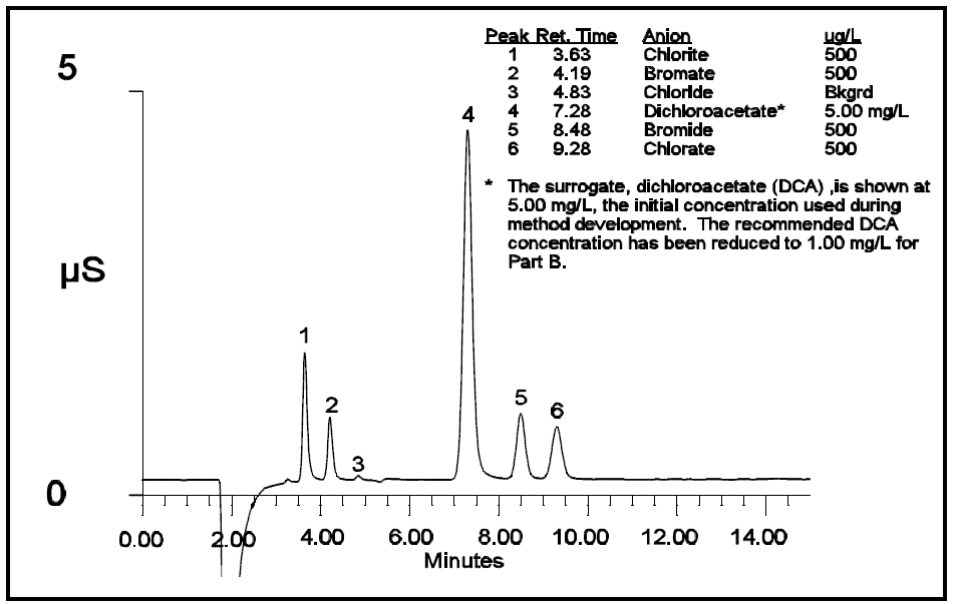
~33 of 51 PWS reporting (Oct. 2014)



UCMR3 – Analytical Method, Data Reporting

Analytical Method

- EPA Method 300.1 (Determination of Inorganic Anions in Water by Ion Chromatography), 1993
- Chlorate classified with Inorganic Disinfection Byproducts
  - Other DBPs: Bromate, Bromide, Chlorite
- Holding time 28 days, ethylenediamine preservative
- MRL = 20 µg/L



Reporting

- SDWARS (Safe Drinking Water Accession and Review System)
- PWS review (60 days)
- NCOD (National Contaminant Occurrence Database)

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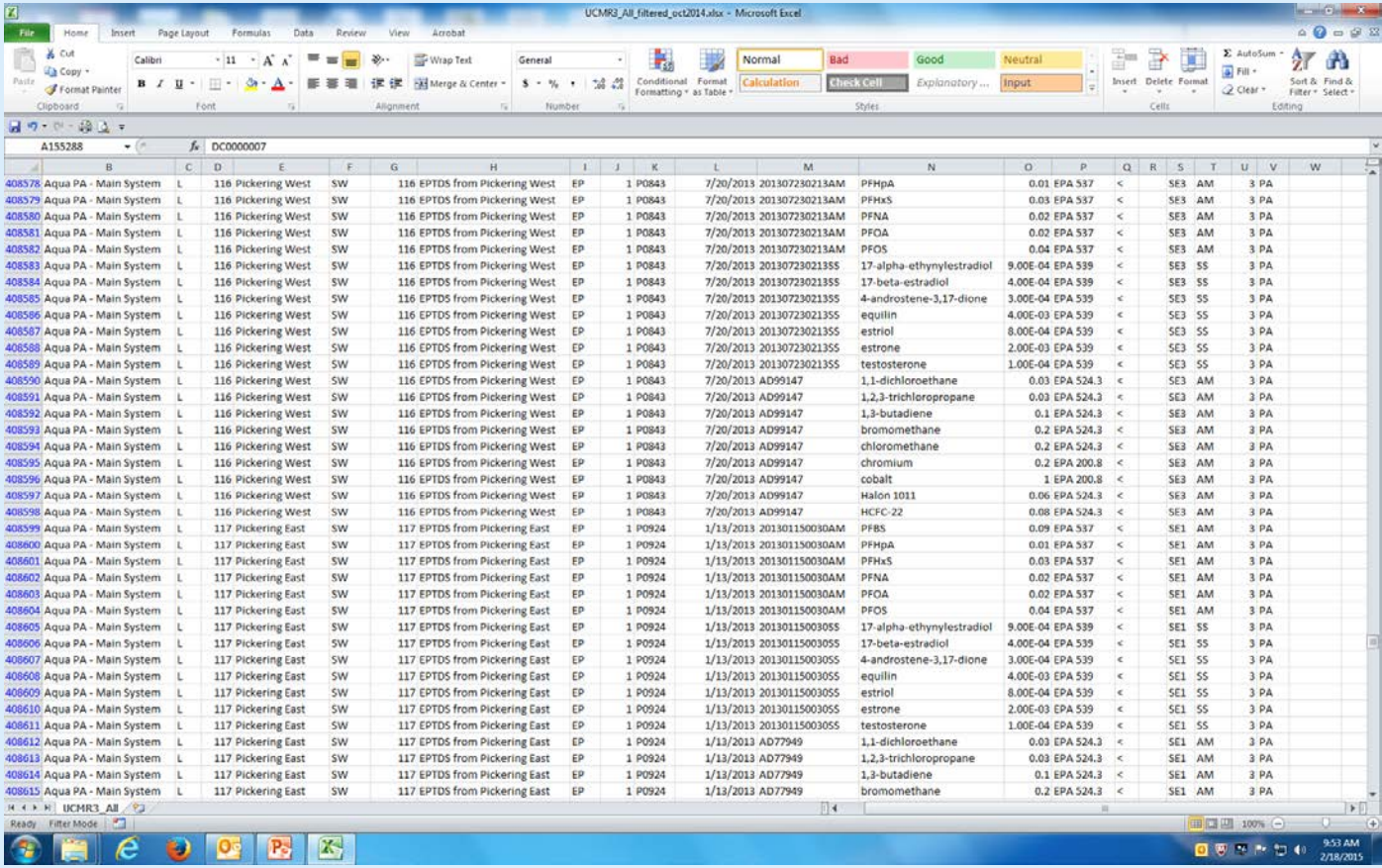
Figures Courtesy of USEPA

UCMR3 – Data Reduction

NCOD Download

- Updated quarterly postings (latest October 2014)
- Download as zip file, .txt format
- Import as Excel file (22 columns, >500,000 rows)

- Filter by Potomac regions states (DC, MD, PA, VA, WV)
- Filter by PWS name/facility ID (~50 in Potomac River basin)
- Surface water sources (excl. groundwater/wells)



	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W
408578	Aqua PA - Main System	L	116	Pickering West	SW	116	EPTDS from Pickering West	EP	1	P0843	7/20/2013	20130723021 3AM	PFHpA	0.01	EPA 537	<		SE3	AM	3	PA	
408579	Aqua PA - Main System	L	116	Pickering West	SW	116	EPTDS from Pickering West	EP	1	P0843	7/20/2013	20130723021 3AM	PFHxS	0.03	EPA 537	<		SE3	AM	3	PA	
408580	Aqua PA - Main System	L	116	Pickering West	SW	116	EPTDS from Pickering West	EP	1	P0843	7/20/2013	20130723021 3AM	PFNA	0.02	EPA 537	<		SE3	AM	3	PA	
408581	Aqua PA - Main System	L	116	Pickering West	SW	116	EPTDS from Pickering West	EP	1	P0843	7/20/2013	20130723021 3AM	PFOA	0.02	EPA 537	<		SE3	AM	3	PA	
408582	Aqua PA - Main System	L	116	Pickering West	SW	116	EPTDS from Pickering West	EP	1	P0843	7/20/2013	20130723021 3AM	PFOS	0.04	EPA 537	<		SE3	AM	3	PA	
408583	Aqua PA - Main System	L	116	Pickering West	SW	116	EPTDS from Pickering West	EP	1	P0843	7/20/2013	20130723021 3SS	17-alpha-ethynylestradiol	9.00E-04	EPA 539	<		SE3	SS	3	PA	
408584	Aqua PA - Main System	L	116	Pickering West	SW	116	EPTDS from Pickering West	EP	1	P0843	7/20/2013	20130723021 3SS	17-beta-estradiol	4.00E-04	EPA 539	<		SE3	SS	3	PA	
408585	Aqua PA - Main System	L	116	Pickering West	SW	116	EPTDS from Pickering West	EP	1	P0843	7/20/2013	20130723021 3SS	4-androstene-3,17-dione	3.00E-04	EPA 539	<		SE3	SS	3	PA	
408586	Aqua PA - Main System	L	116	Pickering West	SW	116	EPTDS from Pickering West	EP	1	P0843	7/20/2013	20130723021 3SS	equilin	4.00E-03	EPA 539	<		SE3	SS	3	PA	
408587	Aqua PA - Main System	L	116	Pickering West	SW	116	EPTDS from Pickering West	EP	1	P0843	7/20/2013	20130723021 3SS	estriol	8.00E-04	EPA 539	<		SE3	SS	3	PA	
408588	Aqua PA - Main System	L	116	Pickering West	SW	116	EPTDS from Pickering West	EP	1	P0843	7/20/2013	20130723021 3SS	estrone	2.00E-03	EPA 539	<		SE3	SS	3	PA	
408589	Aqua PA - Main System	L	116	Pickering West	SW	116	EPTDS from Pickering West	EP	1	P0843	7/20/2013	20130723021 3SS	testosterone	1.00E-04	EPA 539	<		SE3	SS	3	PA	
408590	Aqua PA - Main System	L	116	Pickering West	SW	116	EPTDS from Pickering West	EP	1	P0843	7/20/2013	AD99147	1,1-dichloroethane	0.03	EPA 524.3	<		SE3	AM	3	PA	
408591	Aqua PA - Main System	L	116	Pickering West	SW	116	EPTDS from Pickering West	EP	1	P0843	7/20/2013	AD99147	1,2,3-trichloropropane	0.03	EPA 524.3	<		SE3	AM	3	PA	
408592	Aqua PA - Main System	L	116	Pickering West	SW	116	EPTDS from Pickering West	EP	1	P0843	7/20/2013	AD99147	1,3-butadiene	0.1	EPA 524.3	<		SE3	AM	3	PA	
408593	Aqua PA - Main System	L	116	Pickering West	SW	116	EPTDS from Pickering West	EP	1	P0843	7/20/2013	AD99147	bromomethane	0.2	EPA 524.3	<		SE3	AM	3	PA	
408594	Aqua PA - Main System	L	116	Pickering West	SW	116	EPTDS from Pickering West	EP	1	P0843	7/20/2013	AD99147	chloromethane	0.2	EPA 524.3	<		SE3	AM	3	PA	
408595	Aqua PA - Main System	L	116	Pickering West	SW	116	EPTDS from Pickering West	EP	1	P0843	7/20/2013	AD99147	chromium	0.2	EPA 200.8	<		SE3	AM	3	PA	
408596	Aqua PA - Main System	L	116	Pickering West	SW	116	EPTDS from Pickering West	EP	1	P0843	7/20/2013	AD99147	cobalt	1	EPA 200.8	<		SE3	AM	3	PA	
408597	Aqua PA - Main System	L	116	Pickering West	SW	116	EPTDS from Pickering West	EP	1	P0843	7/20/2013	AD99147	Halon 1011	0.06	EPA 524.3	<		SE3	AM	3	PA	
408598	Aqua PA - Main System	L	116	Pickering West	SW	116	EPTDS from Pickering West	EP	1	P0843	7/20/2013	AD99147	HCFC-22	0.08	EPA 524.3	<		SE3	AM	3	PA	
408599	Aqua PA - Main System	L	117	Pickering East	SW	117	EPTDS from Pickering East	EP	1	P0924	1/13/2013	20130115003 0AM	PFBS	0.09	EPA 537	<		SE1	AM	3	PA	
408600	Aqua PA - Main System	L	117	Pickering East	SW	117	EPTDS from Pickering East	EP	1	P0924	1/13/2013	20130115003 0AM	PFHpA	0.01	EPA 537	<		SE1	AM	3	PA	
408601	Aqua PA - Main System	L	117	Pickering East	SW	117	EPTDS from Pickering East	EP	1	P0924	1/13/2013	20130115003 0AM	PFHxS	0.03	EPA 537	<		SE1	AM	3	PA	
408602	Aqua PA - Main System	L	117	Pickering East	SW	117	EPTDS from Pickering East	EP	1	P0924	1/13/2013	20130115003 0AM	PFNA	0.02	EPA 537	<		SE1	AM	3	PA	
408603	Aqua PA - Main System	L	117	Pickering East	SW	117	EPTDS from Pickering East	EP	1	P0924	1/13/2013	20130115003 0AM	PFOA	0.02	EPA 537	<		SE1	AM	3	PA	
408604	Aqua PA - Main System	L	117	Pickering East	SW	117	EPTDS from Pickering East	EP	1	P0924	1/13/2013	20130115003 0AM	PFOS	0.04	EPA 537	<		SE1	AM	3	PA	
408605	Aqua PA - Main System	L	117	Pickering East	SW	117	EPTDS from Pickering East	EP	1	P0924	1/13/2013	20130115003 0SS	17-alpha-ethynylestradiol	9.00E-04	EPA 539	<		SE1	SS	3	PA	
408606	Aqua PA - Main System	L	117	Pickering East	SW	117	EPTDS from Pickering East	EP	1	P0924	1/13/2013	20130115003 0SS	17-beta-estradiol	4.00E-04	EPA 539	<		SE1	SS	3	PA	
408607	Aqua PA - Main System	L	117	Pickering East	SW	117	EPTDS from Pickering East	EP	1	P0924	1/13/2013	20130115003 0SS	4-androstene-3,17-dione	3.00E-04	EPA 539	<		SE1	SS	3	PA	
408608	Aqua PA - Main System	L	117	Pickering East	SW	117	EPTDS from Pickering East	EP	1	P0924	1/13/2013	20130115003 0SS	equilin	4.00E-03	EPA 539	<		SE1	SS	3	PA	
408609	Aqua PA - Main System	L	117	Pickering East	SW	117	EPTDS from Pickering East	EP	1	P0924	1/13/2013	20130115003 0SS	estriol	8.00E-04	EPA 539	<		SE1	SS	3	PA	
408610	Aqua PA - Main System	L	117	Pickering East	SW	117	EPTDS from Pickering East	EP	1	P0924	1/13/2013	20130115003 0SS	estrone	2.00E-03	EPA 539	<		SE1	SS	3	PA	
408611	Aqua PA - Main System	L	117	Pickering East	SW	117	EPTDS from Pickering East	EP	1	P0924	1/13/2013	20130115003 0SS	testosterone	1.00E-04	EPA 539	<		SE1	SS	3	PA	
408612	Aqua PA - Main System	L	117	Pickering East	SW	117	EPTDS from Pickering East	EP	1	P0924	1/13/2013	AD77949	1,1-dichloroethane	0.03	EPA 524.3	<		SE1	AM	3	PA	
408613	Aqua PA - Main System	L	117	Pickering East	SW	117	EPTDS from Pickering East	EP	1	P0924	1/13/2013	AD77949	1,2,3-trichloropropane	0.03	EPA 524.3	<		SE1	AM	3	PA	
408614	Aqua PA - Main System	L	117	Pickering East	SW	117	EPTDS from Pickering East	EP	1	P0924	1/13/2013	AD77949	1,3-butadiene	0.1	EPA 524.3	<		SE1	AM	3	PA	
408615	Aqua PA - Main System	L	117	Pickering East	SW	117	EPTDS from Pickering East	EP	1	P0924	1/13/2013	AD77949	bromomethane	0.2	EPA 524.3	<		SE1	AM	3	PA	

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UCMR3 – Provisional Results (EP)

Potomac Occurrence (2013-2014)

- Detected frequently (total number of EP tests = 138)
  - Chlorate
  - Chromium, Hexavalent Chromium, Strontium, Vanadium

Celestite ($SrSO_4$)
Strontianite ($SrCO_3$)
Chromite ($FeCr_2O_4$)
Patrónite (VS_4)

Contaminant	Chromium	Hex. Chromium	Strontium	Vanadium
n =	52	126	138	60
*MRL * (µg/L)*	0.20	0.030	0.30	0.20
Range (µg/L)	0.20 – 11.3	0.031 – 2.40	15.0 - 518	0.20 – 1.5
Mean (µg/L)	0.66	0.165	127	0.49
Median (µg/L)	0.31	0.092	125	0.41
*HRL * (µg/L)*	100	10 **	4,000	21

- MRL = Minimum reporting level
- HRL = Published health reference or guidance levels (USEPA sources)
- Cr-6 Max. Contaminant Level (CA)

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UCMR3 – Provisional Results (EP)

Potomac Occurrence (2013-2014)

- Detected infrequently
  - 1 synthetic compound, 2 PFs, 1 VOC
  - Molybdenum
- Not detected
  - Hormones
  - Cobalt

Contaminant	1,4-dioxane	PFHxS *	PFOS *	Halon 1101 *	Molybdenum
n =	3	2	2	2	7
Range (µg/L)	0.076 – 0.150	0.066 – 0.069	0.074 – 0.086	0.080 – 2.01	1.1 – 10 Mean = 3.1

- PFHxS = perfluorohexanesulfonic acid
- PFOS = perfluorooctanesulfonic acid
- Halon 1101 = bromochloromethane

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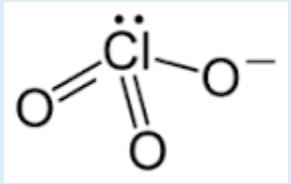
UCMR3 – Provisional Results (EP, MR)



Potomac Occurrence (2013-2014)

- **Chlorate**
  - Detected frequently *

Source	EP	MR
n =	110	106
*MRL * (µg/L)*	20	20
Range (µg/L)	20.5 – 897	24.0 – 934
Mean (µg/L)	207	220
Median (µg/L)	175	172
*HRL * (µg/L)*	210	210

- MRL = Minimum reporting level
- HRL = Published health reference level (USEPA)
- Total number of EP tests = 138, MR tests = 129

Image Courtesy of Wikipedia

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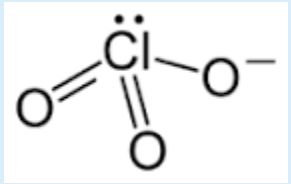
UCMR3 – Chlorate (Raw vs. EP vs. Disinfectant)



Potomac Occurrence (2013-2014)

- **Chlorate**
  - Raw ≈ EP with chlorine gas

Source	Raw (WSSC)	EP (CLGA)	EP (other)
n =	1	21	85
*MRL * (µg/L)*	20	20	20
Range (µg/L)	<20 – 40	20.5 – 350	57.7 – 897
Mean (µg/L)	40	92	233
Median (µg/L)	40	44	190
*HRL * (µg/L)*	n/a	210	210

- MRL = Minimum reporting level
- HRL = Published health reference level (USEPA)
- CLGA = Gaseous chlorine disinfectant

Image Courtesy of Wikipedia

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UCMR3 – Chlorate Sources

from CCL3:

- "Chlorate compounds are used in **agriculture** as defoliants or desiccants . . ."
- ". . . and may occur in drinking water related to use of disinfectants . . ."

Agricultural Uses:

- Desiccant/Defoliant = Sodium Chlorate ($NaClO_3$) CAS RN# 7775-09-9
- Trade names "Helena" or "Defol" or "Poly-Foliant"
- Used on cotton, safflower, corn, flax, peppers, soybeans, grain sorghum, southern peas, dry beans, rice and sunflowers crops
- Non-selective contact herbicide, phytotoxic to all green plant parts
- Acute oral LD50 = 1,200 – 7,000 mg/kg
- Environmental persistence: 3 – 4 months in soil, more rapid decomposition in moist soils, >70 degrees F

Sources Courtesy of EXTOXNET, University of Arizona, New Mexico State University

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UCMR3 – Chlorate Sources

from CCL3:

- "Chlorate compounds are used in agriculture as defoliants or desiccants . . ."
- ". . . and may occur in **drinking water** related to use of disinfectants . . ."

Drinking Water:

- Disinfectants: esp. chlorine dioxide, hypochlorite
- More from Alex Gorzalski (WAD)

Questions / Contact:

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