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Water Quality Update on Unregulated Compounds

August 2018

Background

1980s – TCE contamination at Tucson Airport

1990s – EPA Superfund site; Tucson Water part of remediation plan for TCE; list of responsible parties; trust fund established.

2000s – EPA notifies TCE sites of a possible other contaminant, 1,4-Dioxane; it is discovered present in Tucson site.

2004-2009 – Tucson Water uses water 'blending' to keep values to community from this site at <3.5 ppb

2009 – Health advisory changes to 0.35 ppb for 1,4-Dioxane; Tucson Water can no longer blend. Through regional sampling, discover new compounds referred to as PFAs are present in the Tucson basin.

2010 - Decision to build treatment plant for 1,4-Dioxane.

2014 – Treatment plant goes on line; full destruction of TCE and 1,4-Dioxane

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Background, cont.

2016 – Health Advisory for certain PFAs (PFOA and PFOS) reduce from 400 ppt and 200 ppt, respectively to 70 ppt combined.

Late 2016 – Tucson Water notifies Marana Water and Metro Water that they are finding 1,4-Dioxane and PFAs above the current HAs on the northwest side of Tucson (Marana). Marana confirms 1,4-dioxane in wells and notifies the customer base. Tucson Water and Metro Water turn their affected groundwater sources off.

2017 – Marana confirms the presence of PFAs in some of the water systems and notifies the customer base; Marana sends letter to ADEQ on behalf of Tucson Water and Metro Water asking for an investigation.

2017 – Marana Water initiates a water quality assessment study to identify potential solutions to the issues; ADEQ launches study to collect data from public and private groundwater sources.

December 2017 – Marana finalizes the Water Quality Assessment report.

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Regulatory Standard vs. Health Advisory

- Regulatory Standard
  - Fixed value defined by Safe Drinking Water Act or Clean Water Act
  - Generally known as ‘maximum contaminant level’, or MCL.
  - Created after years of toxicological research studies, national occurrence studies, and economic impact analysis.

- Health Advisory
  - Not an enforceable standard; early in a potential regulatory process
  - Generally set after limited toxicological research studies
  - Further studies on national occurrence
  - Guidance values generally set at a conservative value protective of the most sensitive populations (children, immuno-compromised, etc.)
  - For potential carcinogens, risk factors of 1 in a million lifetime exposure norm

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What are Perfluorinated Compounds?

- Fluorinated organic compounds
  - **PFOA** - Perfluorooctanoic Acid
  - **PFOS** – Perfluorooctane Sulfonate

Any successful stain repellant, water repellant, grease repellant in the last 50 years was most likely a perfluorinated compound.

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Perfluorinated Compounds in the Environment

- Used in manufacture on many products:
  - Carpets
  - Furniture
  - Paper packaging
  - Leather
  - Coating additive
  - Car waxes/coatings
  - Fire resistant material (Foams)

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Perfluorinated Compounds in the Environment

- Depending on the product, exposure to humans is predominantly through diet and dust from products
- Outside use of the product can directly expose soil, surface water, and eventually groundwater.
- Bioaccumulates

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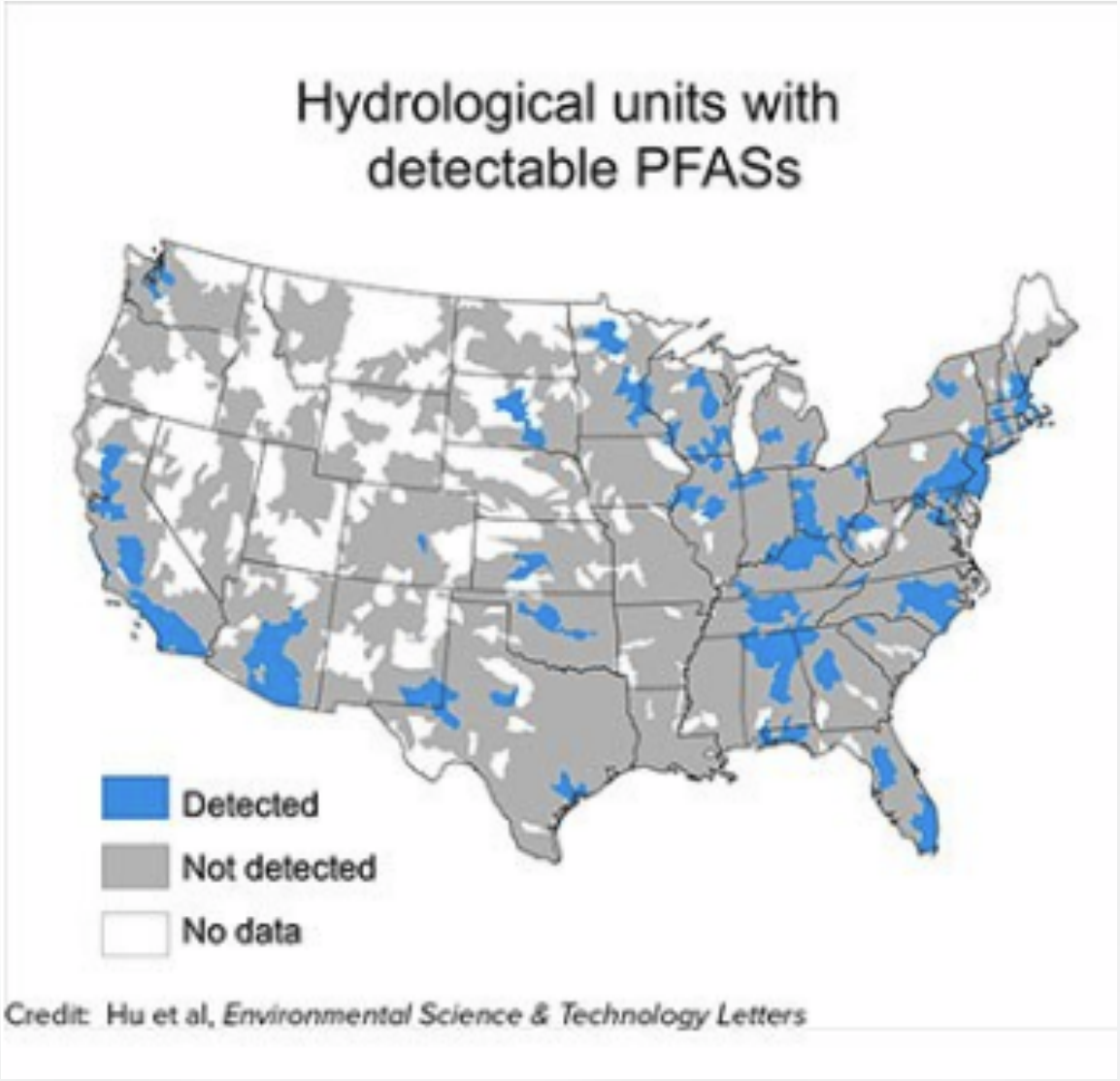
Perfluorinated Compounds in the Environment



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Perfluorinated Compounds in Drinking Water

- In 2009, provisional health advisory of
  - 400 ng/l (PFOA)
  - 200 ng/l (PFOS)

- In May 2016, provisional health advisory
  - Combined advisory of

  70 ng/l for both compounds

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Perfluorinated Compounds in Drinking Water

State	Guideline Value (PFOA)	Guideline Value (PFOS)	Source
Delaware DREC	400 ng/l	200 ng/l	DNREC (2016)
Maine DHHS	100 ng/l		Maine DHHS (2016)
Michigan DEQ	420 ng/l	11 ng/l	Michigan DEQ (2013)
Minnesota Dept. Health	300 ng/l	300 ng/l	MDH (2009)
New Jersey DEP	40 ng/l		NJDEP (2014)
North Carolina Division of WQ	2000 ng/l		NCDEQ (2013)
Vermont Agency of Natural Resources	20 ng/l		Vermont ANR (2016)

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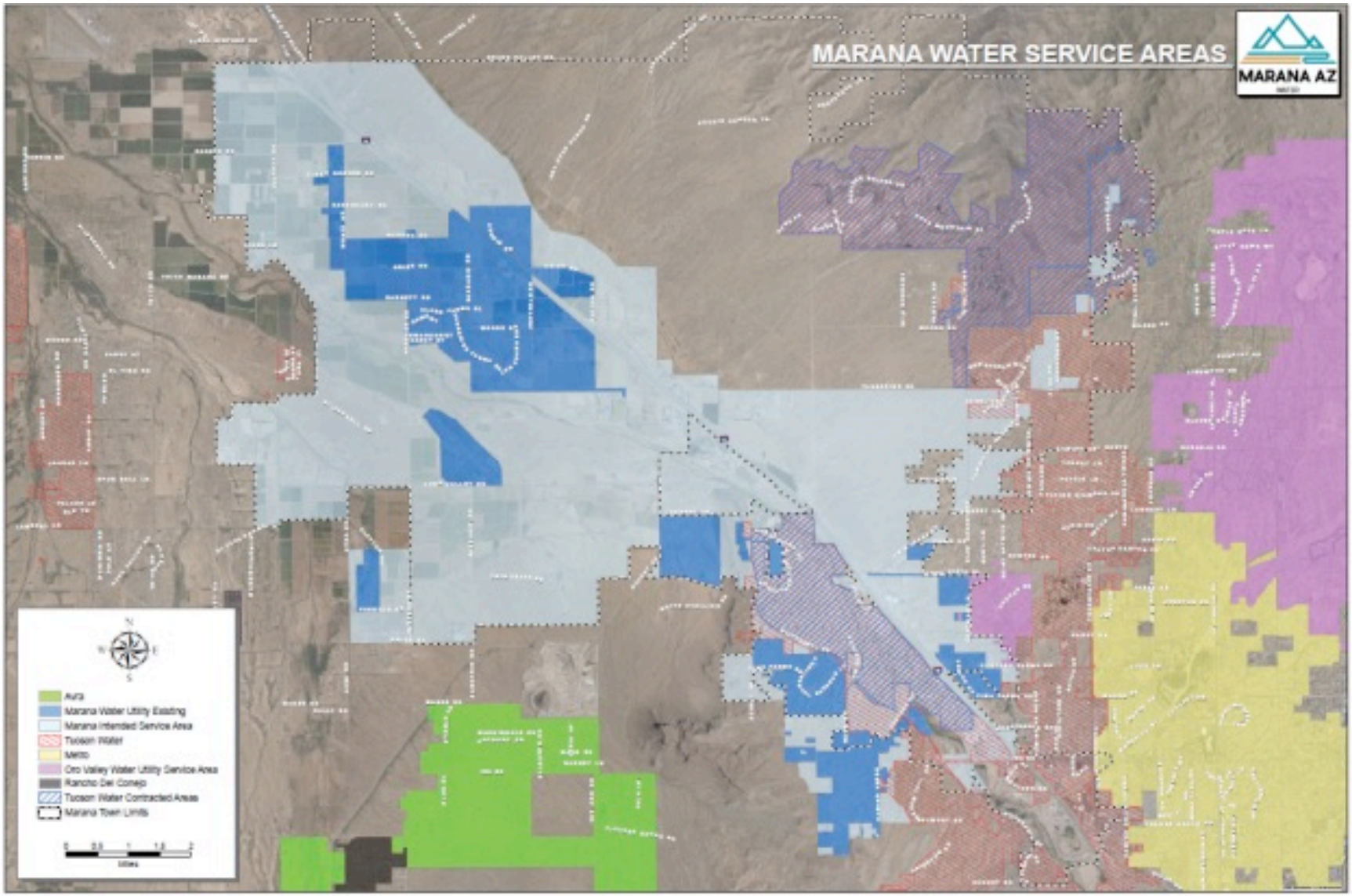
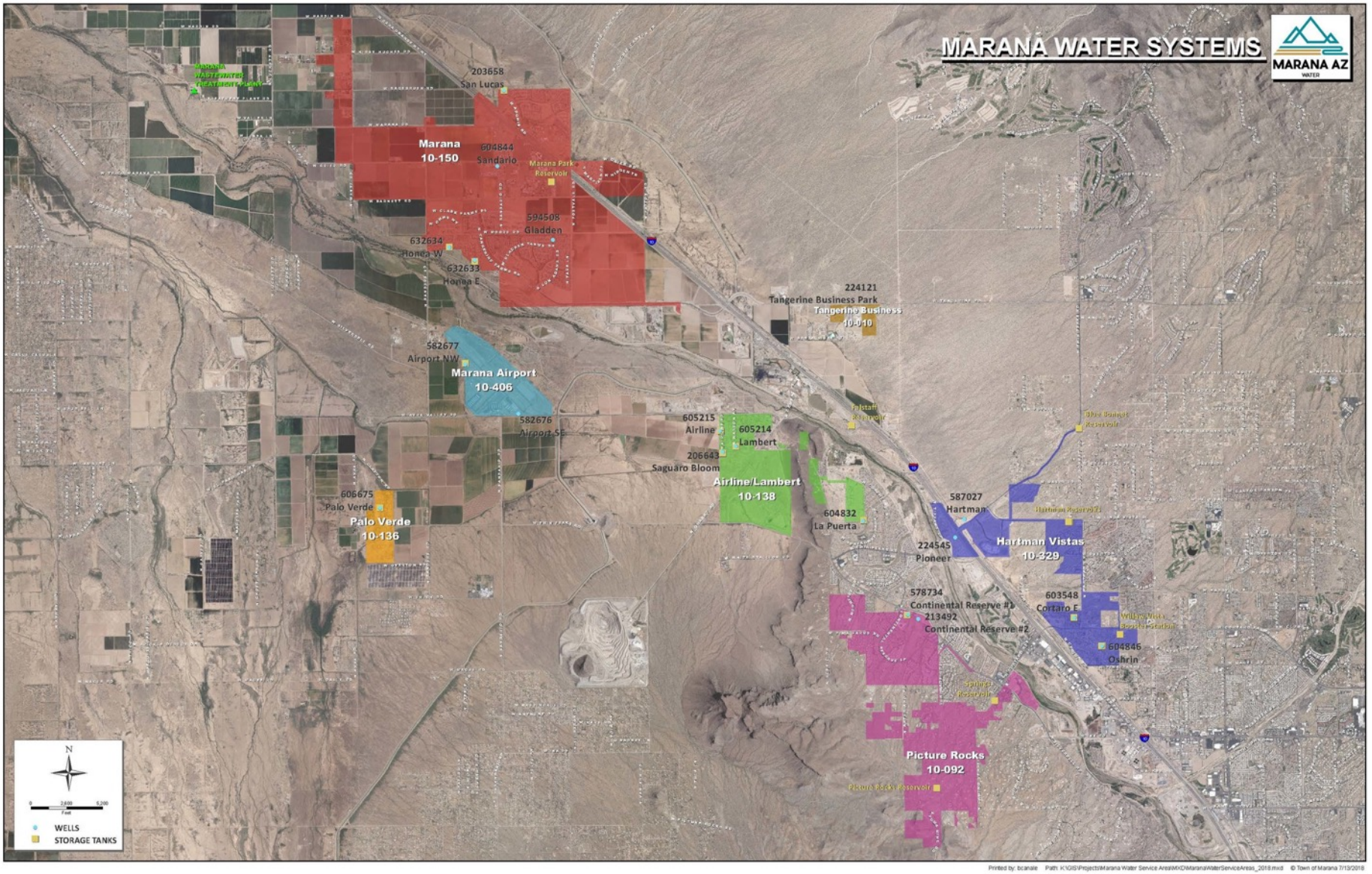
Source: EPA Office of Water, 2016

Water Systems within Town



Marana Water Service Areas



PFOA/PFOS Results

Water Systems	Well Name	Result (ppt) Dec-2016 combined	Result (ppt) Dec-2017 combined
Picture Rocks 10-192	Continental Reserve #1	80	68
	Continental Reserve #2	92	79
Airline/Lambert/Saguaro Bloom 10-138	Saguaro Bloom	109	73
	Airline	102	101
	Lambert	84	76
	La Puerta	90	92
North Marana 10-150	Gladden Farms	20.4	22.9
	Sandario	7.9	5.2
	Honea East	11.9	12.3
	Honea West	8.5	8.7
	San Lucas	n.d.	n.d.
Hartman Vistas 10-329	Cortaro Ranch	n.d.	n.d.
	Hartman	n.d.	n.d.
	Oshrin	9.9	31.2
Airport 10-406	Airport NW	n.d.	n.d.
	Airport SE	n.d.	n.d.
Palo Verde 10-135	Palo Verde	n.d.	n.d.
Tangerine Business	Tangerine Business	n.d.	n.d.
Falstaff	Falstaff	87	80

n.d. = "results below laboratory detection limits"

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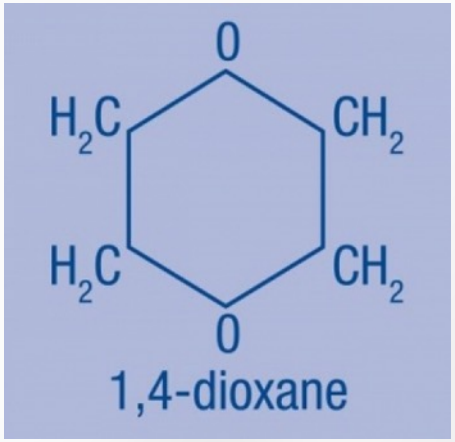
What is 1,4-Dioxane?

- Semi-volatile liquid
- Widespread use as a stabilizer with chlorinated solvents, paint strippers, greases, waxes, and cosmetics
- Classified by EPA as “likely to be carcinogenic”
- Migrates rapidly in groundwater
- Does not bioaccumulate
- No federal “maximum contaminant level” has been established for drinking water
- Lifetime Health Advisory level is 0.35 ppb (ug/L)



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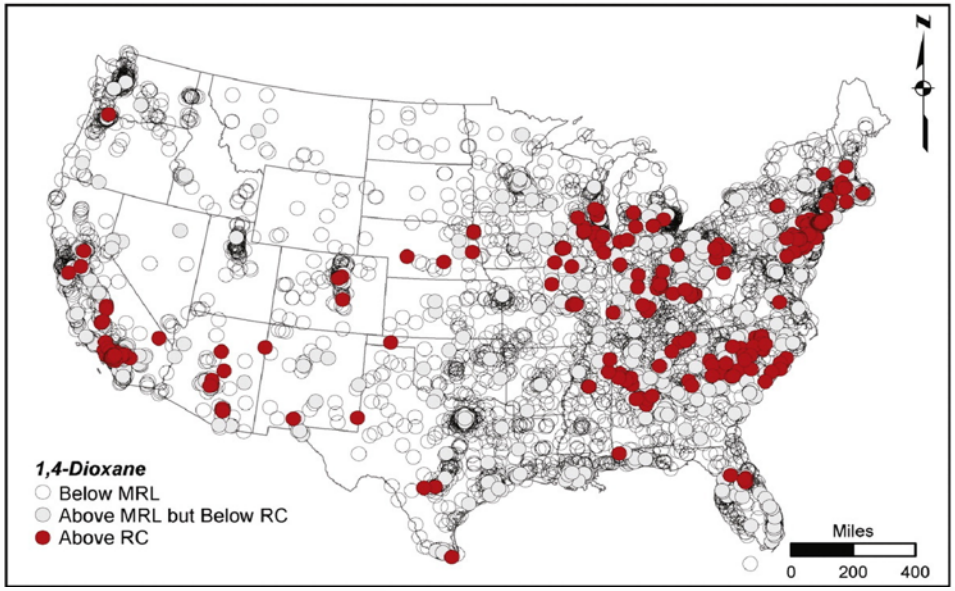
1,4-Dioxane in the Environment

1,4-Dioxane Occurrence in 4864 Public Water Systems Included in UCMR3



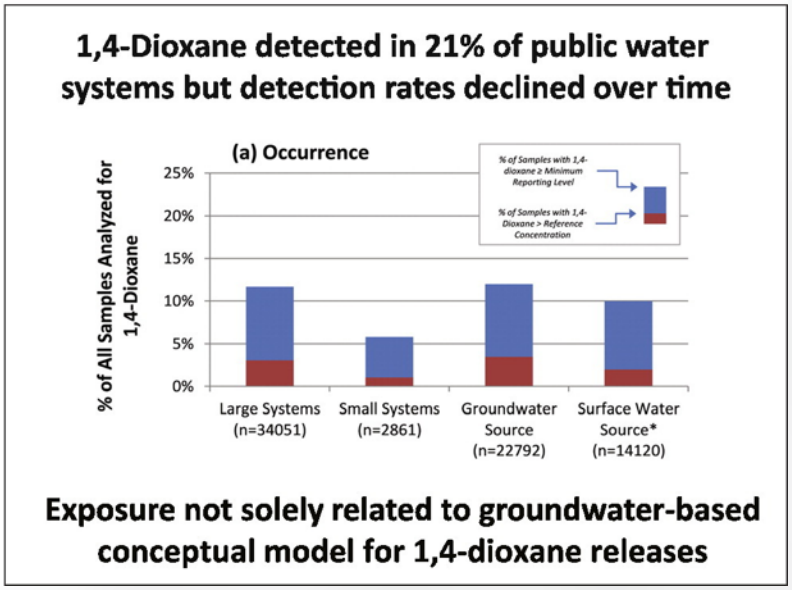


Image recovered from web search on August 9, 2018. Science in the Total Environment "**1,4-Dioxane drinking water occurrence data from the third unregulated contaminant monitoring rule."** https://www.sciencedirect.com/science/article/pii/S0048969717309221#f0040

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1,4-Dioxane Potential Health Impacts

1,4-Dioxane is a likely human carcinogen (research on-going)

Long term (chronic) exposures may cause kidney and liver damage.

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1,4-Dioxane in Drinking Water

Various states have developed drinking water or groundwater guidelines.

State	Guideline (ug/L)
Alaska	77
California	1.0
Delaware	6
Texas	9.1
Washington	0.438
New Jersey	0.4
Indiana	7.8
Massachusetts	0.3
New Hampshire	0.25
Pennsylvania	6.4

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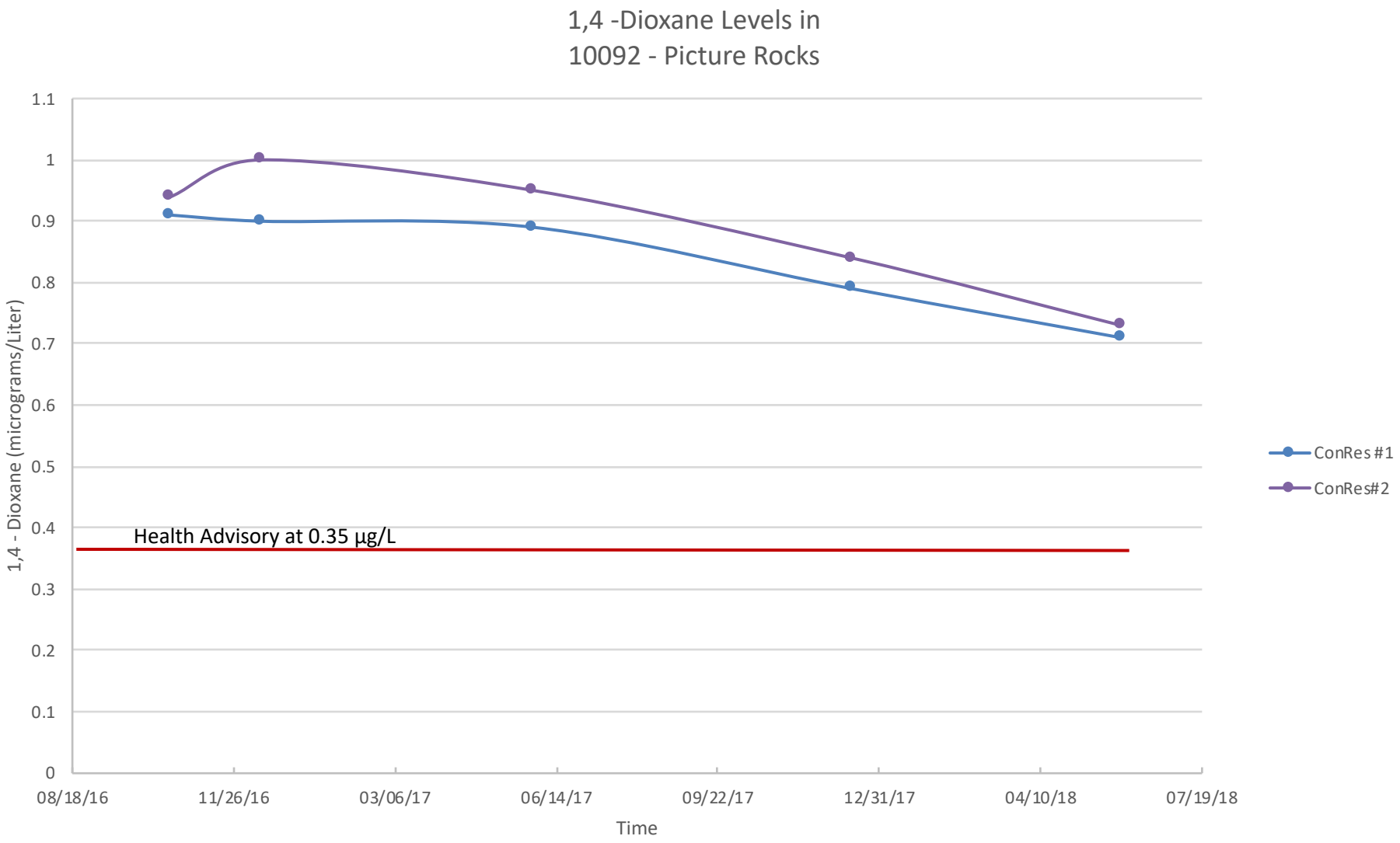
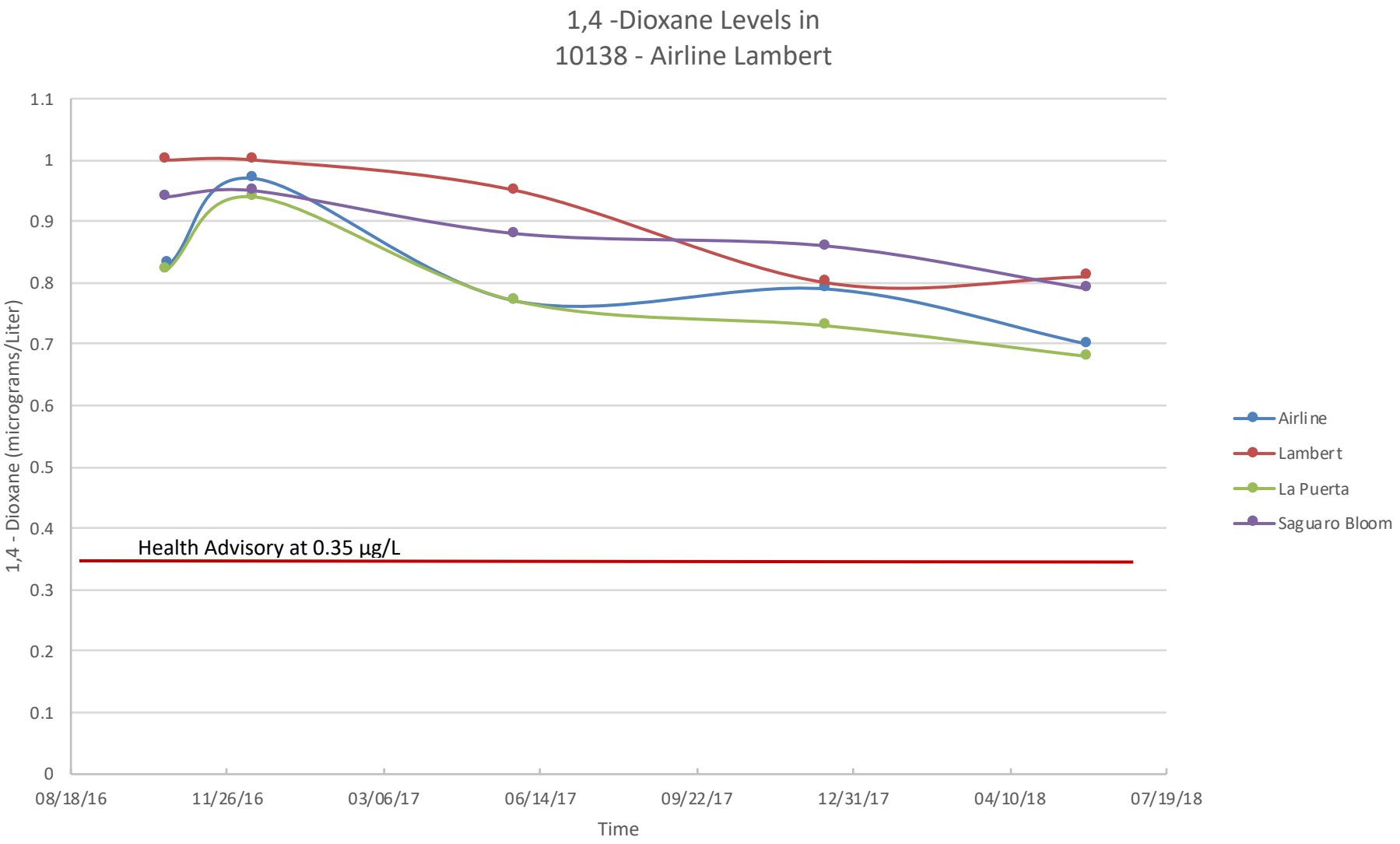
Arizona does not have an established guideline, so we are using the current, most conservative federal EPA guidance of 0.35 ug/L (ppb)

1,4-Dioxane Results

Water Systems	Well Name	Result (ppb) Oct-2016	Result (ppb) Dec-2016	Result (ppb) May-2017	Result (ppb) Dec-2017	Result (ppb) May-2018
Picture Rocks 10-192	Continental Reserve #1	0.91	0.9	0.89	0.79	0.71
	Continental Reserve #2	0.94	1.0	0.95	0.84	0.73
Airline/Lambert 10-138	Saguaro Bloom	0.94	0.95	0.88	0.86	0.79
	Airline	0.83	0.97	0.77	0.79	0.7
	Lambert	1.0	1	0.95	0.8	0.81
	La Puerta	0.82	0.94	0.77	0.73	0.68
North Marana 10-150	Gladden Farms	0.29	n.s.	.19 (Jul-17)	0.41	0.29
	Sandario	0.27	0.23	0.37	0.14	0.17
	Honea East	0.14	0.15	0.14	0.15	0.13
	Honea West	0.08	0.08	< 0.07	<0.1	<0.1
	San Lucas	< 0.07	< 0.07	< 0.07	<0.1	n.s.
Hartman Vistas 10-329	Cortaro Ranch	< 0.07	< 0.07	< 0.07	<0.1	<0.1
	Hartman	< 0.07	< 0.07	< 0.07	<0.1	<0.1
	Oshrin	< 0.07	0.07	0.14	0.25	0.32
	Pioneer					0.28
Airport 10-406	Airport NW	< 0.07	< 0.07	< 0.07	<0.1	<0.1
	Airport SE	< 0.07	< 0.07	< 0.07	<0.1	<0.1
Palo Verde 10-135	Palo Verde	< 0.07	< 0.07	< 0.07	<0.1	<0.1
Falstaff	Falstaff	0.76	0.76	0.66	0.74	0.52
Tangerine Business					<0.1	<0.1

n.s. = "no sample collected"


1,4 -Dioxane Levels in
10092 - Picture Rocks
1.1
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
1,4 - Dioxane (micrograms/Liter)
Health Advisory at 0.35 µg/L
08/18/16
11/26/16
03/06/17
06/14/17
09/22/17
12/31/17
04/10/18
07/19/18
Time
ConRes #1
ConRes#2


1,4 -Dioxane Levels in
10138 - Airline Lambert
1.1
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
1,4 - Dioxane (micrograms/Liter)
Health Advisory at 0.35 µg/L
08/18/16
11/26/16
03/06/17
06/14/17
09/22/17
12/31/17
04/10/18
07/19/18
Time
Airline
Lambert
La Puerta
Saguaro Bloom

Variables (PFAs)

- EPA due to release guidance and cleanup criteria for soil and groundwater contamination in the Fall of 2018. *Will EPA meet their own timeline? How could this affect us?*
- With limited data set, PFA levels showing a gradual decline in the affected water systems. *Will it continue?*
- *Is the source of the PFA compounds deriving from a single source contributor, or the community at large?*

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Variables (1,4-Dioxane)

- *Is there a primary single source contributor, or is it the community at large that is producing the levels we are seeing?*
- The federal guideline lists two levels of risk exposure to consider. 200 ppb for a cancer risk of one in 10,000; or 0.35 ppb for a lifetime Health Advisory for a one in a 1,000,000 risk of affect. *Which one should the community use as guidance?* Our values in affected areas are around 1 ppb.
- If 1,4-dioxane remains within consumer products, this compound will be utilized by the entire community and will most likely stay in use for the indefinite future, thus entering our watershed. *Will manufacturers be reducing 1,4-dioxane in the future within their products?*
- *Is there a national and local trend of decreasing concentrations?*
- *Will this compound ever be regulated as a drinking water standard?*

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What alternatives do we have?

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Water Quality Assessment Program

Background

- Voluntary testing by Marana Water for emerging compounds began fall 2016
- Airline-Lambert and Picture Rocks water systems predominantly affected
- Customer notification
- Hired Carollo Engineers to evaluate blending and treatment alternatives

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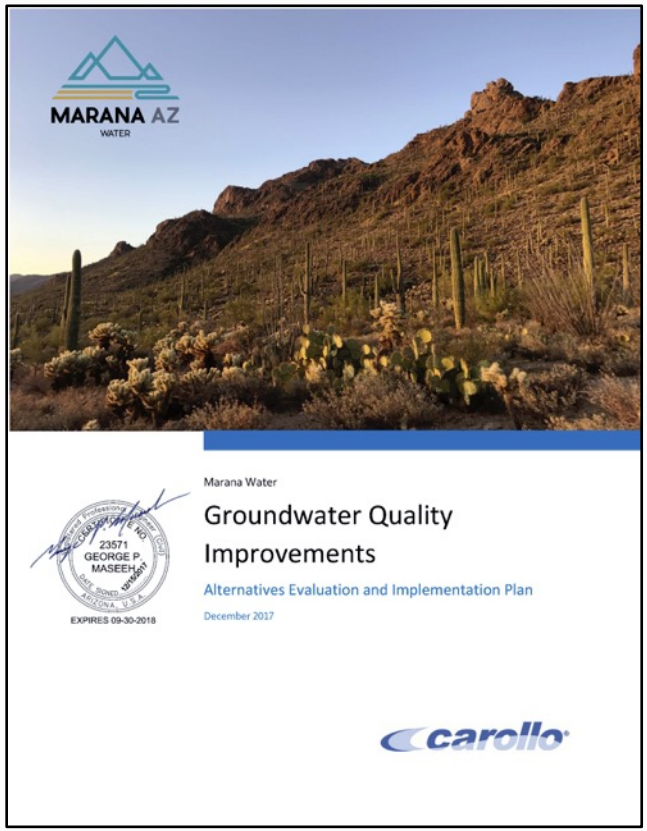
2017 Groundwater Quality Evaluation and Implementation Plan



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Parameter	EPA Health Advisory	Treatment/ Blending Goal
1,4-dioxane	0.35 µg/L	0.175 µg/L
PFOS + PFOA	70 ng/L	35 ng/L

Blending Alternative (dilution)

Picture Rocks

- Interconnect with Tucson Water
- Interconnect with Hartman system & NWRRDS
- Additional wells

Airline-Lambert System

- NWRRDS
- Additional wells
- Separate water line from Marana Airport water system
- CAP Water

- *To meet blending targets, each system would require a replacement capacity of non-detect water at 82%. This devalues the current assets to an 18% effectiveness.*
- *No guarantee of water quality at non-detect levels at the sites used for blending.*
- *Blending Alternative is High Risk.*

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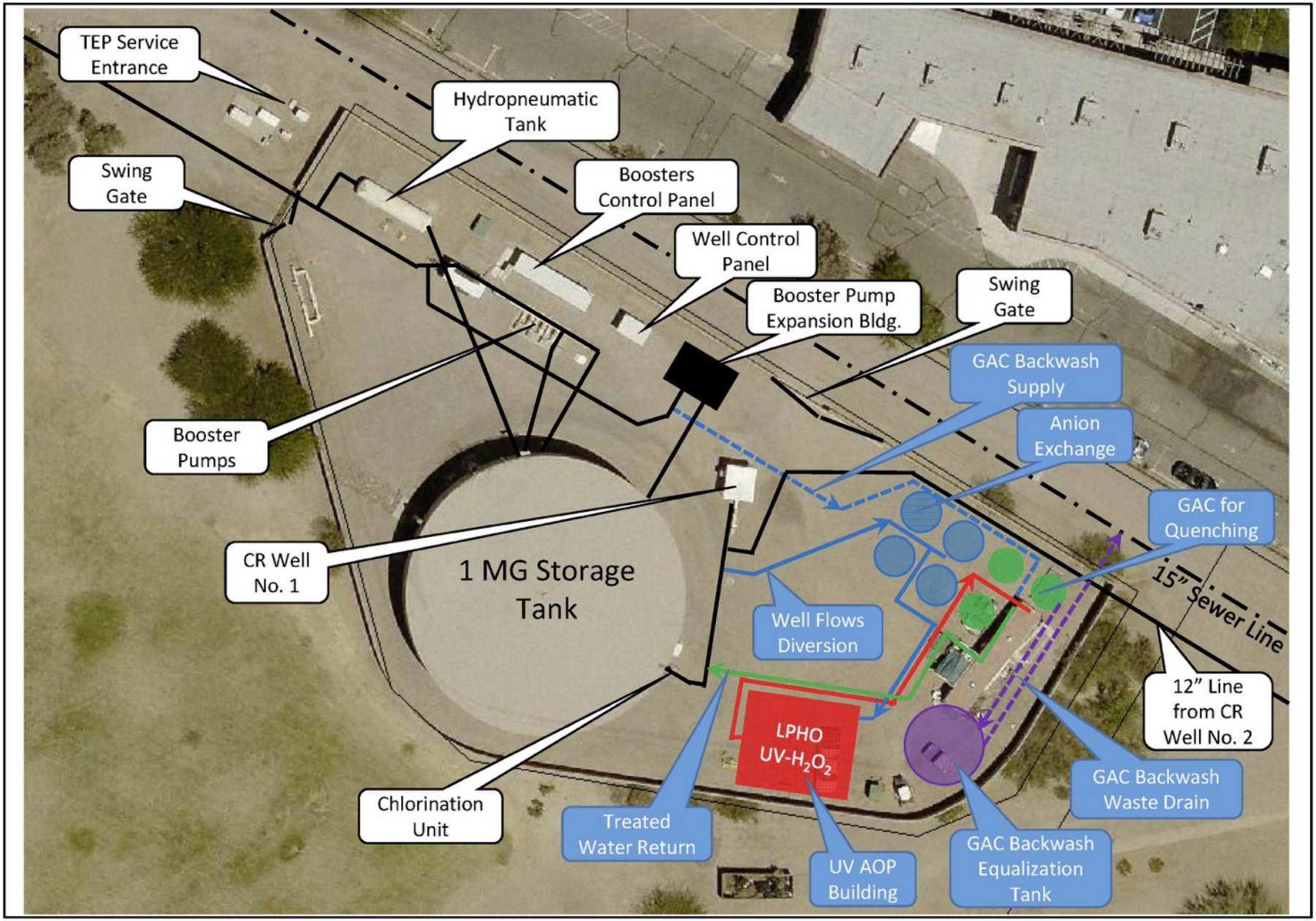
Picture Rocks / Continental Reserve Water System Treatment Layout



Appendix B.1
Continental Reserve Site Conceptual Layout
Anion Exchange + LPHO UV-H_2O_2 + GAC Quenching

2017 Water Quality Alternatives Evaluation and Implementation Plan

Picture Rocks / Continental Reserve	
	Ion Exchange + UV-H_2O_2 + GAC (quench)
Capital Cost	$5.7M
Annual O&M	$165k
Present Worth of O&M	$2.3M
Total Present Worth	***$7.9M***

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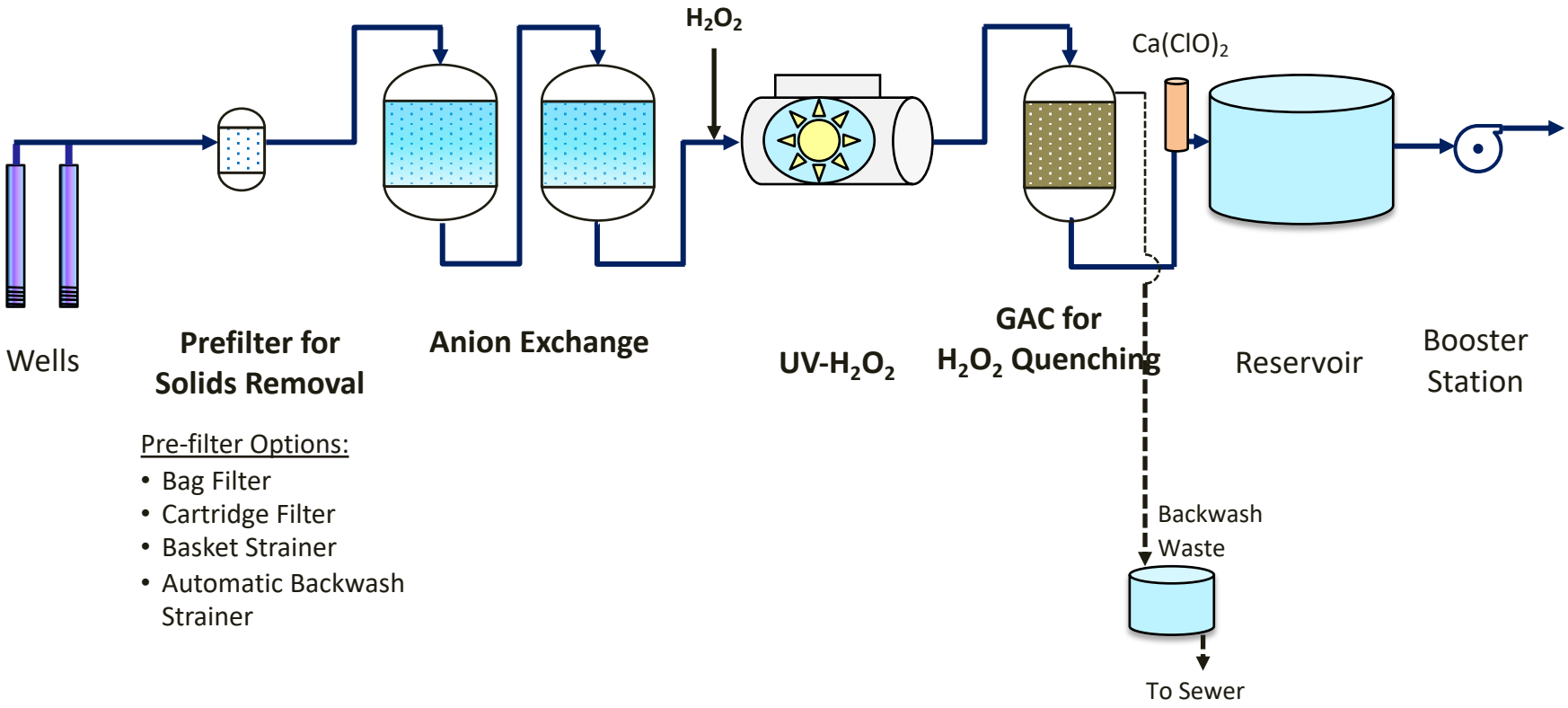
IX + UV-H_2O_2 + GAC

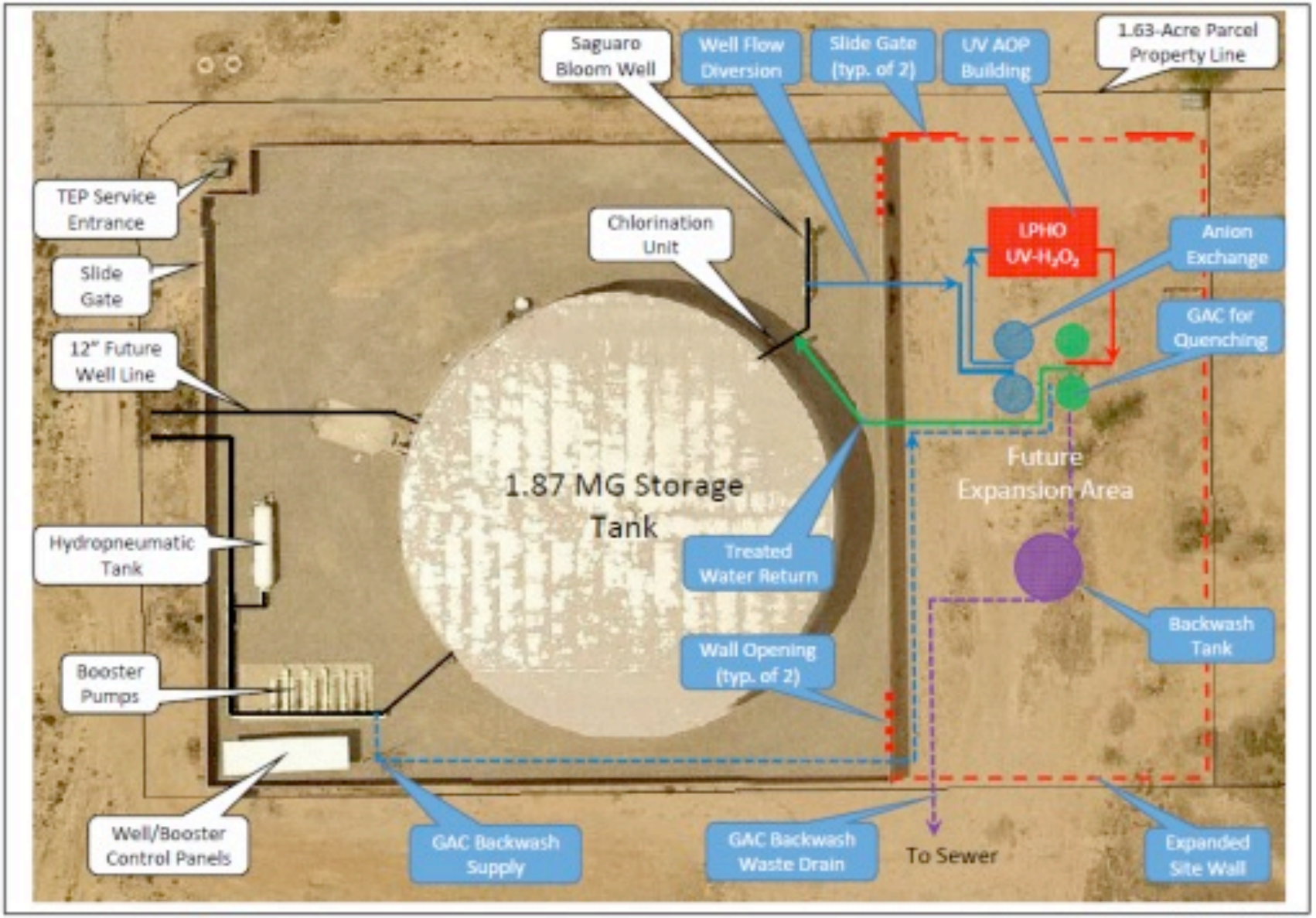
Simplified Process Flow Schematic



Pre-filter Options:

- Bag Filter
- Cartridge Filter
- Basket Strainer
- Automatic Backwash Strainer

Airline-Lambert / Saguaro Bloom System Water Treatment Layout



carollo

Appendix B.2
Saguaro Bloom Site Conceptual Layout
Anion Exchange + LPHO UV-H_2O_2 + GAC Quenching

2017 Water Quality Alternatives Evaluation and Implementation Plan

Airline-Lambert / Saguaro Bloom	
	Ion Exchange + UV-H_2O_2 + GAC (quench)
Capital Cost	$4.3M
Annual O&M	$98k
Present Worth of O&M	$1.3M
Total Present Worth	***$5.6M***

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Current Information from EPA and ADEQ

- 1,4-Dioxane and the Perfluorinated Compounds continue to gain national attention
- Many states and communities are taking a strong approach to PFA remediation and drinking water protection (primarily based on levels detected)
- Regulatory movement on PFAs this fall?
- Questions on validity of 1,4-Dioxane Health Advisory guidance level

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What have our customers been saying?

"This is horrible. You should go right to treatment regardless of cost. I don't want to know chemicals are in my water."

"I don't drink tap water anyway. I normally drink bottled. If I want tap water, I'll just buy a filter and treat for it myself. Any recommendations?"

"Thank you for doing this and letting us know. As more information becomes available, I'm sure the Town will make the right decision one way or another."

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This is what we know.

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What we know

- Marana is downstream of a large metropolitan area
- The Lower Santa Cruz river watershed is comprised of treated wastewater and stormwater runoff; each of which may contain regulated and unregulated compounds at varying levels.
- Federal government, State of Arizona, multiple regional jurisdictions all store future water supplies within and along the Santa Cruz River in Marana.
- The future will continue to create challenges to meet water, wastewater, and stormwater compliance within our watershed

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What we know

- If we believe that the current declining trend were to continue, it will take several years for these compounds to get below the current advisory levels.
- There is no guarantee that the declining trends will continue, or the health advisories will remain the same.

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Summary

- Continue to sample and evaluate the water systems for water quality changes
- Monitor and engage EPA on future Health Advisory changes or movement towards regulatory standards
- Research and identify potential responsible parties and hold them ultimately accountable
- Blending is not a viable option; treatment would be fully effective

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