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Impacted Groundwater to Drinking Water: Large Potable End Use Groundwater Remediation System Design & Permitting

Kirk Craig | 4 December 2017

NGWA Groundwater SUMMIT 2017

Potable End-Use Groundwater Remediation: Defining the Issue

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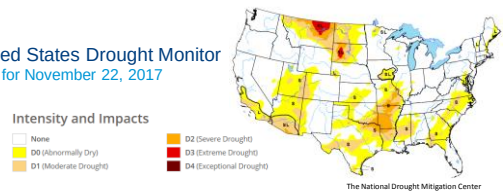
United States' Contaminated Groundwater

Defining the Issue

- Bureau of the Census:
  - U.S. population will grow from 310M in 2010 to 439M in 2050
- >50% of potable water in U.S. is from groundwater
- Increasing scarcity ➡ water providers utilizing impaired water sources
  - Including aquifers contaminated with anthropogenic hazardous chemicals

United States Drought Monitor
Map for November 22, 2017

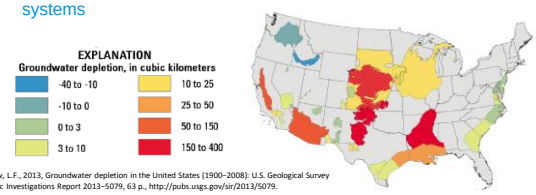


The National Drought Mitigation Center

United States' Contaminated Groundwater

Defining the Issue

- Groundwater depletion has increased markedly since 1950
- Max depletion during most recent period (2008 - 2016)
  - 2008 avg. depletion = ~6.6 billion gal/yr
  - 1900–2008 avg. depletion = ~2.4 billion gal/yr
  - 1900-2008 AZ alluvial basin total depletion = ~27 billion gal (83K acre-feet)
- Map: 1900-2008 cumulative groundwater depletion in 40 aquifer systems



Konikow, L.F., 2013, Groundwater depletion in the United States (1900–2008): U.S. Geological Survey Scientific Investigations Report 2013–5079, 63 p., http://pubs.usgs.gov/sir/2013/5079.

United States' Contaminated Groundwater

Magnitude of the Issue

- Little info about CERCLA, RCRA, DoD, DOE, UST, or other sites directly impacting drinking water supply systems
  - The number of sites adversely affecting drinking water aquifers is not tracked
- Superfund - 1,785 Total National Priority List Sites
  - 83% of NPL Sites require remediation of groundwater
  - 2007 EPA reported, 1,072 facilities had a groundwater remedy
    - 106 have a water supply remedy
    - 10% of NPL sites adversely affect or significantly threaten drinking water supply systems

"Alternatives for Managing the Nation's Complex Contaminated Groundwater Sites", Water Science and Technology Board, National Research Council of the National Academy Sciences, 2013

United States' Contaminated Groundwater

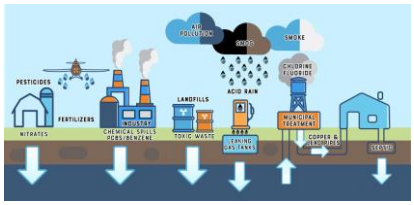
Safe Drinking Water Act (SDWA)

- Contaminant Candidate List (CCL)
  - 100 chemicals and 12 microbiological contaminants
  - MCLs developed for only small subset
  - No MCL does not mean contaminant is not a concern
  - EPA screening or toxicity levels may be lower than MCLs or guidance levels:
    - Lower EPA toxicity level for TCE
    - 1,4-dioxane
      - EPA's Regional Screening Level = 0.35 µg/L
      - CA's Notification Level = 1 µg/L
      - CA's Response Level = 35 µg/L
      - Water purveyors typically go by EPA's Regional Screening Level

United States' Contaminated Groundwater

State Policies for Potable End-Use of Impacted Aquifers

- Various states have policies to protect aquifers so they can be used as water supplies
- Very few states have potable end-use groundwater remediation guidance



Potable End-Use Groundwater Remediation: Where and Why

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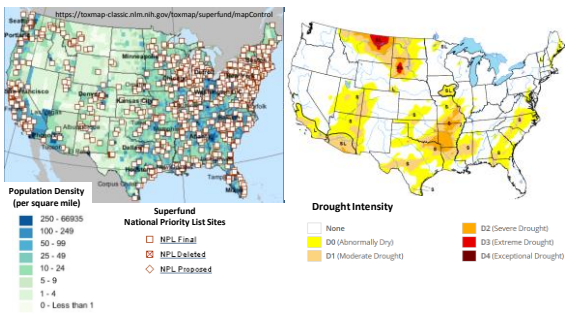
Where: Potable End-Use GW Remediation

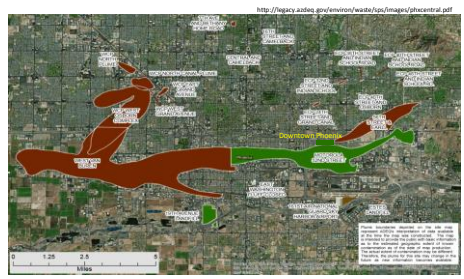
Majority of Contaminated Sites in Densely Populated Areas



Why: Potable End-Use GW Remediation

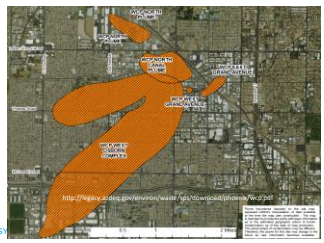
Many of Contaminant Plumes in the Southwest are:

- Old: >10 years
- Large: mile(s) wide/long
- In densely populated areas
- Dilute: Single digit contaminant ppm
- Deep: >100 feet bgs



Why: Potable End-Use GW Remediation

- Complete aquifer restoration is not economically feasible
- Cannot be completed in a reasonable amount of time
- Most GW remedies are already meeting DW standards
- Wellhead treatment is the only feasible near-term remedy for potable aquifer use
- Drinking water is the ultimate beneficial reuse



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Potable End-Use Groundwater Remediation: Challenges

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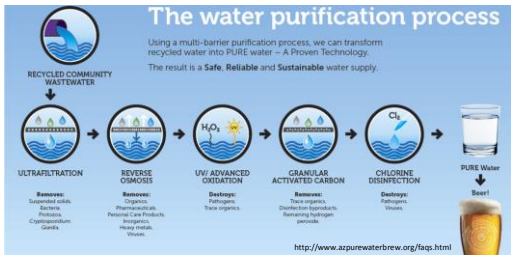
Challenges: Potable End-Use GW Remediation

Public Perception and Education



Challenges: Potable End-Use GW Remediation

Agency and Municipality Acceptance

ADEQ - Potable end use *"is a tool in our tool box for future consideration especially if…(municipalities) expand groundwater resources, which they have told us they are."*

Direct correspondence with ADEQ WQARF Program Manger

"The Drinking Water Program recognizes that there are extremely impaired sources in California that need to be cleaned up and for which the resulting product water represents a significant resource that should not be wasted."

Policy Memo 97-005 Policy Guidance for Direct Domestic Use of Extremely Impaired Sources, November 5, 1997

Challenges: Potable End-Use GW Remediation

Treatment System Challenges

- Evolving DW standards
- New chemicals created, released, detected or deemed harmful
- Advanced toxicological research
- Analytical methods improve
- Costly associated treatment plant upgrades

http://legacy.azdeq.gov/environ/waste/sps/Air_Force_Plant_44_Raytheon_Project_Area.html

Potable End-Use Groundwater Remediation: California Case Study

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California's Contaminated Groundwater

California: *Policy Memo 97-005 Policy Guidance for Direct Domestic Use of Extremely Impaired Sources*

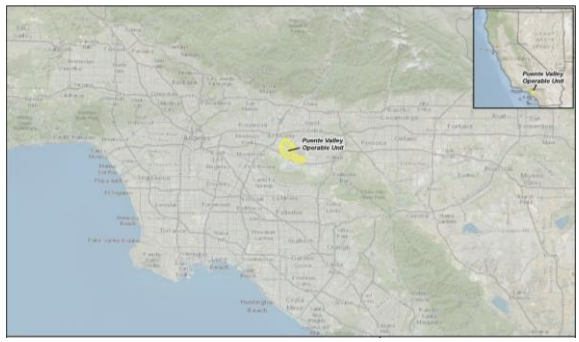
- *"Extremely impaired sources in CA that need to be cleaned up…represent a significant resource that should not be wasted"*
- *"Drinking water quality and public health shall be given greater consideration than costs"*
- Extremely impaired source:
  - Exceeds 10 times an MCL
  - Threatened due to proximity to known impacts
  - Contains a mixture of contaminants of health concern

California's Contaminated Groundwater

California: Policy Memo 97-005

- Evaluation Process for Extremely Impaired Drinking Water Source
  1. Source Water Assessment
  2. Full characterization of raw water quality
  3. Source Protection
  4. Effective Monitoring and Treatment
  5. Human Health Risks Associated with Failure of Proposed Treatment
  6. Plus 6 more requirements…

Case Study
Puente Valley Operable Unit (PVOU)



Case Study – PVOU Overview

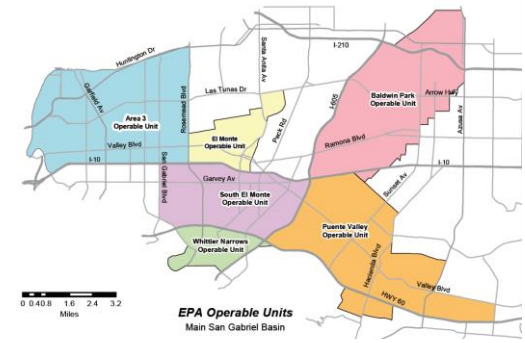
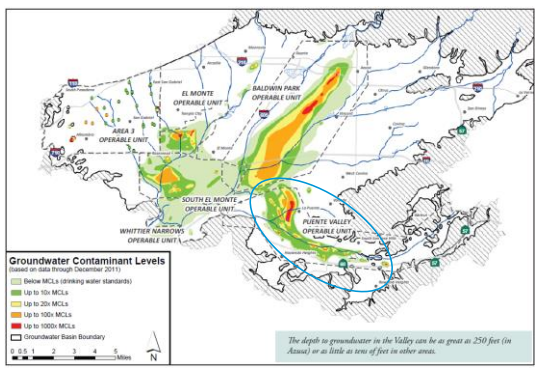


Image: Watermaster, Five Year Water Quality and Supply Plan (2013)

Case Study – PVOU Overview



Case Study – PVOU Adjudication

Adjudicated Basin

- 1973 – Main San Gabriel Basin Judgment was issued
- Main San Gabriel Basin Watermaster – administers adjudicated water rights and manages groundwater resources

MainSanGabrielBasin WATERMASTER

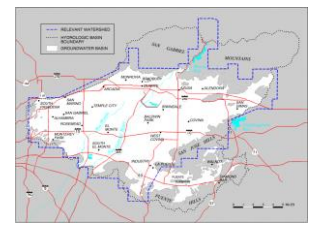


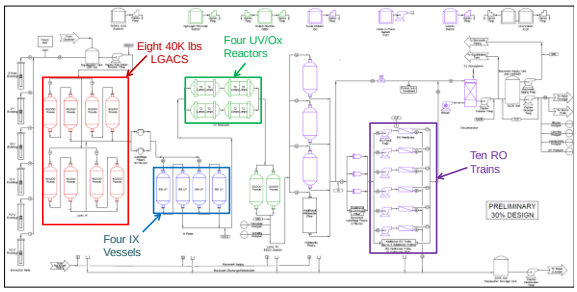
Image Source: http://www.watermaster.org/basinmap.html

Case Study – PVOU Stakeholders

Regulatory Oversight	California Department of Toxic Substances Control
Adjudicated Basin	MainSanGabrielBasin WATERMASTER
End Use	CALIFORNIA ENVIRONMENTAL PROTECTION AGENCY STATE WATER RESOURCES CONTROL BOARD
PRP	• Others in PVOU
Local Agencies	La Puente; CALIFORNIA ENVIRONMENT PROTECTION AGENCY LOS ANGELES REGIONAL WATER QUALITY CONTROL BOARD
Others	• San Gabriel Council of Government, local community, private property owners

Case Study – PVOU Treatment Plant

Case Study – PVOU Process Flow Diagram



Six ext wells → 125K EQ tank → eight 40K GACs → four 318 ft³ IX vessels→ four 144 lamp UV/Ox reactors
two 20K GACs → four multimedia filters → ten RO trains → decarbonator → 500K Clearwell → potable water

PVOU Treatment Plant Current Status

Current Status of the PVOU Potable End-Use Groundwater Remediation Treatment Plant

- Final 100% design complete and under review by EPA
- Permitting is well underway
- Procurement process initiated for construction General Contractor
- Construction anticipated from June 2018 through May 2019
- Final design of smaller, shallow zone non-potable sister system anticipated for mid-2018