CUWA Joint Workshop on Wildfire Impacts
Summary of Impacts on Drinking Water Quality

June 10, 2021

This document is an outcome of CUWA's workshop held on November 12, 2020 with the Water Quality and Emergency Operations Committees and CUWA staff.

This document presents an overview of water quality parameters that can be impacted by wildfires, and a monitoring strategy to assess the short- and long-term consequences for water systems. The depth of this document is limited by the fact that impacts of wildfires on water quality vary largely based on the wildfire location and sites affected.

Impact of Wildfires Near Water Sources

Wildfires in watersheds or near untreated water reservoirs can compromise water quality both during active burning, and for months and years after the fire has been contained. During active burning, ash and associated contaminants can settle on lakes and reservoirs used for drinking water supplies. Vegetation that holds soil in place and retains water is burned away. Storms that follow a major wildfire can flush large quantities of ash, sediment, nutrients and contaminants into streams, rivers, and downstream reservoirs. The absence of vegetation in the watershed can create conditions prone to erosion and flooding and introduce contaminants that can impact drinking water quality.

Water quality impacts from contaminants that can be triggered by wildfires are summarized in Table 1.

Table 1. Contaminants Associated with Wildfires and their Effects on Water Quality

Contaminant	Impact to water quality
General physical-chemical parameters (pH, alkalinity, TDS, conductivity, hardness, dissolved oxygen)	• pH affects all chemical and biological reactions, including coagulation, flocculation, precipitation, softening, biological treatment, disinfection efficacy and microbial inactivation, DBP formation, metal dissolution and corrosion, etc. • Alkalinity influences the performance of coagulants, corrosion, and some chemical and biological processes • TDS and conductivity influence corrosion and metal release, scaling, effectiveness of detergents, aesthetic characteristics, and irrigation systems; other impacts are specific to the ions present • Hardness impacts corrosion and scaling • Decreases in dissolved oxygen may lead to algae growth and cyanotoxins, and influence biological treatment, distribution system water quality, metal oxidation, etc.
Particles (turbidity, TSS, Zeta potential and settleability)	• Increase particle loading and turbidity • Decrease dissolved oxygen and increase temperature in untreated water bodies • Provide support for microbial growth • Interfere with disinfection processes • Can harbor pathogens
Metals[a]	• Non-compliance if metals exceed their respective primary or secondary standards • Impact treatment and disinfection processes depending on metals found • Can accumulate in distribution system and be subsequently released • Can affect aesthetic characteristics
Inorganics (nitrate, nitrite, ammonia, sulfate, phosphorus)	• Ammonia and nitrite consume disinfectant residual, which may influence efficacy of pre-disinfection; they can also lead to nitrification in filters • Nitrate can be responsible for non-compliance • Some fire retardants (including Phos-Chek, a common agent used in California) contain ammonia and phosphate, along with undisclosed performance additives[b] • Sulfate consumes disinfectants and can influence disinfectant stability, and taste and odor • Phosphorous enhances algae growth in surface water reservoirs, which can lead to the presence of cyanotoxins
Nutrients and organics (TOC, DOC, UV absorbance)	• Enhance microbial growth • Decrease disinfectant stability • Increase DBP formation potential
Aesthetic (taste and odor, color)	• Non-compliance with secondary standards • Customer concerns and complaints

a. Mainly aluminum, iron, manganese, and mercury; others to consider include copper, zinc, cadmium, lead, arsenic, selenium, nickel, and chromium.

b. Because these performance additives are unknown, coordination with chemical manufacturers to better identify the content of these products along with a broader water quality monitoring are recommended, including metals and indicators or organic constituents such as TOC, DOC and UV absorbance.

DBP = Disinfection byproduct

DOC = Dissolved organic carbon

TDS = Total dissolved solids

TOC = Total organic carbon

TSS = Total suspended solids

Water Quality Monitoring Near Water Sources

Mitigation actions will have to be taken by water agencies to combat the adverse effects of wildfires on water quality. Some mitigation actions include enhancing source water monitoring and sampling strategy (as demonstrated in Table 2), changing the chemical types or dosages used for water treatment, or implementing alternative treatment strategies. If changes in water quality are significant and occur suddenly, it may be challenging for the impacted water system to remain in compliance

Table 2. Source Water Quality Monitoring and Sampling Strategy for Areas Affected by Wildfire[a]

Tier	Rationale	Sampling trigger	Sampling Frequency
Baseline monitoring	To capture pre-fire conditions to establish a reference or control from which water quality collected from fire impacted areas can be compared	Pre-fire conditions	Quarterly to annually, based on regulatory requirements prior to the fire event
Short-term monitoring	Post-fire, pre-rain events to assess immediate effects of fire on water quality in watersheds	As soon as possible after a fire event	Monthly (more frequently if rain events occur), as possible considering access to watershed
	Post-fire, post-rain events to assess water quality effects of runoff after first-flush and subsequent flushes	As soon as possible after rain events	Weekly, until water quality has stabilized
Long-term monitoring	To assess the extent of water quality impacts to the watershed and rate of recovery	After a fire event	Quarterly to annually

a. *Sampling location are system specific and may include tributaries to the watershed, intakes, and various sites and depths in reservoirs. Monitoring parameters are described above in Table 1.*

Impact of Wildfires Near Water Treatment Plants

Wildfires near water treatment plants can impact treatment processes and treated water quality if plant operation is affected by ash, smoke, or other hazards. Some potential impacts include:

- Increased treated chemical consumption (e.g., coagulants) and associated solids production
- Ozone treatment and monitoring systems are susceptible to power variability, smoke, and/or dust, which may limit or prevent the use of this oxidant/disinfectant during fire events. Water system that rely on ozonation to meet disinfection credits and other water quality goals are advised to plan alternative oxidation/disinfection strategies during fire emergencies
- Plant operation and water quality monitoring may be impacted if conditions become too dangerous to operate on site due to encroaching flames or hazardous air quality, if access to facilities becomes limited, or if staff are personally affected by wildfires.

Contaminants that can potentially be impacted and their effects on water quality are similar to those listed in Table 1. Water quality monitoring would largely depend on the proximity of the fire to the treatment facilities and treatment processes used.

Impact of Wildfires in Service Areas

Fires that affect service areas can impact distribution systems and water quality at customer taps by changing water flow conditions and water demand in distribution system, either to combat fires or because of low-flow conditions due to evacuation. Potential impacts are listed below.

- Limited or restricted access to sampling sites
- Limited field staff because of safety issues
- Changes in water pressure:
  - Higher pressure when filling treated water storage facilities, which may increase breaks and leaks of aging infrastructure

  - Lower pressure if several hydrants are simultaneously open to combat fire
- Decreased water quality due to increased water age in treated water storage reservoirs when higher water levels are targeted to combat fire; for example:
  - Disinfectant decay, Increased microbial growth
  - Increased DBPs
  - Nitrification
- Increased maintenance and repairs following a fire event due to any fire damage or if these activities had to be postponed while responding to the emergency or because of staff limitation (change in priority, limited access, etc.)

Additional Resources:

1. 2019 Camp Fire Research Symposium: https://ucanr.edu/sites/Rangelands/2019_Camp_Fire_Research_Symposium_/
2. Camp Fire Water Quality Monitoring Response: https://ucanr.edu/sites/Rangelands/files/304948.pdf
3. Carr Fire Post-Fire Surface Water Quality Assessment: https://ucanr.edu/sites/Rangelands/files/305065.pdf
4. Discussion of Post-fire runoff and Debris Flow Generation: https://ucanr.edu/sites/Rangelands/files/304949.pdf