Risk Management for Drinking Water Sources

DEQ Forest Water Quality Program

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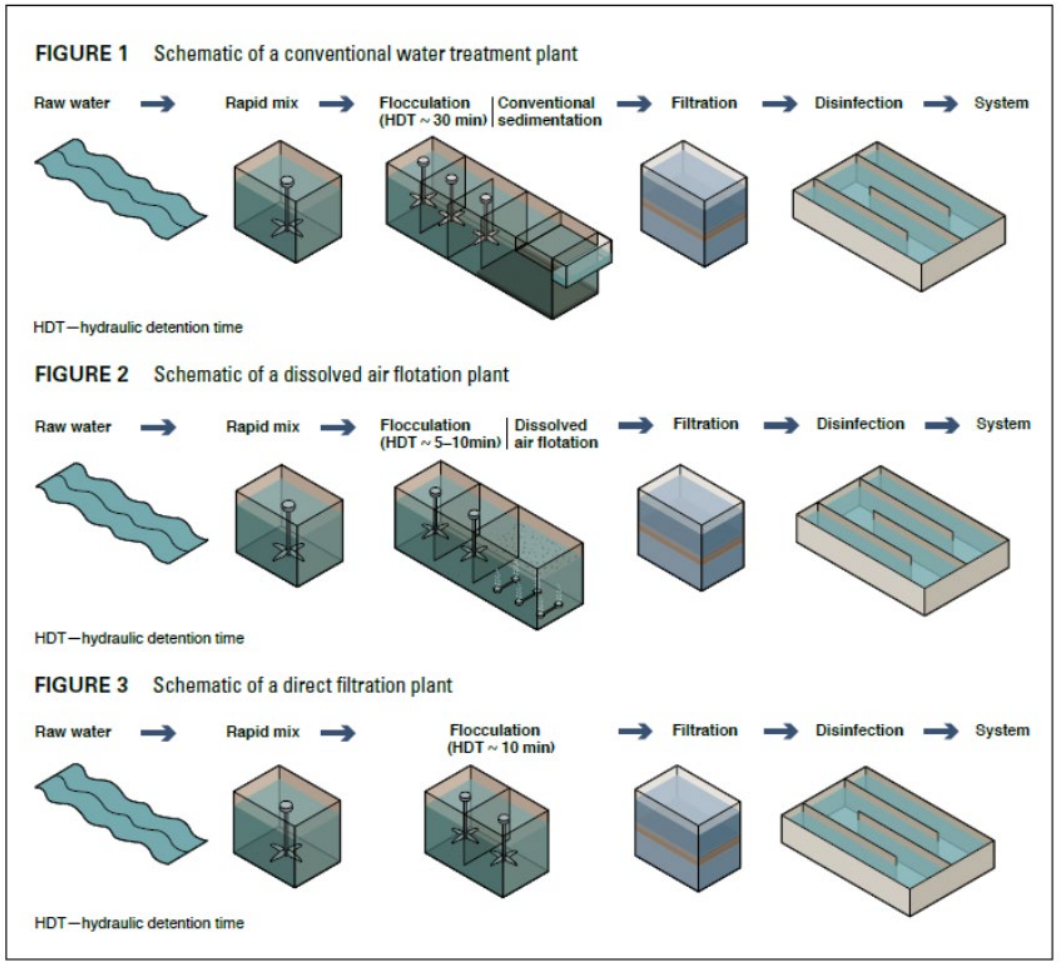
Coastal Workshops

Treatment types and limits

- A given treatment technology has limits on raw water quality
- Regardless of source water quality, water systems must meet SDWA Maximum Contaminant Limits



Treatment types and limits

TABLE 1 Raw source water quality pre- and post-wildfire, post-fire water quality for an unburned reference site, and post-fire rainstorm samples

Water Quality Parameter		Pre-fire Routine Monitoring Samples[a]	Post-Fire Reference Site Samples	Post-Fire Routine Monitoring Samples[b]	Post-Fire Rainstorm Samples[c]
Turbidity—*ntu*	Mean Stdev	3.6 (±4.5)	4.4 (±5.0)	35 (±38)	321 (±291)
TOC—*mg/L*	Mean Stdev	4.8 (±2.8)	4.2 (±1.9)	4.9 (±1.9)	11.8 (±5.6)

Table 4. Recommended Raw Water Turbidity Range for Various Treatment Technologies.

Filtration Type	Turbidity Range (NTU)[1]	Color Range (CU)[1]	Maximum Filtration Rate (gpm/ft^2)[2]	General Design Reference
Conventional	Unlimited	< 75	6.0	Kawamura 2000b
Direct	< 15	< 40	6.0	Kawamura 2000b
Pressure Sand	< 5	< 10	3.0	T.S.S 2007[3]
Membrane	See Note 4	See Note 4	See Note 4	USEPA 2005
Slow Sand	< 10	< 10	0.1	Hendricks et. al. 1991; WADOH 2003b
Cartridge/Bag	< 5	See Note 4	See Note 4	USEPA 2003a
Diatomaceous Earth	< 10	< 5	1.0	AWWA 1999; Fulton 2000; WADOH 2003b

[1]Water quality limitations are adopted from the DOH Surface Water Treatment Rule Guidance Manual (DOH 331-085) and references cited therein.

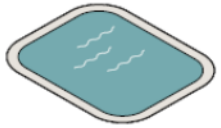
Treatment types and limits

- Upgrade treatment? Protect the source?
- Multiple Barrier Approach:
  - The ecosystem is the first barrier to contamination
  - Treatment processes and maintenance/testing form additional barriers

FIGURE 4 Design recommendations for utilities under the threat of wildfires and extreme weather events

In addition to raw water, the selection of the optimum treatment processes for any given plant is also a function of site-specific conditions (e.g., space limitations) and operational philosophy of the utility. The following recommendations are presented with the assumption sufficient space is available.

1 Pre-sedimentation Basin

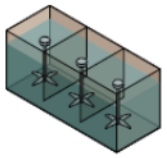


a. May be required/useful if raw water turbidity exceeds 100 ntu for long periods (i.e., days).
b. Include ability to bypass under normal conditions.

2 Coagulation

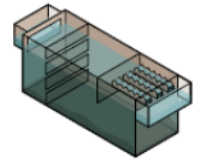
a. Ensure chemical storage and feed pumps can deliver the higher chemical doses that may be needed after a wildfire.
b. Consider polymer feed facilities that may be needed to treat waters with ash content.
c. Develop operational protocols and install equipment such as streaming current monitors or zeta potential analyzers to help determine optimum coagulant dosages.

3 Flocculation



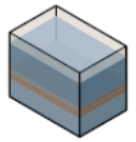
a. Install a means of removing silty solids that may settle out in a flocculation tank under high turbidity conditions.

4 Sedimentation



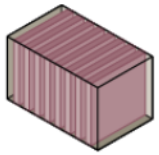
a. Use large conventional sedimentation basins if possible to handle large amounts of solids. If not practical, consider the use of plate settlers.
b. Ensure solids can be easily removed from basins via mechanical sludge removal equipment.
c. If in an area where it is not likely that high turbidity will reach the intake, and there is concern that algal blooms could occur, consider dissolved air flotation.

5 Filtration



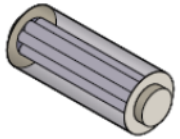
a. Consider the use of deep bed dual-media filters with larger media that can store more solids than conventional filters.
b. Consider GAC in place of anthracite to help with taste and odors.
c. Provide enough backwash water and waste backwash storage so multiple filters can be backwashed at once.

6 Membranes



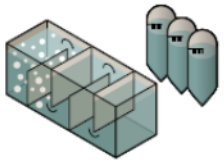
a. Membrane-based treatment systems should not be used if the raw water will be subject to the impact of firefighting foams that could foul membranes.
b. For existing membrane plants, consider adding powdered activated carbon to adsorb firefighting foams before the membranes.

7 Disinfection



a. Higher levels of NOM may lead to DBP compliance issues.
b. Attention should be given to maximizing removal of NOM or relying on the use of alternative disinfectants including UV and ozone.

8 Advanced Treatment



a. Smoky taste and odors could occur after a fire.
b. Nutrient release from wildfires could result in long-term eutrophication and increased algal growth in downstream reservoirs, leading to taste and odors and algal toxins.
c. The installation of powdered activated carbon or post-filter GAC contactors should be considered to handle these events.
d. The installation of ozone/biofiltration should also be considered.

DBP—disinfection byproduct, GAC—granular activated carbon, NOM—natural organic matter, UV—ultraviolet

Drinking water source protection

- Identify potential contaminant sources and risks
- Use risk-reduction and avoidance strategies to prevent contamination of supplies
- Manage watersheds or source areas w/ practices proven to be low- or no-risk to minimize treatment costs
- Use ecological processes and resiliency to reduce impact of disturbances
- Save money and resources in the long-term
- Provide clean, safe drinking water to ratepayers

Forested drinking water sources

- Forestland provides the highest quality drinking water
- Forests slow and store water, capture fog
- Vegetation, soils, wetlands all moderate water movement
- Tree canopy and vegetation layers stabilize and build soil
- Forests are an excellent first filter for drinking water

Forest practice rules

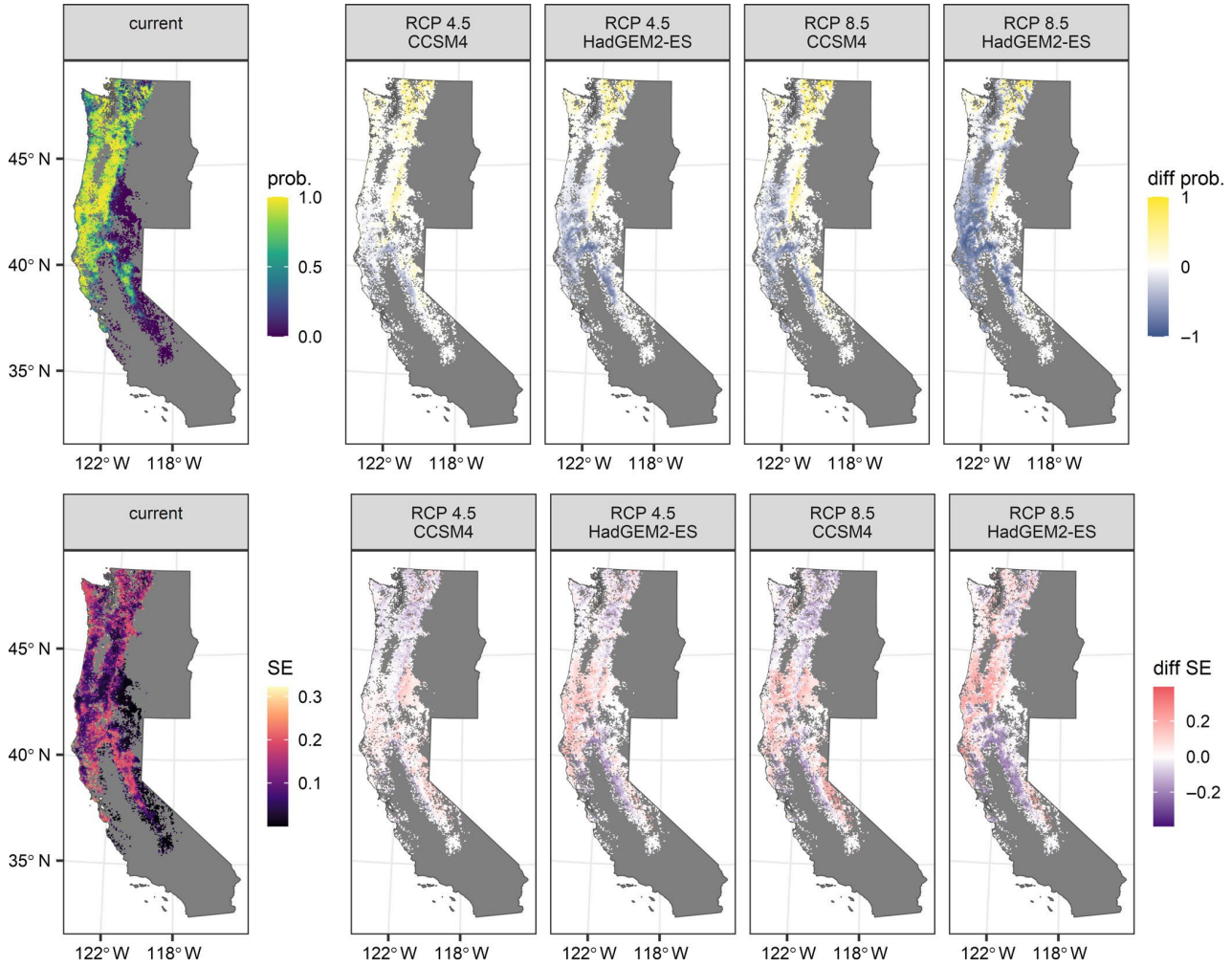
- The Forest Practices Act and rules are the baseline
  - Updated substantially by Private Forest Accord
- Greater protections in place for water resources
- Threatened/endangered species focus
  - Covered species evolved with natural disturbances (which contribute to habitat building processes)
- Drinking water, fish, and wildlife are all beneficial uses addressed in the FPA rules and best management practices

Climate change and management

- Higher temperatures, drier summers, and lower summer/early autumn flows
- Wetter winters with more intense storms increase erosion and flood risks
- Changes potentially interact with management effects on temperature, erosion, and landslide risks

Climate change and management

- Tree species ranges are shifting (pests and pathogens, too)
- Wildfires are more frequent and severe
- Plan ahead for shifting climate patterns and species ranges



Kralicek et al 2023

Forests are natural infrastructure

- Healthy forests are an important part of the multiple barrier approach
- Forests require maintenance like built infrastructure
- Road maintenance, tree planting and care, firefighting, taxes all cost time and money

Drinking water protection and risk management

- Drinking water provision is highly sensitive to sediment/erosion and organic matter in water
- Collaboration is needed
- Must differentiate between definite and potential impacts
  - Dependence on conditions and luck as well as actions

Risk reduction opportunities

- Riparian/Wetland
  - Avoid or cover bare ground
  - Leave fallen trees along slope contour and/or in-stream
  - Allow early successional vegetation to cover soil
  - Leave wider buffers as needed (e.g. to prevent windthrow)
- Steep slopes (landslide-prone areas)
  - Extend partial- or no-harvest protections to additional DSSAs
  - Work with small forestland owners for mutual benefits
  - Allow early successional vegetation to cover soil

Risk reduction opportunities

- Water quantity (peak and low flow changes, fog capture)
  - Limit extent of recently harvested stands
  - Reduce planting density
  - Grow multi-age, multi-species stands
- Roads
  - Work with small landowners on repair projects (mutual benefit)
- Herbicide application
  - Avoid applications when rain is forecast
  - Consider alternate approaches to control competing vegetation

Minimizing risk to drinking water

- Retain leave trees around sensitive sites
- Limit size and extent of canopy removal
- Redundancy is good: multiple canopy layers, multiple ages and species of trees

Balancing risk and cost

- Reducing risk often means leaving more trees or avoiding disturbance around sensitive features
- Additional risk reduction can cause greater cost to landowners and operators (collaboration is key!)
- Site variability and weather fluctuations mean effectiveness of practices has uncertainty
- Many options between “definite impact” and “minimal risk”

Costs and benefits

- Costs are typically incurred in the near term
  - Water systems/communities may need to pay for ecosystem services, restoration, etc.
- Benefits may not accrue until much later
- Manage your watershed to:
  - Prevent immediate impacts
  - Reduce overall risk
  - Increase resiliency and redundancy
- Resilient ecosystems are more sustainable: ecologically, socially, economically

Questions?

- “A society grows great when old [folks] plant trees in whose shade they shall never sit.” (Greek Proverb)

Title VI and alternative formats

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