# Pathogen Reduction by Sub-Surface Desalination Intake Wells

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Diminishing fresh water supplies, population growth and droughts are forcing many communities (e.g., California, Florida and Texas) to consider desalination for augmenting their water portfolio. Because of the negative environmental consequences of entrainment/impingement of marine organisms, regulatory agencies, environmental groups, and the public generally encourage the use of subsurface intakes. However, lack of a regulatory framework for sampling, testing, and treatment requirements can lead to considerable expense, which can possibly negate or exceed the savings that would otherwise be realized from recent technological advances in the desalination industry. Regulators in California are proposing to amend the current *Water Quality Control Plan for Ocean Waters of California* to include regulations that encourage subsurface intakes for desalination plants. Current regulations and desalination treatment requirements do not provide credit for any microbial removal due to filtration through sub-surface intakes. Treatment requirement are also likely to be dependent on the water quality characteristics of water filtered through subsurface intakes. That is, can it be categorized as being equivalent to 'true' groundwater (requiring disinfection only) or Ground Water Under the Direct Influence (GWUDI) of surface water, which requires

However, an ongoing global utility survey has shown where utilities are performing monitoring, its tends to be voluntary and focuses on common indicators or pathogens (i.e., total coliform, *E. coli*, Enterococci and *Cryptosporidium*) in the source water and sub-surface intakes. Given the paucity of data to better understand removal capabilities of subsurface intakes, long-term monthly sampling at two wells in California is ongoing to understand removal of pathogens and particles to better determine treatment credits. Current data indicate subsurface *E. coli*, Enterococci, and aerobic spores average log removals of at least 1.8, 2.3 and 2.0, respectively. AOC in the source water was 26% of TOC but was reduced to only 9% to 14% of TOC in the well water after the water flowed through the well casing. Chlorophyll (algae) removals were 33% at one system and 73% at the other whereas turbidity removal was consistently over 58%. Removal of phycocyanin, tyrosine and tryptophan through the well casing exceeded 40%. Source water SDI frequently had a high fouling capacity but SDI was significantly reduced (by

69.3% to 100%) as the water flowed through the well casing. However, not all indicators demonstrated a reduction post subsurface filtration. For example, humic and fulvic substances increased by 26% to 84% as the water flowed through the soil matrix and well casing.

The presentation will highlight strategies of defining optimal water quality sampling locations, determination of the relationship between various physicochemical indicators, water quality indicators attenuation due to subsurface filtration and the relationship between removal of a variety of indicators and significant human pathogens (e.g. *Cryptosporidium* and *Giardia*). It is anticipated that the outcome of this study will help define removal credits of significant human pathogens as a result of subsurface filtration, in turn allowing water utilities to benefit from this low technology barrier rather than the more expensive engineered barriers (e.g. UV disinfection) that would otherwise be needed in a multi-barrier treatment strategy for minimizing the public health impacts of waterborne human pathogens.