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# Water Needs for Semiconductor Facilities – What are the Issues and Challenges?

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# Presentation Overview

- Water-associated issues & challenges with semiconductor fabs
- How much water does a fab require?
- How is water used in the facility?
- Where can reductions be achieved?
- What waste streams are generated?
- What are the research needs to improve water sustainability?

# Key Issues Associated with a Semiconductor Fab Facility

## Water demand must be met by utility's WTP

- Capacity will increase as additional modules are constructed
- How will this impact the utility's WTP expansion requirements?

## Wastewater discharges must be handled by the utility's WWTP

- What flows and qualities will be discharged?
- Will these change over time based on fab owner's plans for on-site reuse?

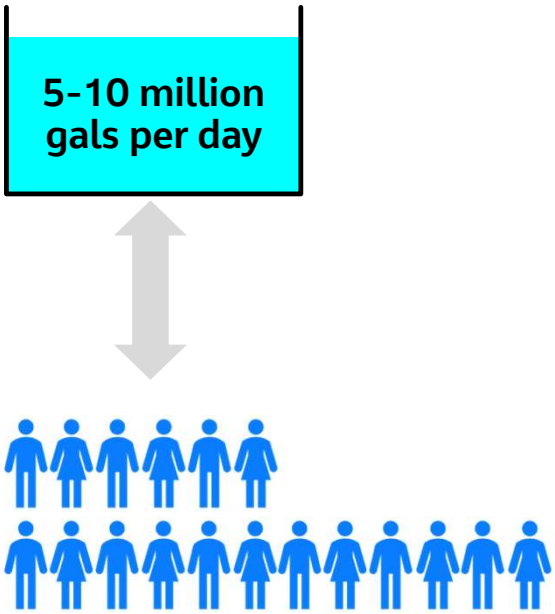
## Fab facility personnel will increase

- utility's drinking water demand
- utility's wastewater flow
- Facility may employ 1,000-2,000 people

## How quickly will utility's facilities need to be in place?

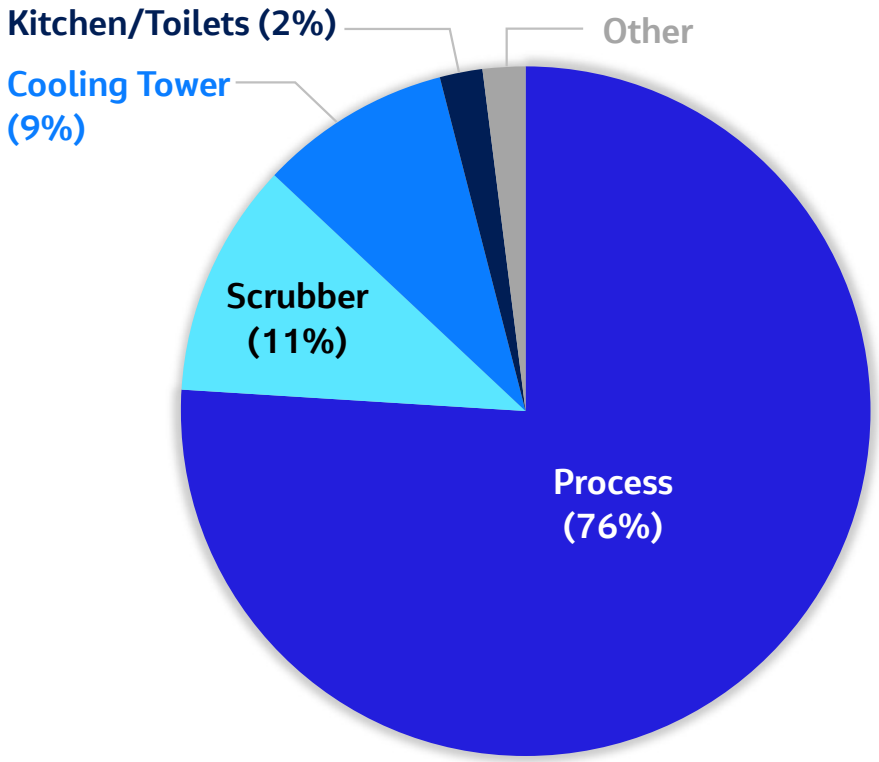
# Semiconductor Fabrication Facility Water Use

- Typical large-fab water use (no on-site reuse)

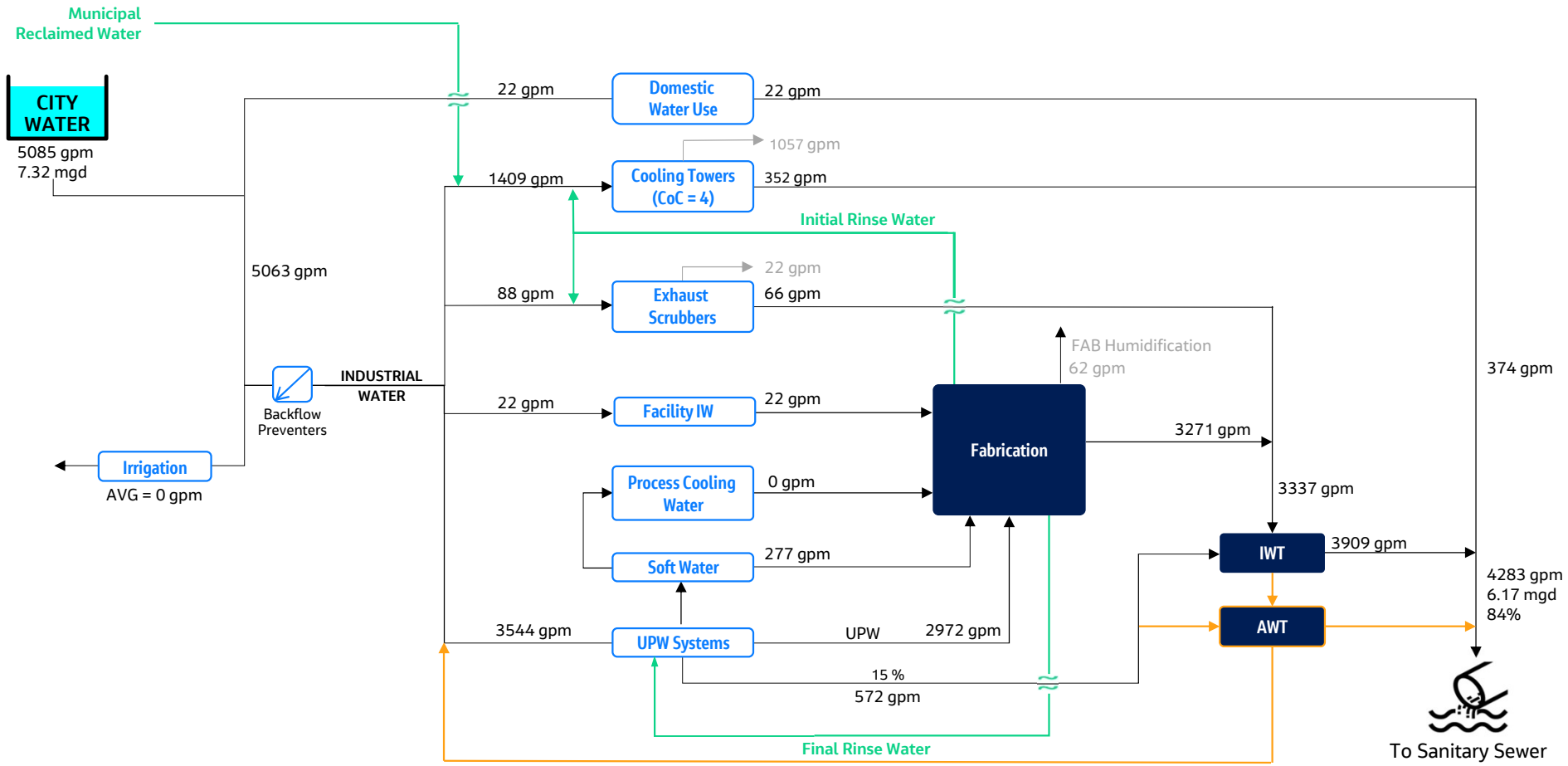



60,000 -122,000
equivalent population

- Water usage within the fab

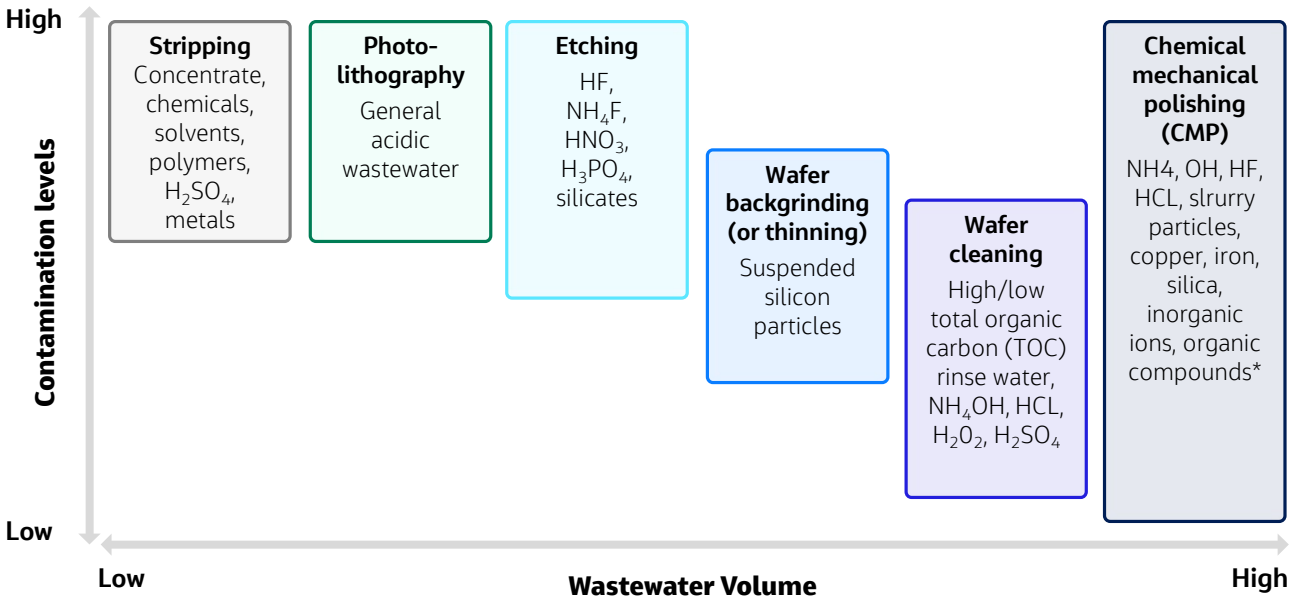


# Fab water balance (nominal 400,000 ft2 clean room)



# Fab clean room waste streams

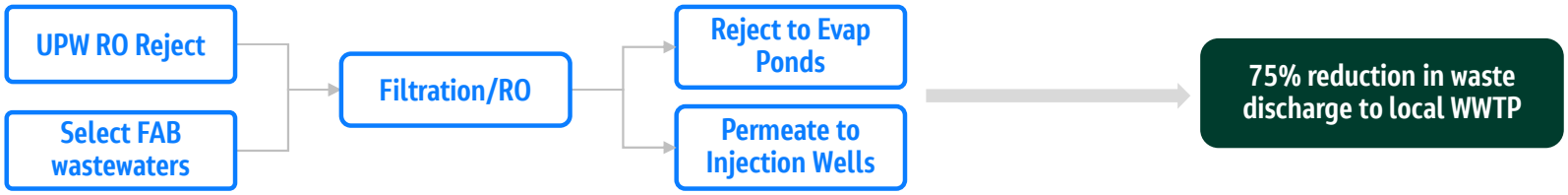
- Multiple streams are generated, varying in contaminant level and volume
- Traditional on-site treatment includes fluoride and ammonia removal as well as pH neutralization



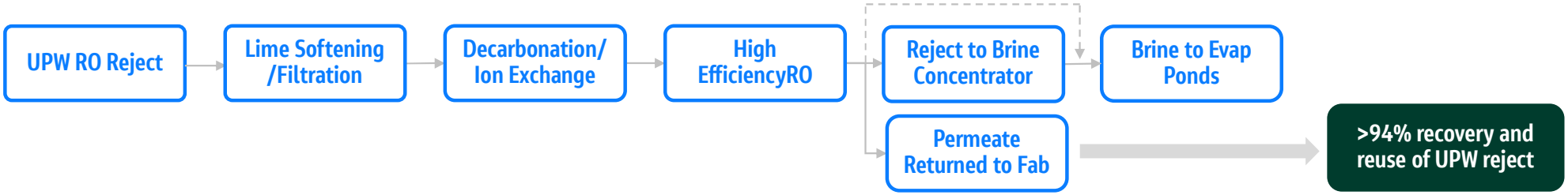

*From Global Water Intelligence, 2021

# Case Study in Fab Water Reuse Evolution – Intel Ocotillo Facility

- Chandler RO Facility (operated by City; paid for by Intel) - 1994




- Cooling tower make-up water supplied by reclaimed water
- Chandler Ocotillo Brine Reduction Facility (operated by City; paid for by Intel) - 2014




- Intel W.A.T.R. Facility (Wastewater Treatment and Recovery) - 2021
  - Treats industrial waste streams for reuse with the fab
  - Minimizes off-site discharge of wastewater to the local WWTP

# Research Areas for Advancing Fab Water Reuse

## Improvements in Wastewater Treatment Technologies

- Advanced membrane-based technologies for increased water recovery
  - 3-D and electrospray membrane printing; 3-D printed spacers
  - Osmotically-assisted RO systems

## Application of novel methods for resource recovery

- Ion selective membranes for selective contaminants (e.g, NH4)
- More cost-effective and efficient electrowinning technologies for high-value metals recovery (e.g., Cu)