

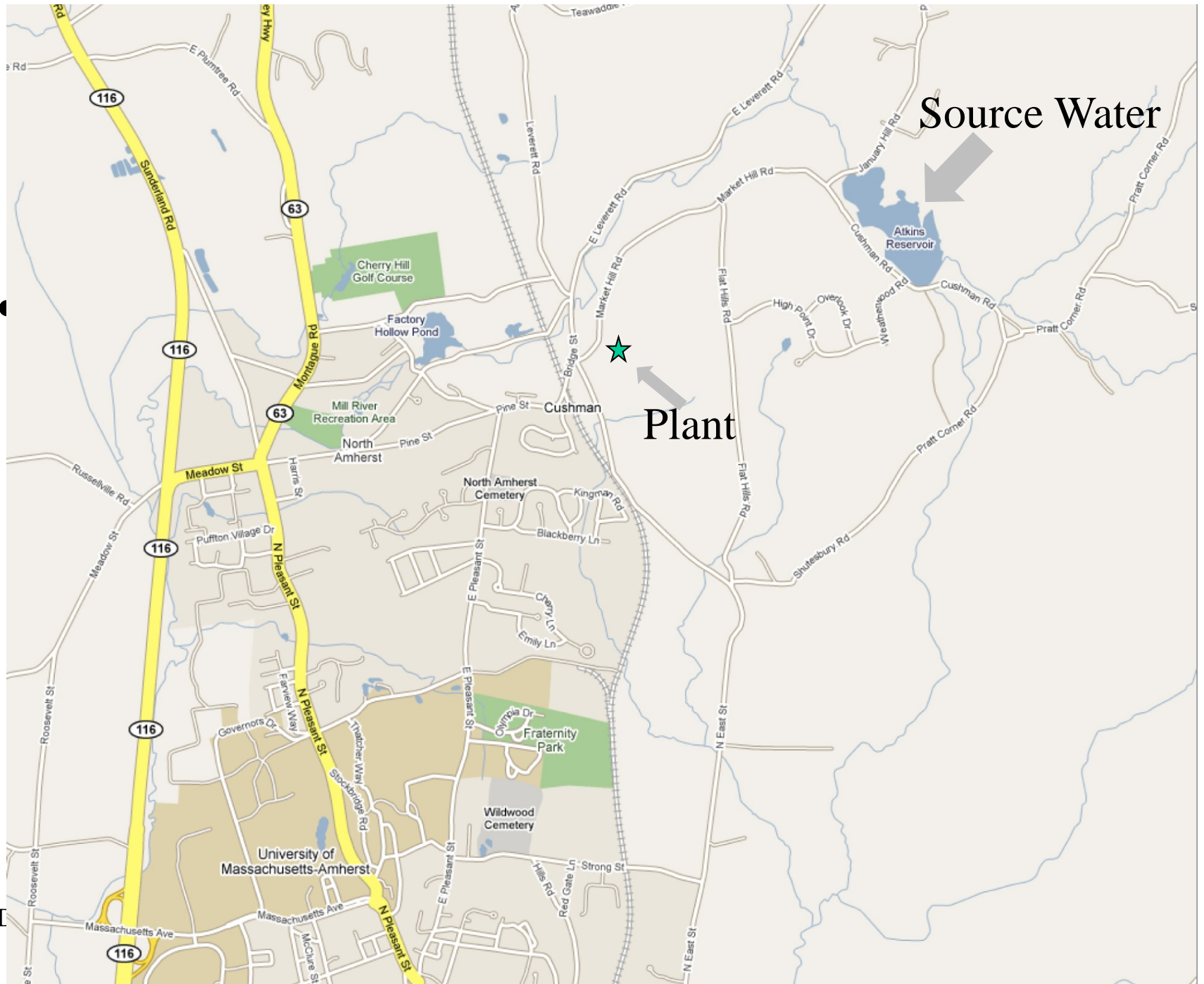
Amherst , MA, Drinking Water System

Atkins Water Treatment Plant

- Planned by:
 - Ad Hoc Citizen's Advisory Committee, Amherst DPW and Consultant (Tighe & Bond, Inc)
- Water Source: Atkins Reservoir
- Design Flow: 1.5 million gallons per day
- On-line: February 1994
- Treatment:
 - Coagulation (addition of caustic soda and polymer)
 - Ozonation (2 locations; raw & filtered)
 - Trident upflow clarification
 - Filtration
 - Disinfection

Directions to Atkins WTP

- 31 Market Hill Road, Amherst, MA
- see following maps and directions
 - Take N or E. Pleasant up to Pine St.
 - Right on Pine
 - Left on Bridge
 - Right on Market Hill Road
 - Right to Atkins WTP Parking lot



Source Water

Plant

I

Close-up of driveway

- To



Park
Here

Overall View

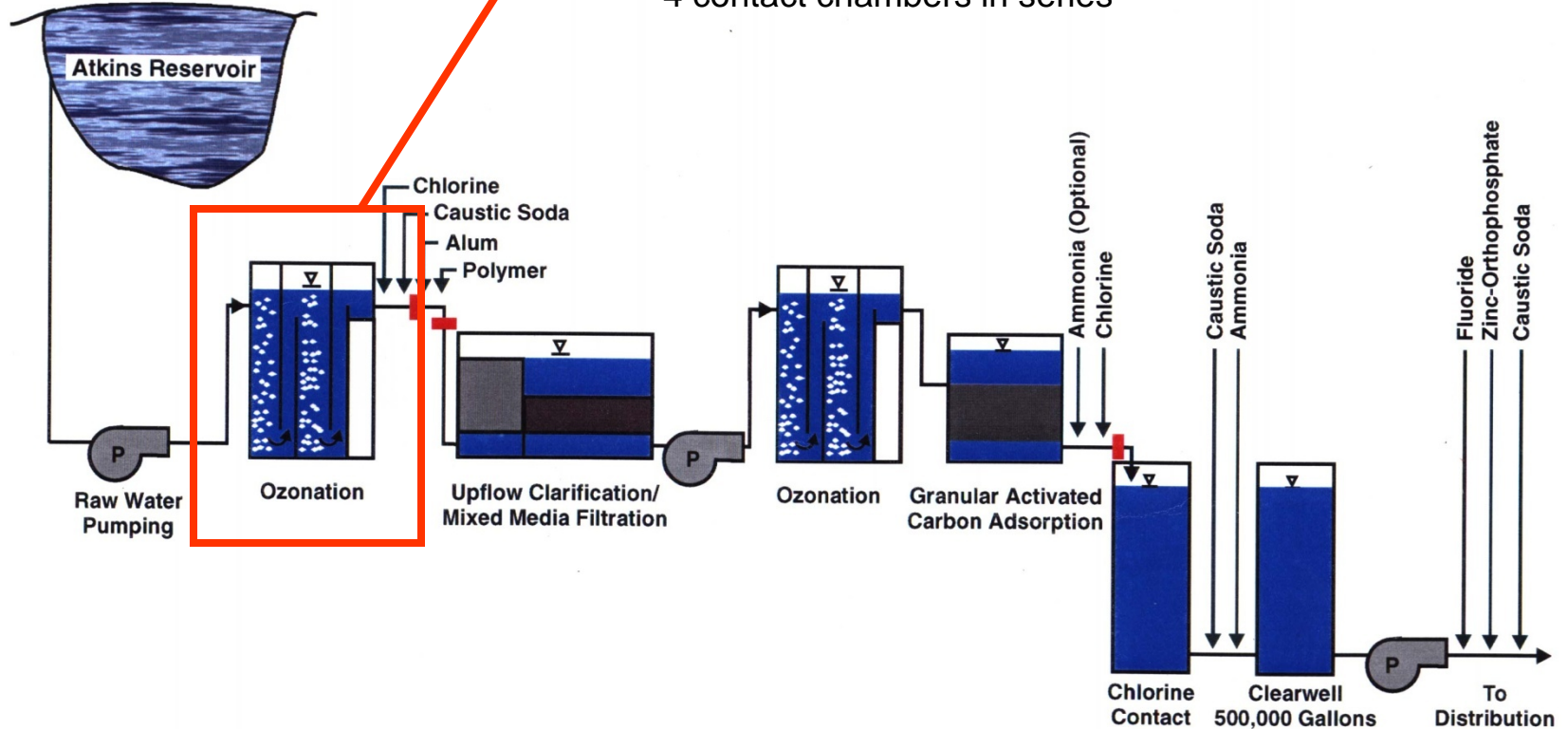


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Atkins Reservoir Water Treatment Plant Process Flowchart

- Pre-Trident Ozonation
 - control of taste and odor, color removal
 - Disinfection (CT credits achieved)
 - 2.5 mg/L ozone added
 - 4 contact chambers in series



Ozonation

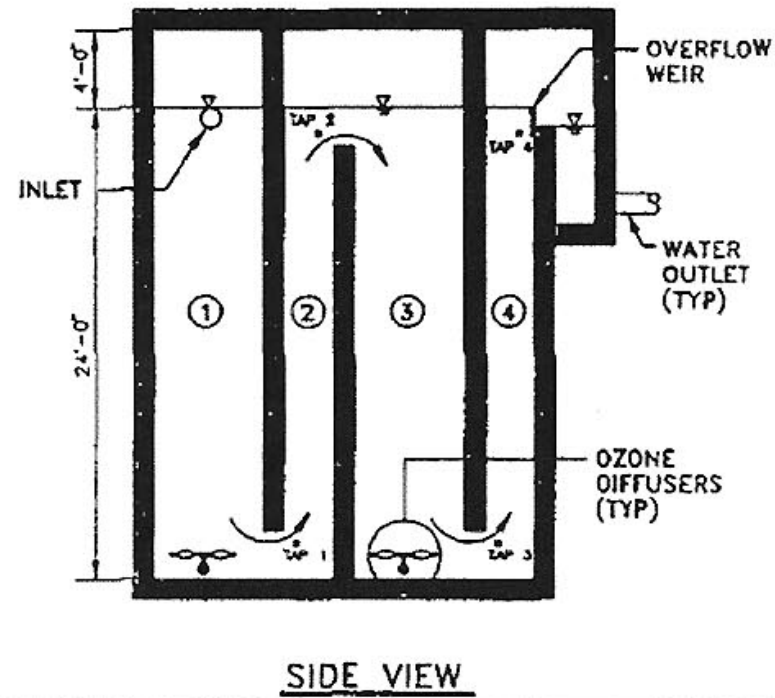
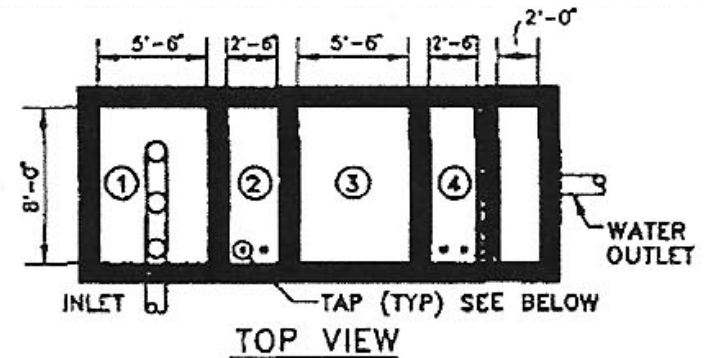
2 Generators

With Air preparation system



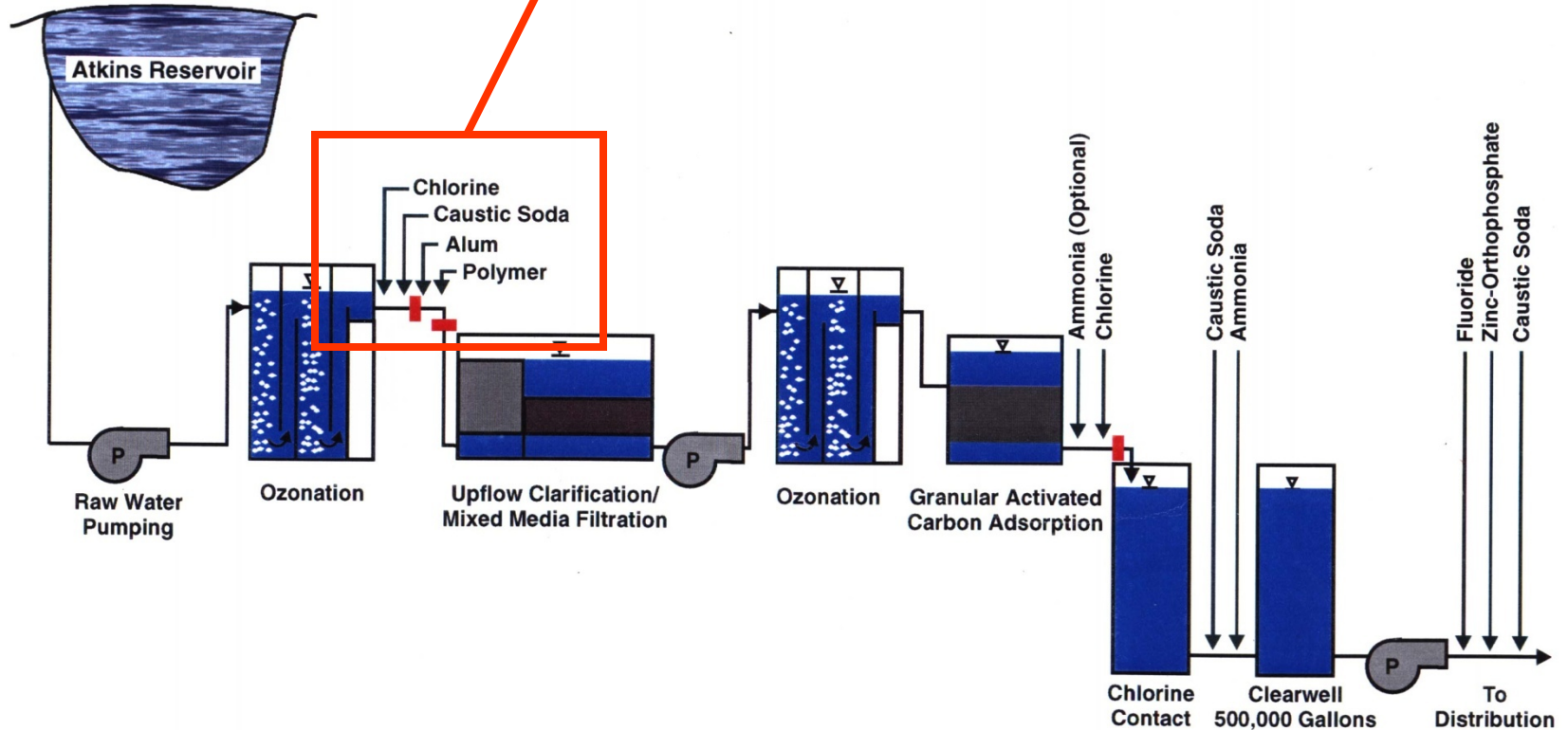
Amherst Ozone Contactors

- Pre and Post contactors are identical
- Four chambers
 - Under/over baffled



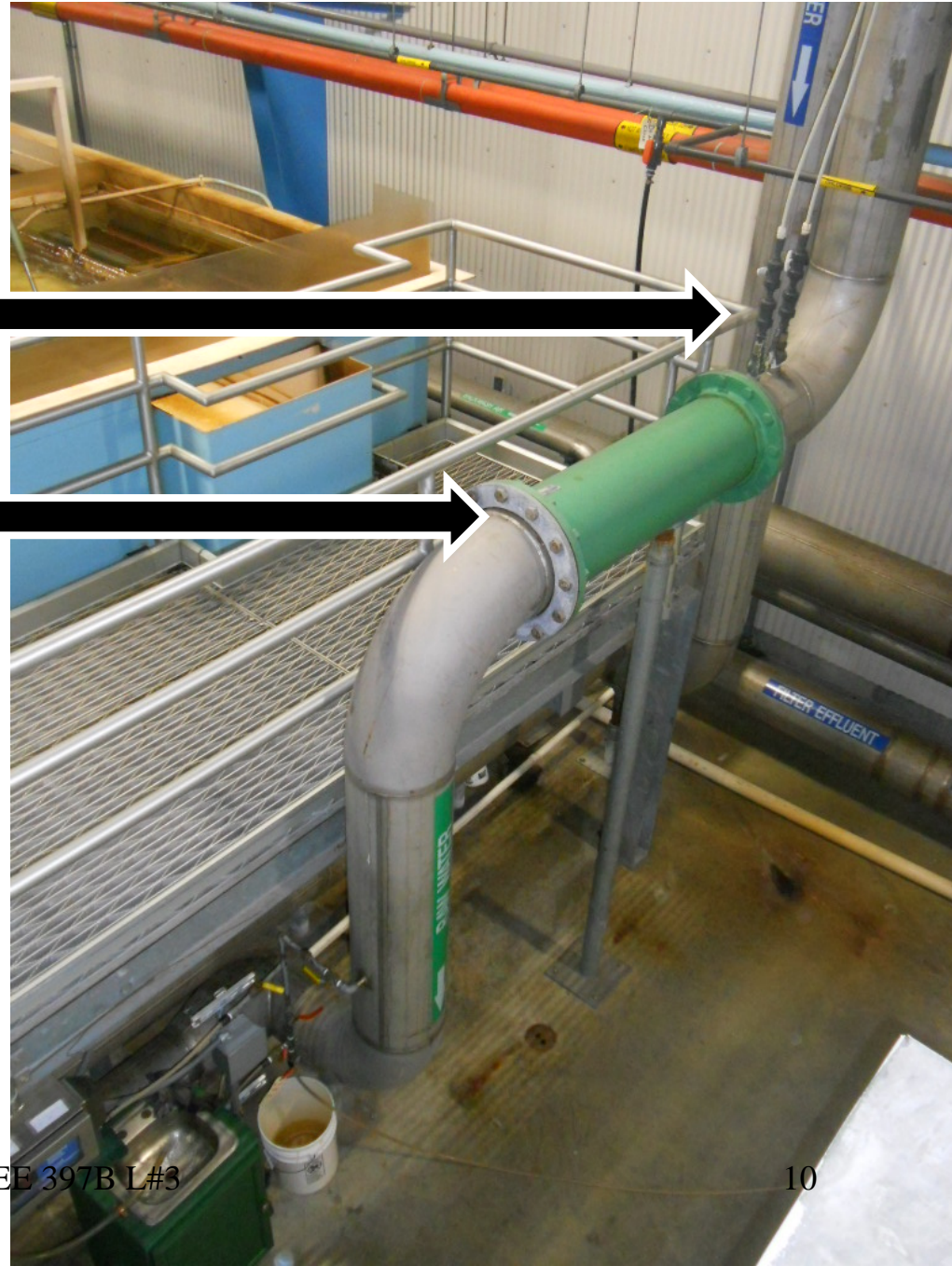
Atkins Reservoir Water Treatment Plant Process Flowchart

- Pre-Trident Chemical Addition
 - coagulant addition (alum and cationic polymer)
 - pH adjustment for optimization of Coagulation



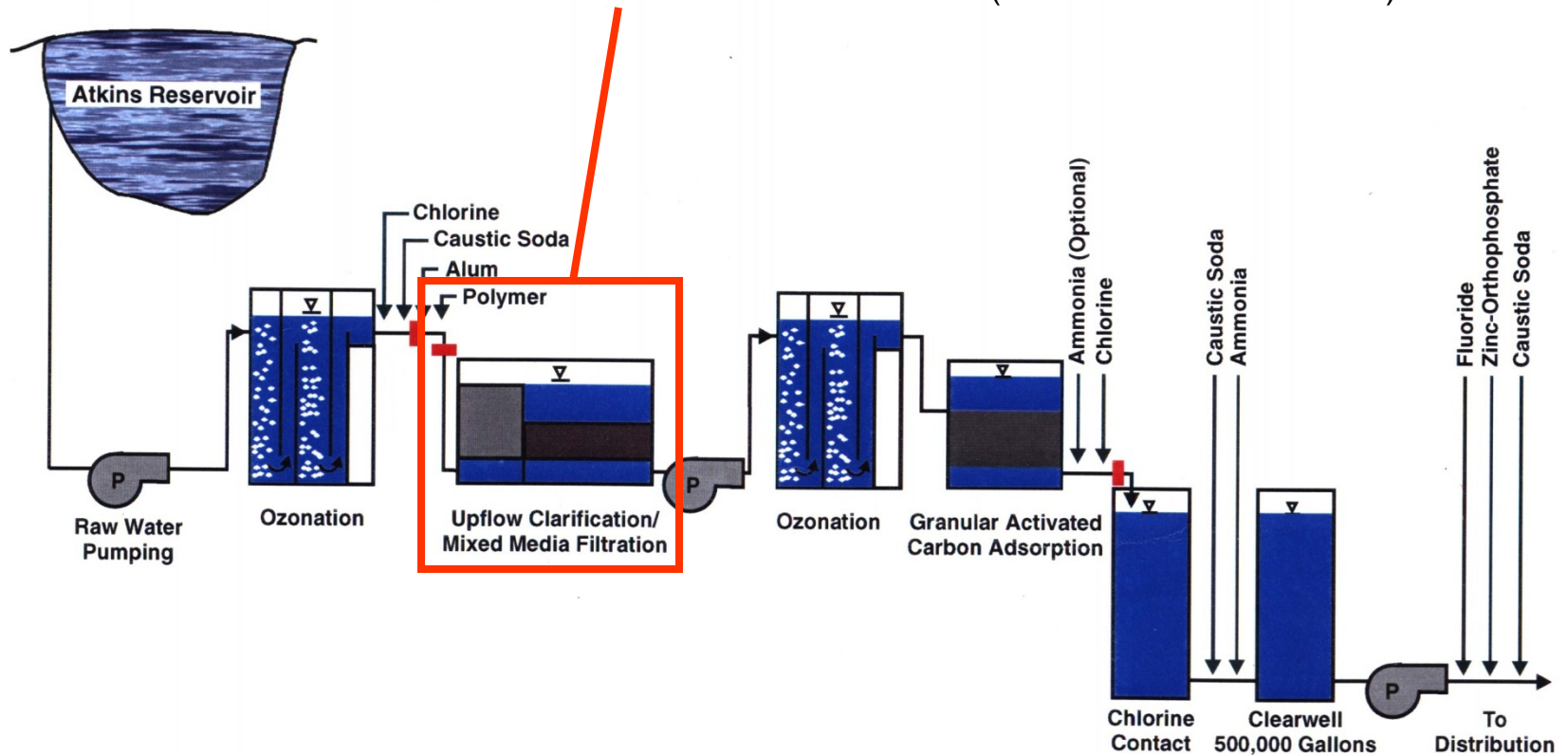
Rapid Mixing

- Chemical injection point
- Static Mixer
 - Internal vanes that cause turbulent mixing



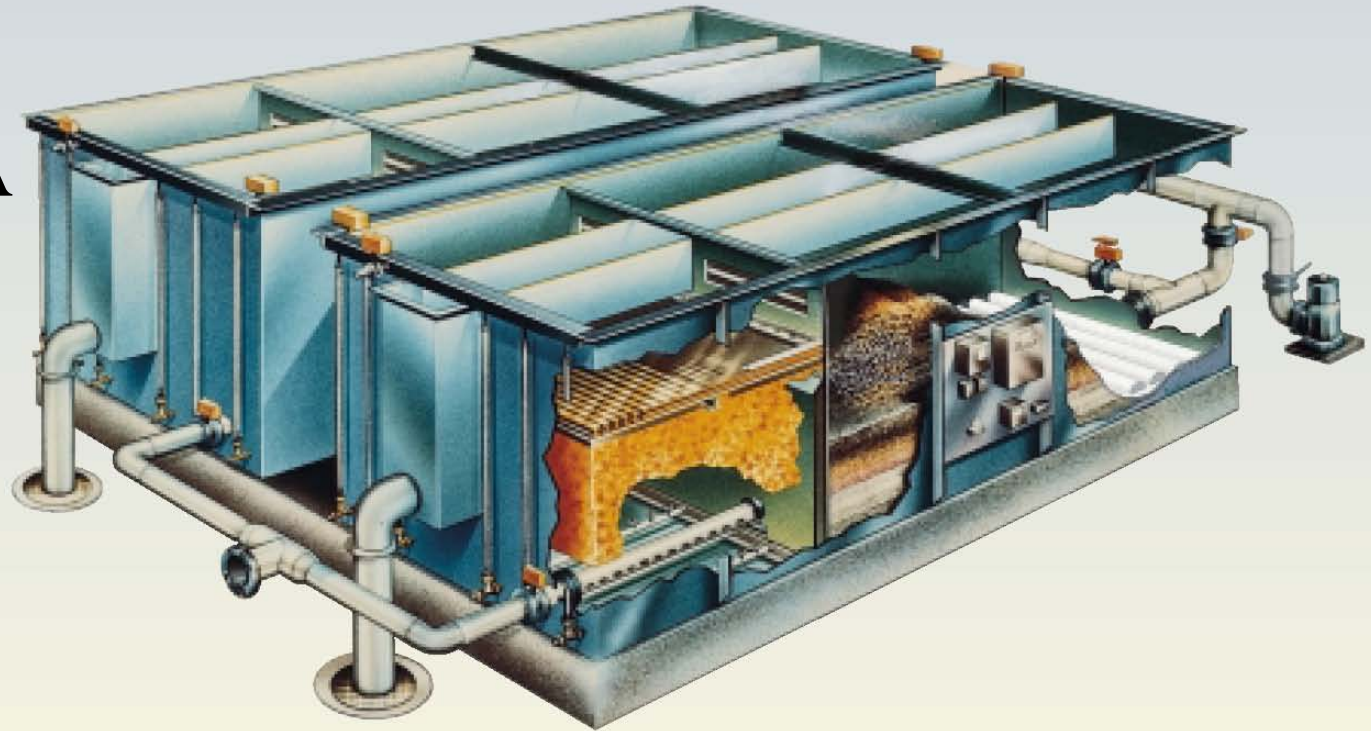
Atkins Reservoir Water Treatment Plant Process Flowchart

- Trident Filtration Process
 - 3 factory fabricated steel tanks, 0.75 MGD each
 - buoyant plastic media in upflow clarifier
 - conventional media filtration (anthracite coal and sand)



Trident Clarification/Filtration Unit

- TR 420A



MODEL		TR-105A	TR-210A	TR-420A	TR-840A	TR-105-LP	TR-210-LP	TR-420-LP	TR-840-LP
Typical Design Flow	GPM*	350	700	1400	2800	350	700	1400	2800
Dimensions (each tank)	Length	10' 1"	14' 5 1/2"	27' 10"	39' 10"	9' 1"	12' 11 1/2"	24' 9"	35' 6"
	Width	6' 11"	8' 11"	8' 11"	11' 11"	6' 11"	8' 11"	8' 11"	11' 11"
	Height	8' 5"	8' 5"	8' 5"	10' 1"	7' 6"	7' 6"	7' 6"	8' 6"

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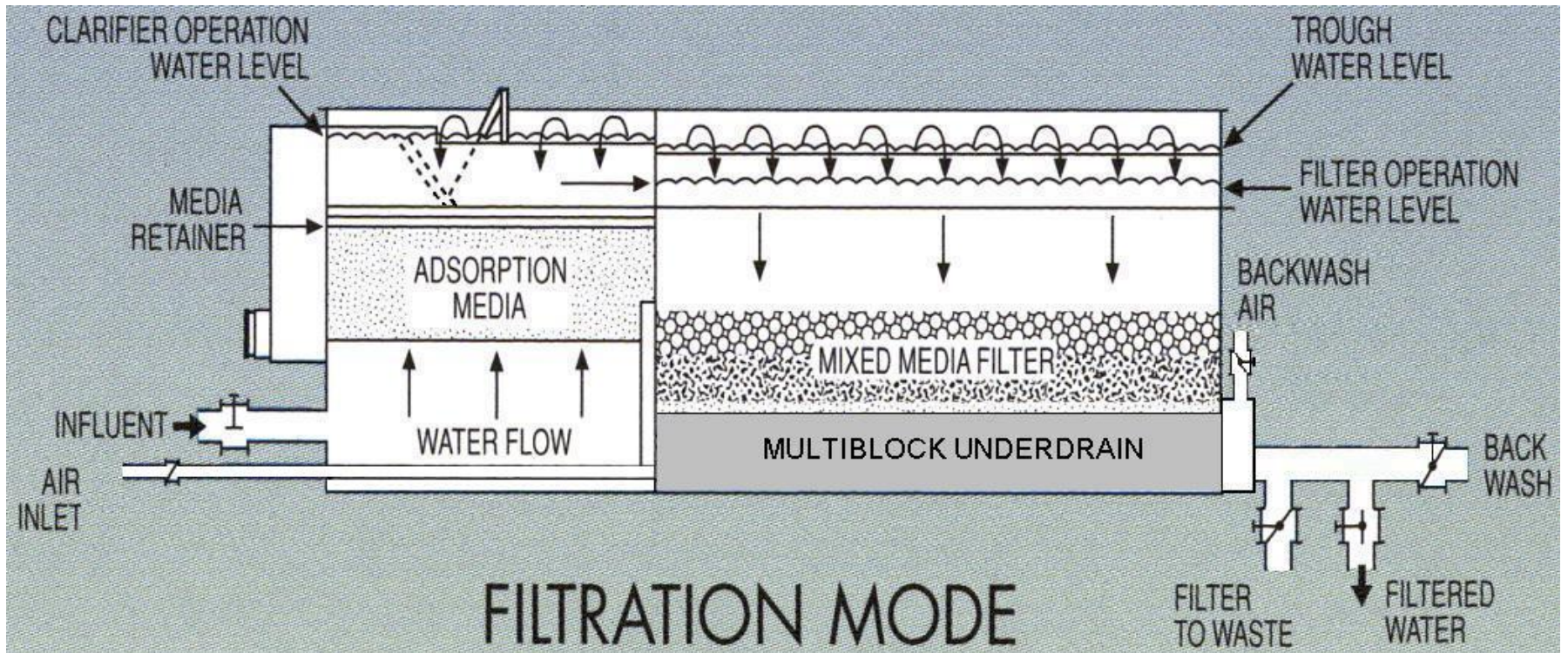
* Design flow is for a two-tank system. Being modular allows us to provide a (1 1/2) TR-210A to treat 1050 gpm with 3 tanks, or a (2) TR-840A for 5,600 gpm, etc.

Adsorption Clarifier Media

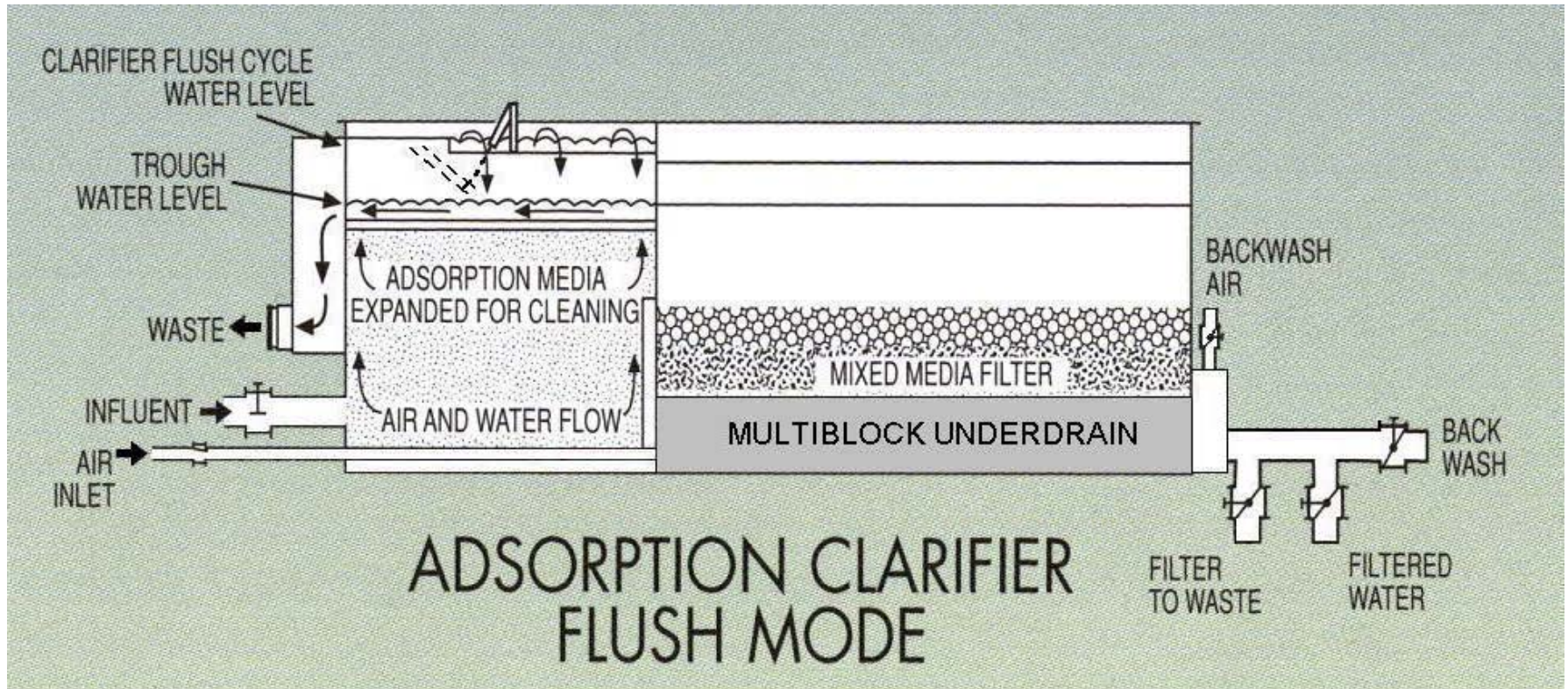
- AC Media Technical Details:
 - Buoyant Media
 - Specific gravity slightly < 1.0
 - Allows for complete fluidization
 - Effective size ~ 2.5 mm
 - Rolled and scarified media
 - Lasts for life of plant
 - No maintenance required



Operation: Filtration

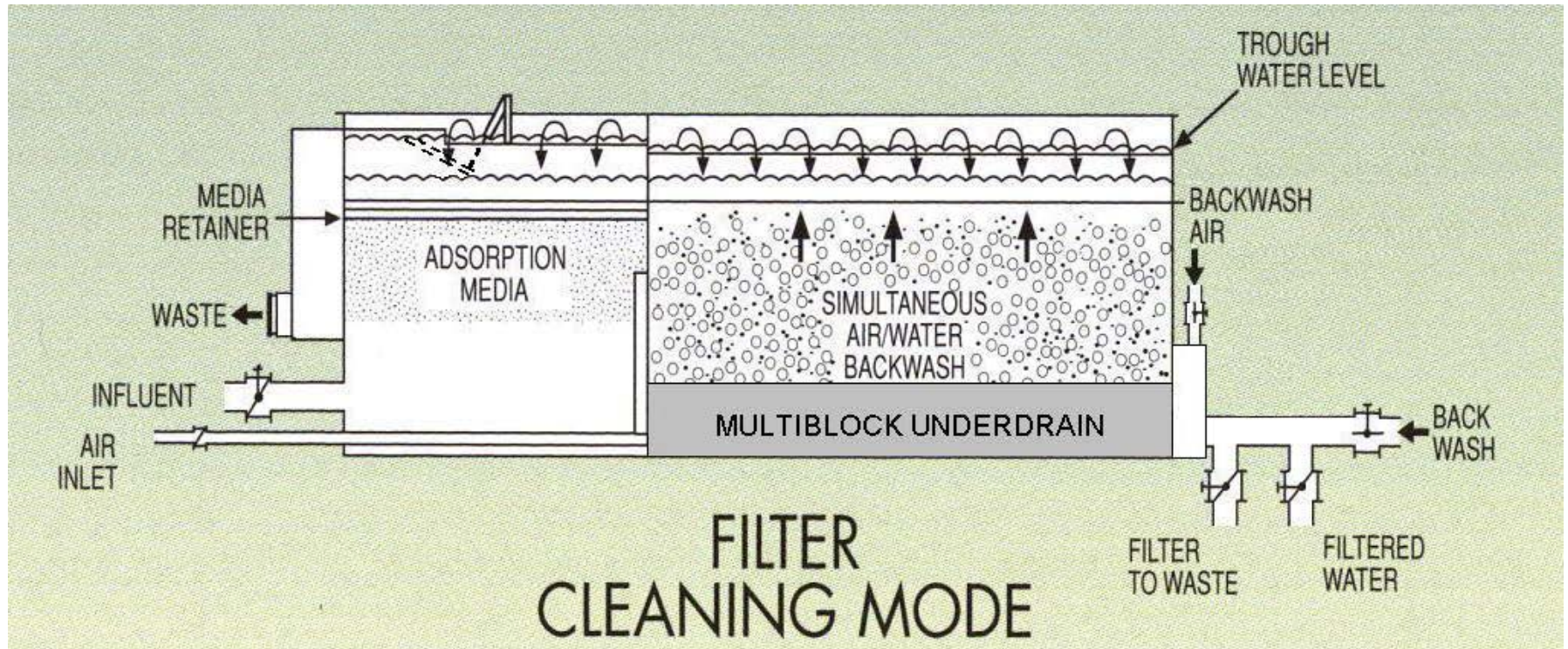


Operation: Clarifier Flush



- AC typically cleans 2 to 4 times per every filter backwash

Operation: Filter Backwash



Clarification & Filtration

Normal Operation

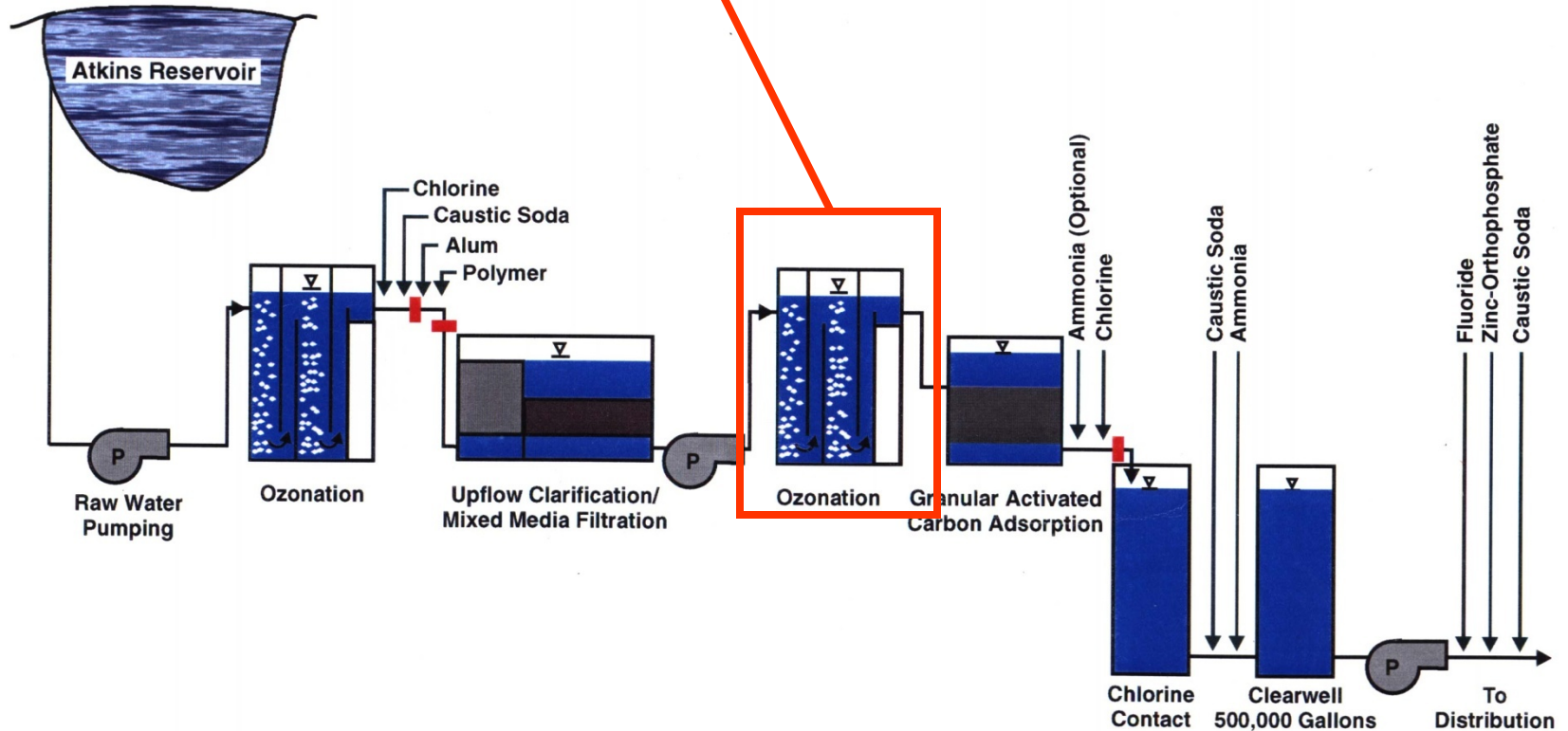


Backflush



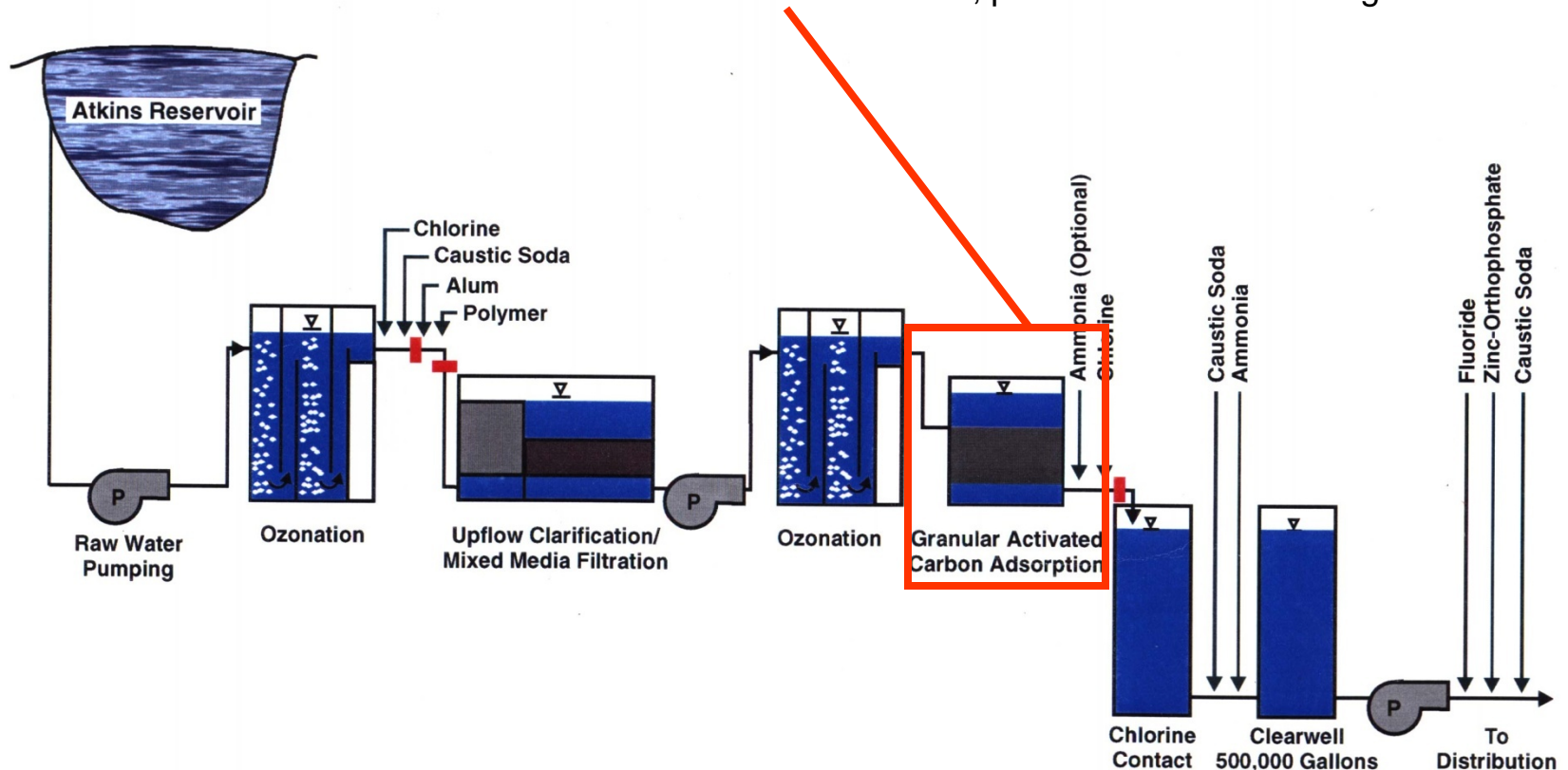
Atkins Reservoir Water Treatment Plant Process Flowchart

- Post-Trident Ozonation
 - redundancy for pre-Trident ozonation
 - removal of dissolved organic carbon
 - 1.5 mg/L ozone added
 - Identical to pre-ozone contactor



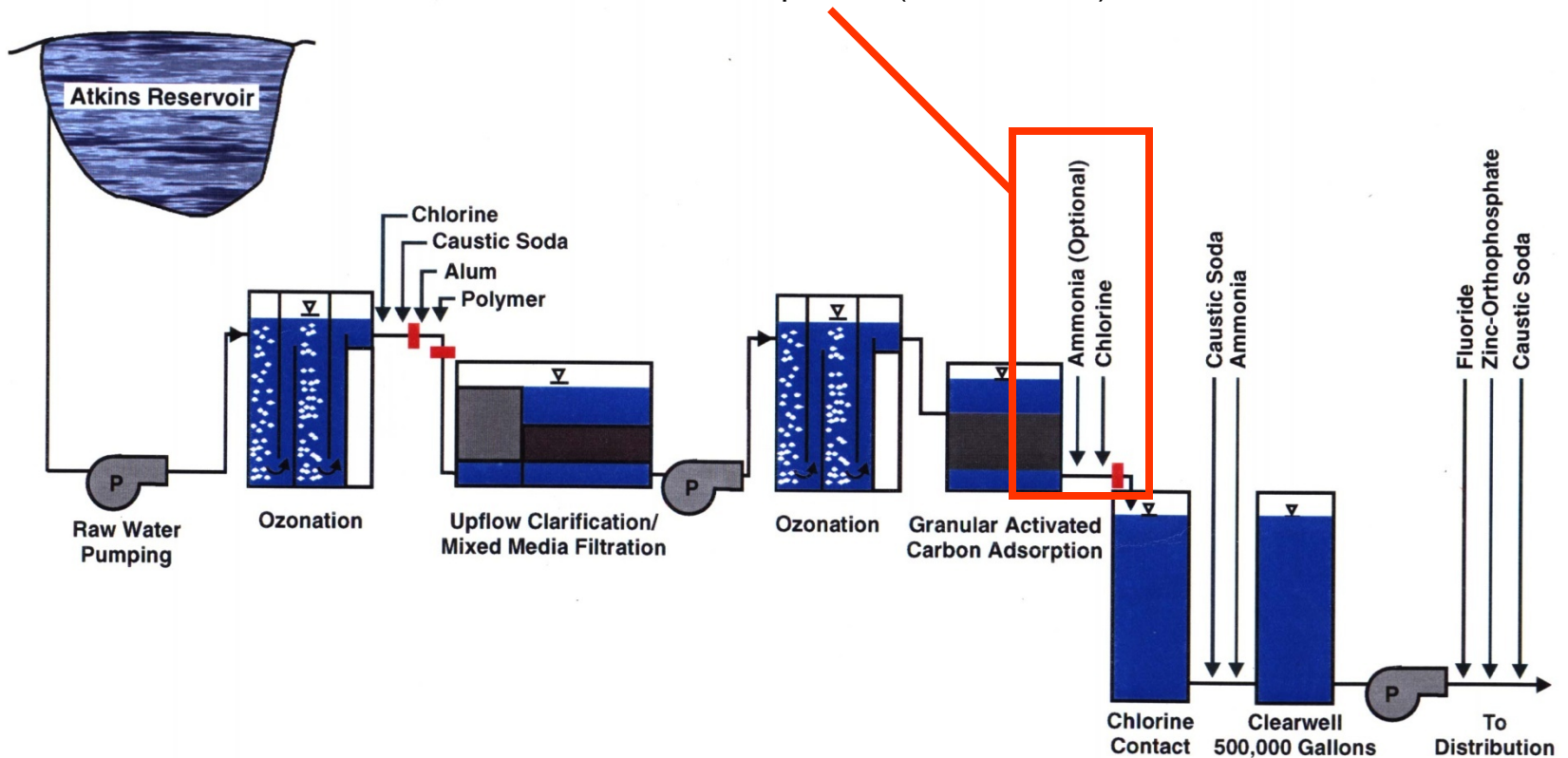
Atkins Reservoir Water Treatment Plant Process Flowchart

- Granular Activated Carbon (GAC) Adsorption
 - reduced taste and odor, chlorination byproduct precursors
 - improved removal of DOC
 - reduced chlorine demand, potential for bacterial regrowth



Atkins Reservoir Water Treatment Plant Process Flowchart

- Chlorine / Ammonia Addition
 - Dose necessary to keep residuals in system
 - ammonia is optional (chloramines)



Chlorination

Chlorine Storage

- pressurized tanks of Cl_2



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Chlorine Contact Tank

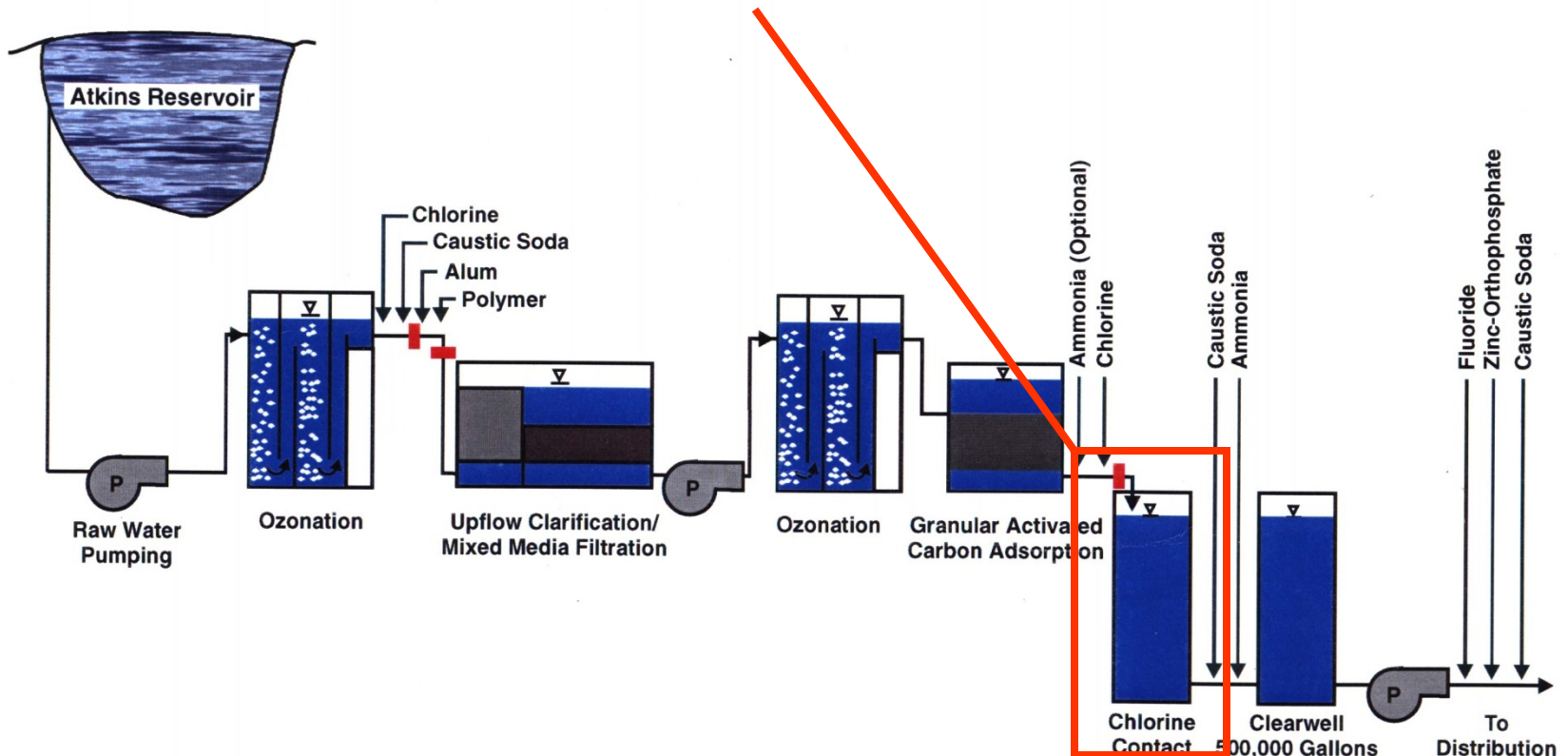
- Tank below floor



21

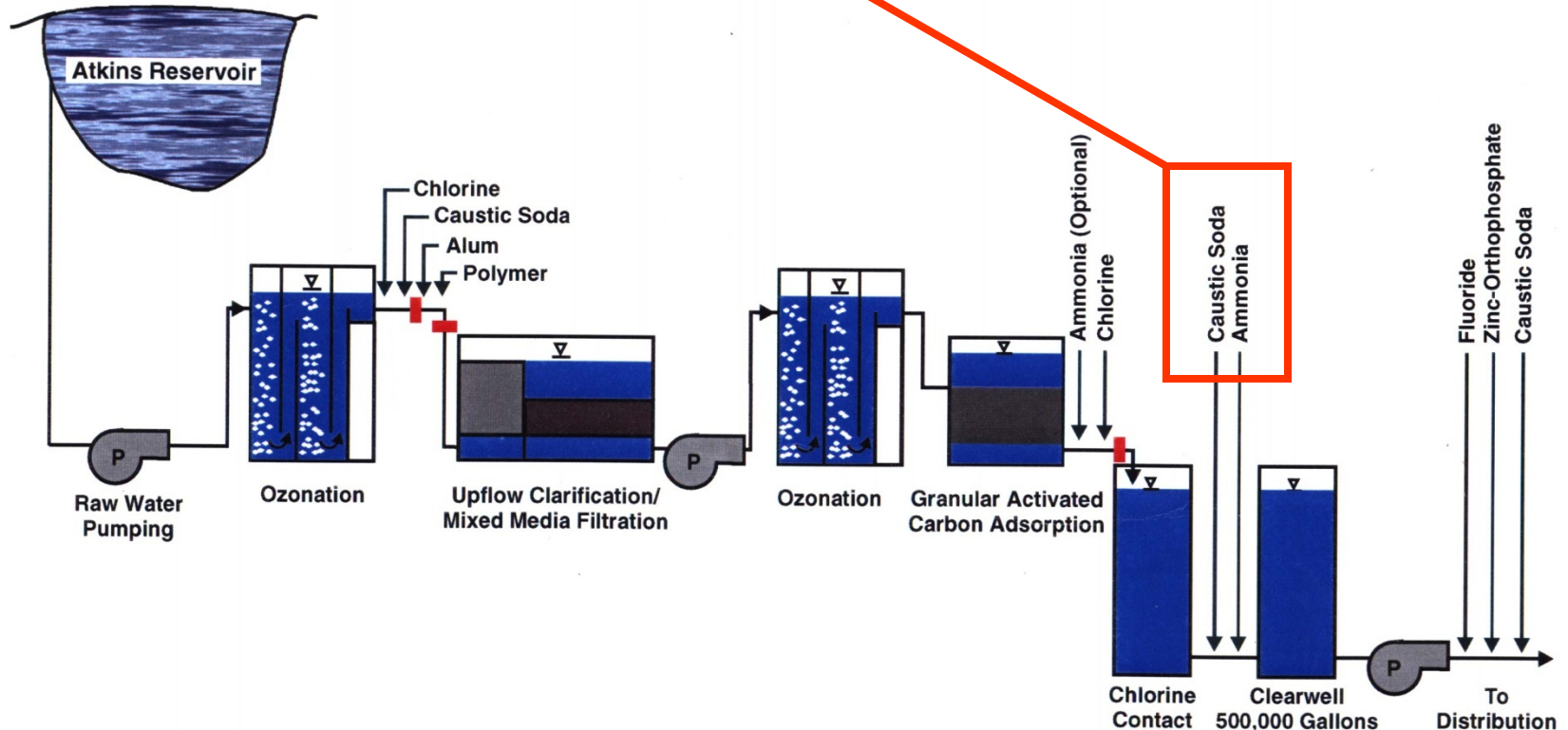
Atkins Reservoir Water Treatment Plant Process Flowchart

- Chlorine Contact Tank
 - 22.5 ft depth, L/W ratio = 14
 - with 5 redwood perforated baffles
 - Backup for disinfection (CT requirement)



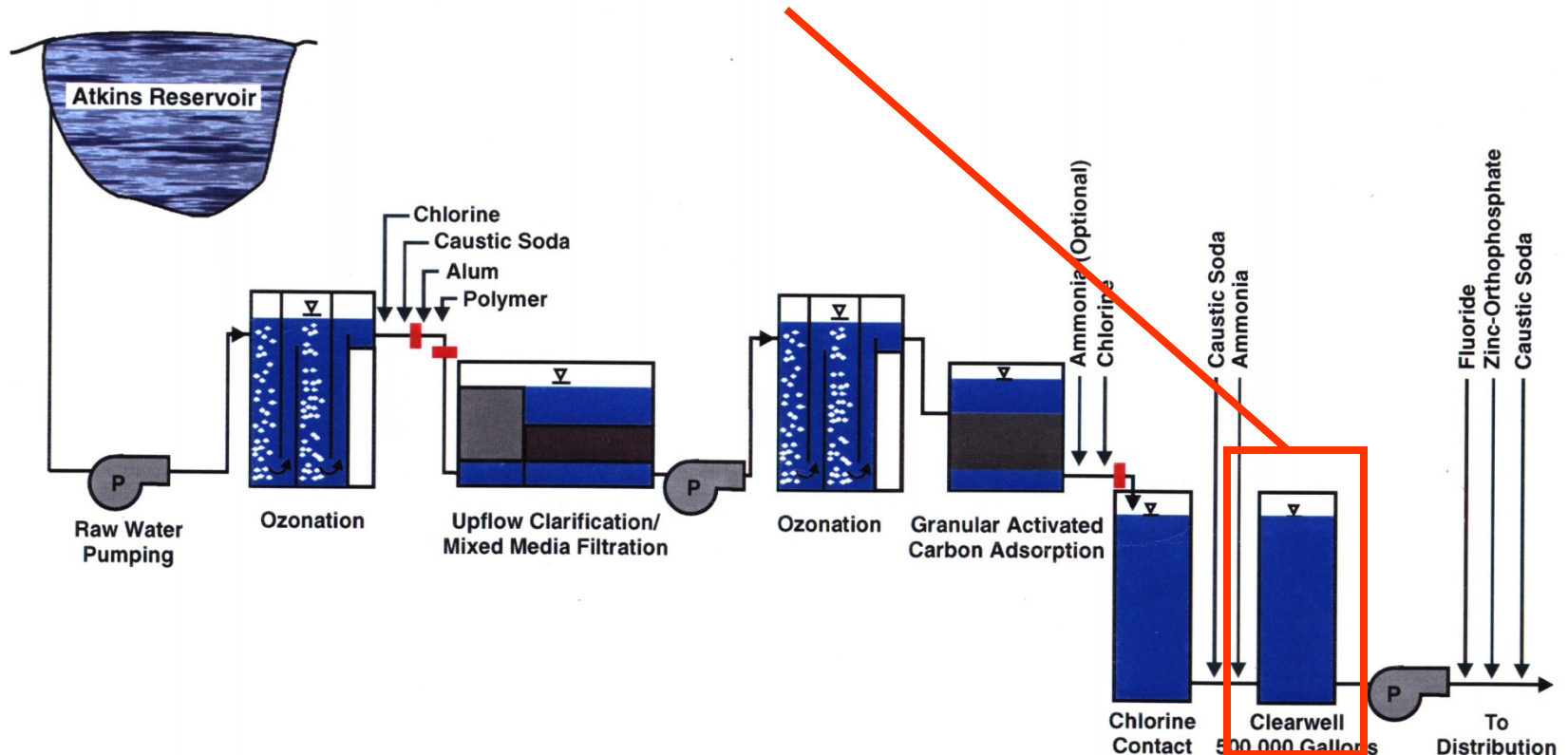
Atkins Reservoir Water Treatment Plant Process Flowchart

- Caustic Soda Addition (raise pH)
 - corrosion control in distribution system
- Ammonia Addition (convert chlorine to chloramines)
 - control of trihalomethanes, other disinfectant residuals



Atkins Reservoir Water Treatment Plant Process Flowchart

- Clearwell Storage Tanks
 - additional disinfectant contact time
 - flow equalization and backwash control
 - 2 tanks with 250,000 gallon capacity each



Support Equipment

Chemical Storage

- Polymer, alum, fluoride, etc.

High Lift Pumps

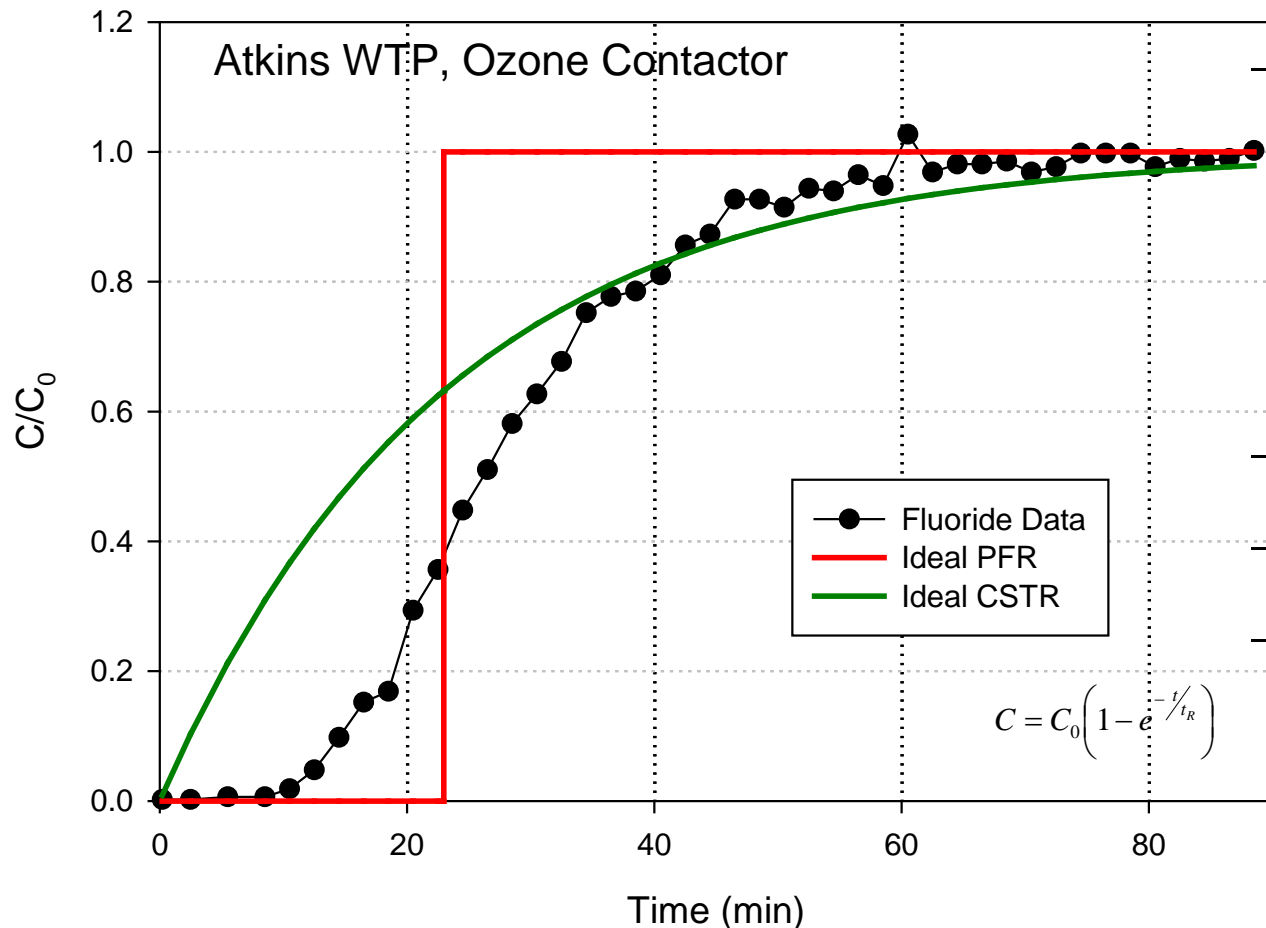
- Sending water on to the distribution system



The End

Amherst O₃ Contactor II

- Fluoride Tracer test



Step feed @ $t=0$

- 2.4 mg/L
- Added to inlet
- Measure F⁻ at outlet vs time

Q=1000 gpm

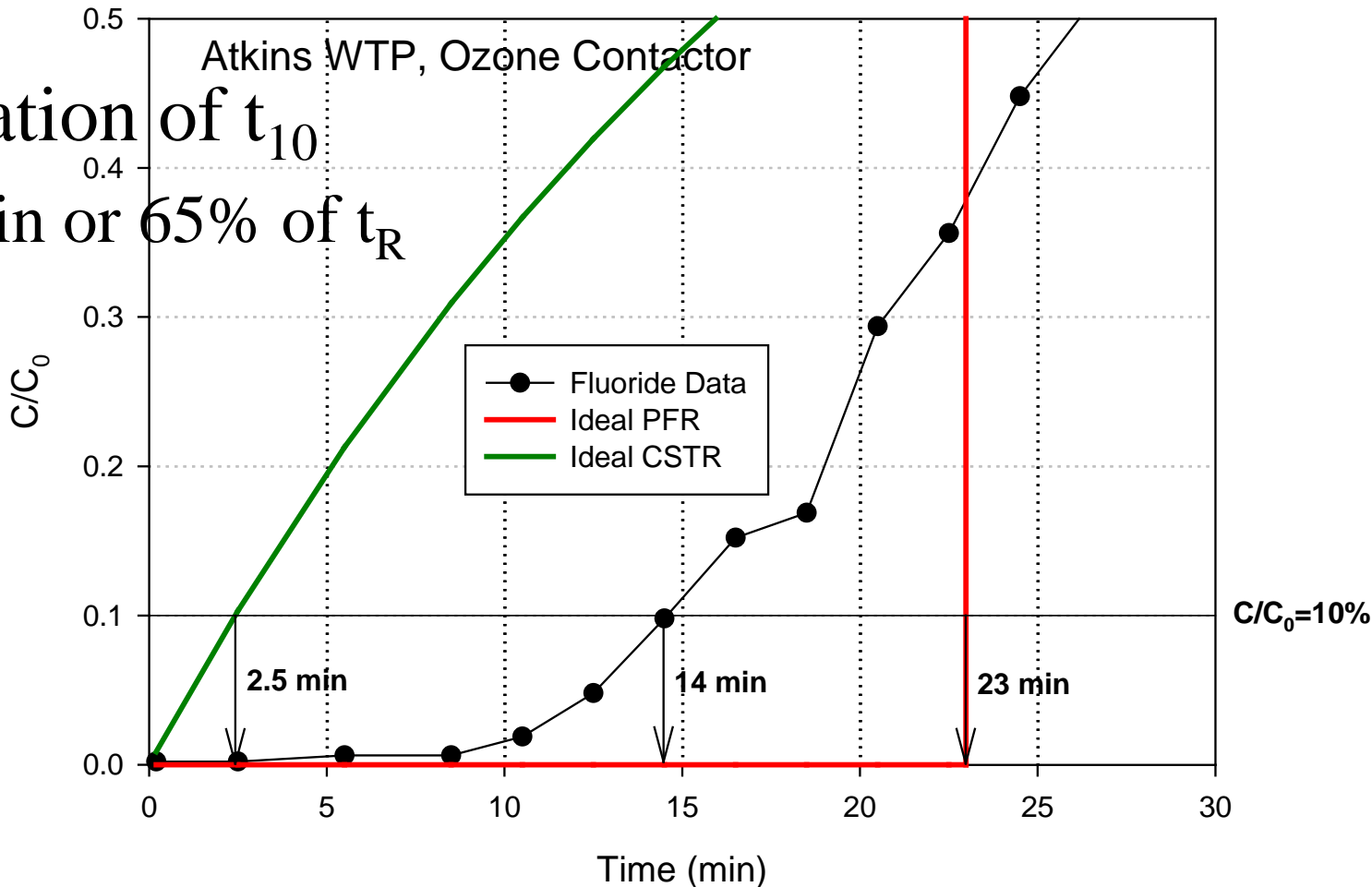
V=22,980 gal

$C_0=2.4$ mg/L

Data from :Teefy, 1996
[AWWARF Report]

Amherst O₃ Contactor III

- Calculation of t_{10}
 - 14 min or 65% of t_R



Data from :Teefy, 1996
[AWWARF Report]

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Ct values for Viruses

- For Viruses at various temperatures
 - pH 6-9

H&H Table 7-5, pg 245

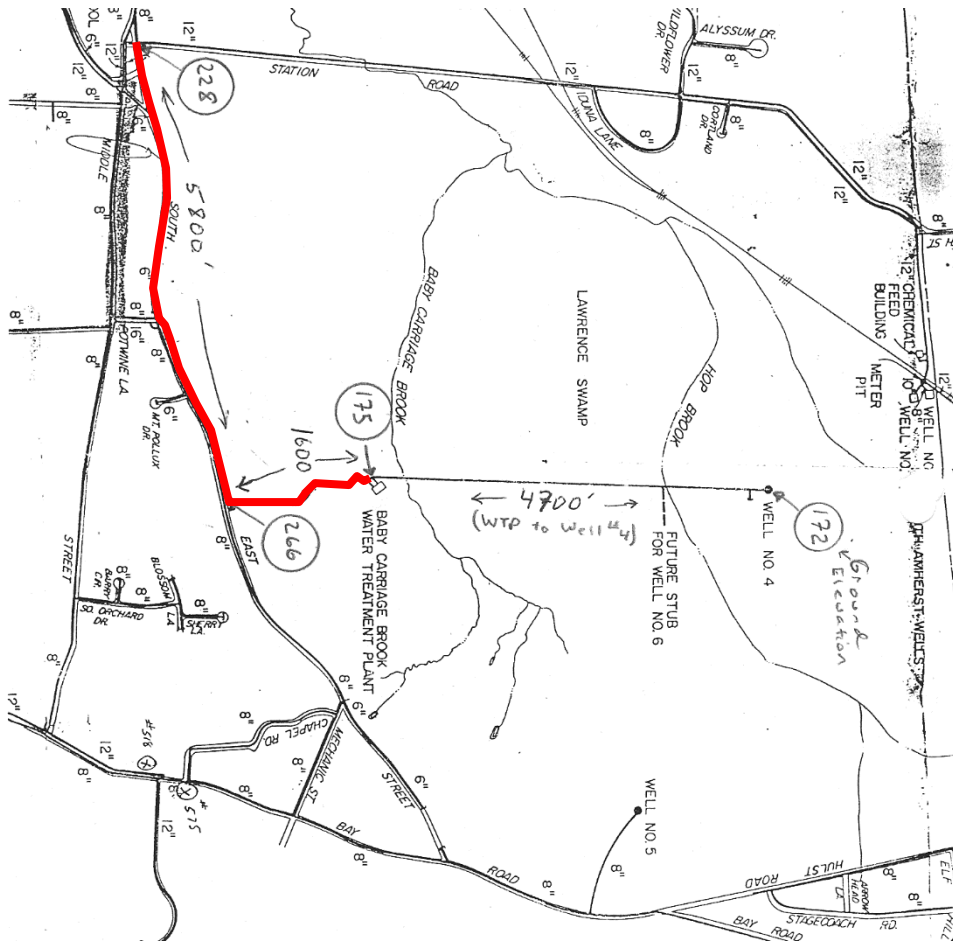
	LOG INACTIVATION	WATER TEMPERATURE				
		0.5°C [(mg/l) · min]	5°C [(mg/l) · min]	10°C [(mg/l) · min]	15°C [(mg/l) · min]	20°C [(mg/l) · min]
Free chlorine	2.0	6	4	3	2	1
	3.0	9	6	4	3	2
	4.0	12	8	6	4	3
Preformed chloramine	2.0	1200	860	640	430	320
	3.0	2100	1400	1100	710	530
Chlorine dioxide	2.0	8.4	5.6	4.2	2.8	2.1
	3.0	25.6	17.1	12.8	8.6	6.4
Ozone	2.0	0.9	0.6	0.5	0.3	0.2
	3.0	1.4	0.9	0.8	0.5	0.4

Source: Adapted from *Guidance Manual for Compliance with the Filtration and Disinfection Requirements for Public Water Systems Using Surface Water Sources*. U.S. Environmental Protection Agency.

Amherst O₃ Contactor IV

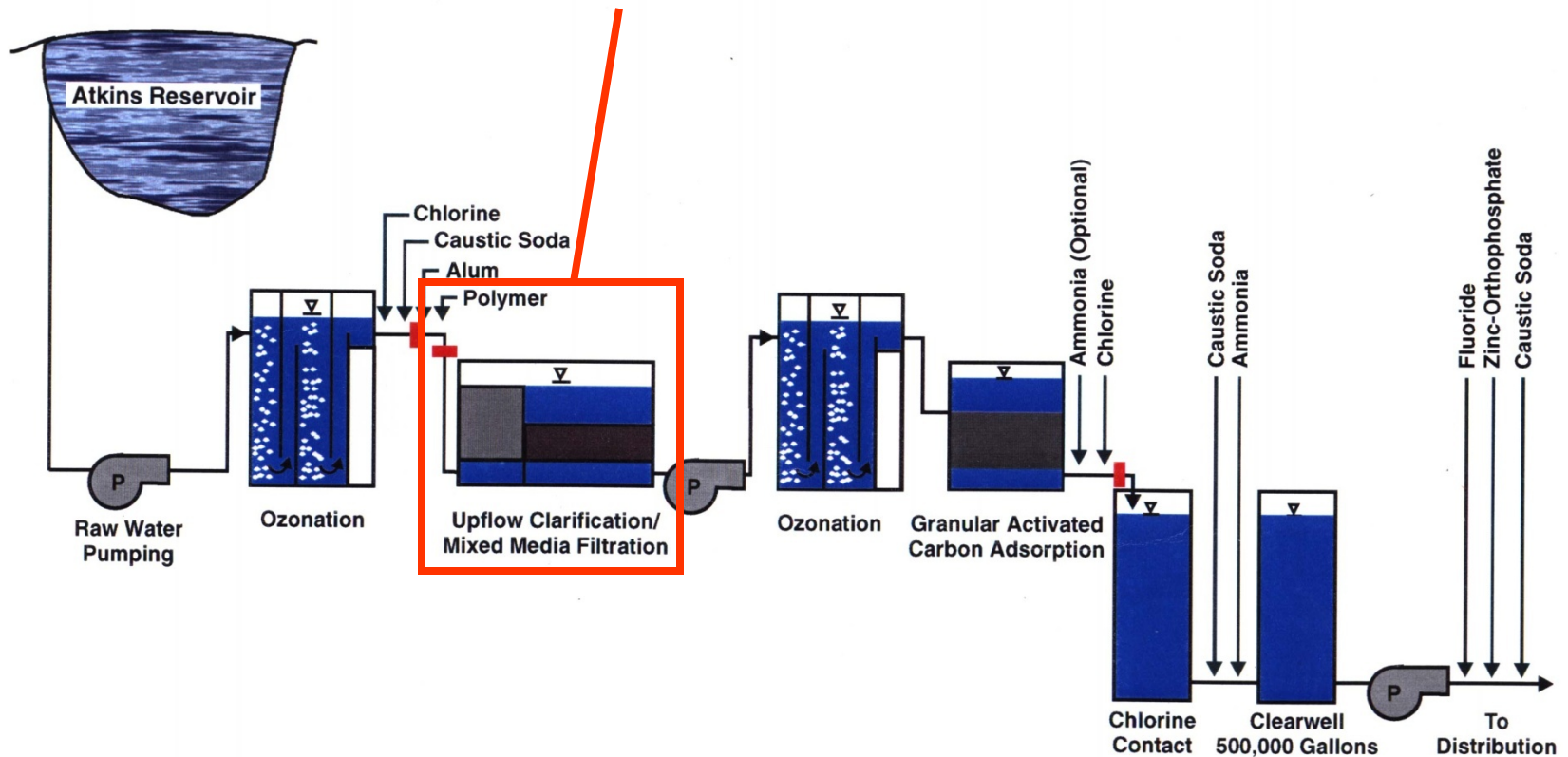
- Use of t_{10} for disinfection compliance
 - Conventional treatment requires 2 log virus inactivation by disinfection
 - For ozone 0.9 mg/L – min is worst case (0.5°C, in H&H table 7-5)
 - With a if $t_{10} = 14$ min, then we need to have 0.065 mg/L ozone residual at outlet of tank

$$C_{\min} = \frac{(Ct)_{\text{required}}}{t_{10}} = \frac{0.9 \frac{\text{mg}}{\text{L}} \text{ min}}{14 \text{ min}} = 0.065 \frac{\text{mg}}{\text{L}}$$



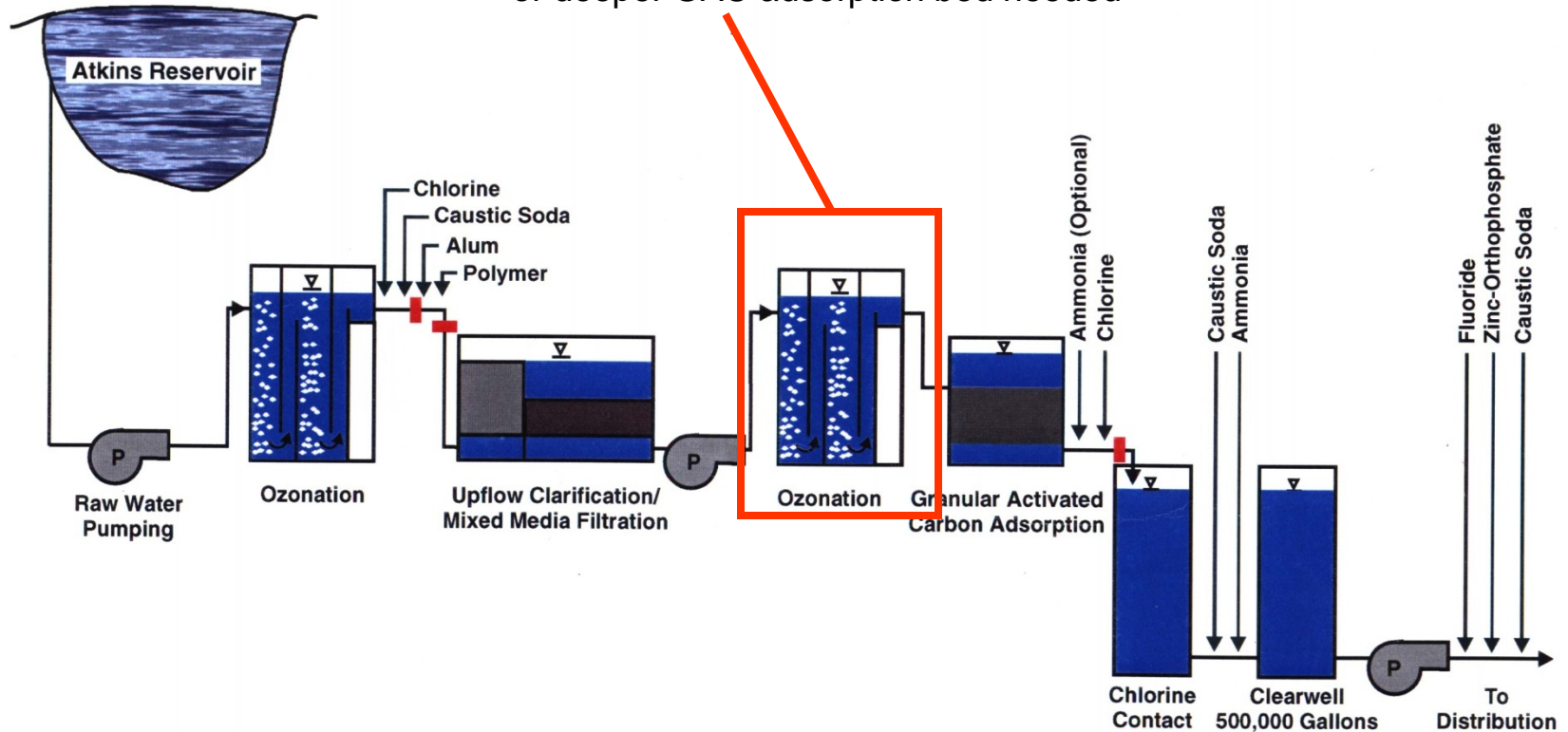
Atkins Reservoir Water Treatment Plant Alternate Methods

- Replace Trident units with standard flocculation/settling tanks
 - allows for more specific design parameters than prefabricated units
 - larger and more expensive than Trident units

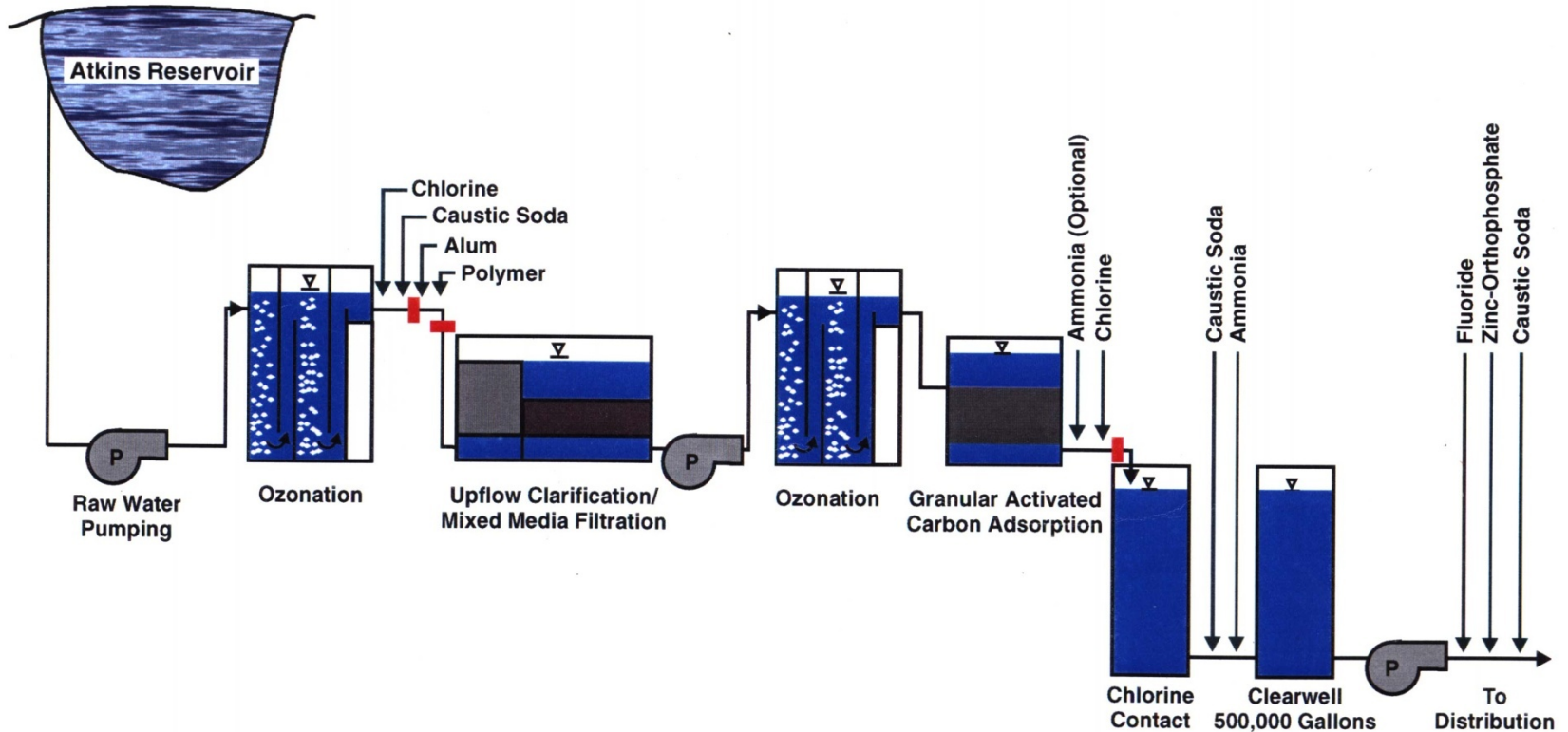


Atkins Reservoir Water Treatment Plant Alternate Methods

- Eliminate post-Trident ozonation
 - GAC adsorption can remove organic carbon, taste, odor
 - GAC adsorption may not be as efficient without ozonation
 - more CT needed (larger tanks or higher concentration of chlorine) or deeper GAC adsorption bed needed



Atkins Reservoir Water Treatment Plant overall

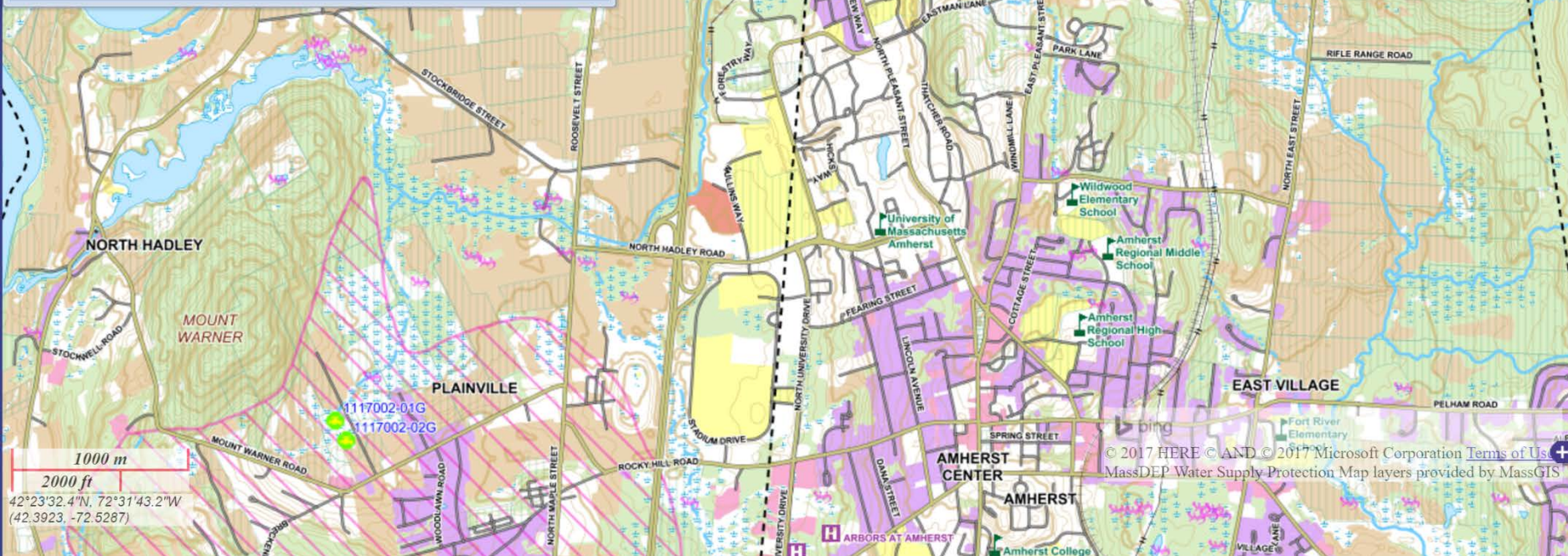


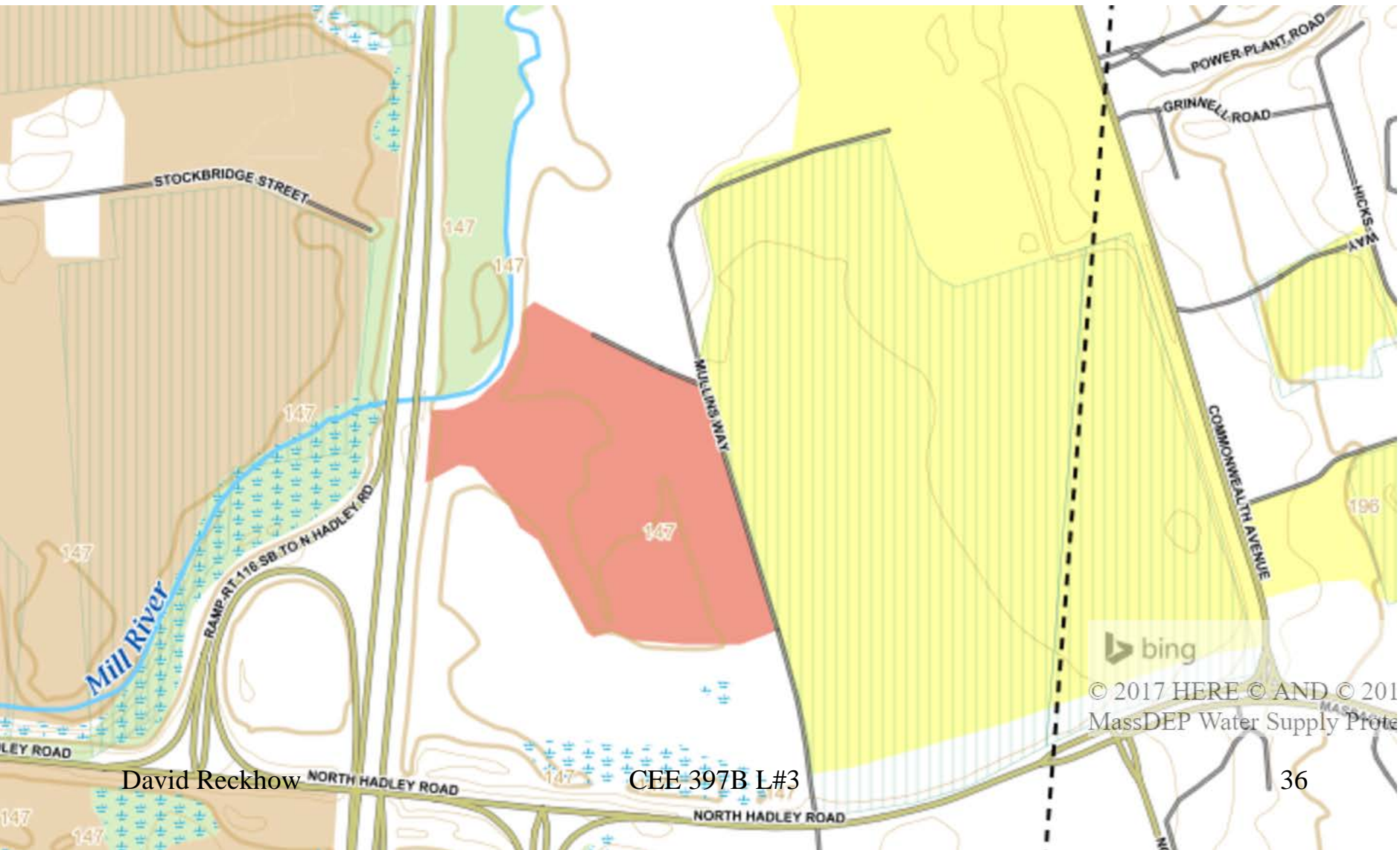


Water Supply Protection Areas Map

Map Tools

Overview Map Layers Legend Map Help Contact





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36

	Community Groundwater Well		Town and State Boundary		Surface Water Supply Watershed Bound
	Community Surface Water Intake		DEP Region Boundary		Public Water Supply Protection Area (Z)
	Emergency Surface Water Intake		15 Meter Contour Interval		Interim Wellhead Protection Area (IWPA)
	Non-Community Groundwater Well		3 Meter Contour Interval		Approved Wellhead Protection Area (Z)
	NHESP Certified Vernal Pool		Perennial Stream or Shoreline		Solid Waste Landfill
	NHESP Potential Vernal Pool		Intermittent Stream		Areas of Critical Environmental Concern
	School		Intermittent Shoreline		EPA Designated Sole Source Aquifer
	Hospital		Manned Shoreline		Protected Open Space
	Long Term Care Residence		Ditch or Canal		Non-Potential Drinking Water Source Ar
	Prison		Aqueduct		Non-Potential Drinking Water Source Ar
	Pipeline		Dam		Potentially Productive High Yield Aquife
	Powertline		Channel in Water		Potentially Productive Medium Yield Aqu
	MBTA Blue Line		Open Water		Public Water Supply Reservoir
	MBTA Green Line		Tidal Flat		Inundated Area
	MBTA Orange Line		Fresh Water Wetland		Cranberry Bog
	MBTA Red Line		Salt Water Wetland		
	Active Rail Lines				
	Major Highway - Limited Access				
	Major Road - Not Limited Access				