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GAC VS. PAC

A Tale of Two Water Plants

Todd Reynolds | Water Practice Leader
Alex Page | Civil Engineer
Cayla Whiteside | Civil Engineer

Kennedy Jenks


San Luis Reservoir
West Hills WTP
Lessalt WTP
San Justo Reservoir
Pacheco State Park
San Luis Reservoir
Casa De Fruta
San Felipe
Dunneville
Hollister
Corners
Google My Maps

Why is Carbon Treatment Needed?

Moderate to High Organics in Source Water

Parameter	Units	Historic Source Water Quality		
		Average	Minimum	Maximum
Total Organic Carbon	mg/L	3.5	3.1	5.5
Total Dissolved Solids (TDS)	mg/L	307	240	370
Manganese (Mn)	ug/L	25	15	73

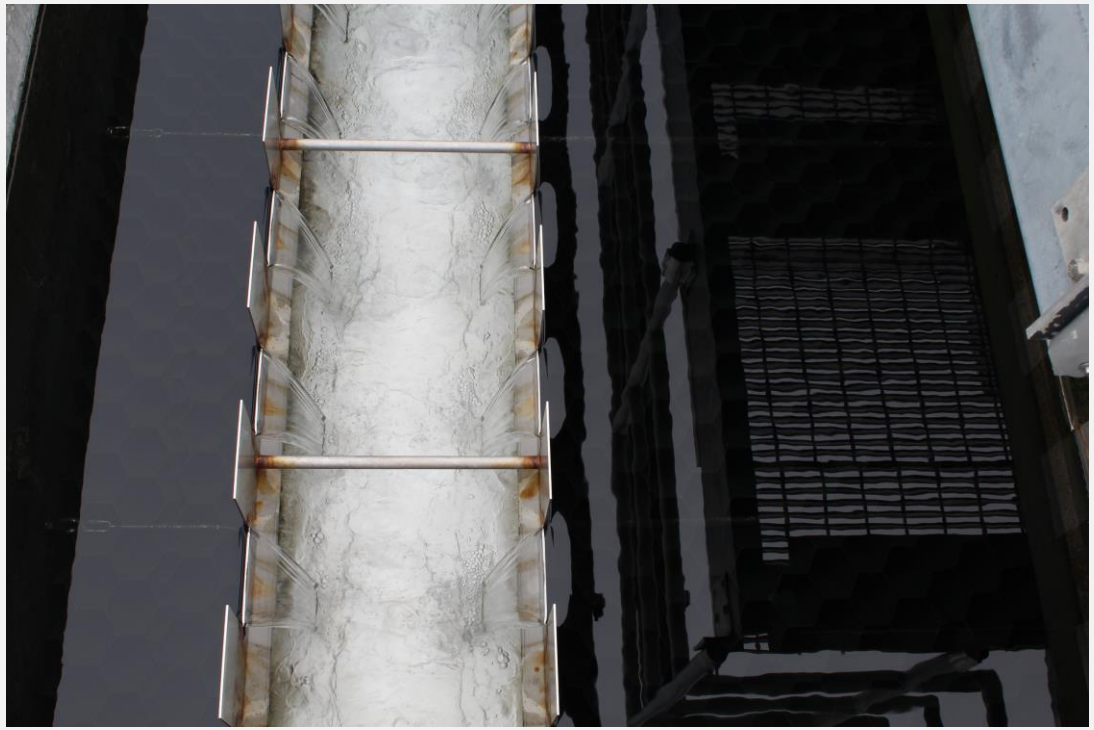
Without Treatment disinfection byproducts (DBPs) in the Distribution System exceeded the Stage 2 D/DBP limits.

Overall Water Treatment Objectives

- **Turbidity and Pathogen Removal**
- **TOC Removal**
- **Maintain free chlorine residual in the distribution system**

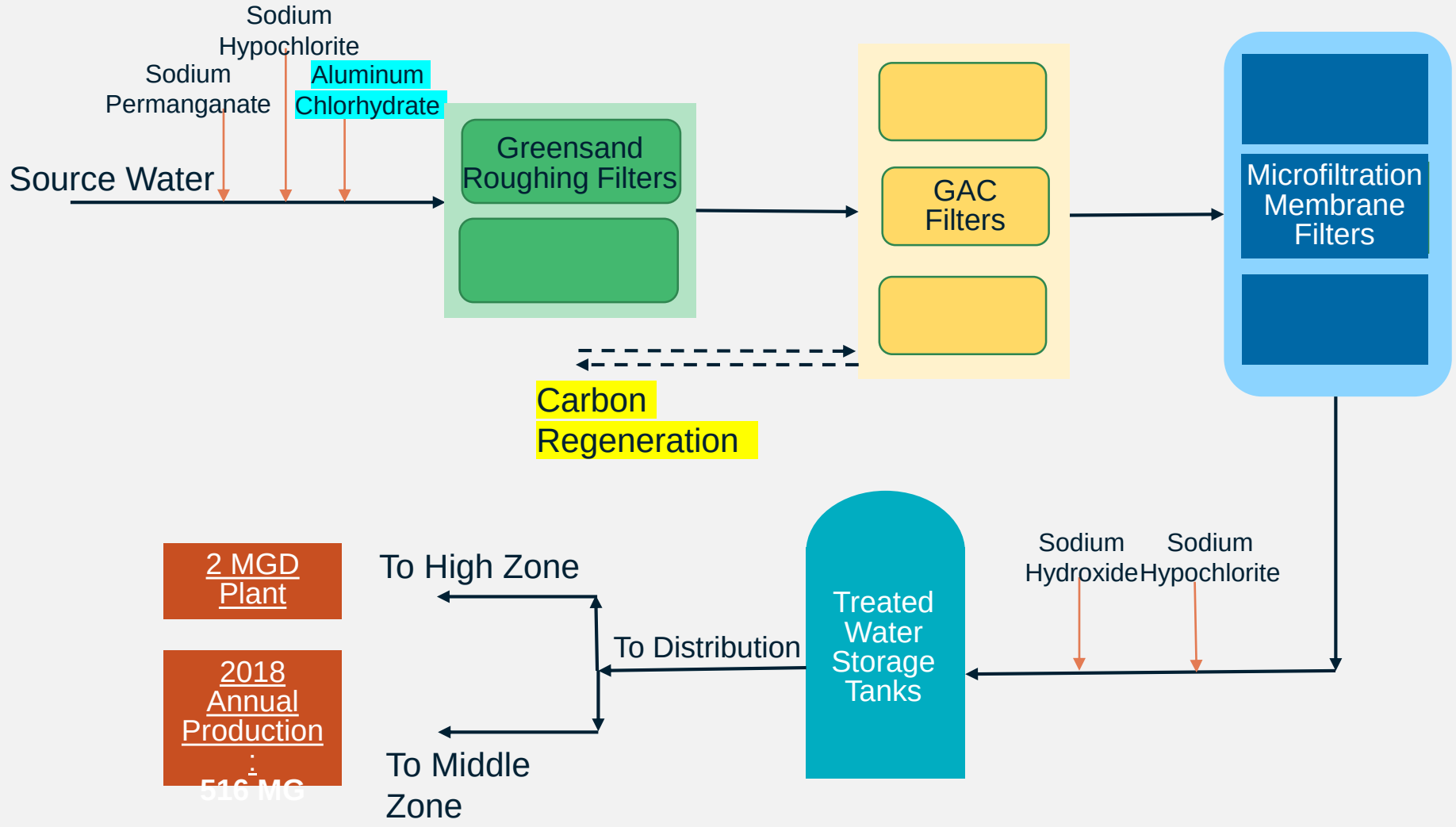
Product Water Objectives	
Turbidity	<0.1 NTU
TOC	**<1.5 mg/L**
Iron	<0.1 mg/L
Manganese	<0.02 mg/L

Distribution System Objectives for DBP's	
TTHM	< 80 ug/l
HAA5	< 60 ug/l



Simulated Distribution System Testing showed TOC <1.5 mg/L was needed to meet DBP objectives

Lessalt Treatment Process Flow (GAC)



LESSALT WATER TREATMENT PLANT

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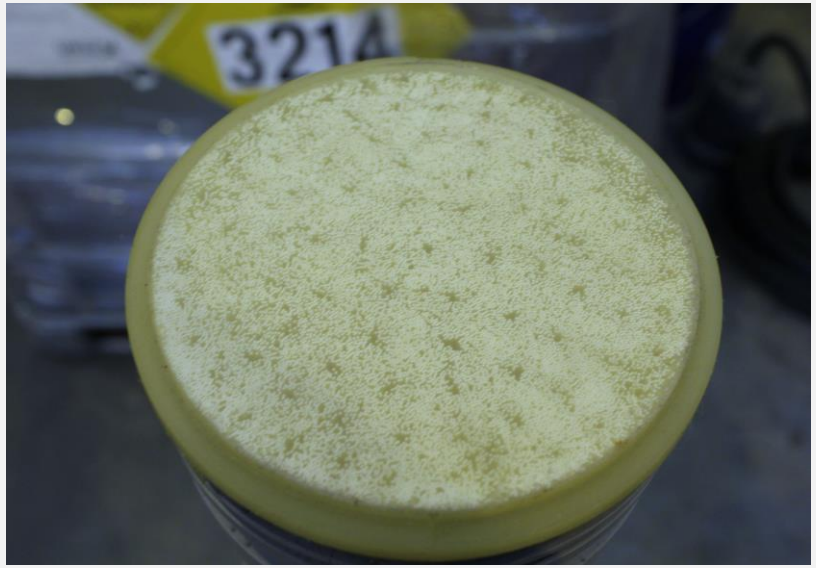
LESSALT WATER TREATMENT PLANT



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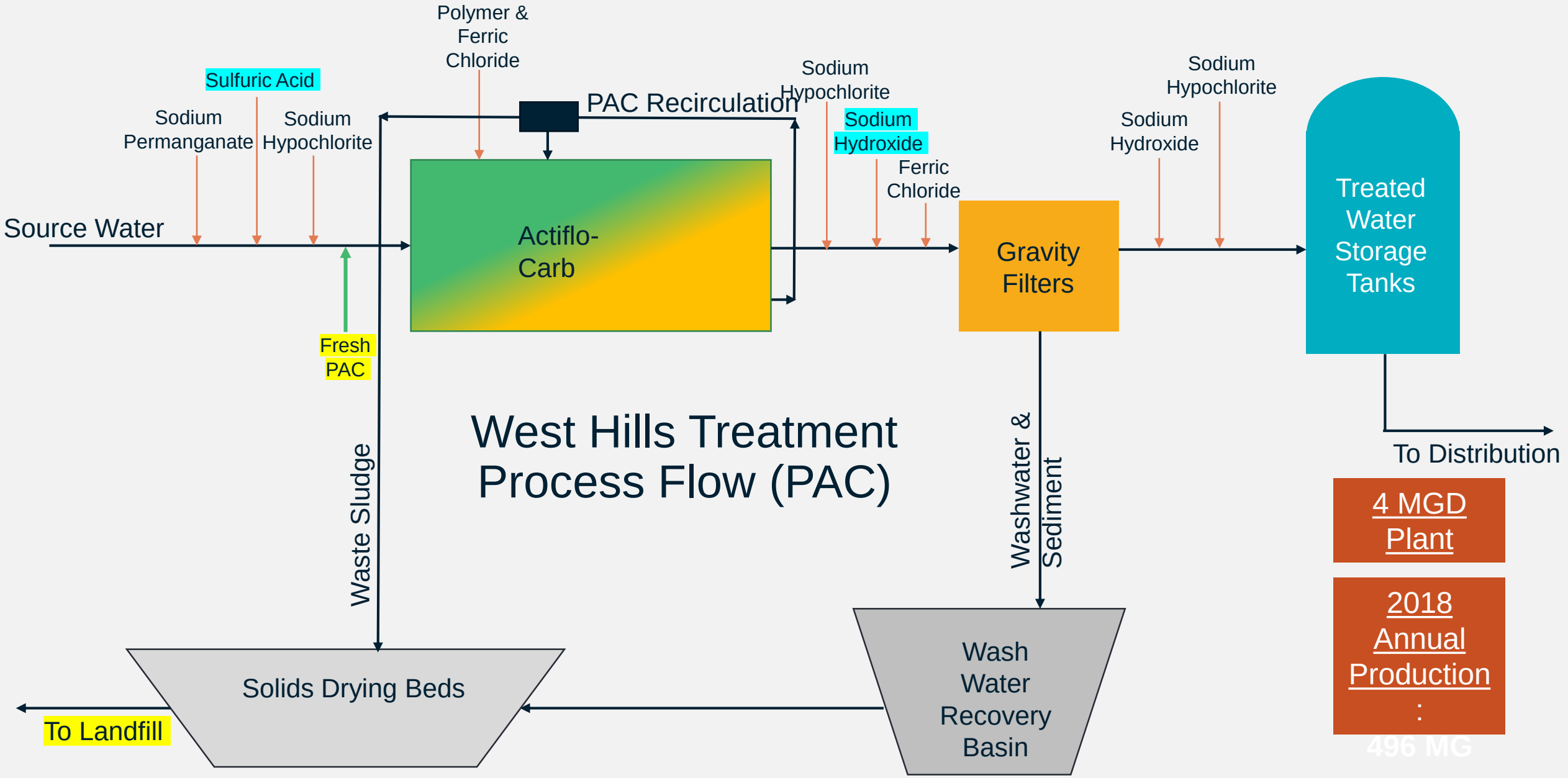
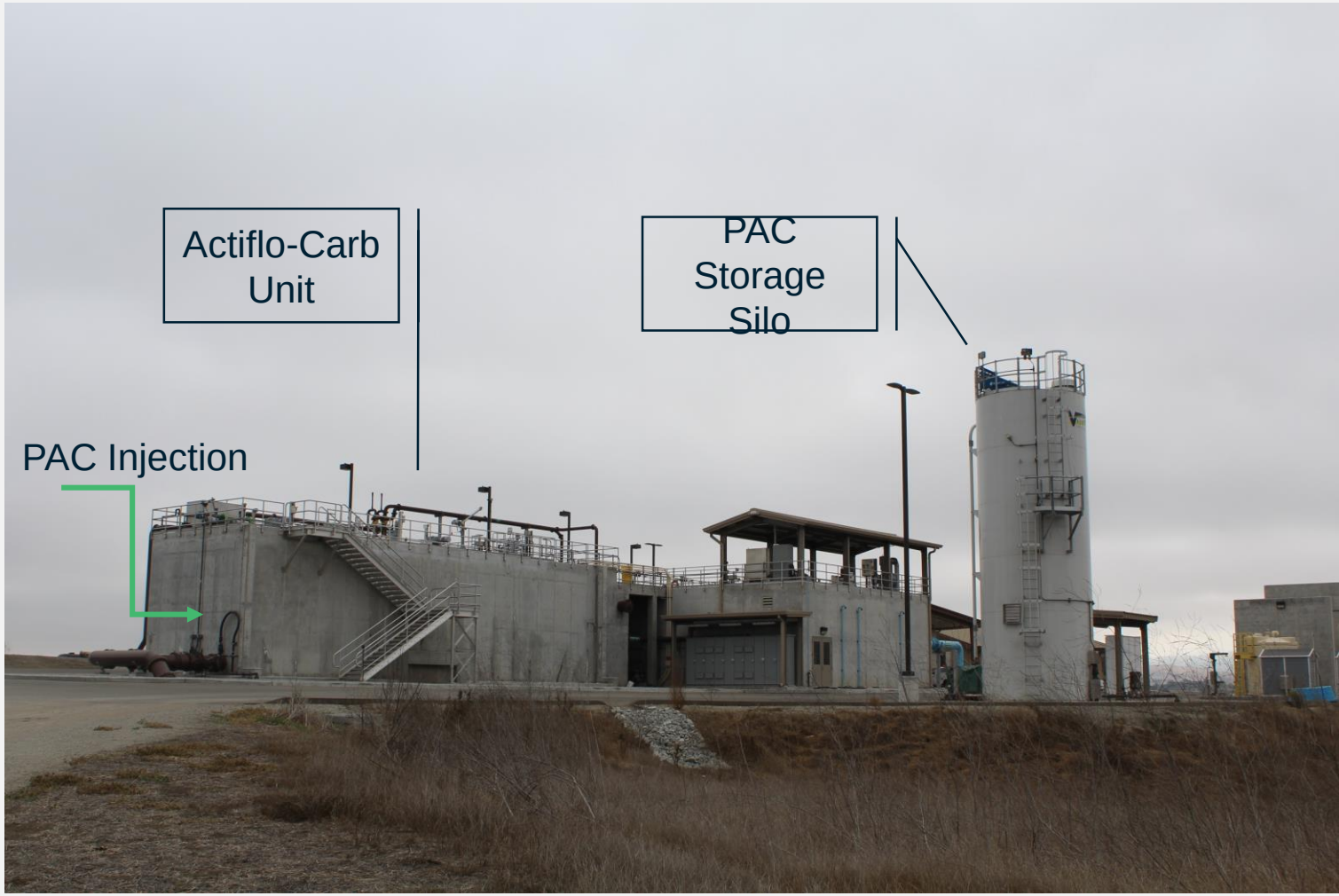

Polymer & Ferric Chloride
Sulfuric Acid
Sodium Permanganate
Sodium Hypochlorite
PAC Recirculation
Sodium Hypochlorite
Sodium Hydroxide
Ferric Chloride
Sodium Hypochlorite
Sodium Hydroxide
Source Water
Actiflo-Carb
Gravity Filters
Treated Water Storage Tanks
Fresh PAC
West Hills Treatment Process Flow (PAC)
Waste Sludge
Washwater & Sediment
To Distribution
4 MGD Plant
2018 Annual Production : 496 MG
Solids Drying Beds
Wash Water Recovery Basin
To Landfill

West Hills Water Treatment Plant



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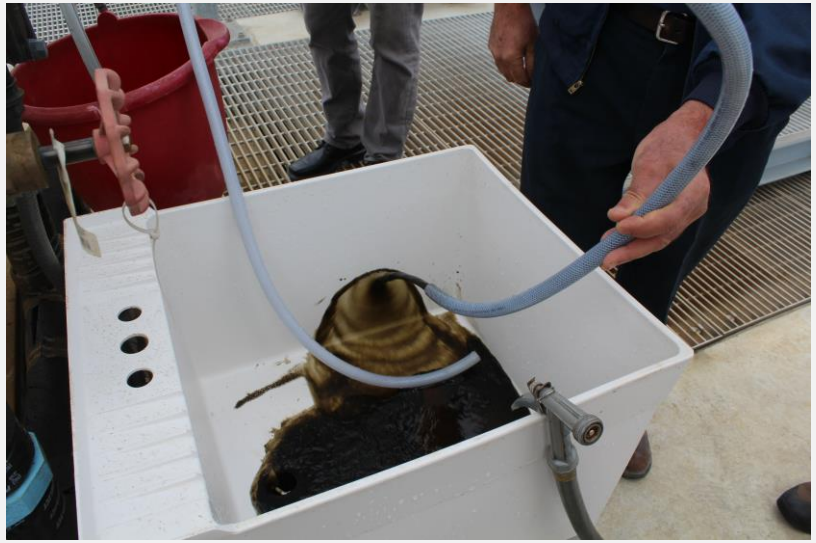
West Hill: PAC is recirculated within the Actiflo-Carb Process to increase contact time



PAC is continuously wasted to drying beds as new PAC is added

GAC and PAC Comparison

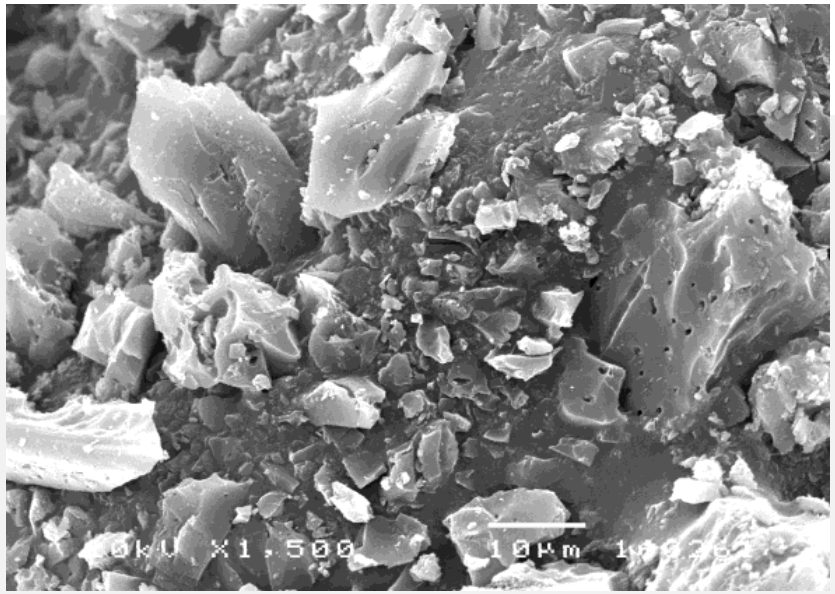
Granular Activated Carbon

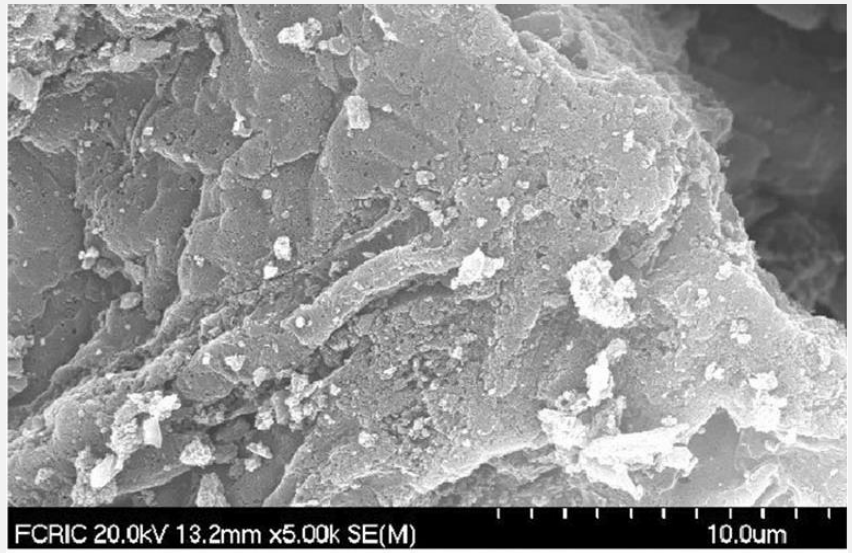
Powder Activated Carbon

Activated Carbon

Diameter (mm)	
Granular Activated Carbon	~0.5
Powdered Activated Carbon	~0.05

- 1 g of activated carbon can have a surface area of 500 - 1500 m^2
- The high surface area and micro-porosity of activated carbon enhances adsorption
- Adsorption is taking place on the micron level for both GAC and PAC
- **Is one better than the other?**



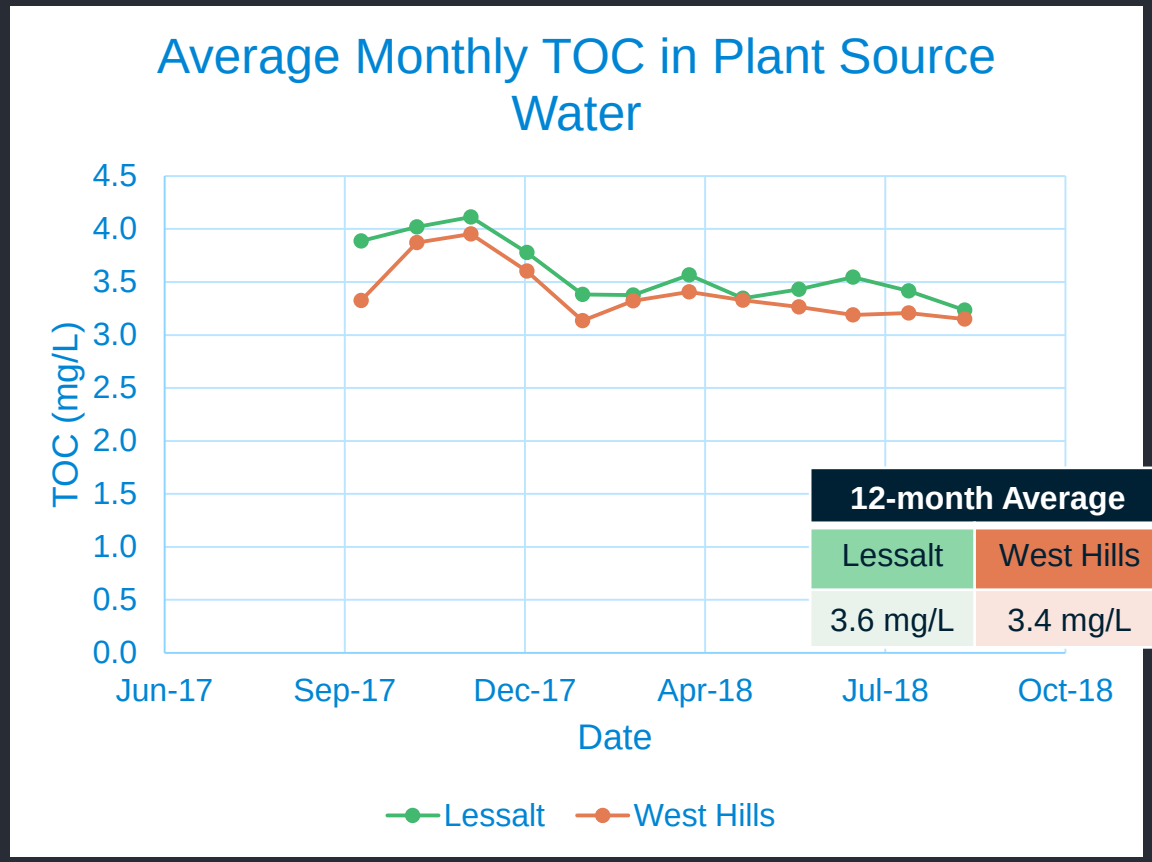


GAC vs PAC – Contact Time

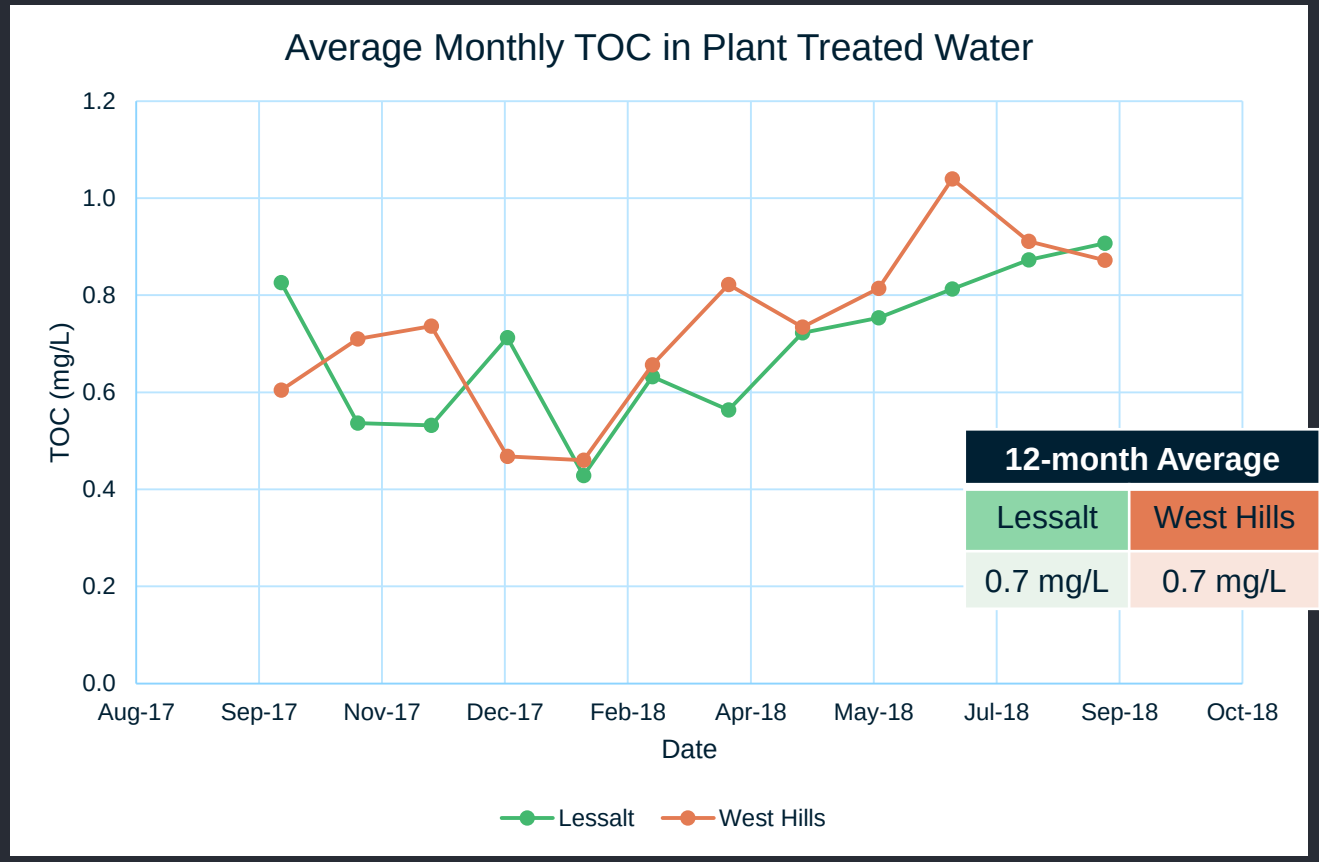
Lessalt GAC Adsorption Vessel
Empty Bed Contact Time: 15 mins

Westhills PAC in Actiflo Carb Process
Contact Time: ~50 mins (with recirculation)

Source and Treated Water TOC

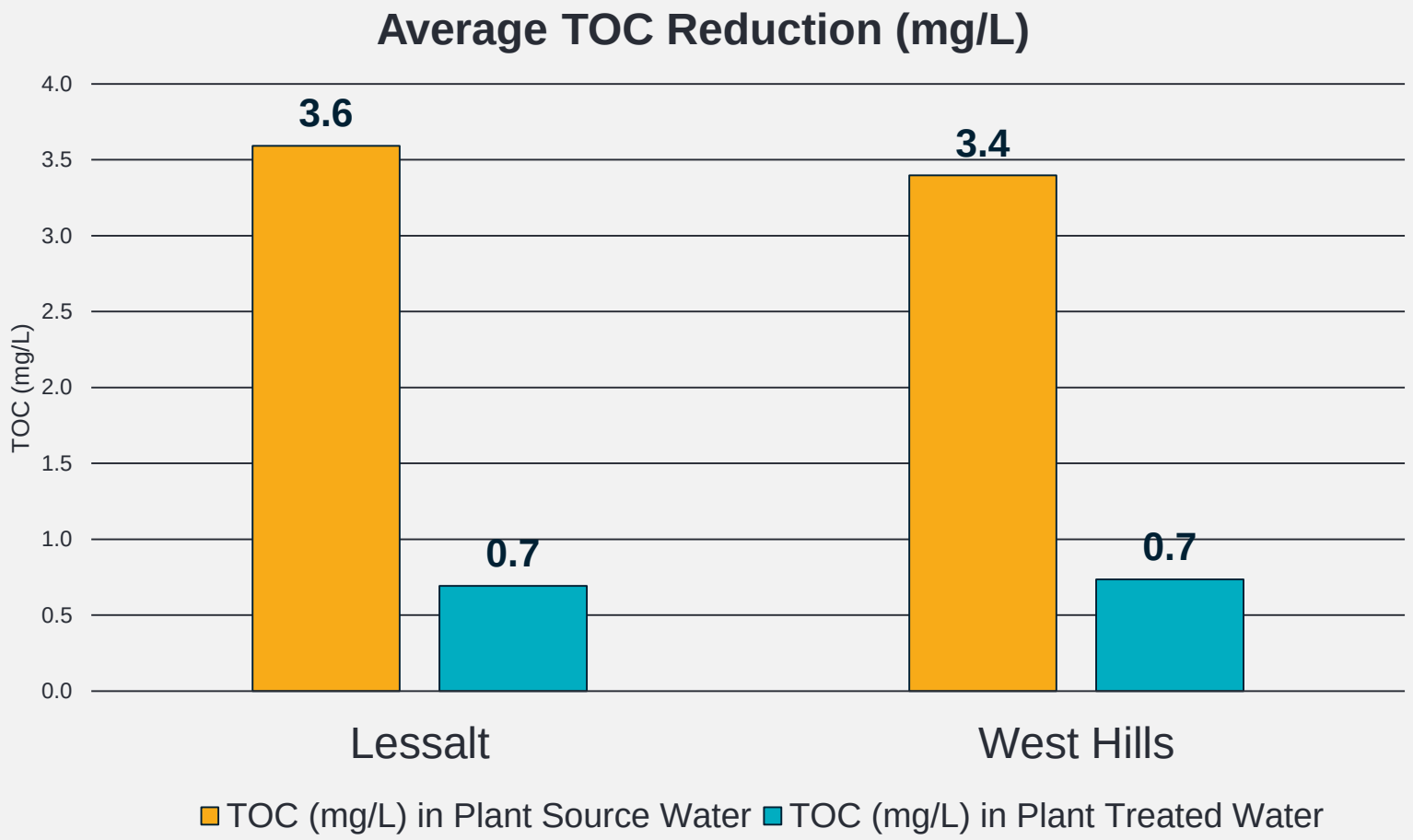


Same average Source Water TOC …



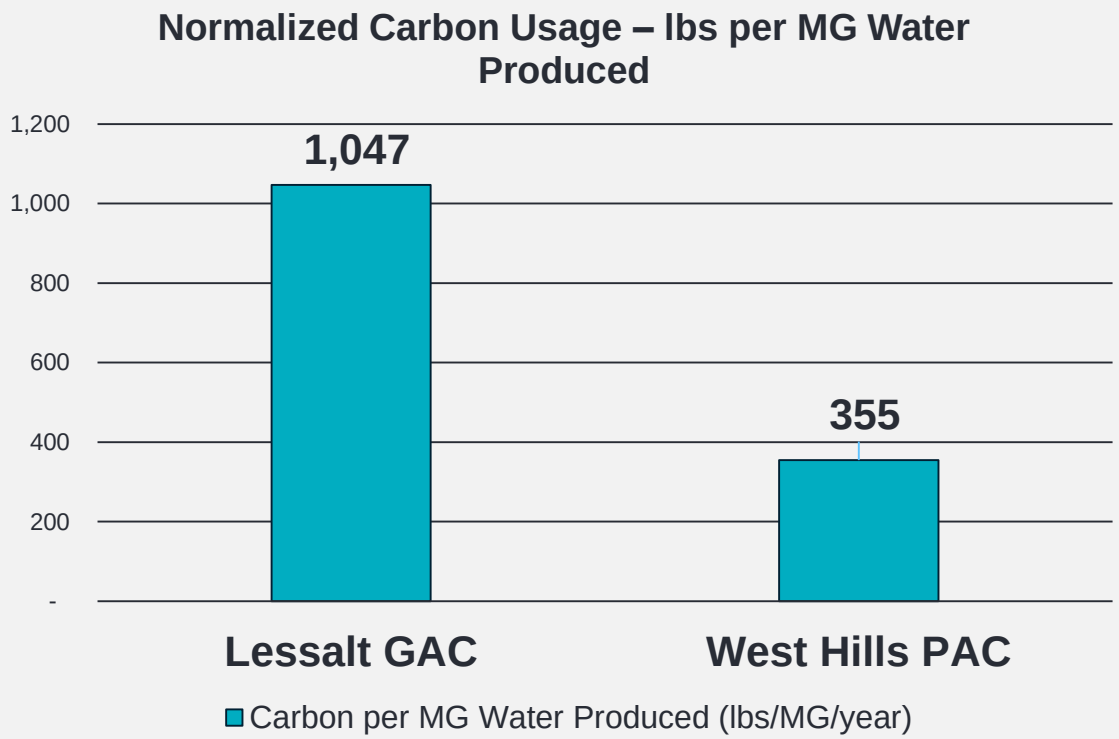
…Same average Treated Water TOC.

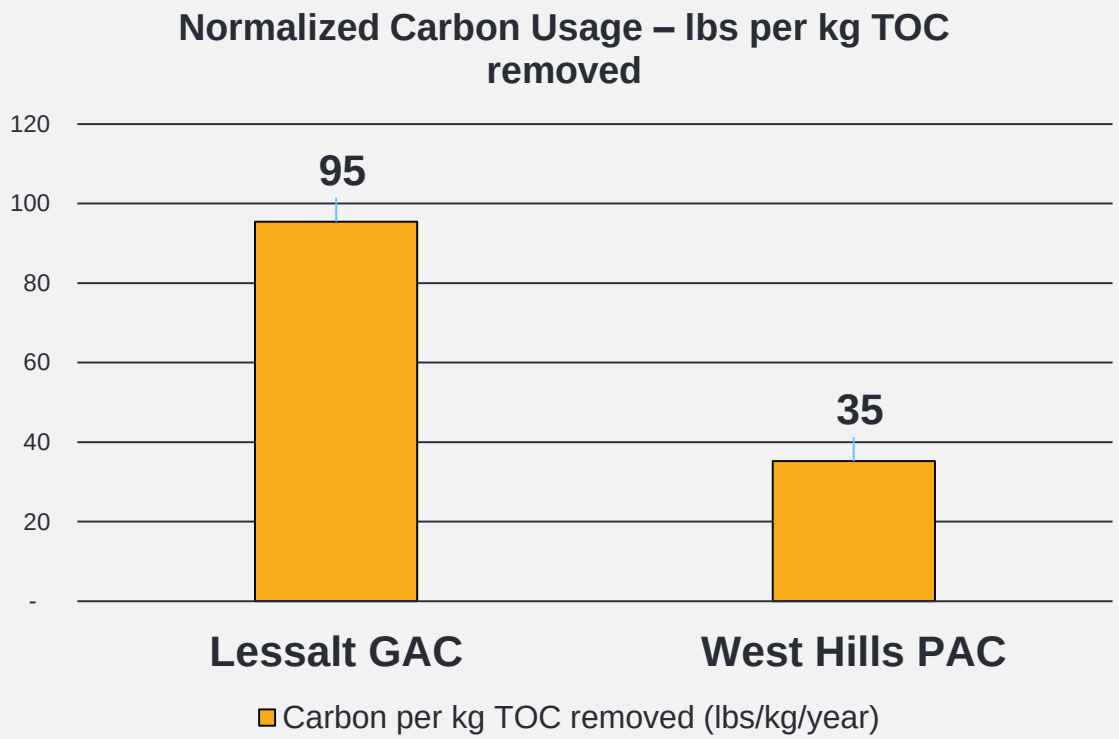
Average TOC Reduction



Average % Reduction	
Lessalt	West Hills
81%	78%

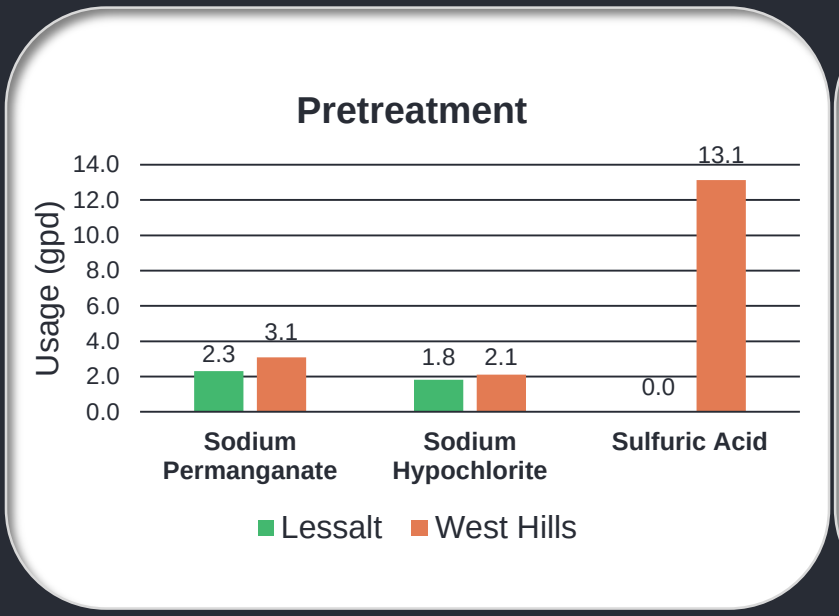
Normalized Carbon Usage

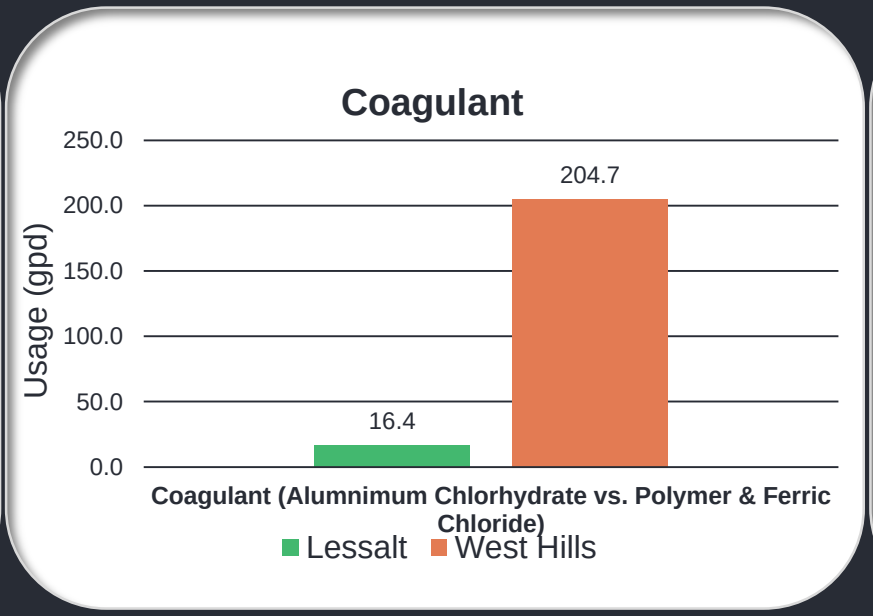


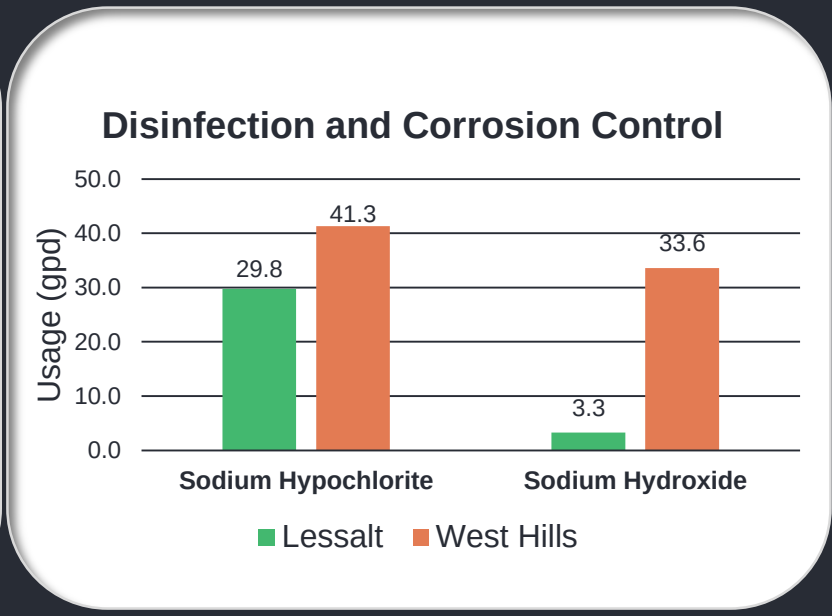


But wait…. Carbon alone is not the whole story

Chemical Usage





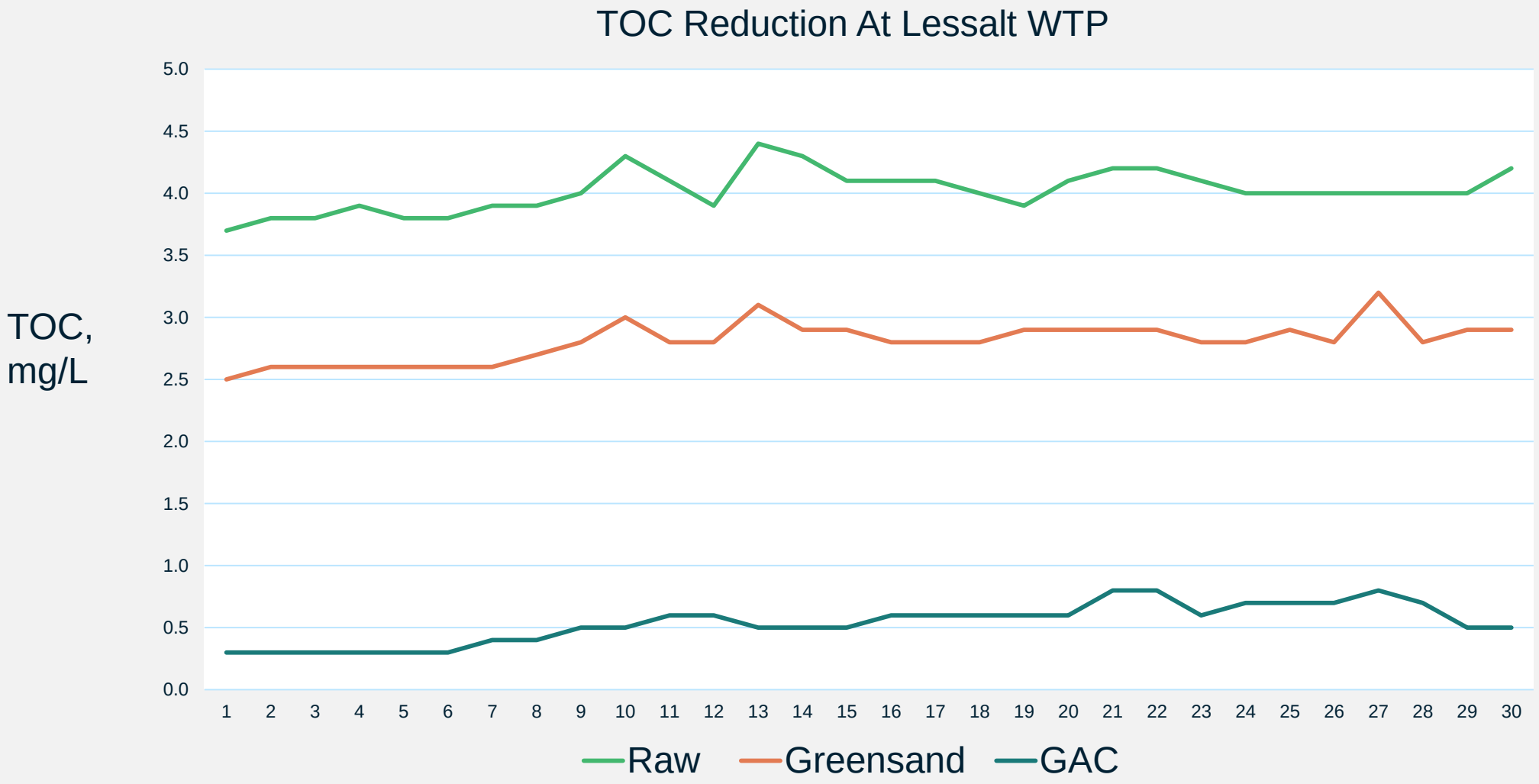


Lessalt WTP Coagulant Dose: ~10 mg/L

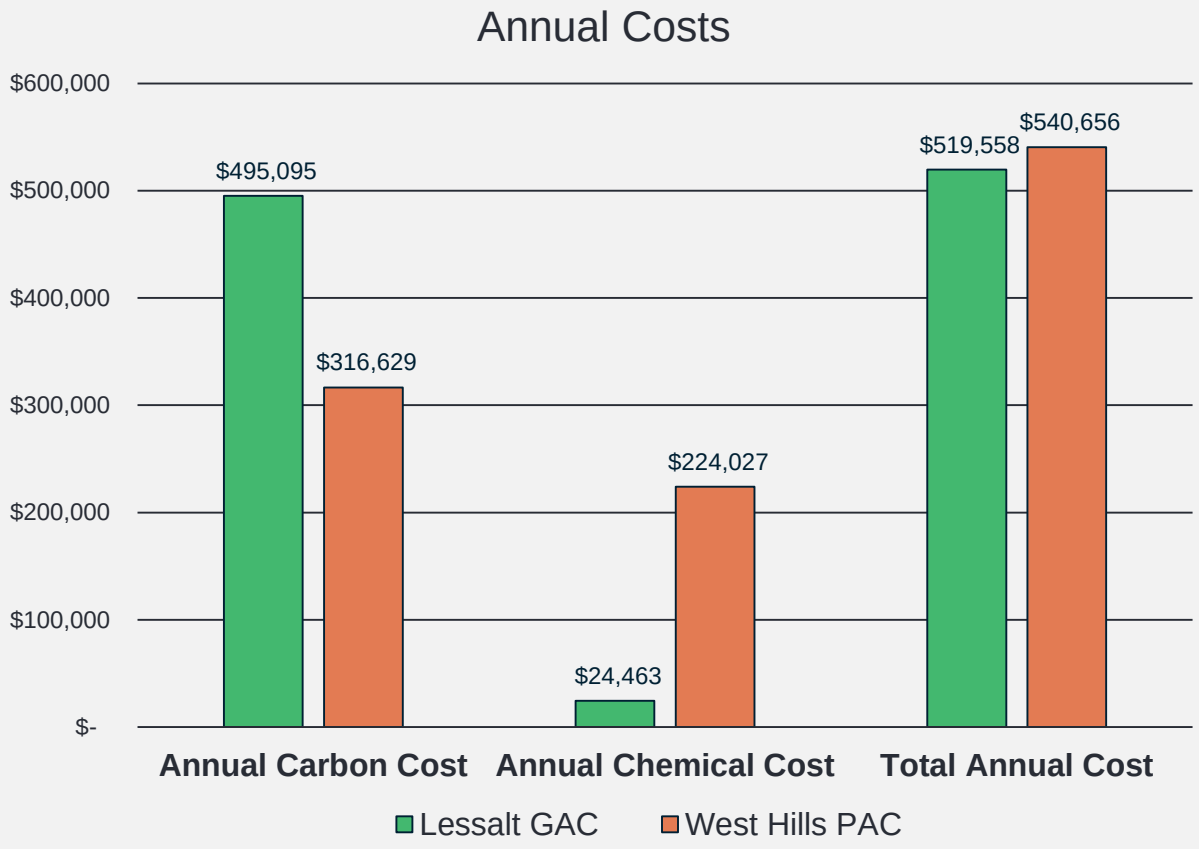
West Hills Coagulant Dose: ~30 to 65 mg/L Actilflo SW pH at ~5.8

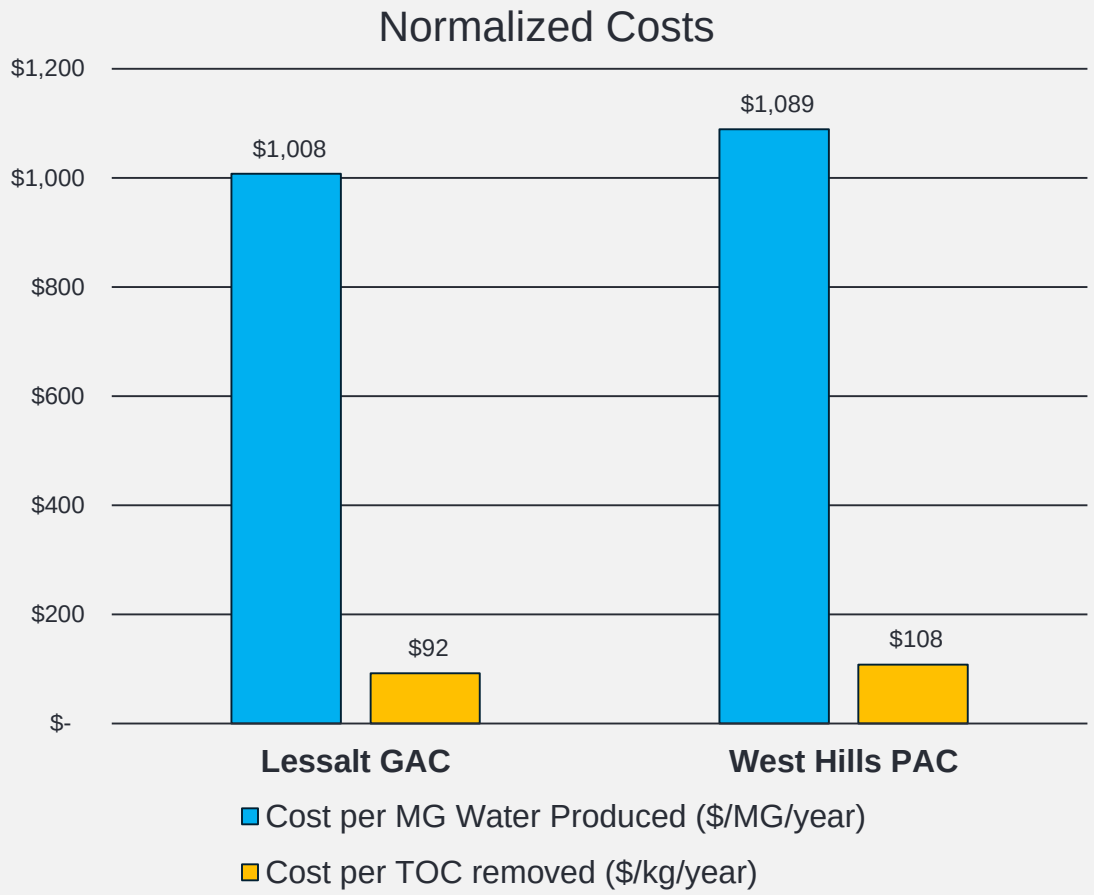
Carbon or Chemical ?

At Lessalt WTP: Coagulation ~ 25% & GAC ~60% of TOC Removal



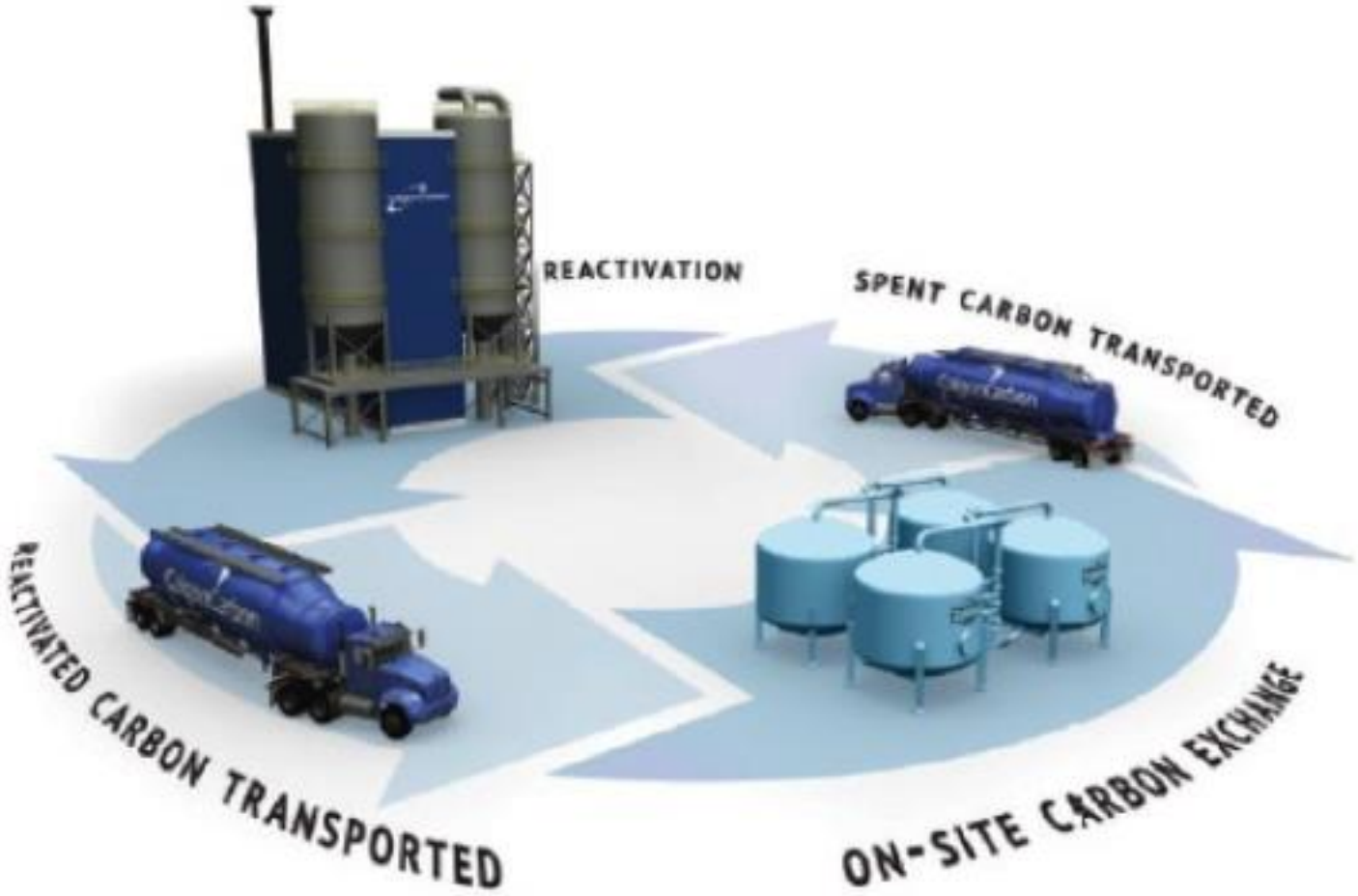
Annual and Normalized Costs





Lessalt and West Hills WTPs annual combined carbon and chemical costs are about the same

Carbon Regeneration (GAC)



Courtesy of Calgon

Carbon Regeneration (GAC)

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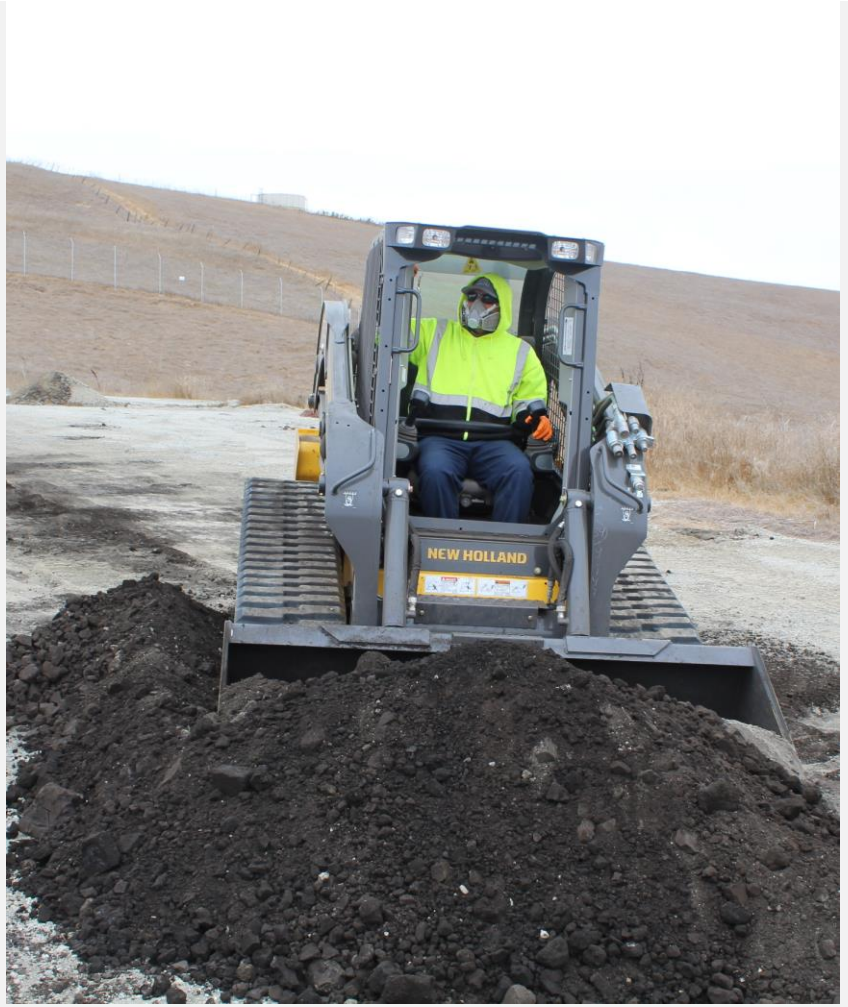
Carbon Disposal (PAC)

- PAC is discharged to solids drying beds
- PAC is stored over the winter and disposed of in the summer on a ~weekly basis
- PAC is taken to a landfill for disposal

Carbon Disposal at West Hills

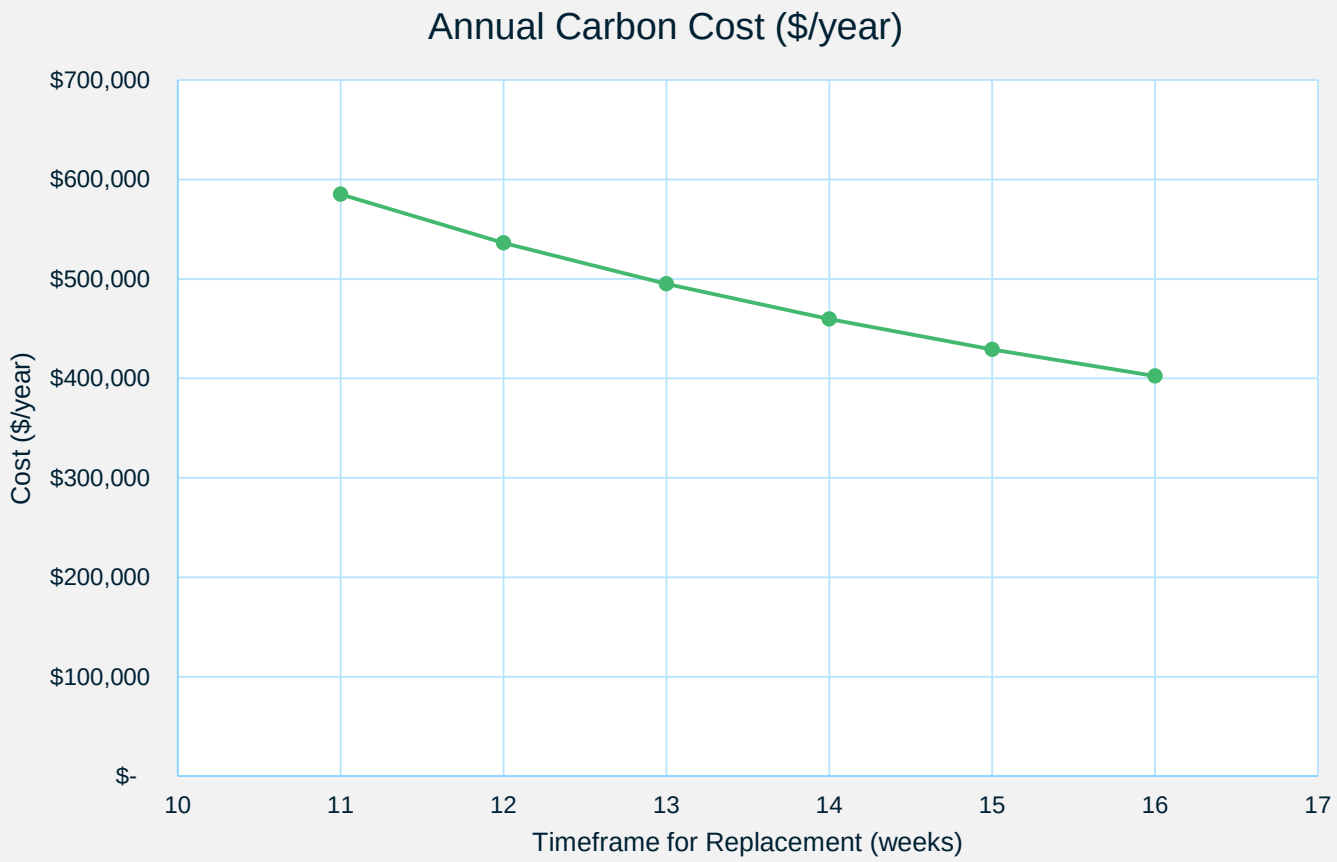
- Labor and Landfill disposal costs for West Hills PAC are not currently included in our comparisons
- GAC removal and regeneration costs are a part of the Lessalt Carbon cost



What do the Operators say?

- 👍 Liked the PAC because easier to “dial in treated water TOC reduction” – increase or decrease chemical or PAC dose
- 👍 Liked GAC because it is simple process and removal and regeneration of GAC is part of delivery – no solids to deal with
- 👍 TOC reduction at both plants has been below design target with varying source water quality
  - PAC Silo needs daily checking and “TLC”
  - Monthly GAC change-out requires “baby-sitting” of the delivery
  - PAC solids removal is a dirty and dusty process

Opportunities for further optimization – Extend GAC life



Timeframe for Replacement (weeks)	Annual Carbon Cost ($/year)
11	$585,112
12	$536,532
13	$495,095
14	$459,731
15	$429,082
16	$402,264

Opportunities for further optimization

- Chemical use at West Hills could be further evaluated and optimized.
- Further testing and data analysis could be conducted to understand the TOC removal contribution of chemicals and PAC at the West Hill WTP.
- Evaluate and optimize chemical and PAC use to reduce overall costs.

Thank you!

Kennedy Jenks