

# Evaluation of Membrane Technologies and Options for Meeting the Ultimate Capacity Demands at the Kennewick WTP

Pierre Kwan, PE  
HDR



# Acknowledgements



- Nathan Kutil, PE
- Ryan Oberg, PE



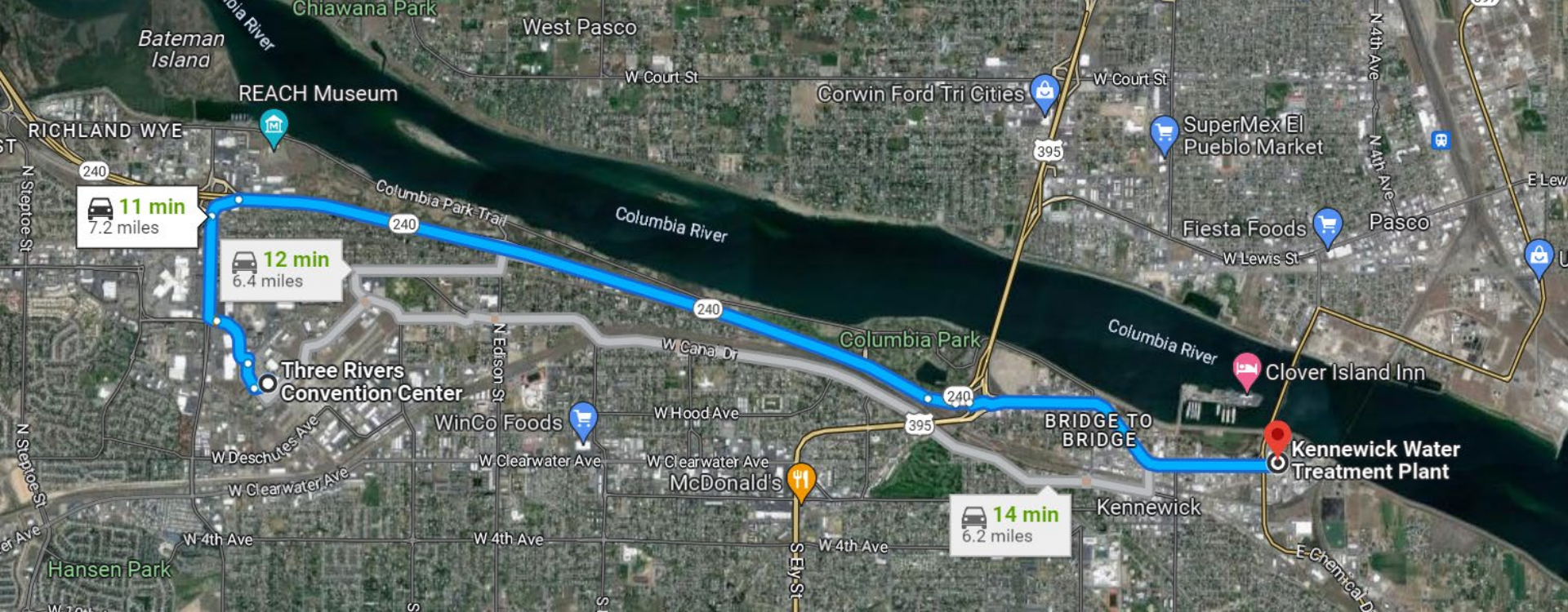
- Jeremy Lustig, PE

# Agenda

- Project History
- Current Operating Conditions
- Options Analyzed
- Selected Direction and Current Activities



# **Project History**



# Kennewick Water Treatment Plant

Water supply from Columbia River

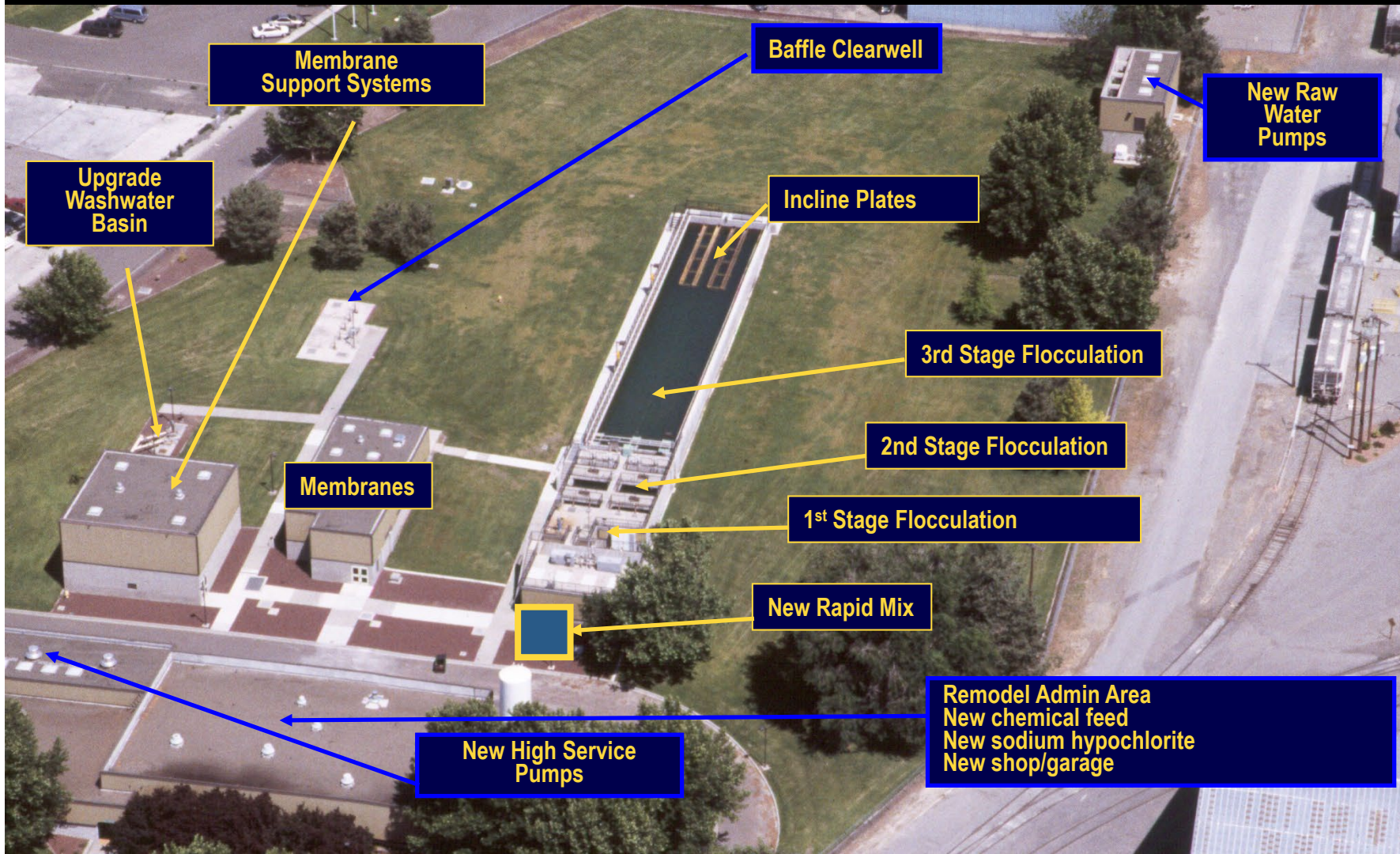
# Raw Water Quality

- Turbidity: 0.5 NTU, spikes up to 20 NTU
- Alkalinity: 45 – 75 mg/L as  $\text{CaCO}_3$
- Hardness: 45 – 90 mg/L as  $\text{CaCO}_3$
- pH: 7.3 – 8.6
- Total organic carbon: 0.7 - 4.0 mg/L
- Temperature: 2 – 22 deg. C



# **Kennewick WTP**

- Constructed in 1978
- Seasonal 7.5 MGD conventional filtration plant
- Major renovation from 2004 – 2007
- Retrofit submerged membranes into existing filter basins
- 7.5 mgd membrane filtration by 2005
- 15 mgd capacity by 2007
- 20 MGD ultimate capacity
  
- New aeration and compressed air systems
- New chemical systems



Membrane Support Systems

Baffle Clearwell

New Raw Water Pumps

Upgrade Washwater Basin

Incline Plates

3rd Stage Flocculation

Membranes

2nd Stage Flocculation

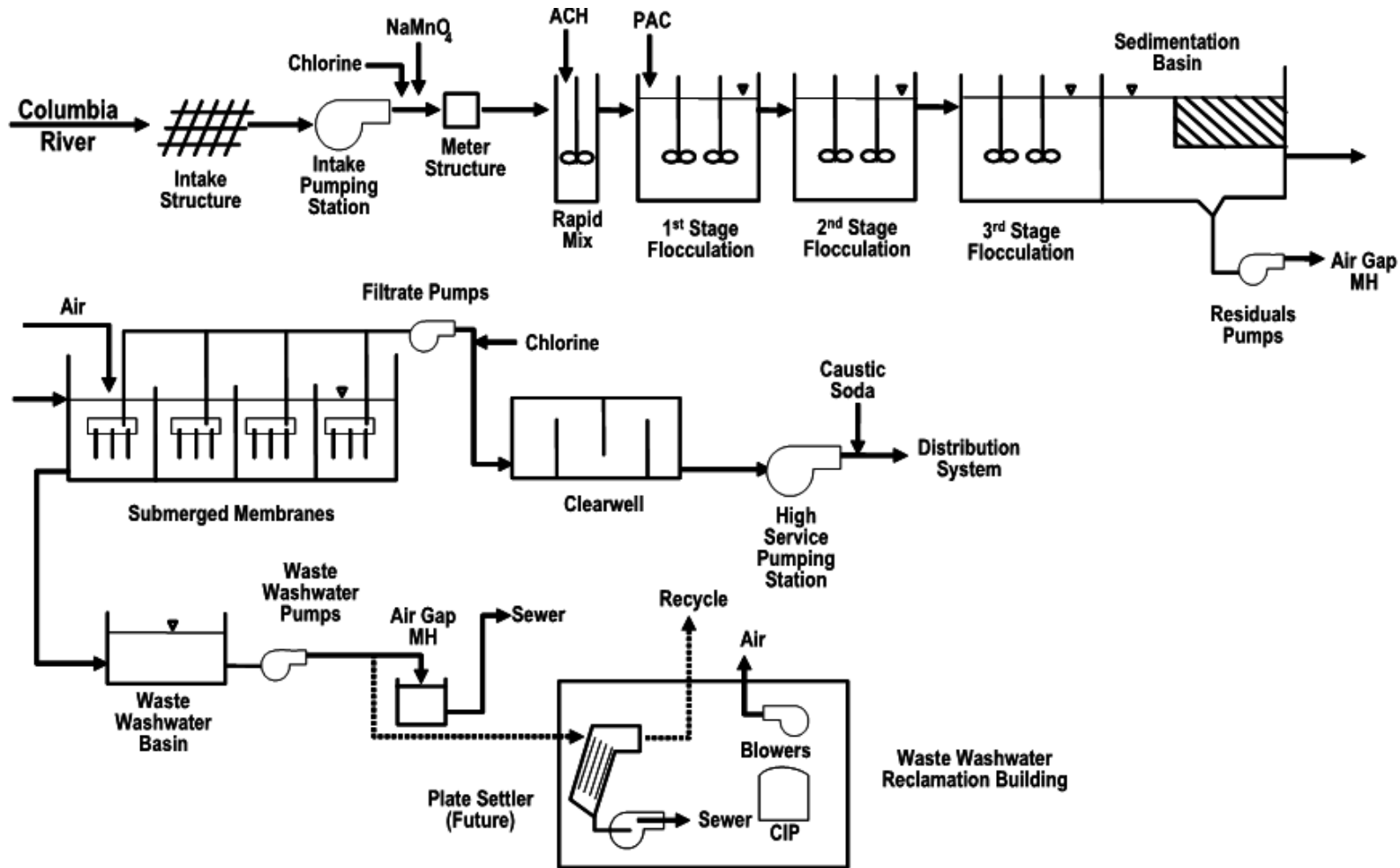
1st Stage Flocculation

New Rapid Mix

New High Service Pumps

Remodel Admin Area  
New chemical feed  
New sodium hypochlorite  
New shop/garage









## **Memcor Membrane Rack with Blank Spacer**

Spacers to distribute flow throughout basin

# **Current Operating Conditions**

# Membrane Condition and Warranty

- Each set of membranes procured with 10-year warranty
- Guaranteed membrane replacement pricing for 20 years – through 2024
- Installed with Memcor S10V membranes
- All membranes replaced once already with S10V modules
- Current membranes need to be replaced too

# 2021 Operational Setpoints

Item	Unit	Value
Backwash interval	Minutes	38 (fixed)
Pressure decay test interval	Hours	24
Filtrate pump maximum capacity	gpm	3,800
CIP interval (citric acid and hypochlorite)	Hours	720
CIP heater	-	Non-operational / off
Acid CIP	-	0.5% citric acid @ pH 2.3
Hypochlorite CIP	-	800 mg/L
Chemically enhanced backwash	-	None

**Options Analyzed**

## Future Demands

- Installed with 15 mgd of membranes (firm capacity)
- Built with 20 mgd ultimate capacity
- City water master plan wants 30 mgd from facility

Item	Unit	Current cell	Capacity of cell
No. of membrane modules per cell	-	448	576
Maximum design flux	gfd	49	49
Flow at maximum design flux	gpm	3,820	4,911
Four cells net filtration volume	mgd	20.4	26.2



## **What To Do?**

1. Continue with Memcor submerged membranes
2. Switch to different submerged polymeric membrane
3. Retrofit with plate-style ceramic membranes
4. Convert to pressurized membranes

# Continuing with Memcor Submerged Membranes

- Pros
  - Familiarity with equipment and operations
- Cons
  - Lacks modern systems features
    - CEBW
    - Optimized backwashing
    - Reduced waste generation
  - Fiber breakage issues
  - Challenges increasing capacity



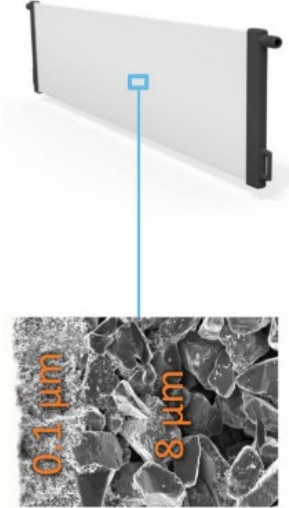
# Switch to Different Submerged Membrane

- Pros
  - Some familiarity with operations
  - CEBW
  - Optimized backwashing
  - Reduced waste generation
- Cons
  - Fiber breakage?
  - Challenge with retrofit
    - Filter basin configuration
    - Tight filter gallery
  - Not certain on meeting 20 or 30 MGD

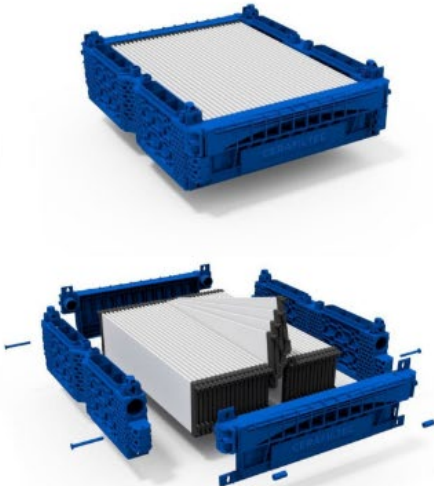


# Retrofit with Plate-Style Ceramic Membranes

CERAMIC FLAT SHEET  
MEMBRANE PLATE



FILTRATION  
MODULE



SINGLE  
FILTRATION

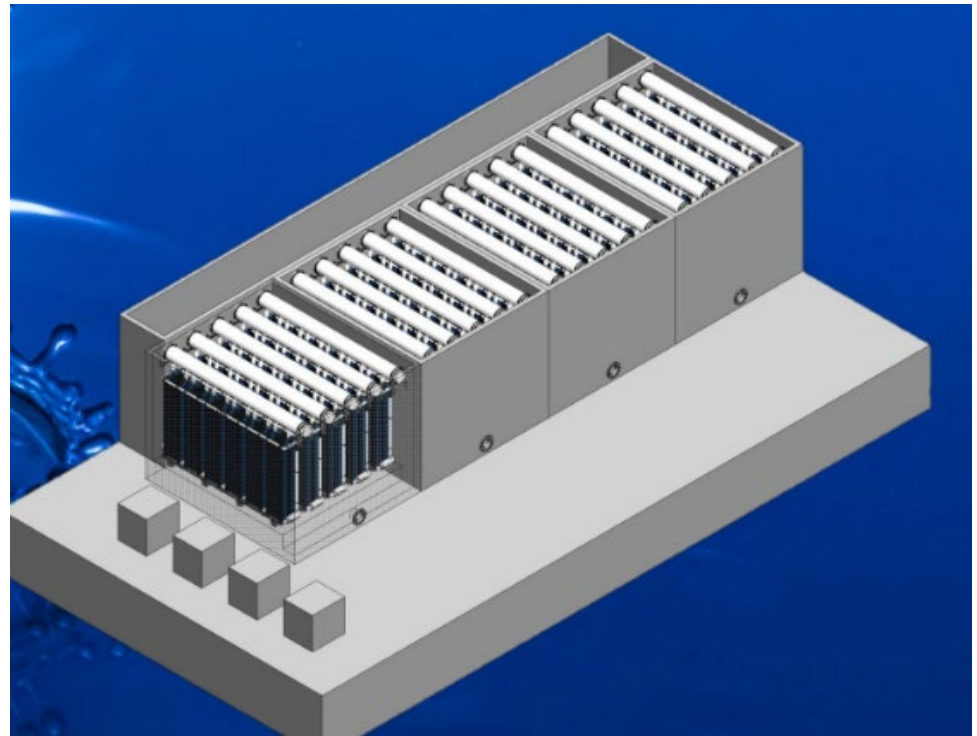


MULTI TOWER  
CONFIGURATION



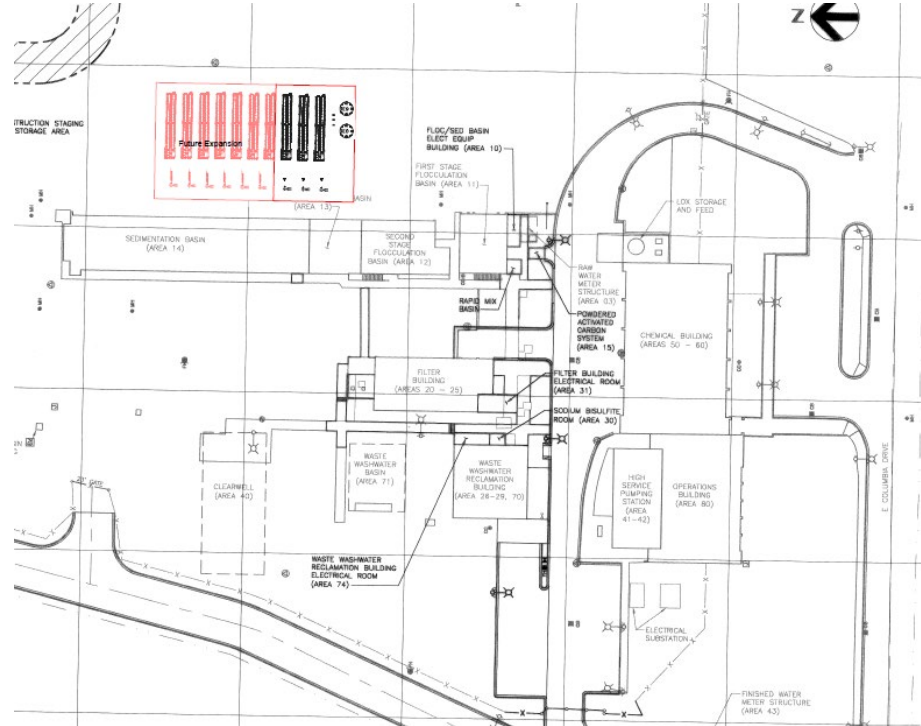
# Retrofit with Plate-Style Ceramic Membranes

- Pros
  - Potentially more robust membrane
  - Avoid fiber breakages
- Cons
  - \$4.6 million estimate retrofit cost
  - Requires pilot testing
  - New technology for the operators
  - Replacement piping and permeate pumps in confined filter gallery
  - Warranty period
  - Future capacity concern



# Convert to Pressurized Membranes

- New building adjacent to existing sedimentation basin
- Pros
  - New membrane system
  - Avoids work in 45+ year old building
  - Readily meet future capacity
- Cons
  - Hydraulic grade line issues
  - What to do with existing buildings?



# **Selection Direction and Current Activities**

## Current Activities

- No capacity upgrade at this time
  - Replacing spacers with more membranes are physically doable
  - Requires replacing permeate pumps – very difficult
  - Requires additional upgrades throughout plant
  
- Membranes
  - Filters 1 and 2 – no changes
  - Filters 3 and 4 – warranty replacement to get another 7 years



# Current Activities

- Multi-year renovation of support systems
  - Equipment is also ~20 years old
  - Tired despite regular maintenance
  - Chemical feed systems
  - Transfer pumps and motors
  - PLCs
- Installation / replacement during winter while plant is shut down



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Pierre Kwan, PE  
206-826-4735  
[pierre.kwan@hdrinc.com](mailto:pierre.kwan@hdrinc.com)

