

GE Power & Water

Water & Process Technologies

# Membrane Retrofits and Implementation Options into Existing Facilities

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11-May-17



imagination at work



# Background

Upgrade Time !!! – You are not alone....

- Increasing number of requests to upgrade various plants due to:
  - Increased Loads – Hydraulic or Process
  - Permit / Effluent Demands
  - Poor Performance
  - Lack of Efficiency
  - Outdated or shorter than expected technology life

# Background

## Wishlist....What do Plants want the most?

- Simple Operations
- Robust Technology
- Proven Success
- Lower Operating Costs
- Committed Partners.....



# Today There are Many Options...

**Tertiary Retrofits**



**MABR /ZeeLung**



**Side Stream MBR**



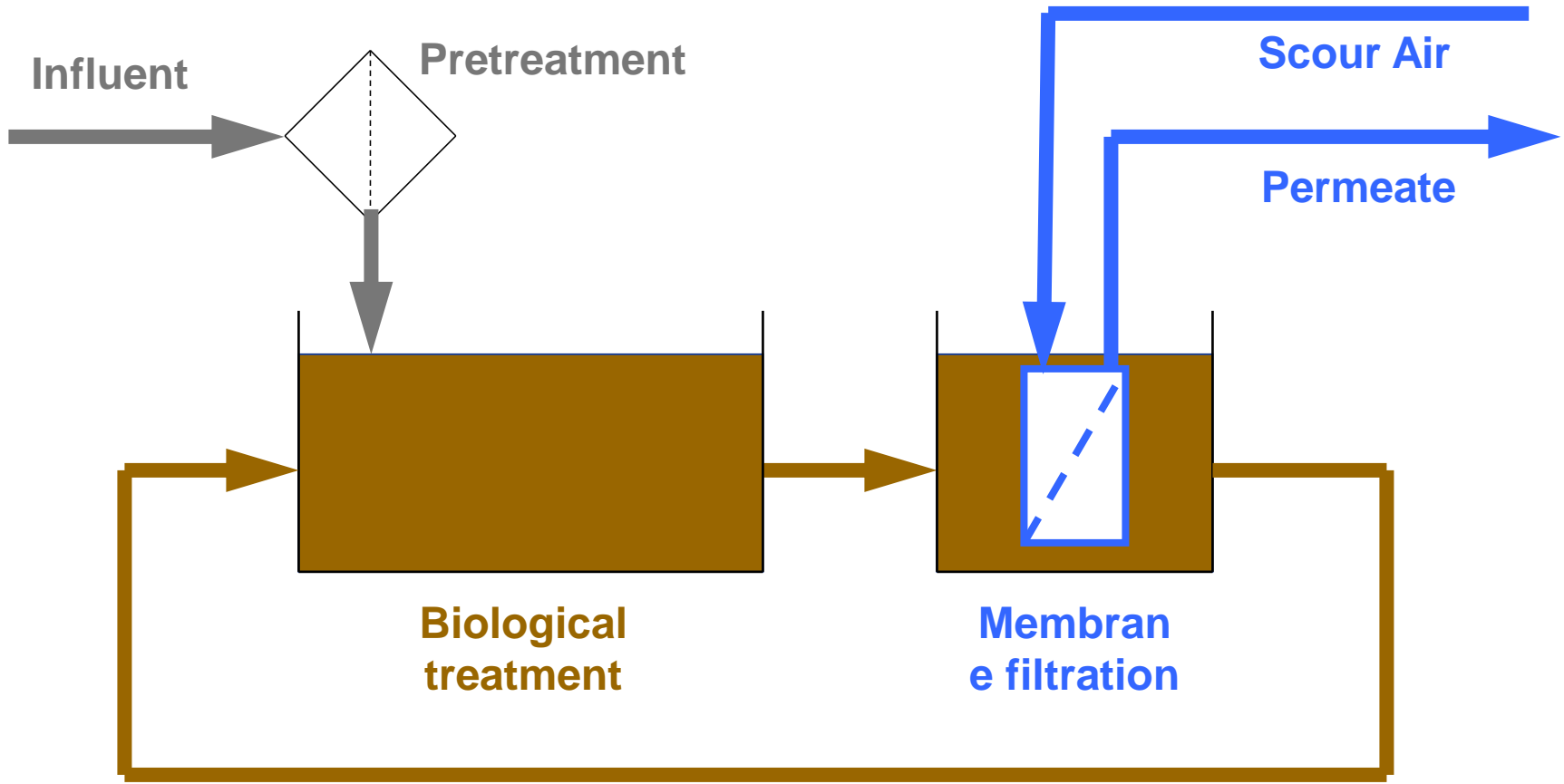
**Immersed MBR**



**Retrofits Driving Membrane Growth**

# Membranes – Dispelling the Fears

Back to Basics = Simple Operations...



Mixed liquor recycle

# Membranes – Dispelling the Fears

## Advanced Scouring Technology



LEAPmbr Aeration



Sequential Aeration

# Membranes – Dispelling the Fears

## Optimal Design Philosophy

Reliable Pre-Treatment  
+  
Responsible Bio Design  
+  
Proven Flux  
+  
Robust Cleaning strategy  
=  
Consistent Operations &  
Long Membrane Life



**Traverse City Membranes after  
10 years in mixed liquor**

# Euclid, OH Small Footprint + CSO Upsets

## 66 MGD MBR Retrofit of a Pure OX / Clarification

### Plant Overview:

- EPA Consent Decree
- PureOX followed by 2x rectangular clarifiers
- Extremely Small Footprint
- 5.2 Mgals total volume
- Wet Weather to 240 MGD
- Full Upgrade to MBR
- Increase plant from 25 to 66 MGD



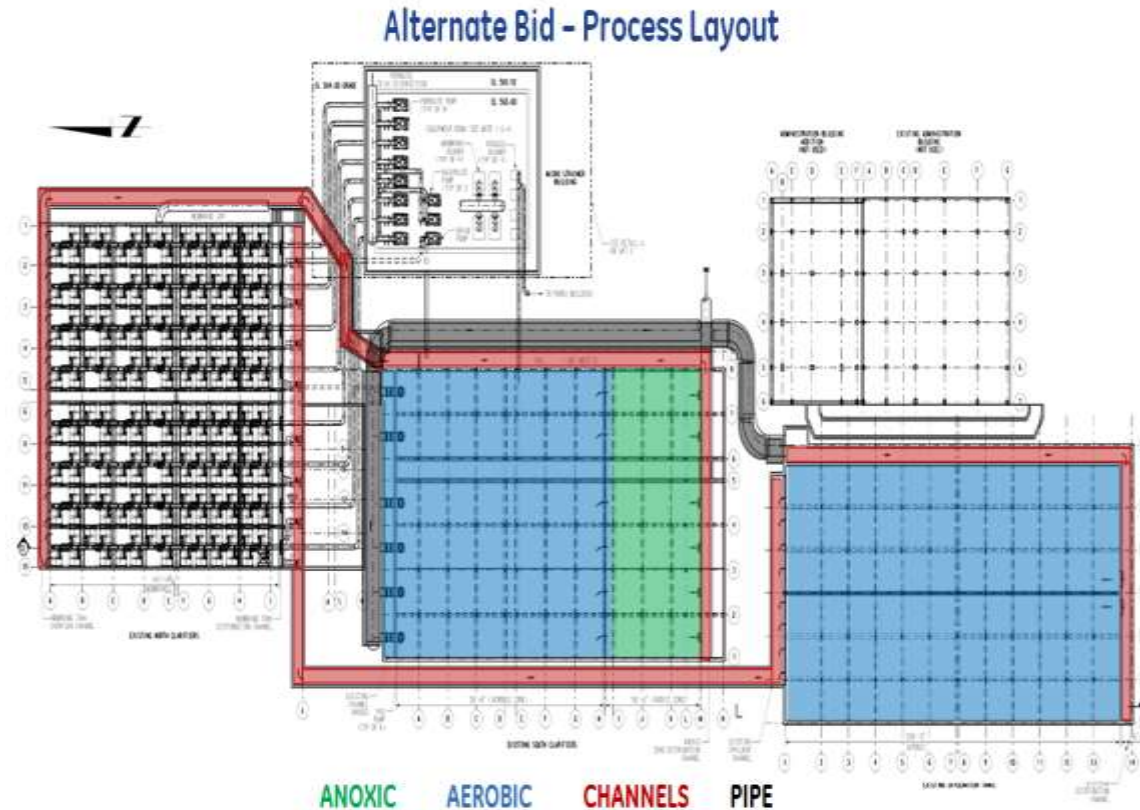


# Euclid, OH Small Footprint + CSO Upsets

## 66 MGD MBR Retrofit of a Pure OX / Clarification

### Plant Overview:

- Pure Ox to Fine Bubble
- South Clarifier to Anoxic/fine bubble
- North Clarifier to 8x trains of membranes
- Final Effluent <15 / 20 / 1 for BOD / TSS / TP
- Ability for Plant to run during construction
- Savings of >\$23k / month on Pure oxygen rental alone plus ~10% power savings to go with MBR



# Euclid, OH Small Footprint + CSO Upsets

## 66 MGD MBR Retrofit of a Pure OX / Clarification

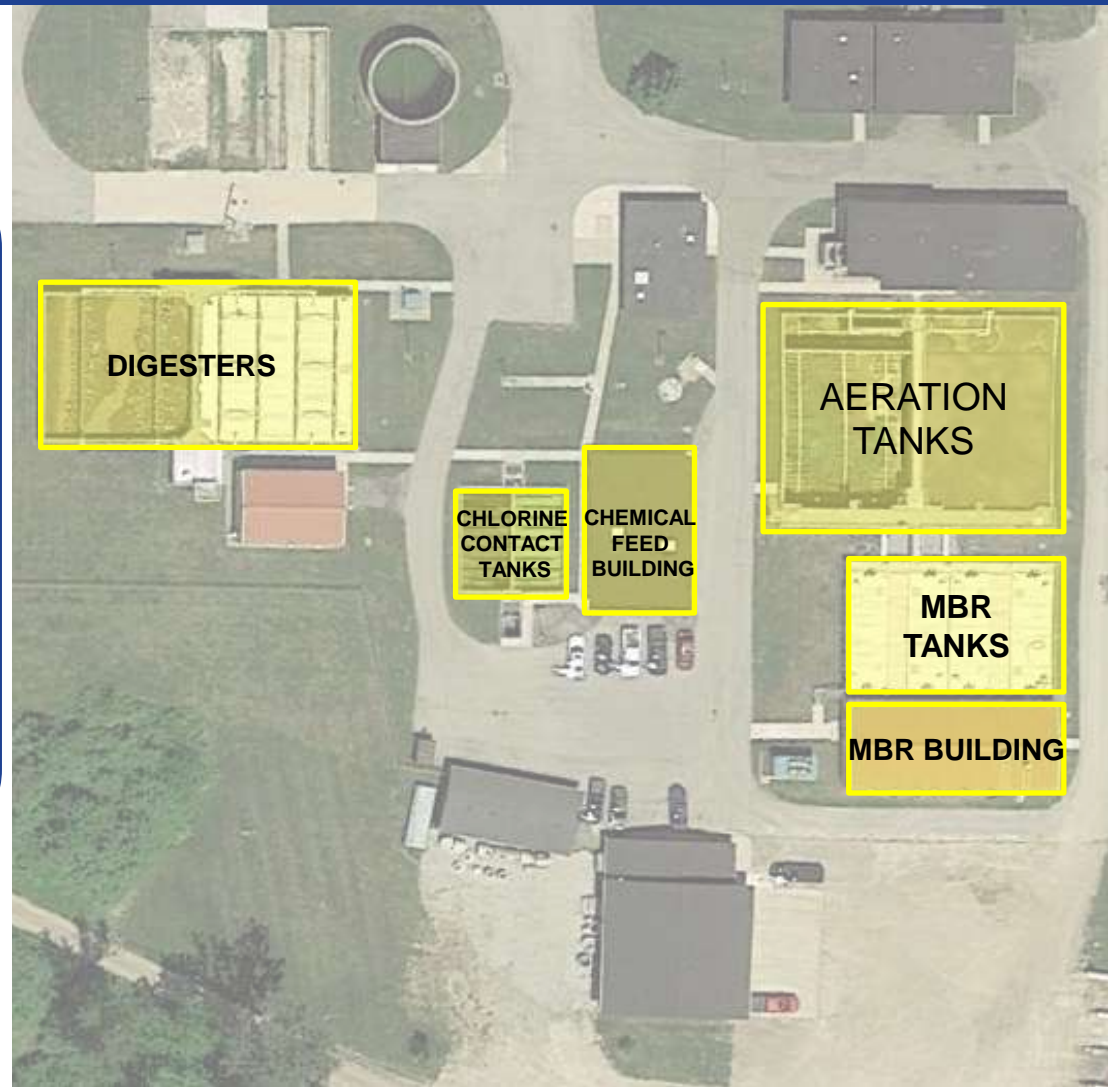
<b>Number of Membrane Trains</b>	<b>8</b>
Number of Cassettes Installed Per Train	24
Number of Cassette Spaces Per Train	28
Number of Modules per Cassette	48
Total Number of Installed Cassettes	192
Membrane Module Surface Area	370 ft <sup>2</sup>
Spare Space	14.3%
MLSS Design	8,000 mg/L – 10,000 mg/L
Flux at Average Daily Flow	6.5 gfd
Flux at Peak Hourly	19.4 gfd
Membrane Air requirement (All trains)	19,132 scfm

# Dundee, MI – Flow + Technology Challenges

## Upgrade of Technology

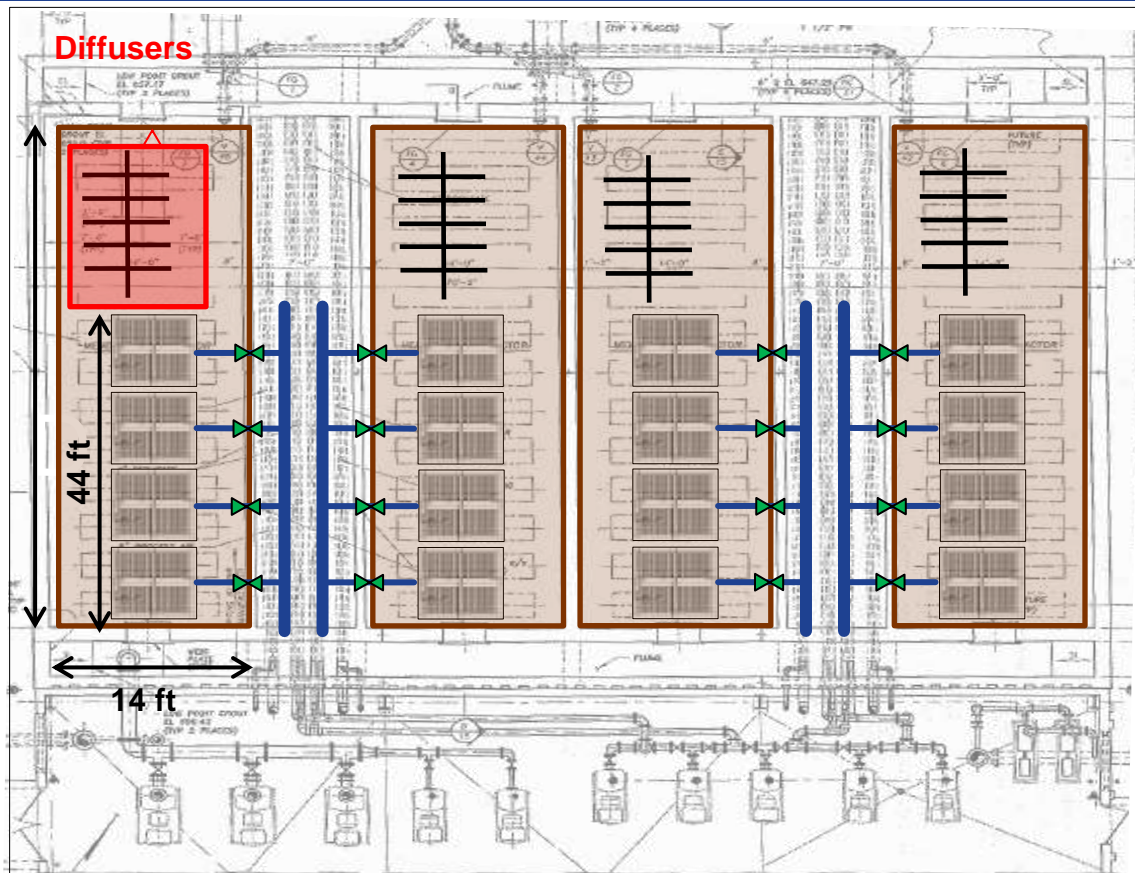
### Plant Overview:

- 4 MBR Basins
- Actual Flow closer to 0.8 MGD
- Multiple technology upsets
- Flat Panel Membranes at end of useful life
- Increased flow / load demands due to increased development
- Plant to run during staged construction



# Dundee, MI – Flow + Technology Challenges

## Designed Retrofit – Cassettes in Existing Tanks



### Revised Plant Overview:

- 1.5/1.9/3.0MGD  
ADF/MMF/MDF
- Can run 1.9MGD at N-1
- Removal of 1x 75 hp blower
- Biological MLSS to stay at 6,000 mg/L
- Reuse of RAS, Blowers and sundry equipment
- Upgrade of Permeate and Cleaning Equipment
- Plant can expand to 2.3 MGD MMF

# Dundee, MI – Flow + Technology Challenges

## Designed Retrofit – Cassettes in Existing Tanks

<b>Number of Membrane Trains</b>	<b>4</b>
Number of Cassettes Installed Per Train	4
Number of Cassette Spaces Per Train	4
Number of Modules per Cassette	40
Total Number of Installed Modules	640
Membrane Module Surface Area	370 ft <sup>2</sup>
Spare Space	23%
MLSS Design	6,000 mg/L *Expandable to 8,000-10,000 mg/L
Flux at Average Daily Flow	6.3 gfd
Flux at Maximum Daily Flow	12.7 gfd
Membrane Air Usage	1750 scfm

# MBR Now Makes Sense for All Types of Plants

## Competitive

- MBR Competitive with CAS - cheaper for Nutrient Removal and Reuse
- Membrane costs, advancement in design and reduction in energy

## Small Footprint

- Significant expansion in existing footprint and assets
- WWTP often encroached on by expanding cities

## Technology Maturation

- Proven Performance
- Membrane Life exceeds estimates
- Simple and Reliable Operation

## Demand for High Quality Effluent and Reuse

- MBR meets Regulations pushing for higher quality effluents
- Stress on freshwater resources and reduction of nutrients

## Retrofits Driving MBR Growth





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