

Wastewater Center of Excellence

Wastewater Treatment & Recovery Plant (WWTRP)

FHQ Presentation

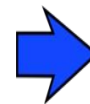
June 6, 2016



**Raw
Sewage**



**Modular Treatment
Plant (in a box)**



**Clean, Recovered
Water for Reuse**

SWAN Background

Water is emerging as the
dominant issue for the
world's future

It is the “new oil”

SWAN Background

- SWAN is a non profit organization founded in 2013 that includes members from: Government, Academic and Private Business
- SWAN works with “action oriented” organizations that strive to deliver innovative, sustainable solutions to better manage water
- SWAN supports advanced projects ready for market (impact)

SWAN Background

- SWAN (SK Water Action Network) sees sewage as an untapped resource to help address the ever growing water crisis (better ways to recycle, reuse & lessen demand of potable water)
- A sample SWAN objective is to support designs of decentralized, packaged, automated, modular Wastewater Treatment and Recovery Plants (with advanced quality, cost savings & reliability)
- Please visit SWAN website for more:
www.swanprojects.ca

Traditional Vision

- Water infrastructure projects are generally designed to meet current regulations, however regulations are often out-of-date
- Consultants over-design (30 year plan) which is wasteful for first half-life of plant, and inaccurate guessing
- If not broken don't touch it, consultants prefer old solutions that protect liability risk (however now unable to take advantage of new advancements, learning and education)

Traditional Vision

Old Way of thinking (*still current with many*)

- **Dilution is the Solution to Pollution**
- **Take ALL the Space You Need**



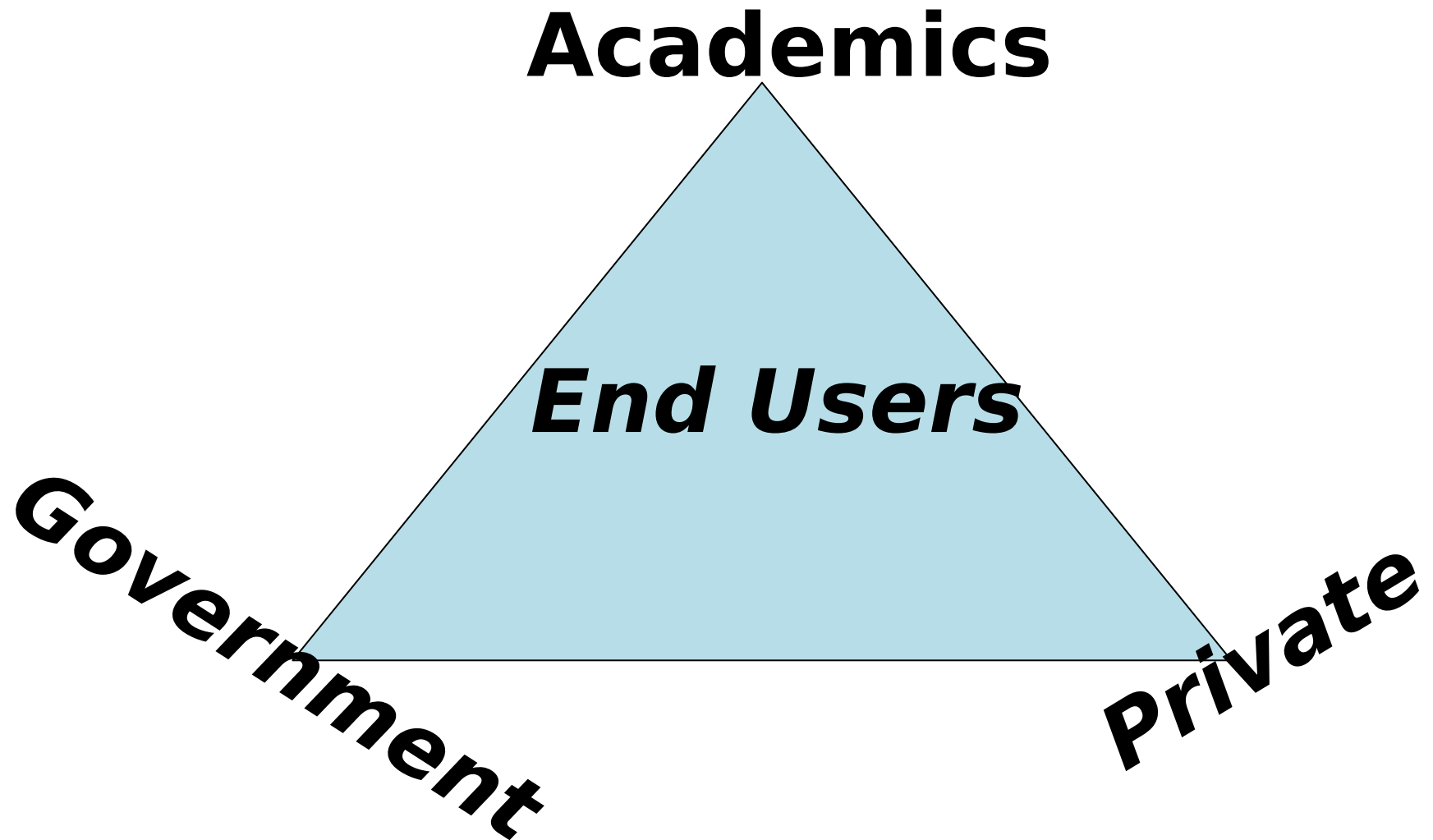
SWAN Vision

- Attract members that are Sustainable, Certified Professionals & follow innovative project management for water recovery infrastructure (*not sewage treatment*)
- Support actionable projects to lessen use of potable water & address future regulations (not past) with focus on environmental, social & economic benefits
- Get projects out to the people, but find lower cost & better quality than traditional ways of thinking

New Way of Thinking

- Sewage = Value
- 99% recovered water





Current Areas of Specialization and related Members

- **Academic** - Sask Polytechnic, U of S Chemistry, Computer Science, Engineering
- **Government** - Innov Saskatchewan, Ag West Bio, NSERC

Small Private Businesses:

- **Accounting** - Advance Tek
- **Civil** - Canadian Mats
- **Construction** - Allan Construction, Bow Homes, ConTech, Points Athabasca, Selinger Construction

Membership

- **Developments** - Floral Developments
- **Engineering** - 5 Spheres, EngComp, Enviointegration, Pinter
- **Legal** - Miller Thompson
- **Membranes** - Koch Membranes, Proteus Waters
- **PM, IT and Training** - , NexLev Solutions IRG Health Infomatics
- **Trades & Mechanical** – EMW, Peak Mechanical, Shaughnessy Electric

Sample Project

- An Innovative Investment Group will design, manufacture, deliver, commission & operate WWTRP by August, 2016
- Located NW Saskatoon, strong support and direct involvement from Residents, Businesses, Academics, Governments and Associations
- Will become a Center of Excellence for water management and wastewater infrastructure advancement

Solution

- “Sewage Plant in-a-box” (packaged, reliable design within Sea Containers (40x8x8 feet))
- Advanced product, proven over decades in Canada, USA and rest of world, warranty & performance backed
- Modular, scalable piece of equipment that uses MBR (Membrane Bio-Reactor) as the treatment process/technology
- Manufactured vs Constructed (accurate/consistent planning)

Solution



Team Leads

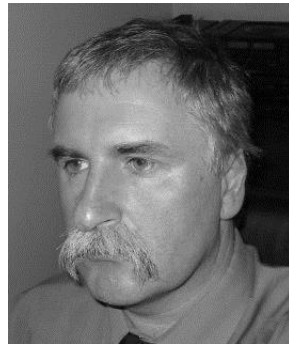


- Jason Tratch
(BSA, BSc
P.Ag)

- Mr. Tratch, certified in: PMP, ISO 9000, Six Sigma, FITT, WWT, CCA.



- Andy Ciesinski
(MEng)



- Andrew Potrzebka
(KMS - MEng)

- Proteus has been operating since 2009 (Europe & Canada) with global references/awards, wastewater certified

NOTE: top alliances include:

- Dr. Jackson Chan (PhD, Eng)
- Carlos Guzman (MSc Eng)

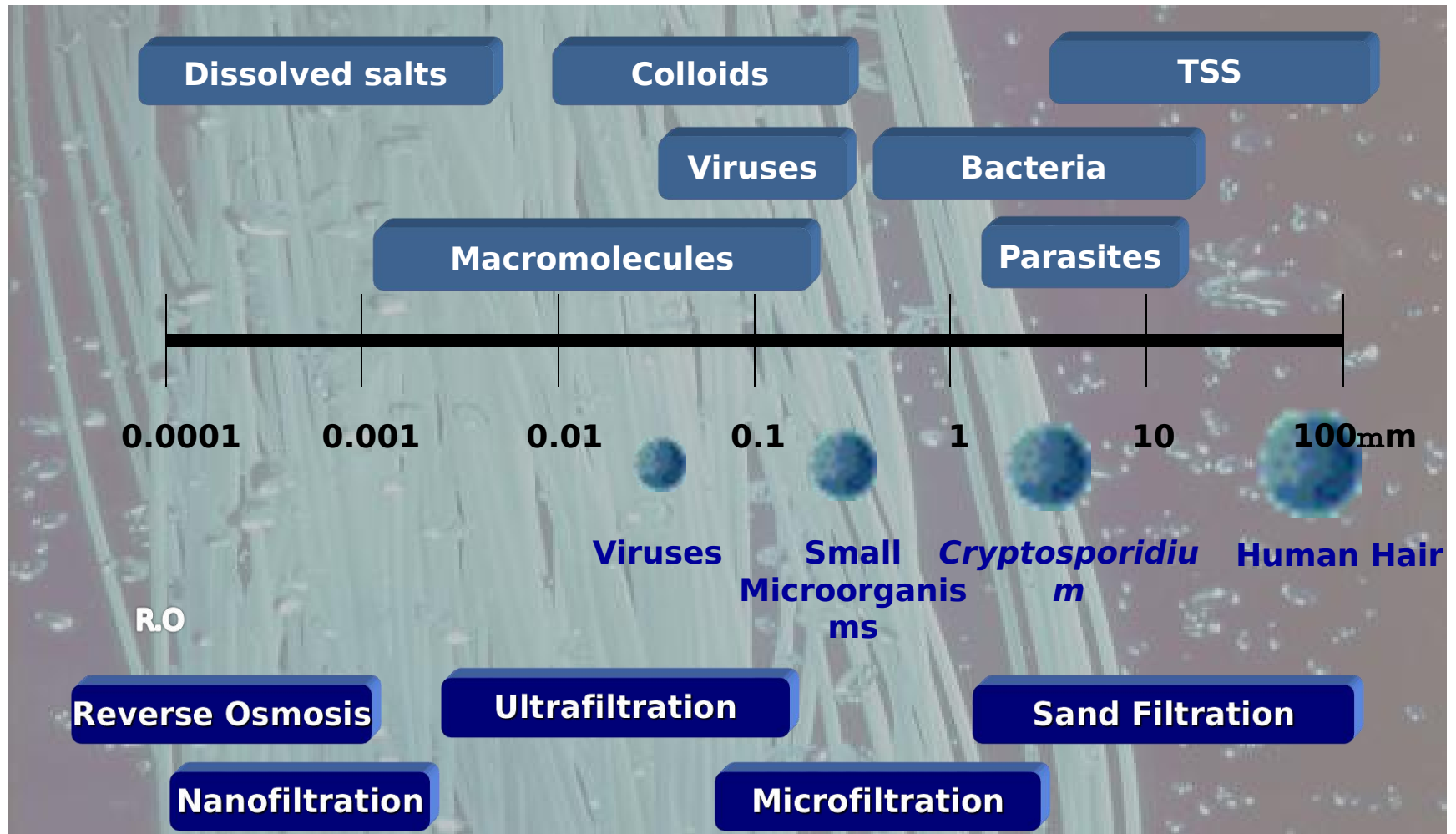
- Businesses, Associations, Tech-

A typical Wastewater Treatment and Recovery Plant (WWTRP) has three main parts:

- 1. Collection Infrastructure** (houses, buildings, septic truck drop off stations, pumps, into a centralized collection tank)
- 2. Treatment & Recovery Plant** (4-6 sea containers placed onto an engineered pad and connected to input/output hoses)
- 3. Distribution/Storage** (piping to transport clean water away from plant, into irrigation pond, sludge goes into belt press for fertilizer, excess water can be stored as needed)

BASICS OF MEMBRANE FILTRATION

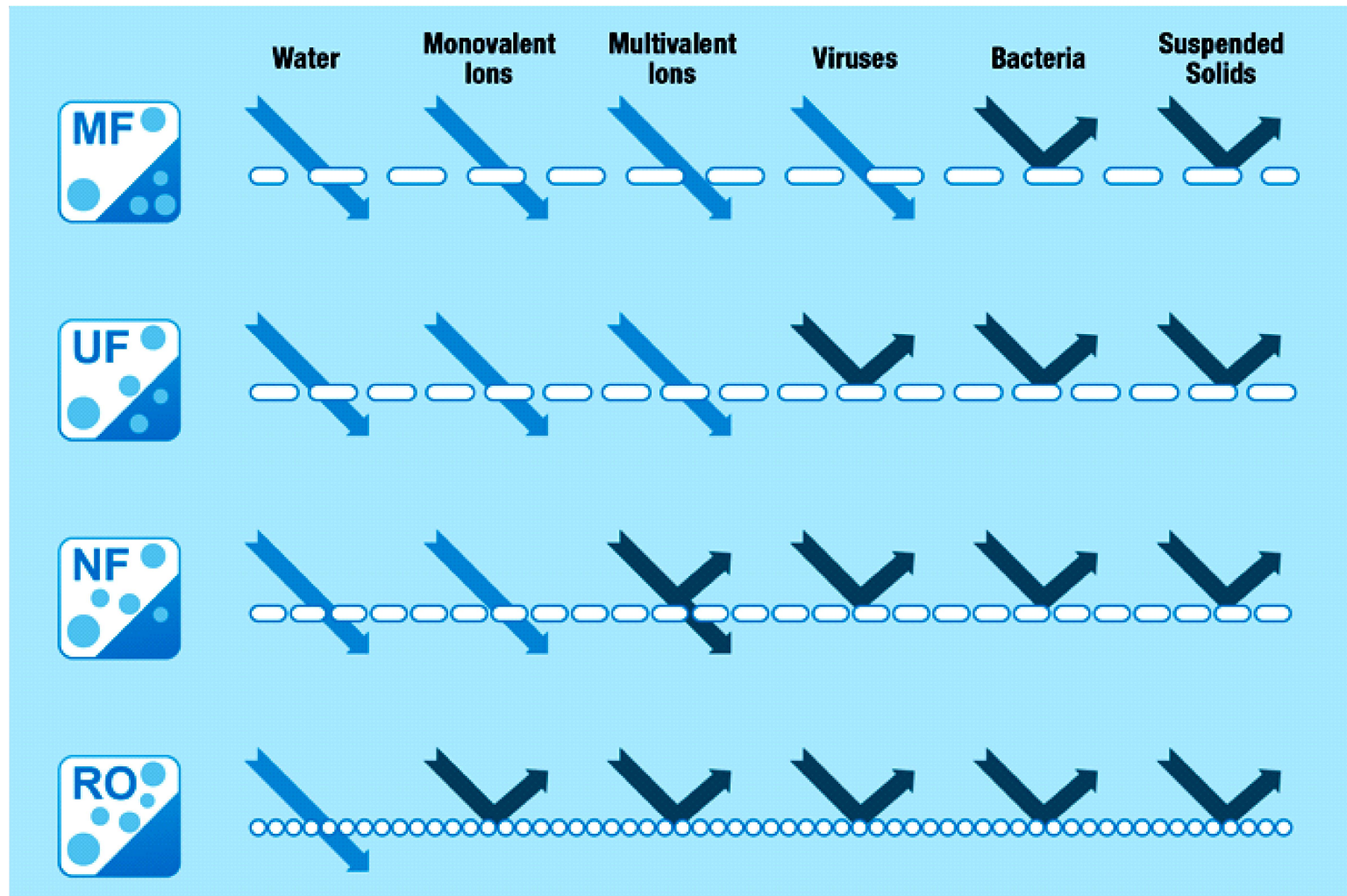
Filtration Processes



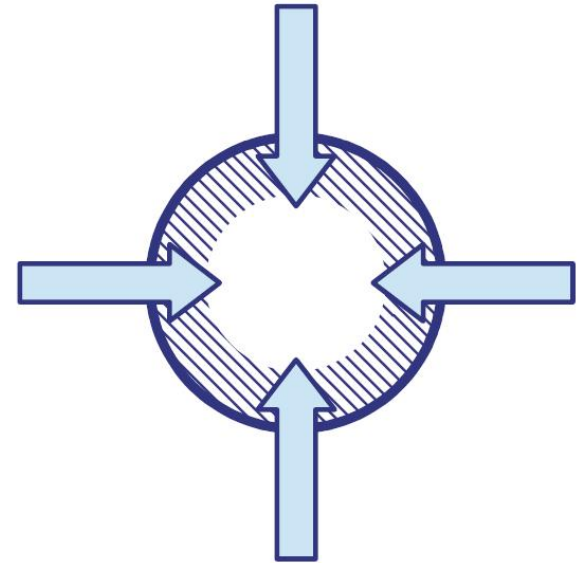
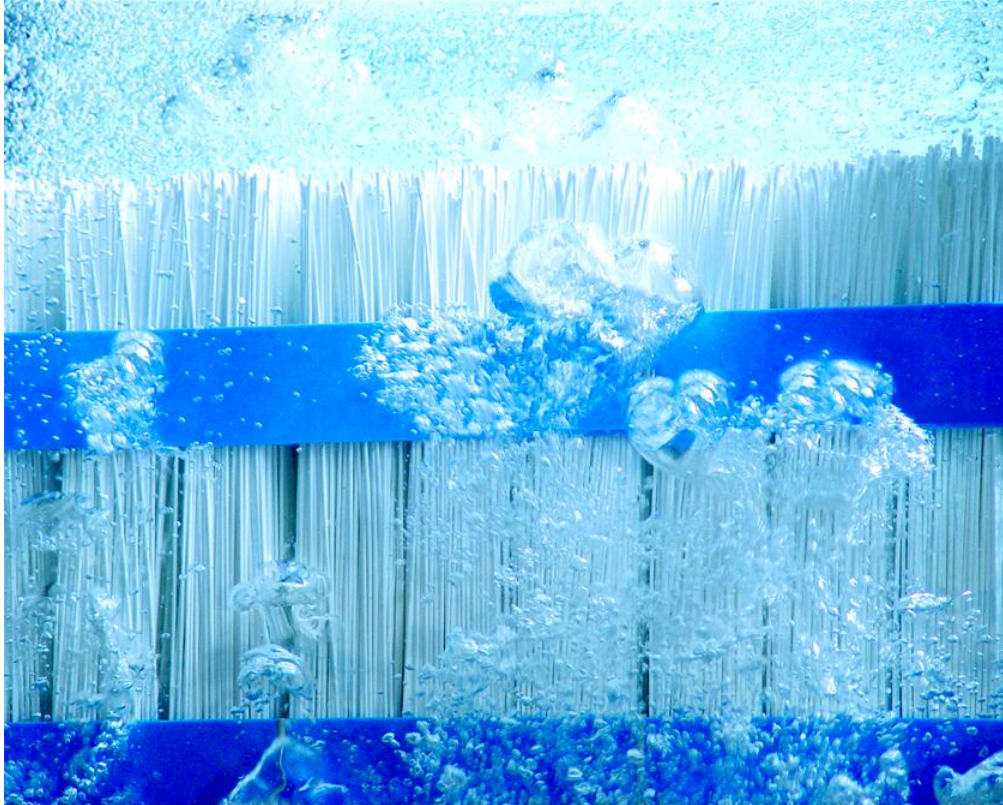
Membrane Filtration – Pore Size

- Microfiltration, MF (0.1 - 1 μm)
- Ultrafiltration, UF (0.01 - 0.1 μm)
- Nanofiltration, NF (0.001 - 0.01 μm)
- Reverse Osmosis, RO (0.0001 - 0.001 μm)

Membrane Filtration – Pore Size



Hollow Fiber Membranes



Flow through membrane

Historical Background of Membranes

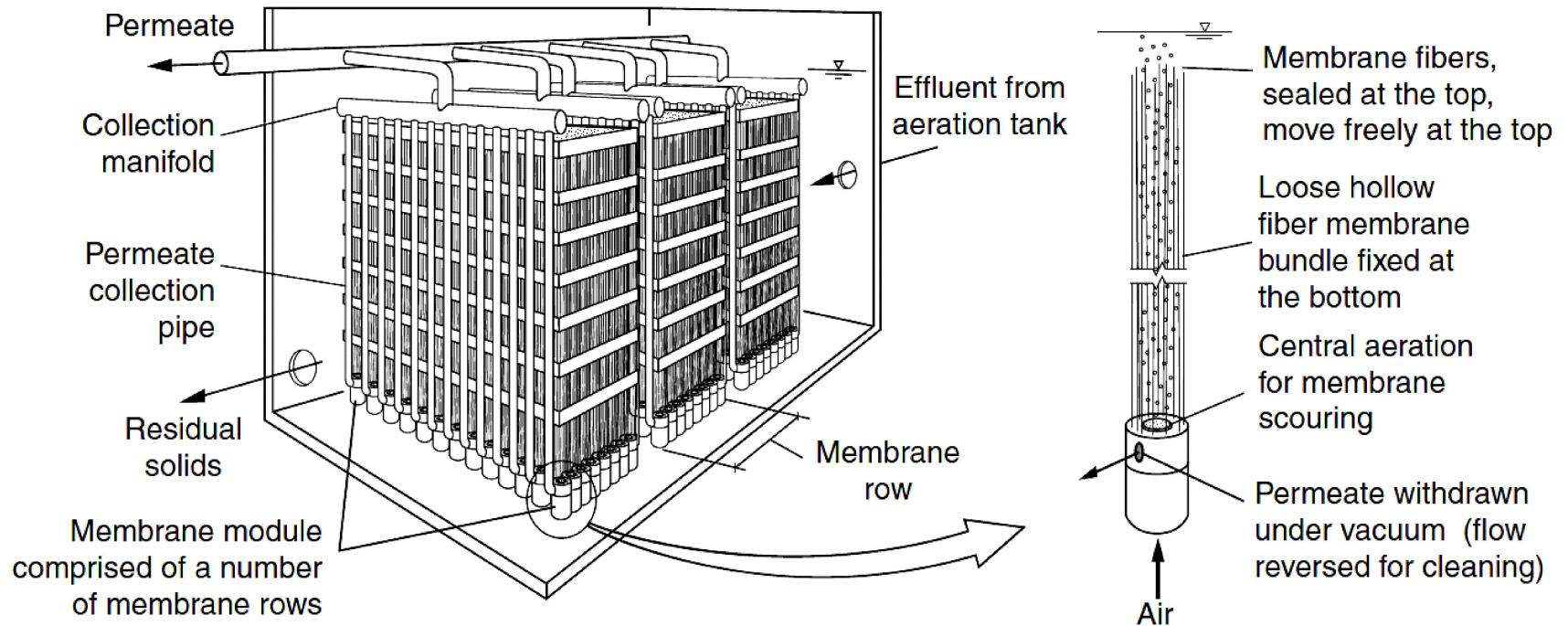
- 1969 – First commercial side-stream FS-UF MBRs introduced by Dorr-Oliver
- 1989 – Yamamoto et al. developed a submerged HF-UF MBR process
- 1993 – Zenon Environmental receives patent for their ZenoGem submerged HF UF MBR process
- 1994 – Kubota develops a FS-MF submerged MBR module

Project Technology (MBR)

How membranes work

- Membranes are based on filtration methods
- Hollow polymer fibers (tubes) with billions of microscopic pores
- Pores are on the surface and much smaller in size than contaminants, bacteria and viruses (cannot pass through)
- Application of pressure with slight vacuum inside is all that is required to draw water into the membrane
- Membrane only allows clean water to pass through while rejecting impurities— consistent, exceptional water quality
- Membranes are flexible and have regular

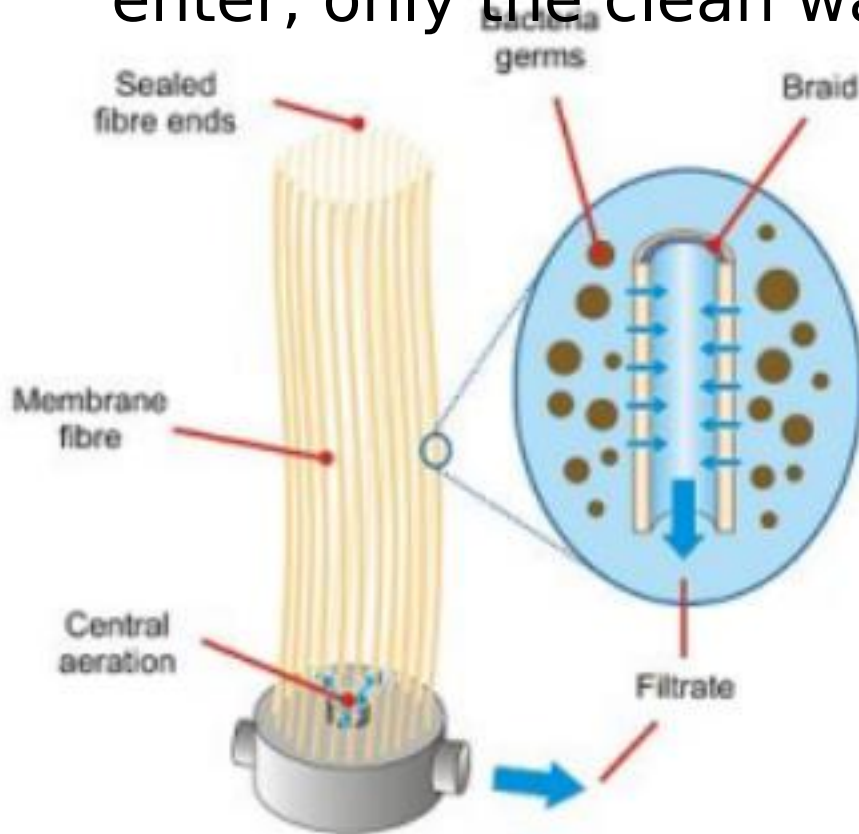
Hollow Fiber Membranes



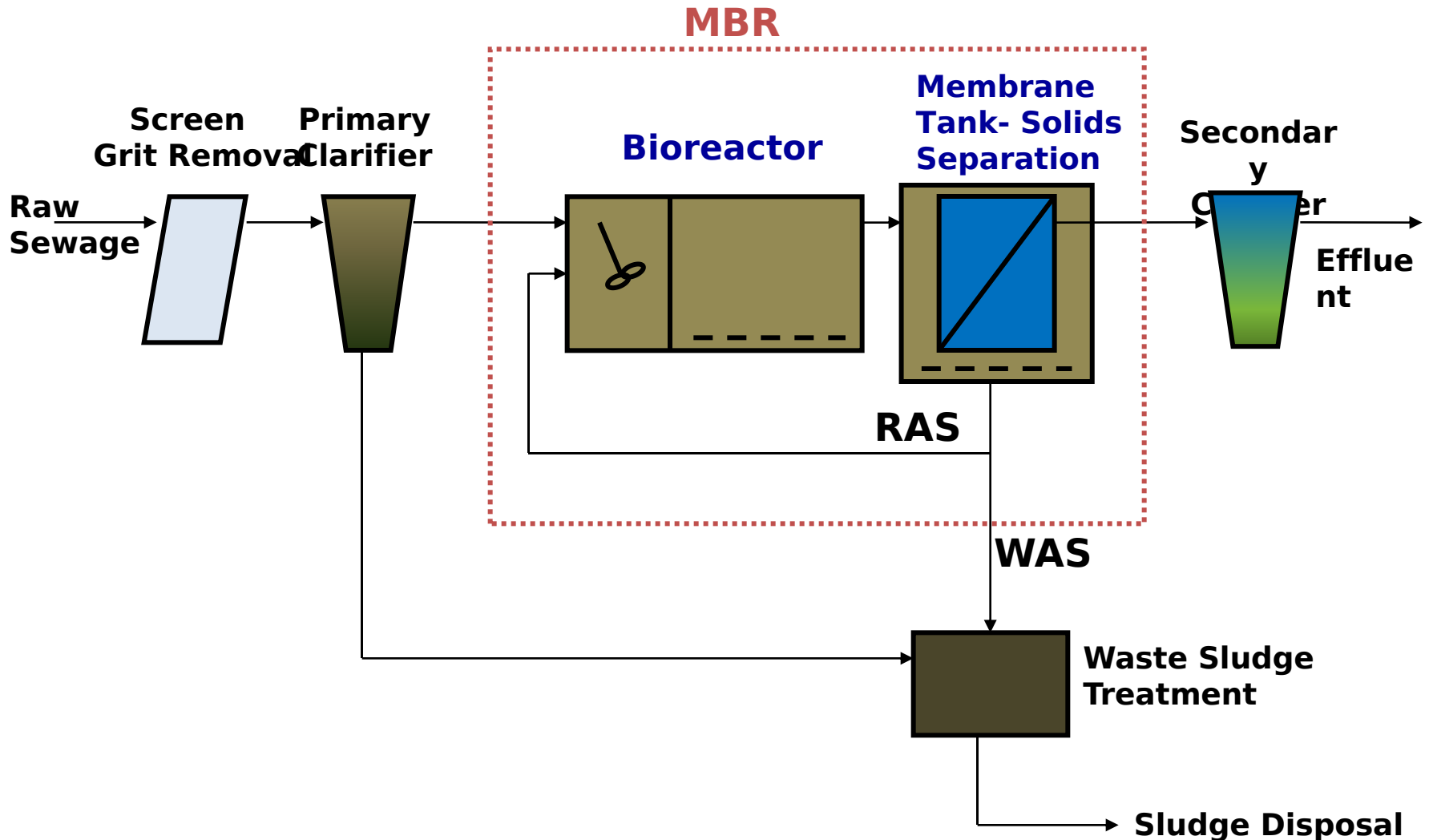
Schematic of placement of bundles (Koch Membrane Systems)

MBR Treatment Engine

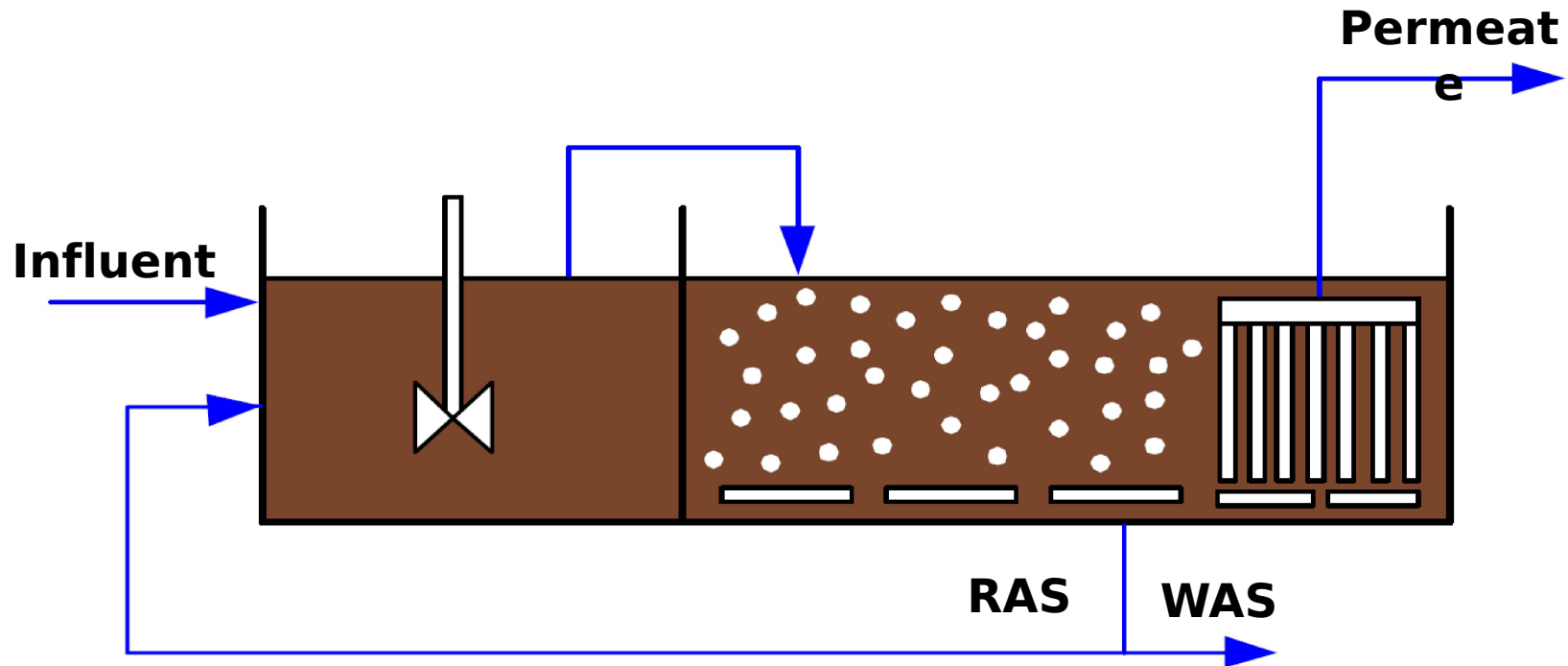
- Hollow Fiber Membrane module is submerged directly into the sewage and wastewater must flow through the fiber to exit (bacteria cannot enter, only the clean water is sucked in)



Comparison with Conventional Activated Sludge (CAS)



MBR System Configurations - Submerged



MBR Reliability

- MBR is a mature technology around the world
- MBR has passed strict environmental codes of California, USA (global leader for both environmental & economic solutions), MBR technologies basically “rubber stamped”
- MBRs are well known in Canada and were invented in Ontario (Zenon 1980-2006, sold to GE), advancing in all provinces, in both private and municipal environments
- In Europe is considered a BAT (best available technology) so is fast tracked in regulatory approvals

MBR Treatment Quality

- See below for average Safety, Health & Quality differences

| Parameter | Lagoons (legacy) | Conventional (semi- mechanical) | MBR (advance d) |
|--------------------------------|-----------------------------|--|--------------------------------|
| BOD5 (mg/L) | < 70 | < 25 | < 5 |
| TSS (mg/L) | < 60 | < 25 | < 1 |
| Total N (mg/L) | < 35 | < 35 | < 10 |
| Total P (mg/L) | < 7 | < 6.5 | < 1 |
| Total Coliforms, eColi , | | | |

MBR Summary

- Uses a filter, thus does not primarily depend on wind, sunlight, living organisms to operate (as per a lagoon)
- Automated web control (monitor, operate over internet/cell)
- Collection of water and human health data (water and health Data Analytics and Business Intelligence)
- Packaged, modular design (build with a 7-10 year plan and be scalable as needed, thus avoid trying to predict populations in 30 years, or losing out on new advanced technologies that become available on the market every year)
- No Secondary Clarification or Filtration (no toxic smell or scum)

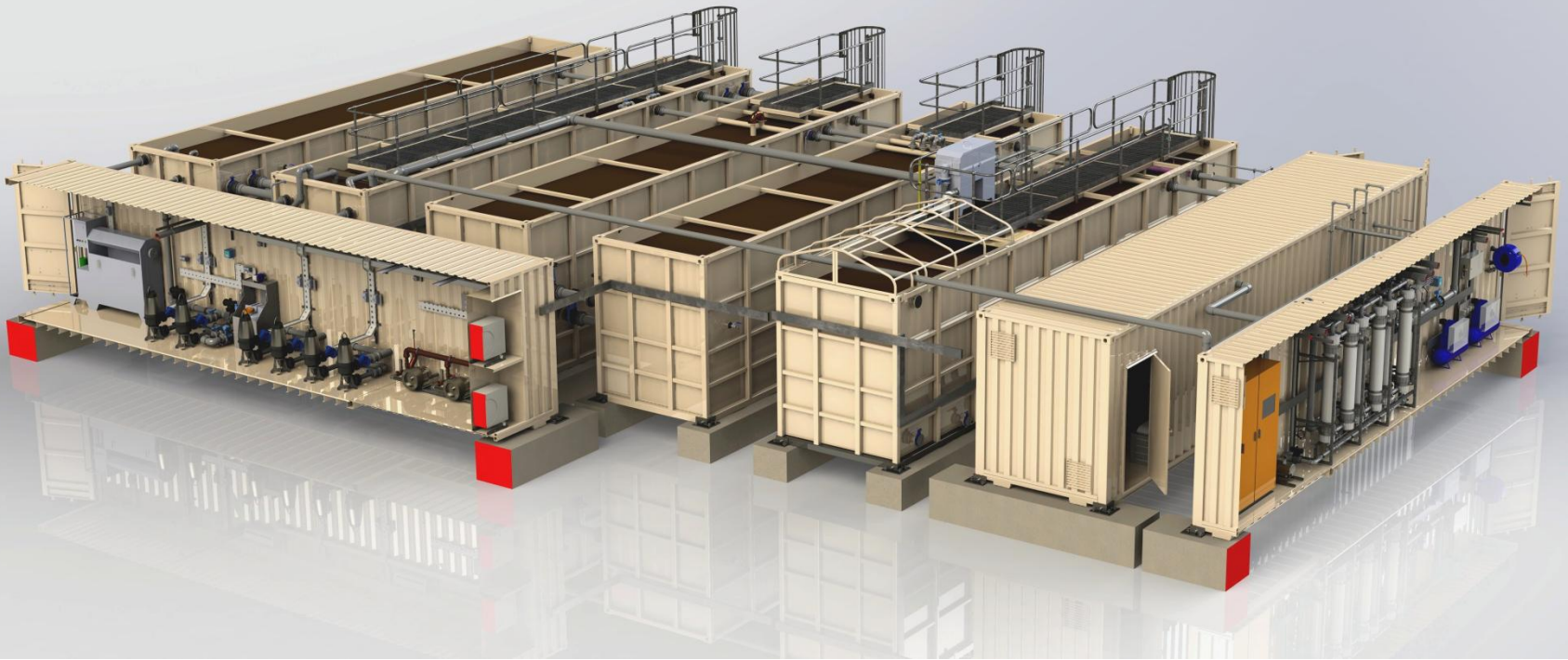
Sample Plants



Sample Plants



Sample Plants



Sample Plants

Dockside Green

- operation since 2009
- beneath apartments
- Reuse treated water saves over 100 million litres of drinking water
- 2,500 people



Sample Plants

Oxford

- Existing plant, built in 1960, needed expansion to service new residential developments
- Tripled capacity and improved the output quality without altering the building footprint
- Awards of Excellence in 2011 by Canadian Consulting Engineering



Sample Plants

Santa Paula Water Recycling

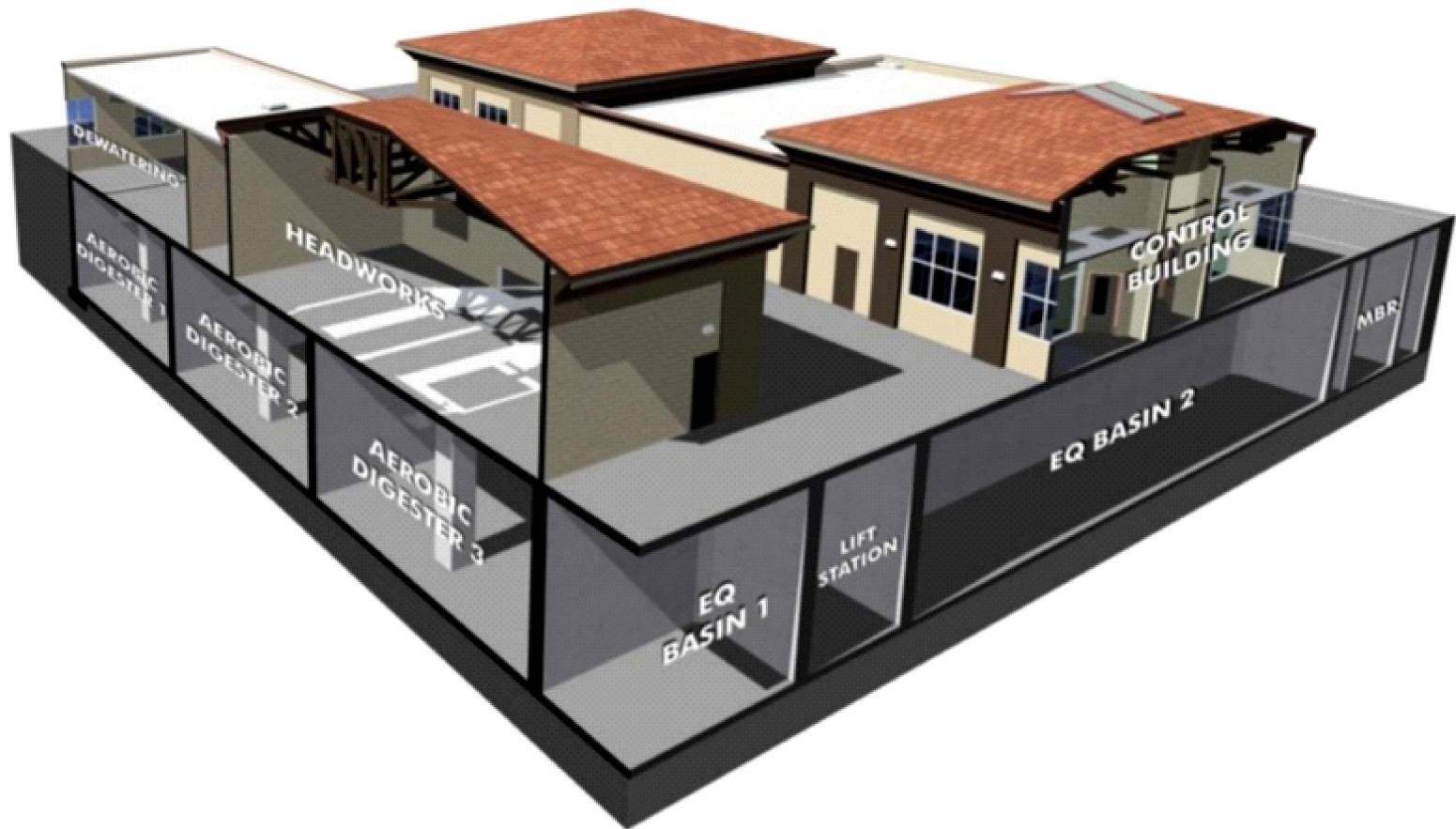
- 15,900 m³/day
- California's First Design-Build-Operate-Finance Water Recycling Facility
- EPA and the California RWQCB Title 22 Class A+



Santa Paula Water Recycling Facility (CA, US)

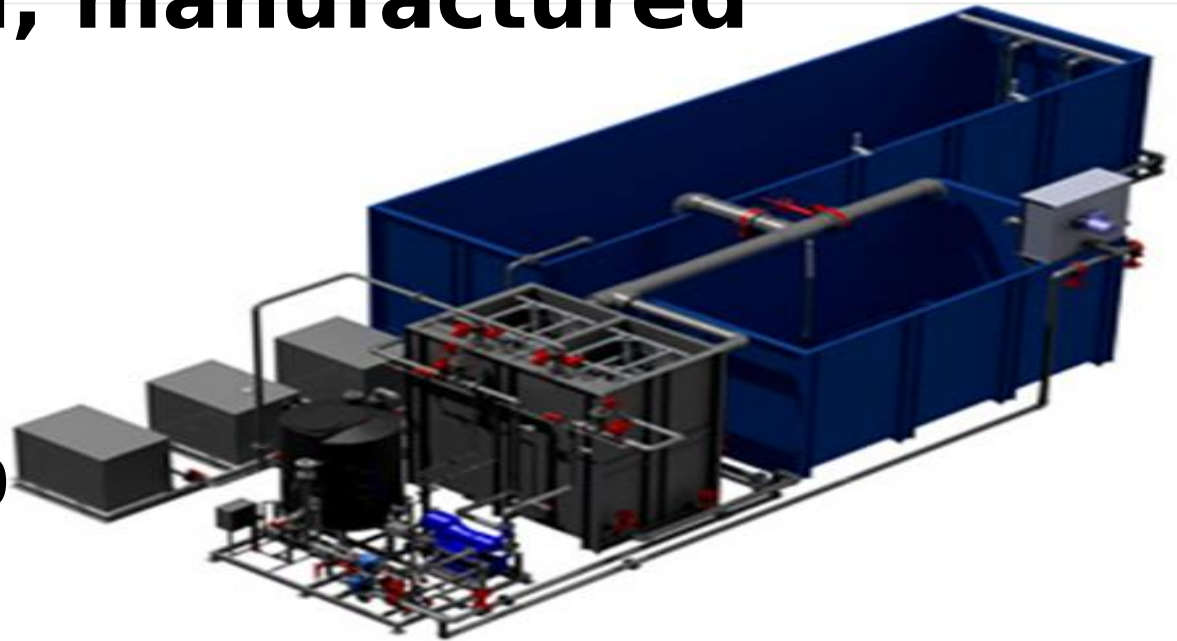


Santa Paula Water Recycling Facility (CA, US)



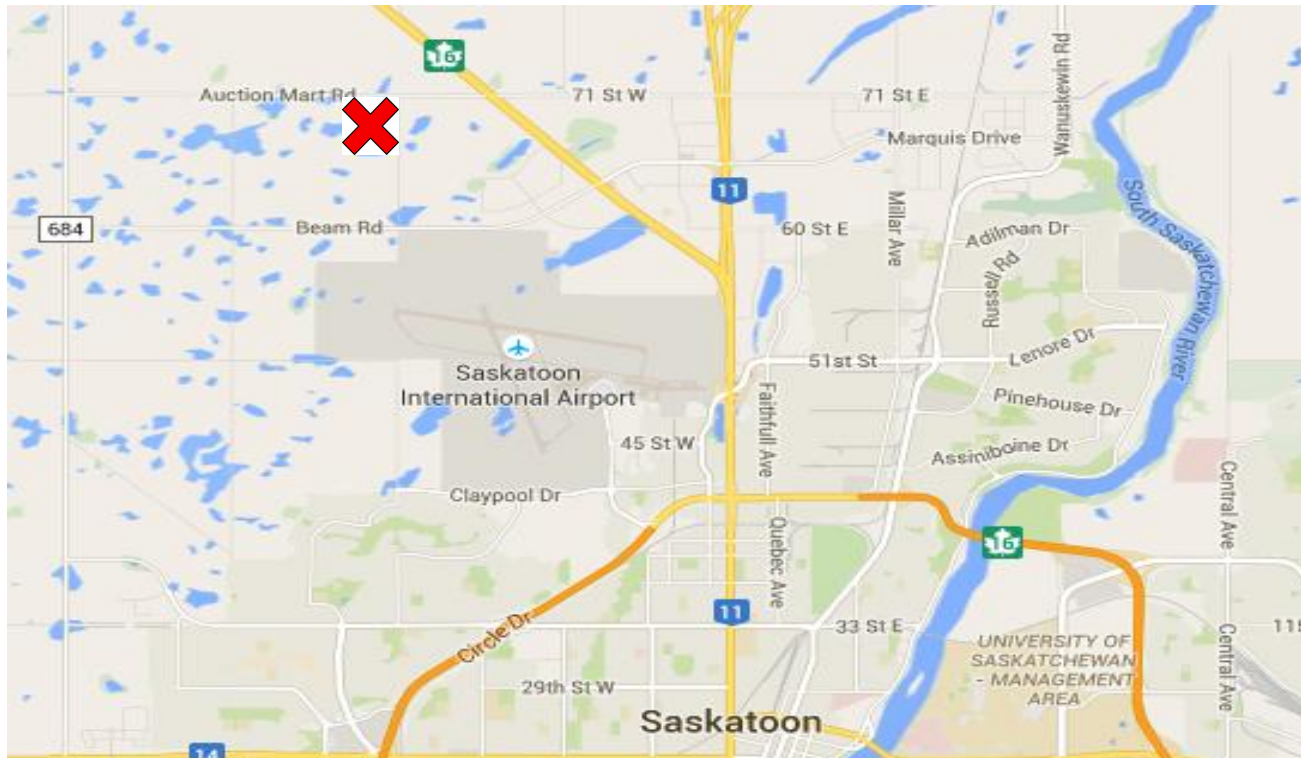
Small scaled, manufactured design

- MBR modules with blue collection/treatment tanks
- Design can fit the plant into 40 foot sea containers
- Scalable (plant of 1800 sq feet treats 1250 people)



Project Location

- City limits (NW corner of Saskatoon, see red X below)
- 1 mile West of Hwy 16/Auction mart Road Junction
- Strong support from businesses, government, etc.



Primary Revenue Source

- Membership of Septic Hauling trucks, re-direct approximately 20 truck loads per day from Saskatoon WWTP
- Business model has monthly planned revenue & volumes from Septic Haulers based on tremendous value, including: save 10-15% drop off cost, no line-ups, closer distance, no residential traffic or lights. better roads, less stainable and



Secondary Revenue Source

- Adjacent apartments, businesses, residential communities, developments, trailer parks, etc. with municipal sewage that can be piped directly into the plant



MBR Advantages

- Proven and popular around the world due to key advantages:
 - a) tiny footprint
 - b) high treated effluent (water) quality
 - c) reliability (warranties) and consistency (avoid crashes)
 - d) remote monitoring/operations (simple and confident)
 - e) Low price (capital cost)
 - f) Lower risk to future health, safety, environment and cost and ability to incorporate advancements (new technologies)
 - g) Confidence in quality and operations

- **Environmental:** high quality (ecosystem, human, fish health), recycle/reuse clean water, less demand for potable water
- **Agricultural :** recover nitrogen and other fertilizers (in both the irrigation water and the biosolids)
- **Less Complaints:** oversized Septic Trucks in school, residential neighbourhoods (health & safety, leaks, smell, aesthetics, etc.)
- **Less Road Damage:** wear & tear on residential roads from heavy industrial tanker trucks

Benefits

- **Proactive:** businesses/septic tank #s are growing, new Federal laws finding new information so becoming safer (lagoons shutting down), more trucks dump at advanced stations (e.g. city/town), protect and better manage a most precious resource (water)
- **More Confidence:** less risk for engineering/construction over-runs, deliver warranties to the client due to high quality
- **Future Innovation Availability:** technology changes every 1-2 years, these inventions need to be able to be integrated into existing designs (take advantage) as they come to market
- **Changing Weather:** ability to better manage our water will allow us to be more adaptive and

Future Optimizations

- Existing projects/grants that will be based through SWAN and this SWAN based project include:
 - Automation for operations and maintenance
 - Automation for monitoring and data collection
 - Training for diverse environments
 - Data identification, collection and analytics
 - Costs and expenses of plant design and delivery
 - Reuse of irrigation water and fertilizer on Agricultural lands
- Note: more grants/projects are in discussion and SWAN is actively supportive and open to new partnerships/alliances

Future Projects

Planned upcoming project collaborations include:

- Private businesses (local, national, international)
- Manufacturing of plants
- Training and certifications (Trades)
- Universities and Polytechnic Institutes
- Governments and Associations
- First Nation Communities, Towns, Villages, Municipalities
- Training and Education (online & in-class blended learning)
- Data Analytics & Business intelligence in water health (human and environmental ecosystem impacts, trends and risks)
- Advanced levels of research in areas such as:

Thank you

