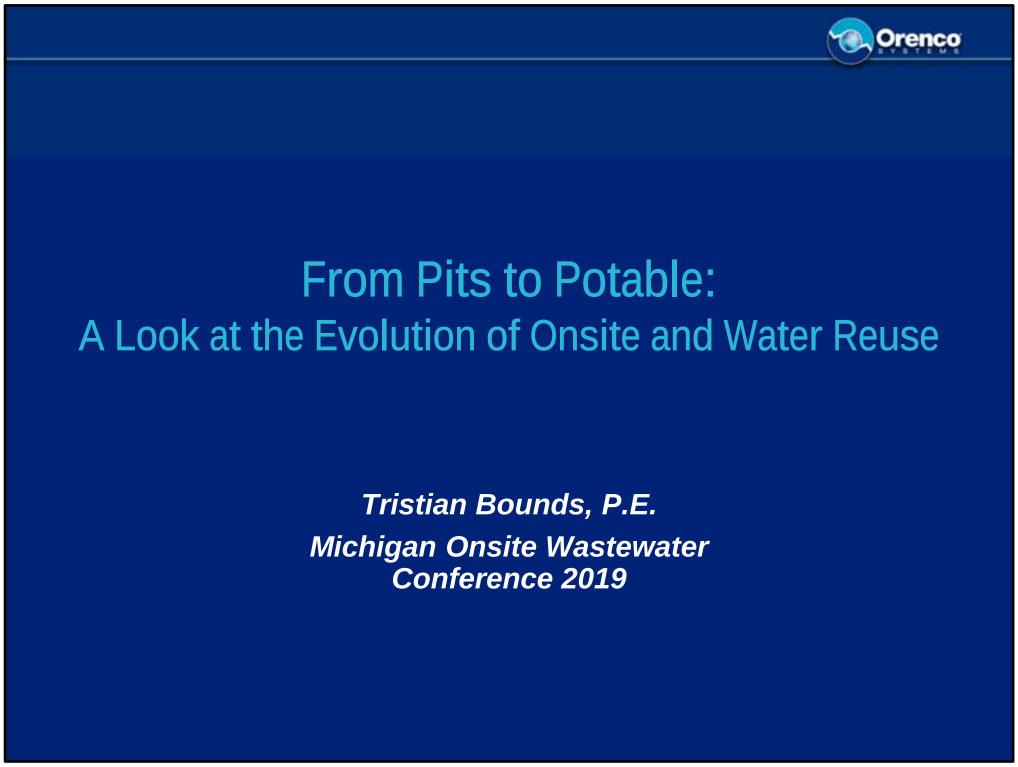
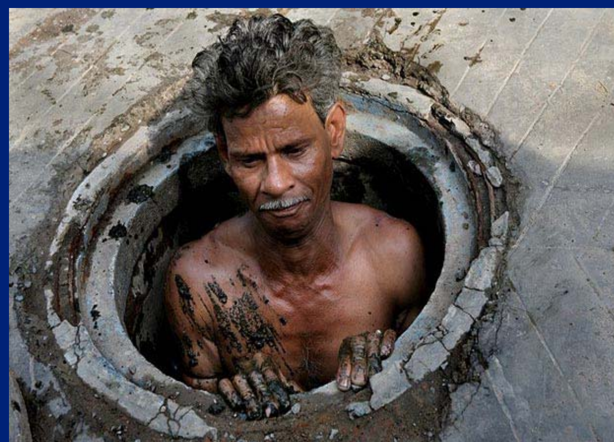


Thank you very much for having me.

It’s been many years since I’ve been to this wonderful state and I’m happy to be back.

The Business of “Waste” Water

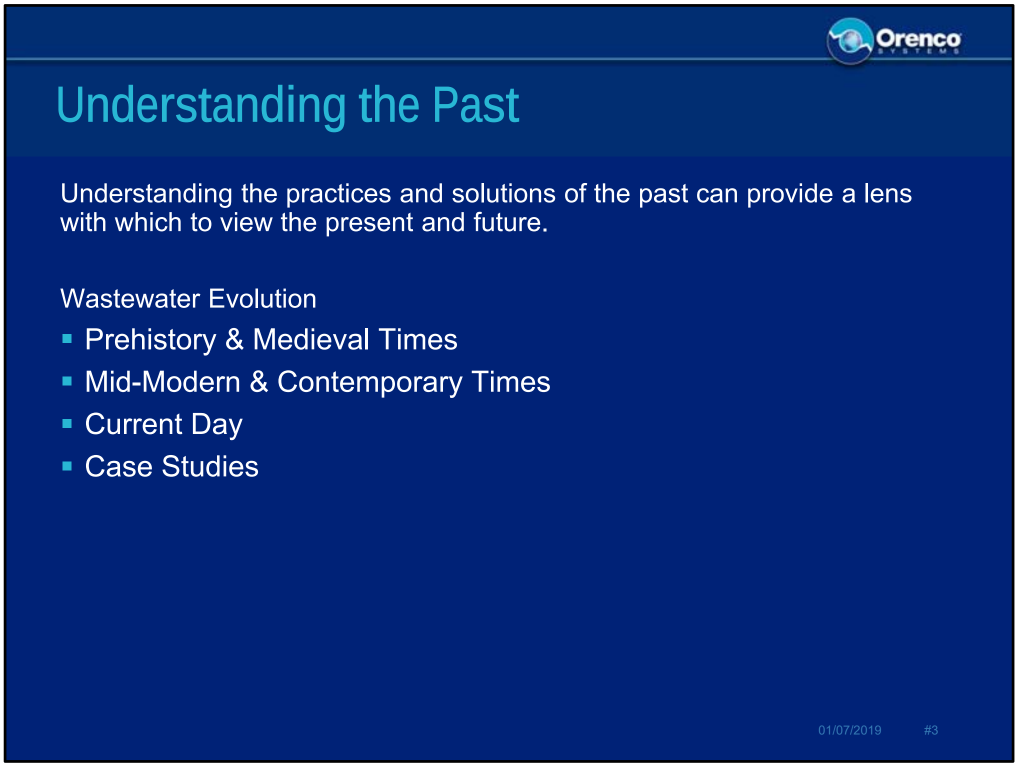


01/07/2019 #2

15th Century Definition of Wastewater:

Water that has been used

In this industry we’ve all found ourselves stuck in a hole covered in dung wondering what drove us to choose this line of work. Hopefully today is one of the days we are reassured of the good work that we do in this world and can find inspiration to continue to pursue this passion for cleaning our used water.



I believe that understanding the practices and solutions of the past can provide a lens with which to view the present and future.

Today we will be taking a brief look at those past practices and solutions, then view the current day situation and discuss a few case studies

3000 BCE Wastewater Treatment

Minoans in Crete develop first advanced disposal system

01/07/2019 #4

The human thought of disposing sewage began around 3000 BC

Minoans in Crete developed advanced sewerage systems that disposed of wastewater to the rivers, the sea, or to agricultural land for irrigation and fertilization purposes.

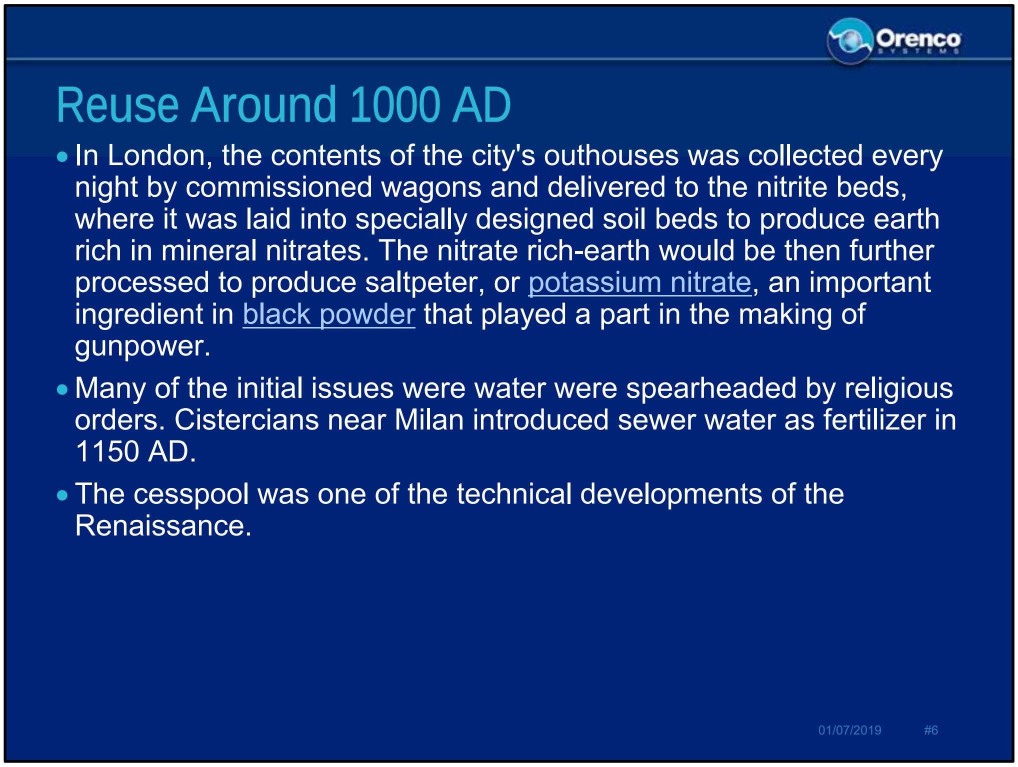
3000 BC – 1850 AD

- Land application
- Direct raw discharge
- Privies

4,850 YEARS!

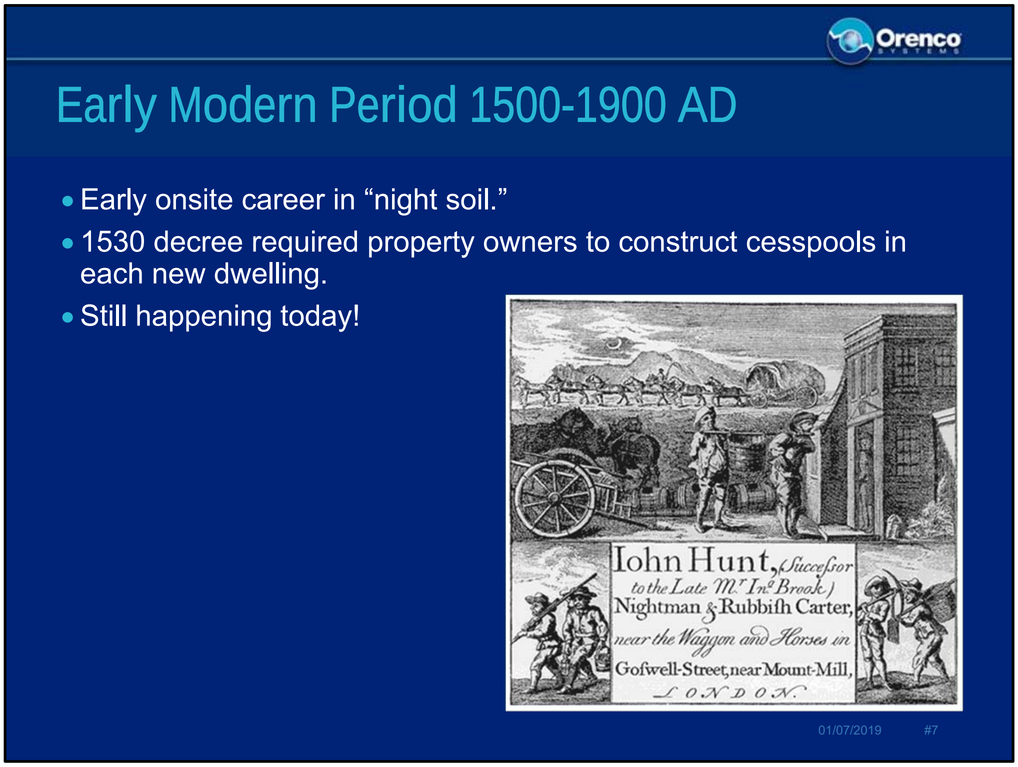
01/07/2019 #5

Only 3 disposal techniques utilized for 4,850 years.



Many of the changes in water issues were spearheaded by religious orders. “Near Milan, the Cistercians introduced the use of city refuse and sewer water as fertilizers on their land about 1150 AD

The cesspool was one of the technical developments of the Renaissance.



Night soil is a historically human excreta collected from cesspools, privies, and septic tanks, etc. This material was removed from the immediate area, usually at night, by workers employed in this trade called nightmen.

The pay was decent, even if the work was not. The night soil men used rudimentary long-handled dippers or buckets to scoop the waste into barrels or tanks on a wagon.

A typical privy vault had to be emptied and cleaned a couple of times a year.

By 1880, two-thirds of flush toilets still emptied into backyard cesspools, which had to be cleaned sometimes as often as every 10 days to keep from overflowing.

The Indian government's Union Ministry for Social Justice and Empowerment stated in 2003 that 676,000 people were employed in the manual collection of human waste in India.

Modern Japan still has areas with ongoing night soil collection and disposal.

The Early Business of Wastewater

Early adoption of water reuse has been documented through the use of cesspit waste to make gun powder and, additionally, the use of lagoons and other dispersal systems to utilize the water and nutrients for farming or fish ponds.

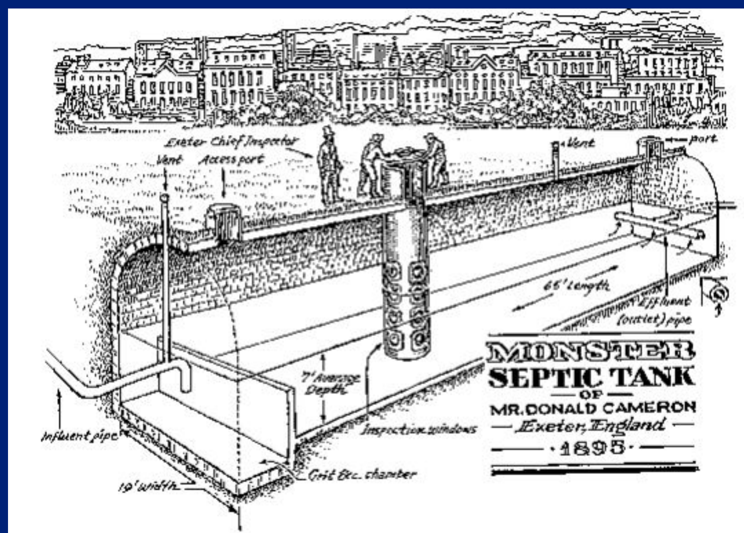
Wastewater became a business once people realized they could utilize it as a product. Creating gunpowder, fertilizer, and feed.

First Agricultural Use

- The first known application of wastewater for agricultural usage occurred in Bunzlau (modern day Poland) in 1531.
- Later, in 1650, land application was used in Scotland

01/07/2019 #9

Invention of Septic Tanks - 1860's

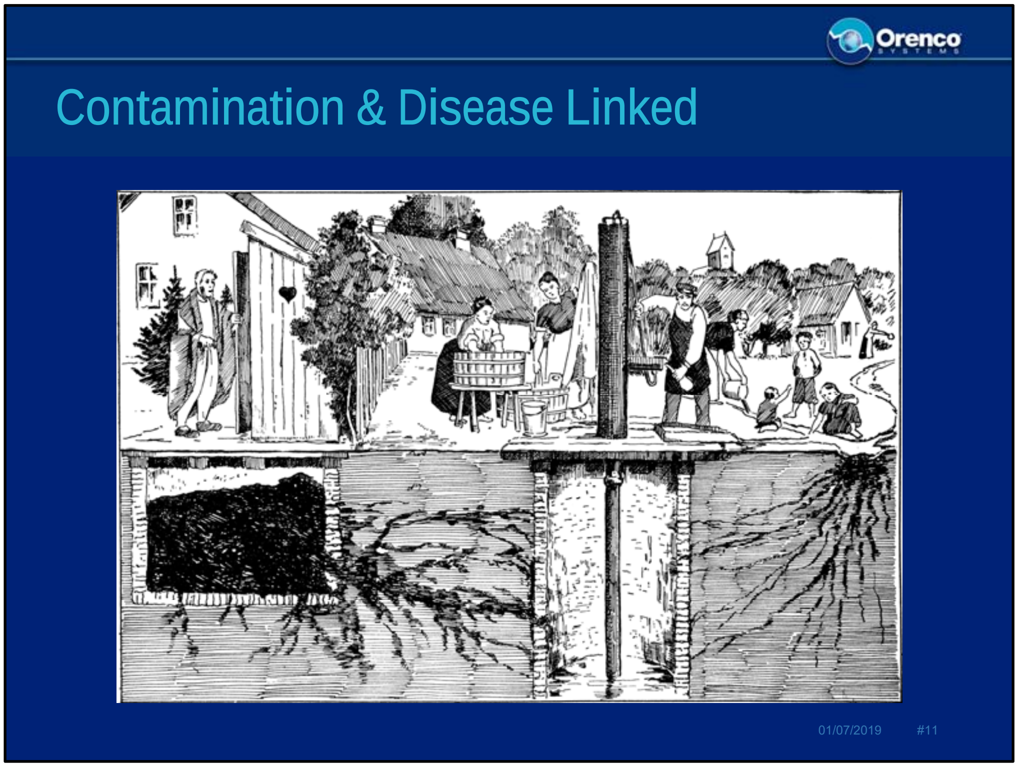


01/07/2019 #10

In 1860 Louis Moureas invented the septic tank; however, it would not be given this name until 1895.

Septic tanks at this stage were large and were used to treat sewage from communities.

The first time we see a real understanding of the benefit of removing solid.



A link between wastewater discharge and contaminated potable water sources and the cause of disease began to change mindsets with regards to the disposal of waste.

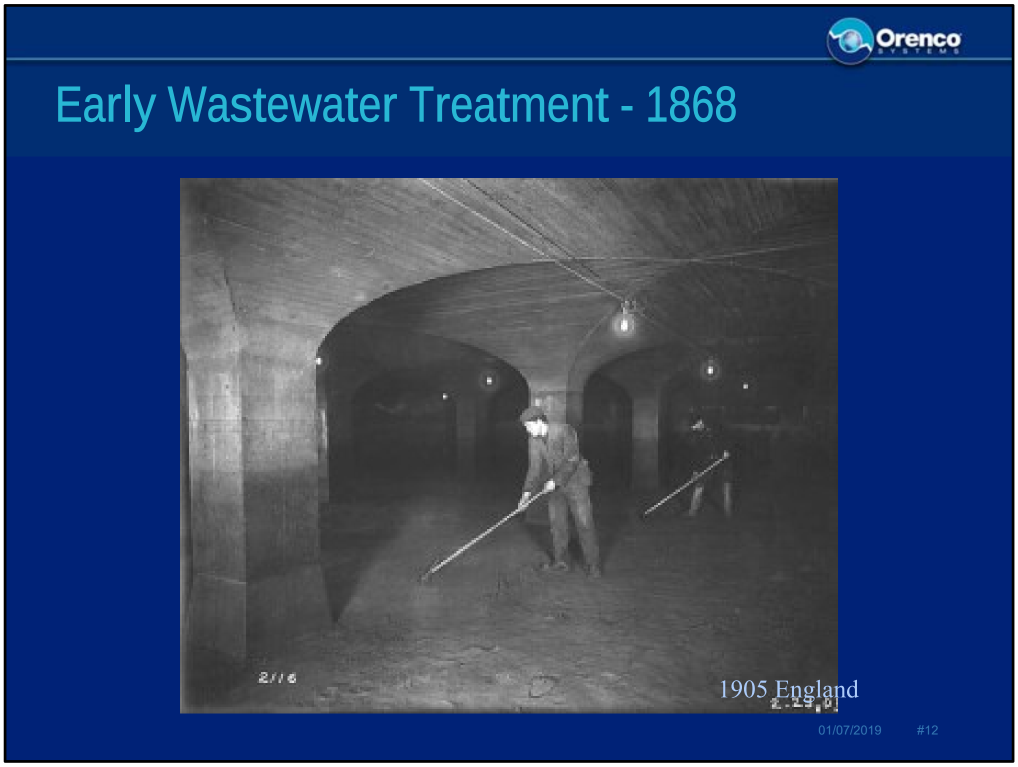
In the mid-19th century a world-wide epidemic of cholera occurred.

The relationship of cholera to water was discovered by the English physician John Snow.

Snow traced the contamination to public wells that were being contaminated by privy vaults in the epidemic of 1854 in London.

The need to solve this health care concern in large cities marked the 19th century as the beginning of municipal socialism.

The remaining 88,000 Cesspools in Hawaii have recently been declared a 1.75 Billion Dollar crisis that is threatening the drinking water, coral reefs and famous beaches that are the lifeblood of its tourist economy. They are working hard to remediate the problem today.



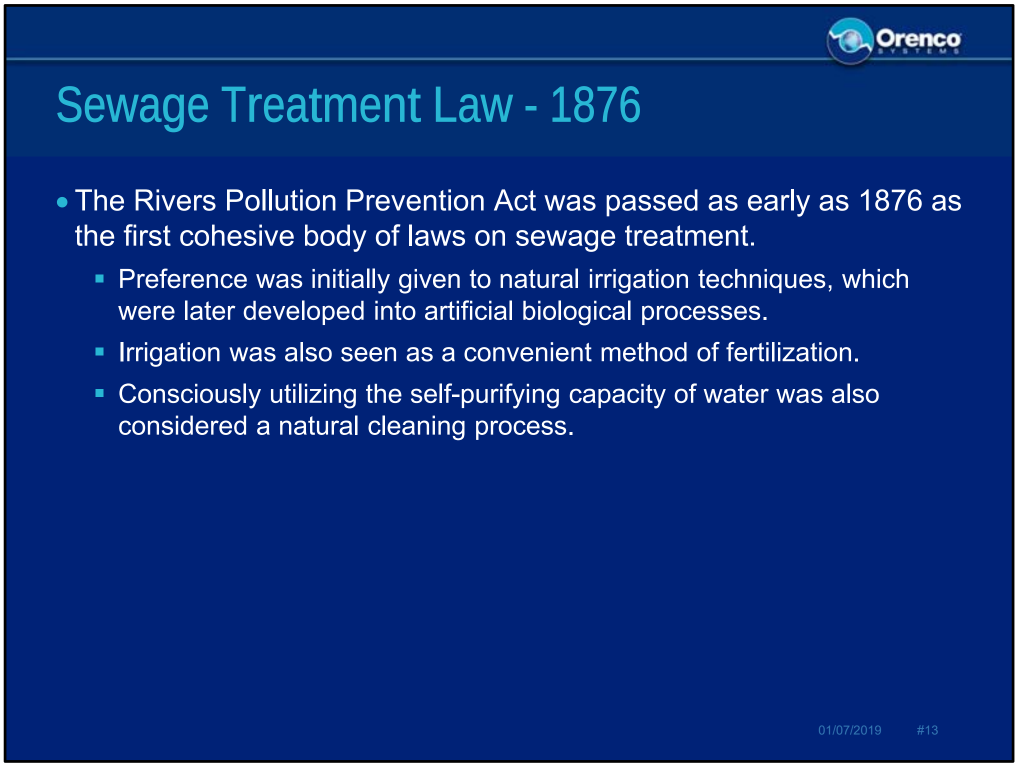
Edward Frankland, in 1868, developed trickling sand filter technology.

He devised a system consisting of six-foot high, ten-inch wide cylinders, filling each with different medias like sand and soil.

He then ran sewage at different doses through the different tanks.

He calculated the capabilities of the different media in purifying the wastewater.

The above picture is of a raking crew on a sand filtration system in London in 1905



Largely in response to the problem of sewage pollution, Parliament passed the Rivers Pollution Act of 1876.

This Act forbid pollution and solid matter from being deposited into streams and rivers.

The Act had little effect, however, because it provided no clear definition of pollution and created no clear enforcement mechanism.

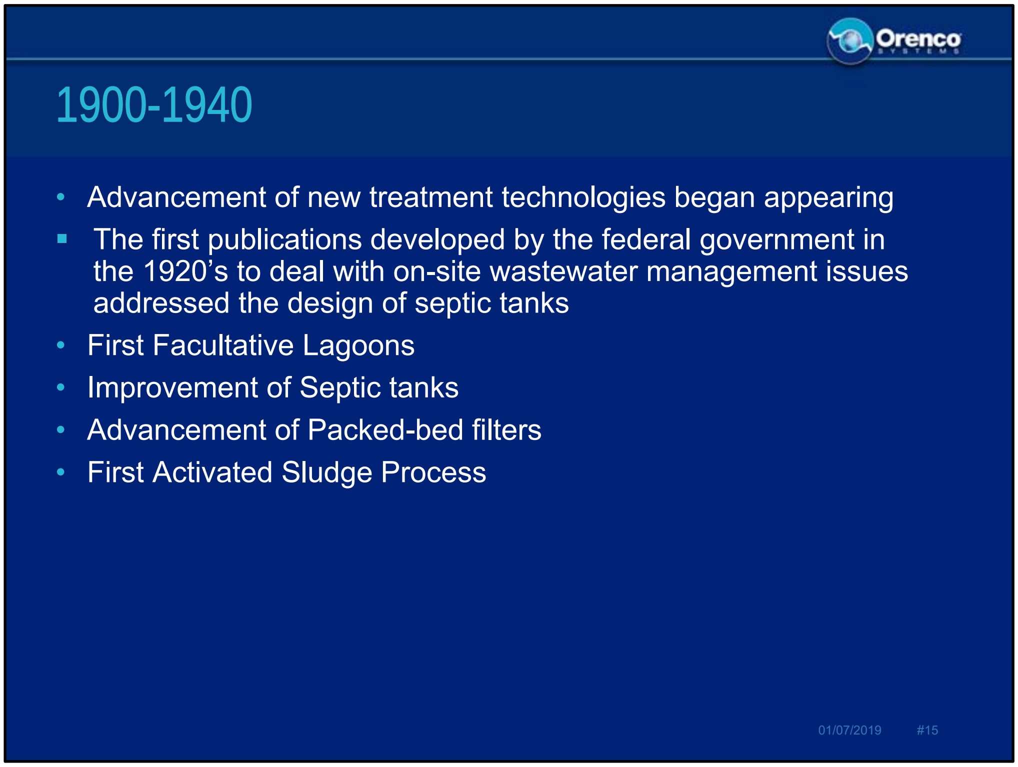
The Fathers of Process Treatment

- In 1882, Warington wrote that, “Sewage contains the organisms for its own destruction, and these may be so cultivated as to effect the purpose.”
- In 1887, William Dibdin – London Metropolitan Board of Works stated, “In all probability, the true way of purifying sewage will be first to separate the sludge, and then turn into neutral effluent a charge of proper organism, whatever that may be, specially cultivated for the purpose; retain it for a sufficient period, during which time it should be fully aerated, and finally discharge it into the stream in a purified condition.”

01/07/2019 #14

The first statements in the development of the modern treatment process.

Dibdin defined the multi step treatment process



First government onsite publication in 1920 on the design of septic tanks

Facultative Lagoon Treatment were utilized around 1900

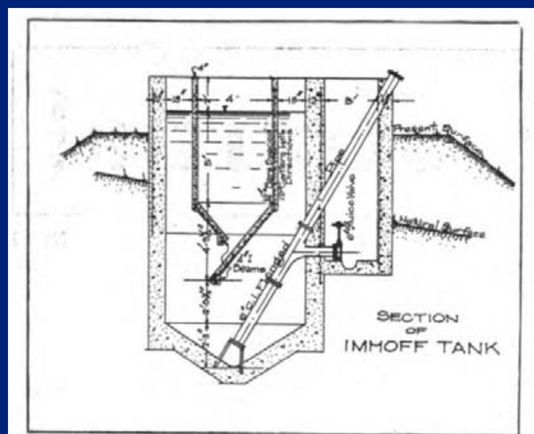
Imholf Tanks designed in 1906

Improvements on sand filtration systems occurred

The first activated sludge processes were developed

Imhoff Tank

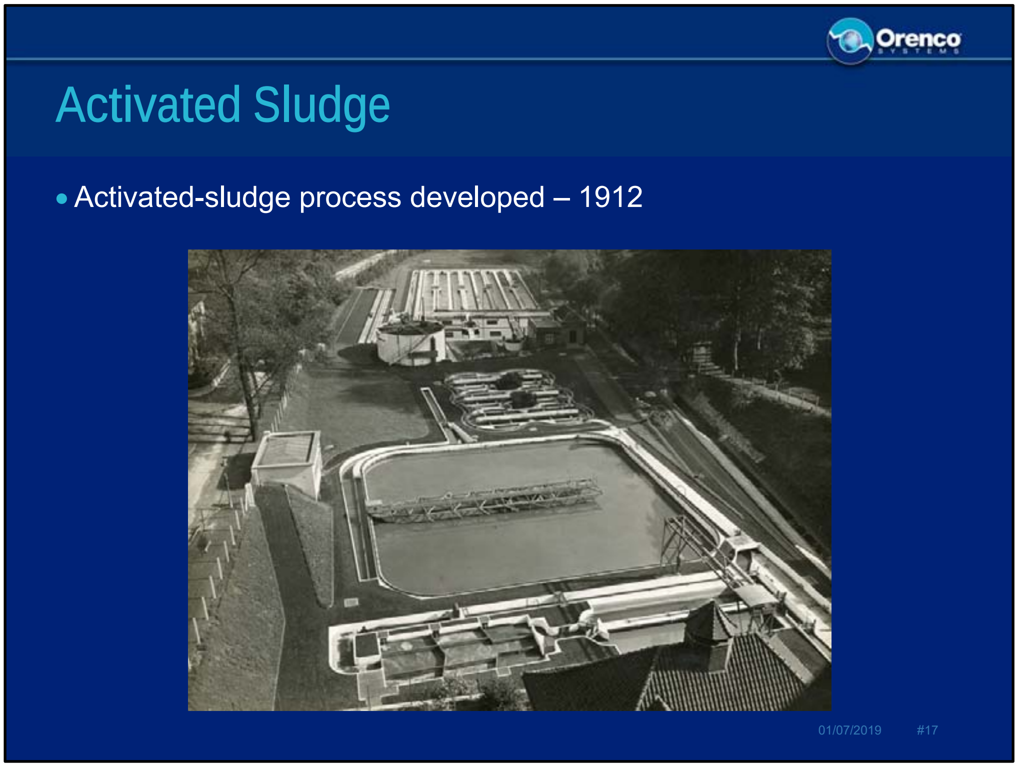
- Imhoff tank developed – 1906



SECTION OF IMHOFF TANK, DELAWARE CO. HOME.

The first imholf plant was put into operation two years later.

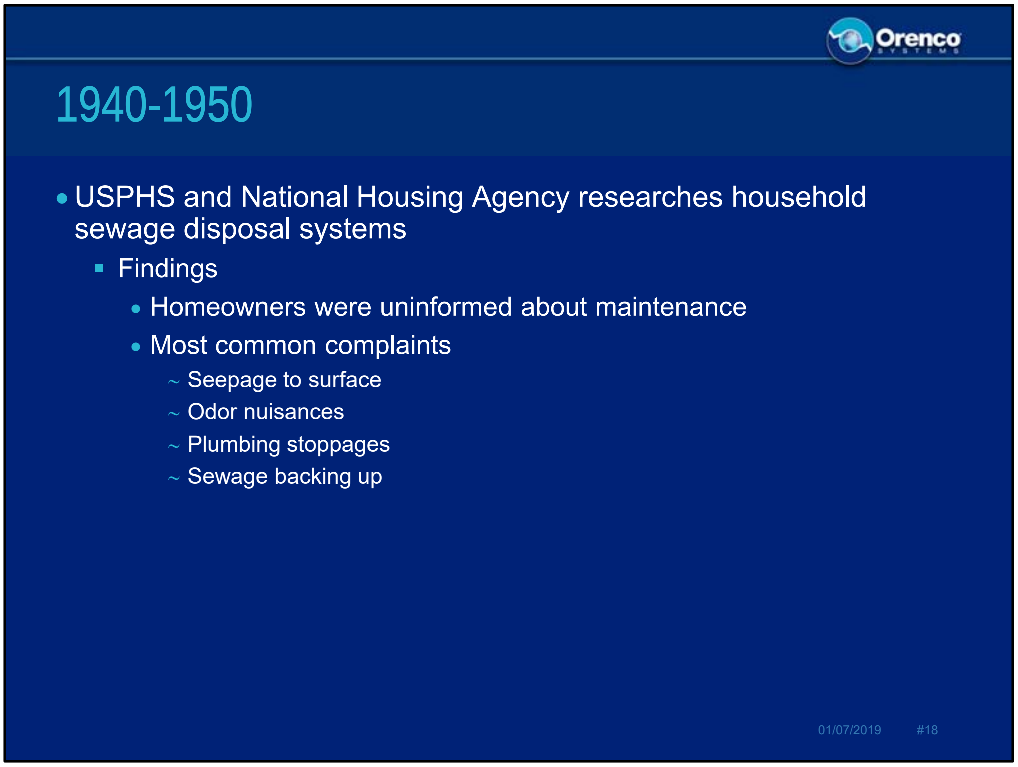
The main advantage of this type of tank over the septic tank is that sludge is separated from the effluent, which allows for more complete settling and digestion.



The first activated sludge process was developed in Boston in 1912.

By the time the first book was written in 1927 on the activated sludge process the process was being used in the US, Denmark, Germany, Canada, the Netherlands, and India. By 1938 the process was utilized in hundreds of plants around the world.

The activated sludge process and its many variants is now the main engine of secondary sewage treatment and has probably had the biggest impact of all processes upon environmental improvement in the past century.

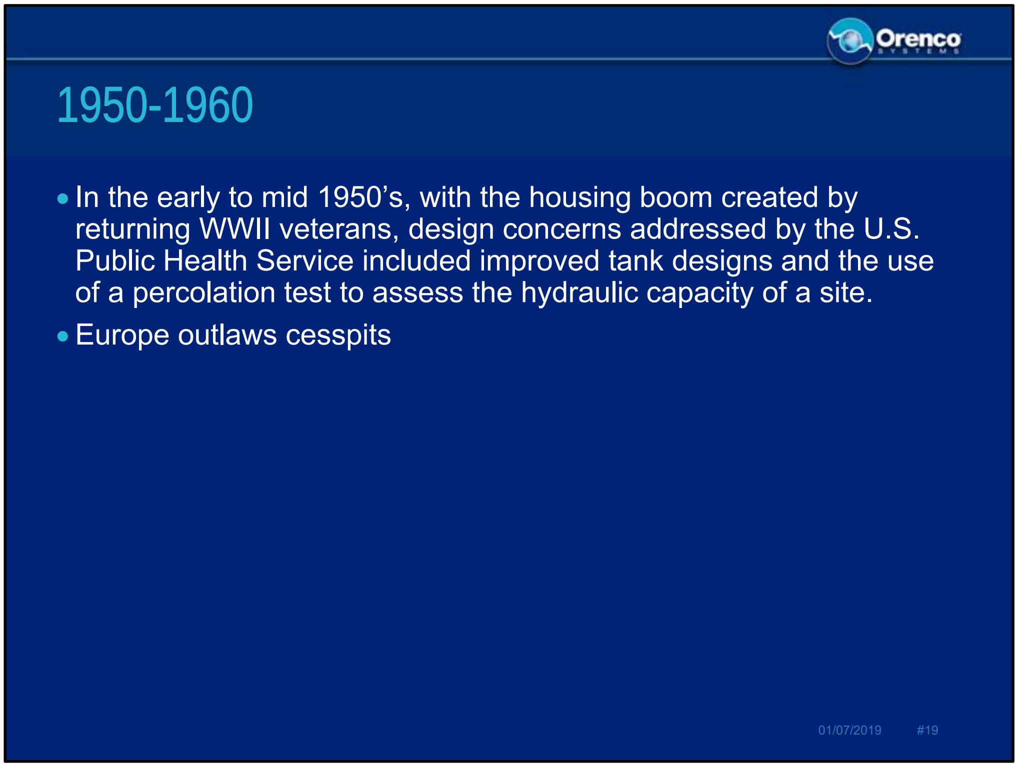


In the 40's the USPHS and National Housing Agency researched home sewage systems

Findings

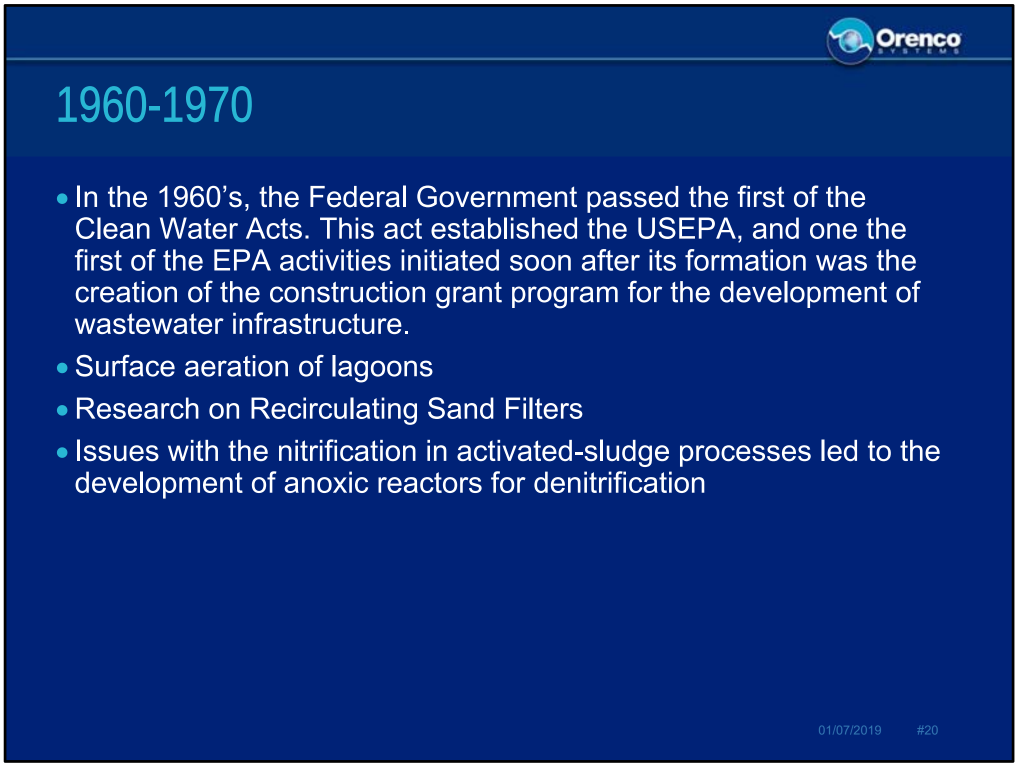
- Homeowners didn't understand that maintenance was necessary – I could put that on just about every slide for the rest of the 20th century!

- Complaints included surfacing, odors, stoppages and backing up – Those complains sound familiar too!



The housing boom shortly after WW2 created concerns with how we addressed wastewater, and lead to the development of improved tank designs and the use of perc tests to address hydraulic capacity

Around the same time Europe outlaws cesspits

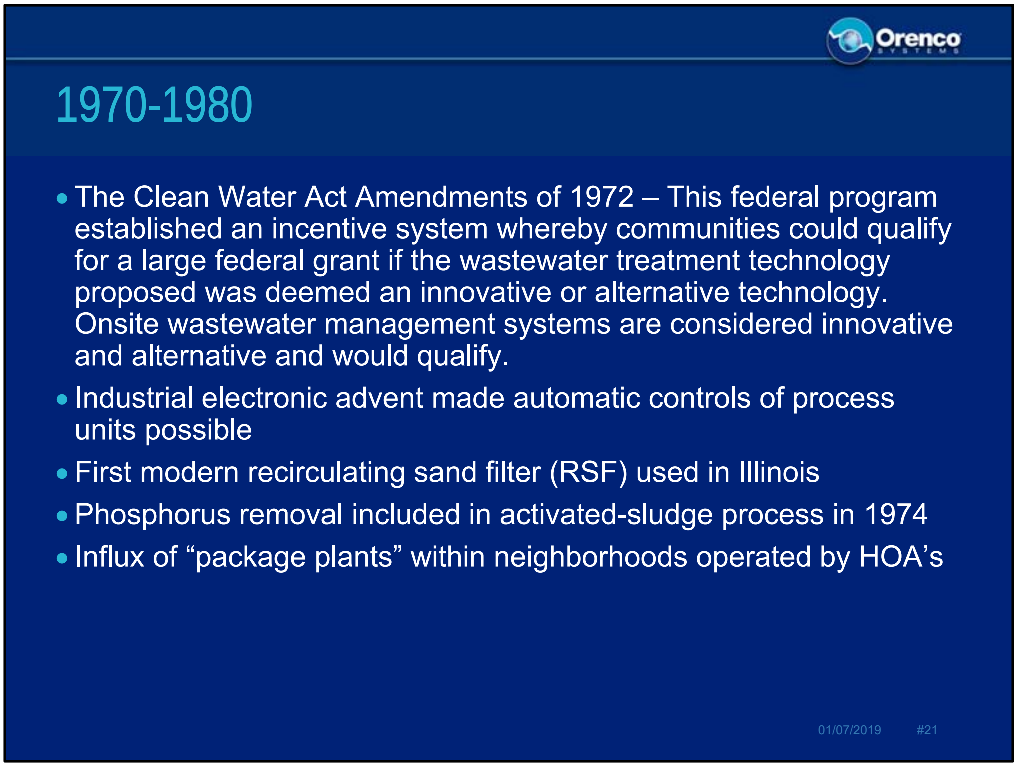


The 60’s brought the first Federal Government Clean Water Acts, and the establishment of the EPA.

Aeration was incorporated into lagoons to improve the lagoon treatment process.

Mike Hines and other began research on recirculating sand filter processes.

Nitrifications issues were recognized in activated sludge processes and led to the development of anoxic reactors for process denitrification



The 1972 Clean Water Act Amendments provided an avenue for federal funds to be available for wastewater infrastructure. Onsite systems were considered innovative and alternative technologies and received funding.

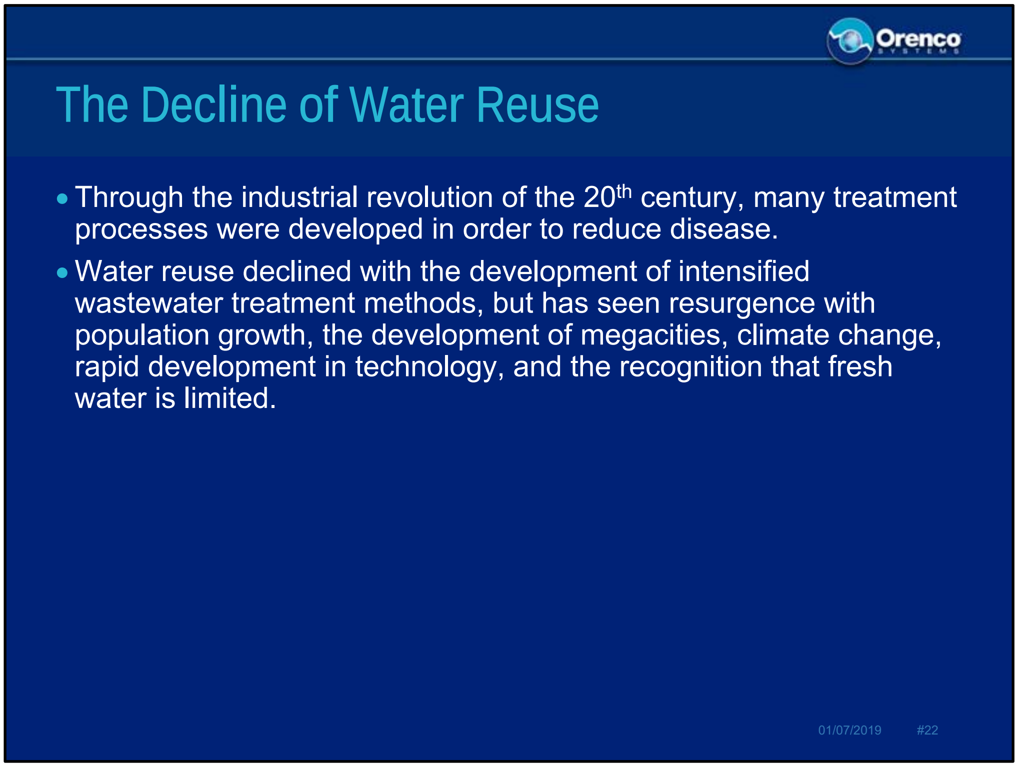
Residential and commercial low pressure pipe systems, mound systems, recirculating sand filter systems, and the first residential spray irrigation systems were constructed through this effort.

Many of the systems constructed in the late 1970’s remain in operation today.

The advent of automated electronics improve process controls

Modern recirculating sand filters were put into operation

And an influx of activated sludge package plants were installed all over the place.



With the focus disease prevention treatment processes in the 20th century water reuse declined in exchange for mechanical treatment methods. Water reuse however has seen a resurgence in recent decades.

1980-1990

- Evolution of today's RSF
- Removal of package plants and connection to centralized sewer
- Course-bubble aeration utilized in activated-sludge plants
- Personal computing leads to the development of computer models of treatment processes and automation

01/07/2019 #23

Evolution of RSF's occurred

The desire to take ”sewer” everywhere sparked the removal of many package plants and connection to centralized systems

Decentralized systems were considered temporary solutions, only necessary until the centralized systems were installed….this is still many people perception today.

Course bubble aeration was developed for activated sludge plants

The personal computing wave leads to further development of automated processes and computer modeling of wastewater processes, specifically Activated sludge process modeling.

The EPA's 1997 response to congress reaffirms that decentralized systems are not temporary solutions but long term alternatives.

Alternative medias are utilized to improve efficiencies and size of packed bed filters

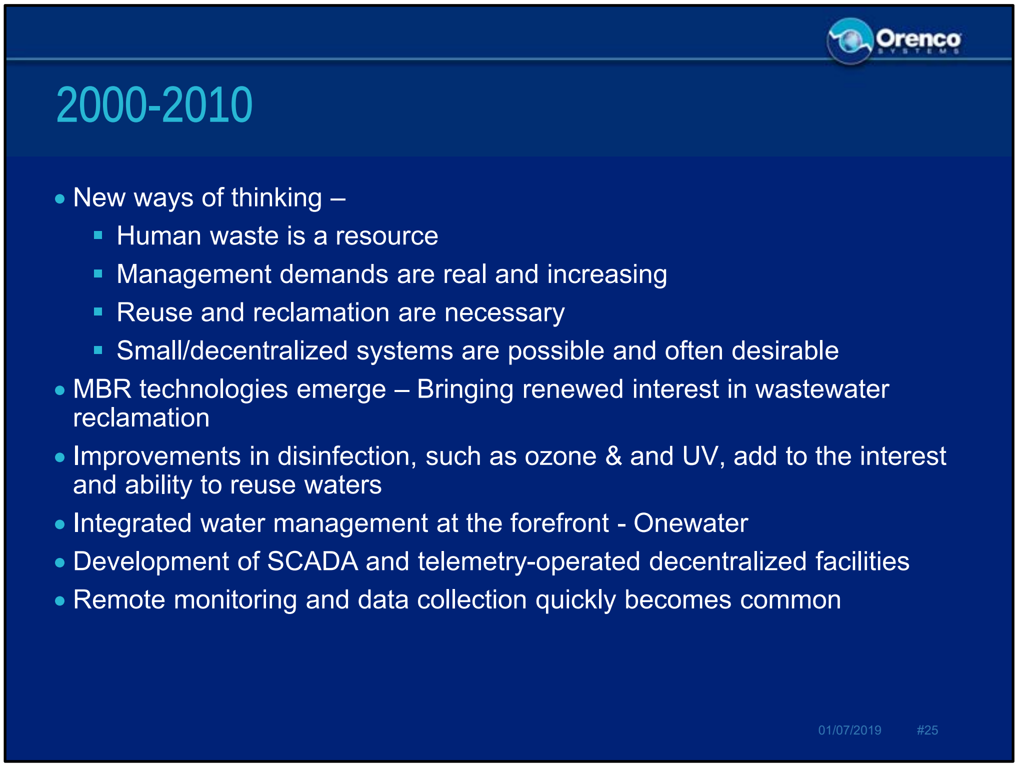
Constructed wetlands surface as alternatives for low energy treatment

Drip irrigation makes a debut as a wastewater alternative for irrigation

Many demonstration projects with new wastewater technologies and packaged systems are installed an tested.

Fine-bubble becomes the preferred alternative for activated sludge plants

And, the SBR makes a comeback as a reliable alternative no that automation had reached a point in development to reduce operational oversight.



At the break of this century a new wave of thinking started to get legs. Maybe we shouldn't be thinking of this as waste, but as a resource.

Smaller systems and reuse was becoming more desirable alternatives.

MBR technologies started to emerge

Various disinfection alternatives became available.

The concept of a single management for all water resources was discussed – Onewater Concept

Telemetry based controls became common and economic alternatives for smaller systems

Remote monitoring and data collection was now possible for all systems.

A few new technologies of interest

The price and efficiency of Membrane Aerated BioReactors makes them very attractive, along with the nitrification/denitrification potential.

Membrane systems have become 4 times more economic over the past 30 years, which allows them to be cost competitive in decentralized applications.

Upflow Anaerobic Sludge Blanket systems are not a new idea, however utilizing them for blackwater treatment from lower flow toilet and kitchen waste systems may be, this has potential for residential reuse systems.

Heat and gas recovery for energy conservation has potential to impact our industry in the coming years as well.

The three elements that I see driving innovation today include; reuse, nutrient reduction, and energy and operations efficiency.

We are all aware of the **current water situations** we face.

Scarcity

Climates shifting

Patterns in weather

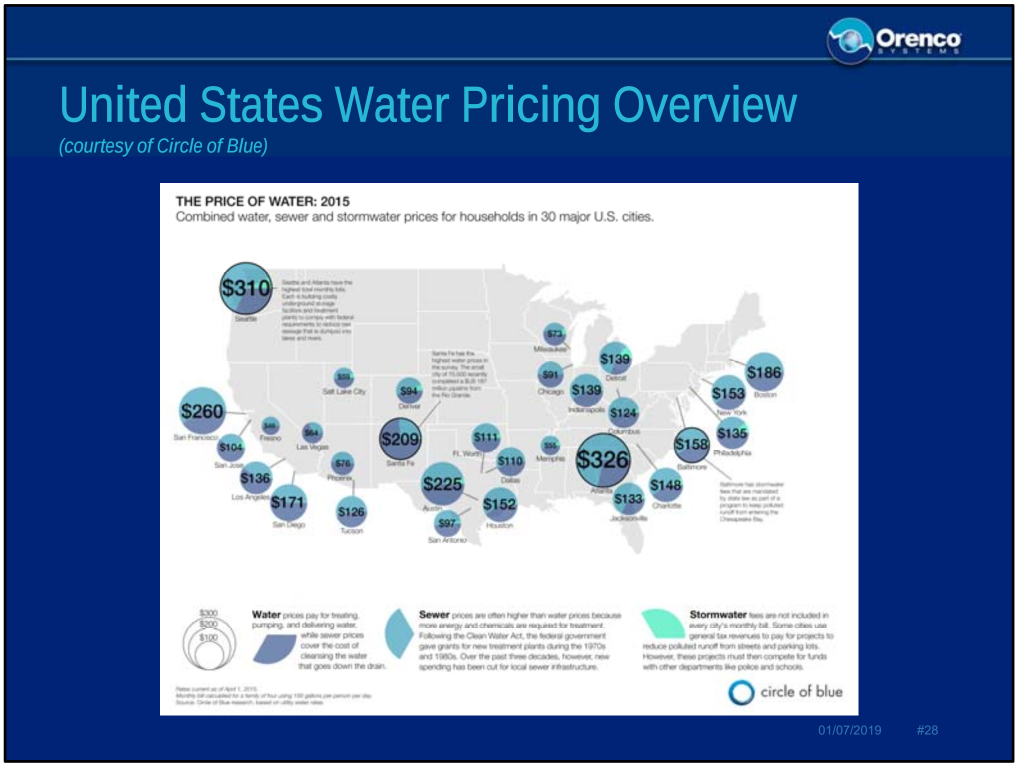
Growth

Nutrient needs

And the Annual increases in the price of water

The **World Bank** estimates that we could be looking at a **40% shortfall between demand and supply by 2030.**

All **data** points toward **higher demands and more scarcity**…which will in turn continue to **increase the price of water**.



This illustration, published by the Circle of Blue in 2016, provides a picture of how water prices have increased in the last few years. Between **2010 and 2015**, the average price of water **increased by 41% in thirty major cities across the US**.

These are monthly combined rates for water and sewer, and some as you can see are as high as $326 (Atlanta)

In many parts of the United States, **drought and increased demand** have led **governments** to **impose scarcity restrictions** on both **residential and industrial users**.

With improved effluent water quality, there has been a global trend to diversify water reuse practices beyond agricultural and landscape irrigation, to recreation and environmental reuse, industrial reuse, groundwater recharge and potable reuse.

We're all familiar with the need to **reduce potable water consumption** and the need to **increase water recycling**. Of the available alternatives **decentralized water recycling can offer security and independence at an economical price**.

Its my belief that Investing in efficiency should be a lot more effective than mindlessly plowing more money into the expansion of existing systems.

We are making **great strides** toward a **sustainable water future** with **all but 3 states** implementing **regulations for non-potable water reuse**.

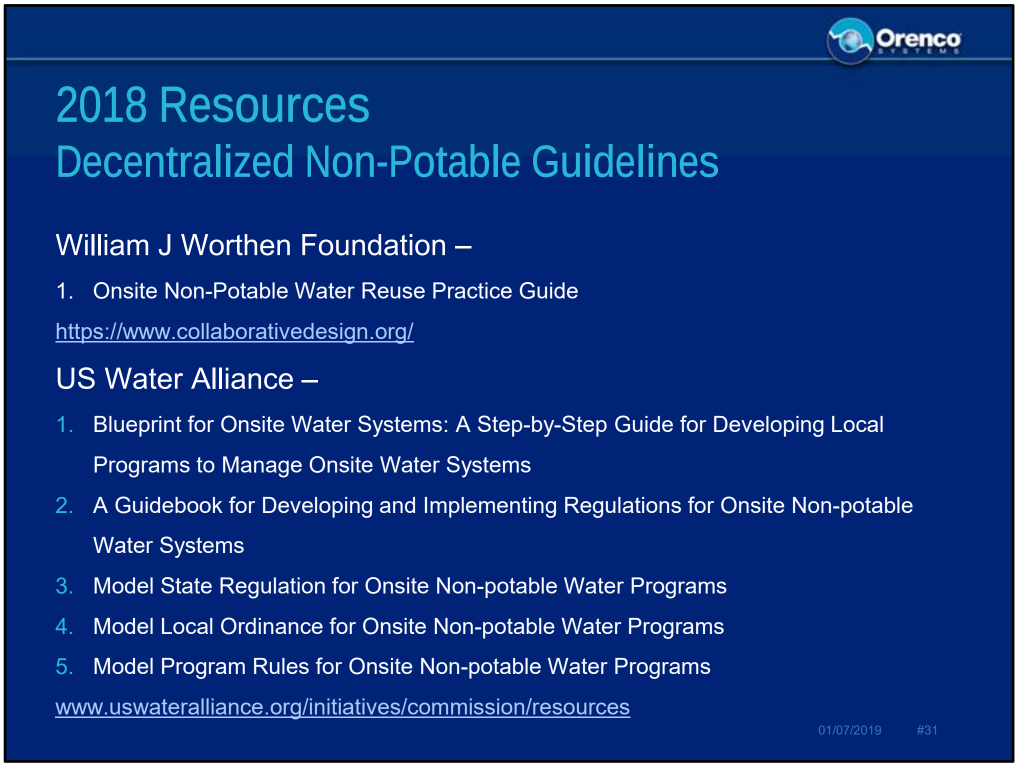
Additionally, The **US Water Alliance** has partnered with the Water Environment & Reuse Foundation and Water Research Foundation to establish the **National Blue Ribbon Commission** which serves as a **forum for collaboration** and **knowledge exchange** on **policies**, **best management practices, procedures, and standards for on-site water systems for non-potable purposes.**

NSF/ANSI has established the 350 standard and certification for on-site **residential and commercial greywater treatment systems**. Treated effluent that meets this standard can be used for **restricted indoor water use**, such as **toilet** and urinal flushing, and **unrestricted outdoor water use**, such as lawn **irrigation**.

Another factor in acceptance for water reuse is the rising **trend in sustainable building**, which is driven mainly by **client demand**, however in many areas we are seeing **a trend toward government involvement** in the requirement of **green building practices**.

Change agents in this green building industry include **Living Future with the Living Building Challenge, Leadership in Energy and Environmental Design (LEED), and the Sustainable SITES Initiative**.

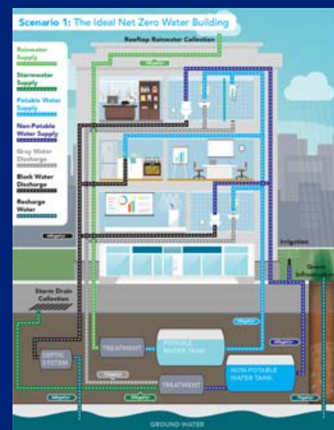
In addition the San Francisco 12C health code is making waves



All of these resource are focused on the establishing a regulatory environment and design requirements for non-potable water reuse programs. Both the William Worthen Foundation and the US Water Alliance are paving the way in water reuse.

Future - Urban Building Water Reuse

Ideal Urban Building Water:
- Rainwater catchment – potable water supply
- Stormwater catchment – non-potable supply
- Greywater collection – non-potable supply
- Blackwater collection – composting or discharge



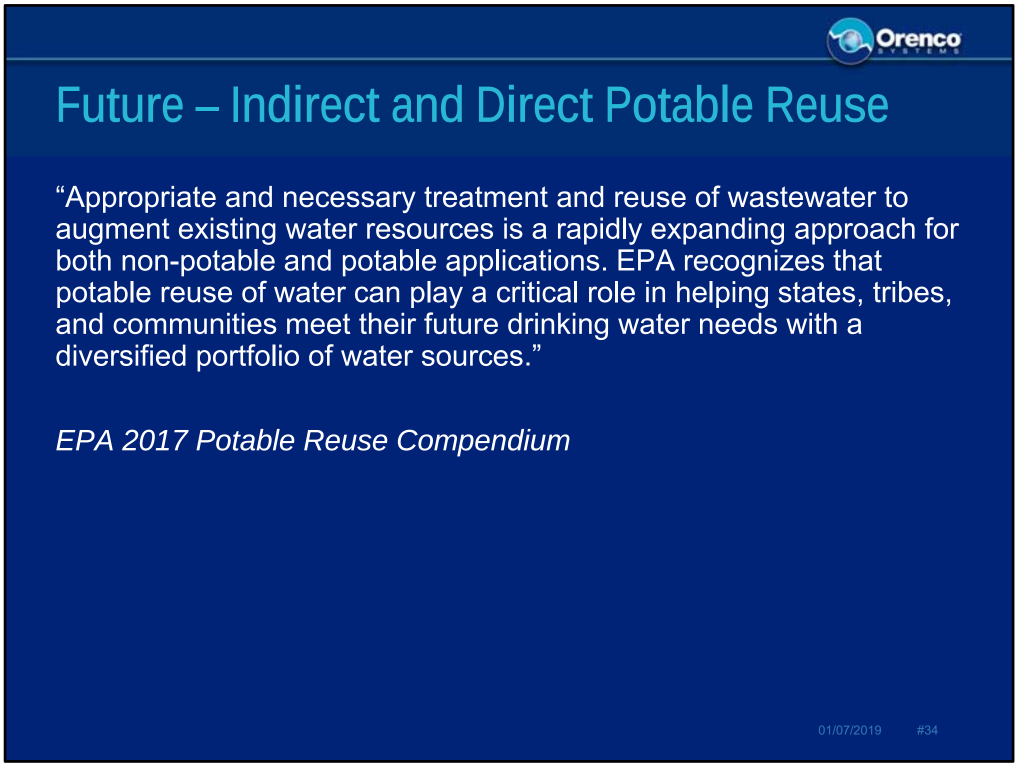
Alternative Urban Building Water:
- Rainwater catchment – non-potable water supply
- Greywater collection – non-potable water supply
- Stormwater catchment – city service
- Blackwater collection – city service
- Portable water –city service

01/07/2019 #32

There is no one size fits all method, it will take a suite of technologies and techniques to meet out coming water management needs.

Future – Decentralized Grey & Black Water Reuse

- San Francisco 12C REQUIRES all new buildings over 250,000 sqft to incorporate greywater reuse into the design and operation of the facility for irrigation, toilet flushing, cooling towers, etc.
- Salesforce new complex in SF will take it to the next level, installing a full BLACKWATER treatment system for reuse including irrigation, toilet flushing, and other uses.
- Other jurisdictions around the country have started to follow suit by requiring water balances during new commercial building planning and greywater reuse within buildings.



Indirect and Direct potable water reuse is a hot topic today as well

The EPA reported in 2017 in its Potable Reuse Compendium;

“Appropriate and necessary treatment and reuse of wastewater to augment existing water resources is a rapidly expanding approach for both non-potable and potable applications. EPA recognizes that potable reuse of water can play a critical role in helping states, tribes, and communities meet their future drinking water needs with a diversified portfolio of water sources.”

Orenco SYSTEMS

Indirect Potable Reuse Examples

- Upper Occoquan Sewage Authority, North Virginia – Since 1978, Potable Water Source Reservoir Replenishment
- Orange County Water District Ground Water Replenishment System – operated since 2008.
- SWIFT (Sustainable Water Infrastructure For Tomorrow) project in SE Virginia – Hampton Roads Sanitation District (HRSD) will take highly treated effluent and add it to the Potomac aquifer, where it will indirectly supply sustainable groundwater for future generation.
- Pure Water Program in the City of San Diego – The program will treat up to 83 MGD to produce 1/3 of the region's water supply by 2035.

➢California, Texas, Nevada, Colorado, Arizona, Washington, Oklahoma, and Florida

➢Various military agencies are considering direct potable reuse

01/07/2019 #35

Future – Law and Rule Amendments

- Further development of greywater and blackwater reuse code
- Development of enhanced performance verification programs for all on-site systems
- Acceptance of risk based analysis for design and operation of non-potable water reuse systems
- Better training and education
- Flexibility to accept new technologies under proper risk based designs and performance verification programs
- Incentive programs for decentralized water reuse to reduce expense of infrastructure expansion

Now for the **case studies**. First off we are going to review a **decorated ecovillage** on the **Queensland Coast in Australia.**

The Ecovillage at Currumbin is an **international award winning sustainable community**. The **270 acre site is set 7 minutes from the Currumbin Beach on the Gold Coast.**

Orenco SYSTEMS

The Ecovillage at Currumbin

- 272-acre site with 147 home lots, schools, shops, and offices
- Employs greywater reuse for toilet flushing, car washing, and irrigation
- Chosen by International Real Estate Federation as 2008's "World's Best Environmental Development"
- One of the most award-winning developments in Australia

courtesy of Landmatters Pty Ltd

01/07/2019 #38

The Eco-Village is home to more than **300 residents** and contains over **20 different** types of **community facilities**, including a community **hall, kitchen, playgrounds, shops and a cafe**.

The Homes use **rain water** for potable uses and share a **large commercial waste water treatment** system that delivers high quality **recycled water** back around the village for **toilet flushing, car washing, and irrigation.** The ecovillage is **100% water self-sufficient**

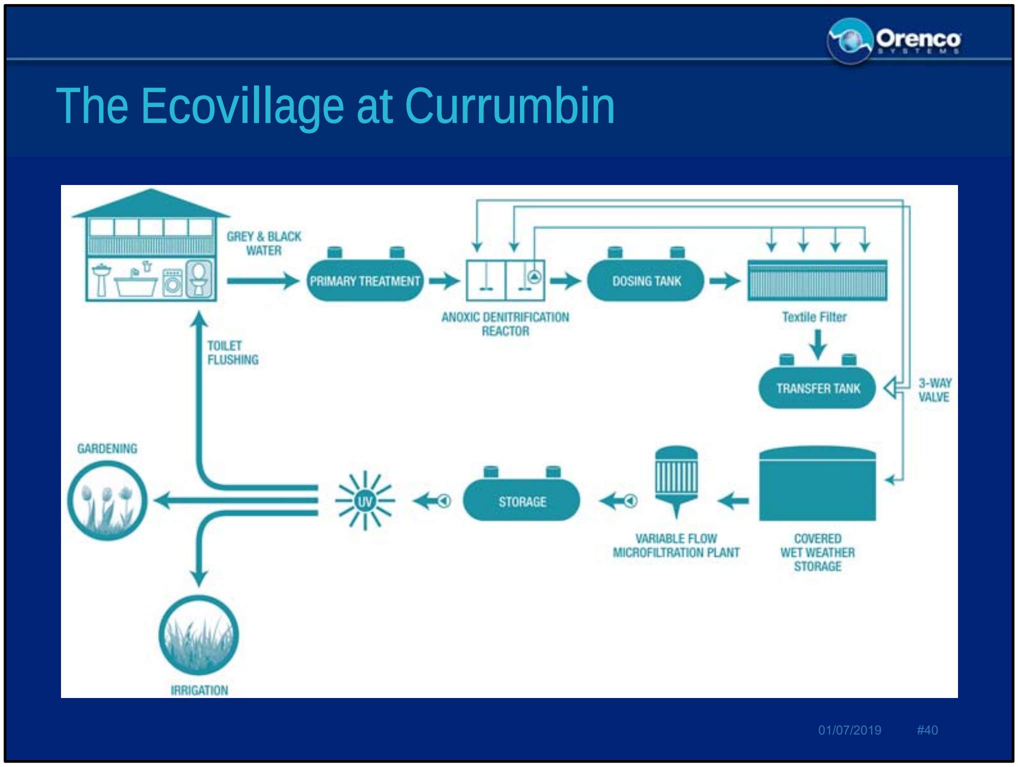
This community is the **most awarded** estate in Australia with over 33 accolades, including being awarded "**The World's Best Environmental Development**" **2008**.

The Ecovillage encourage **sustainable** building practices which **improve quality of life** and help to **reduce on-going operation costs**.

The **features** of the wastewater **treatment** system are **similar,** designed to encourage **sustainable results** by **minimizing energy consumption and maximizing resource recovery**.

Maximizing solids digestion, nutrient reuse, minimal energy consumption, and maximizing non-potable water reuse are all elements the designers focused on to providing a **truly sustainable solution.**

As a result, **most residents have very small utility bills**.



Wastewater from the residence is **collected** in a primary tanks where solids are **settled and digestion is maximized**.

From the primary treatment tanks the wastewater **flows to a pre-anoxic** reactor which mixes with **recirculated water** from the **textile secondary treatment system for nitrogen reduction**.

From **the pre-anoxic** reactor the **blended water** enters the **recirculation tank** which doses the secondary treatment system, a **packed bed filter textile system**.

Secondary treated **effluent** is then **stored** prior to being filtered through a **microfiltration unit**.

After final filtration, effluent is **stored again** and dosed out through **UV disinfection** and supplies the **various reuse applications throughout the community**.

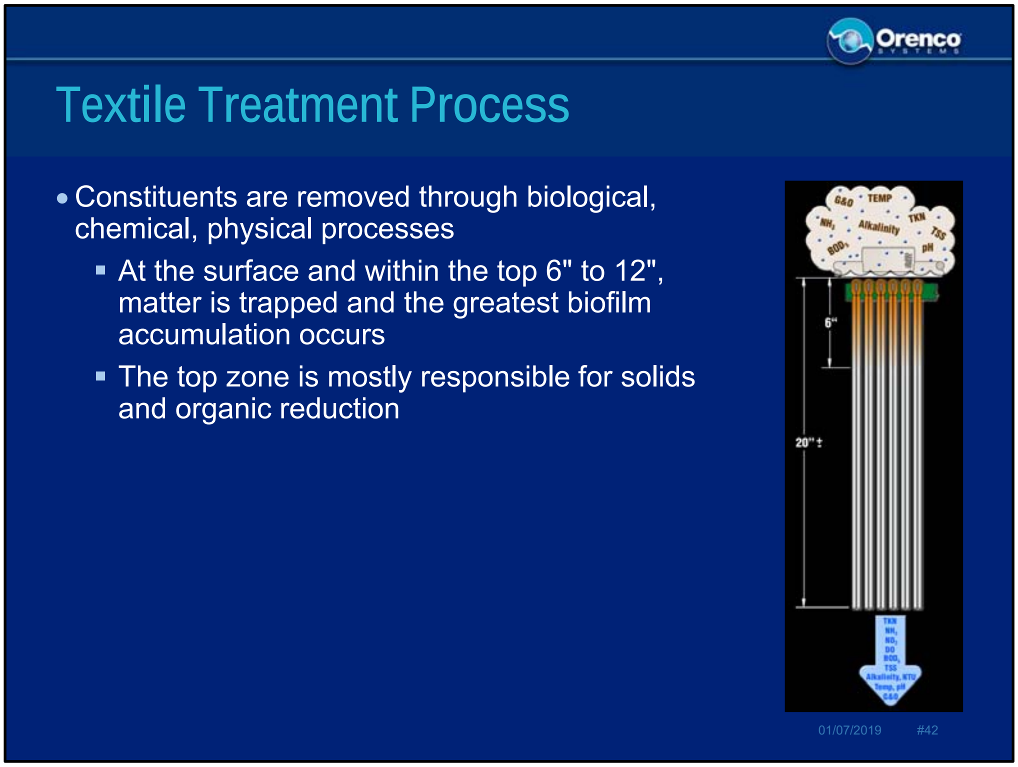
The recirculation pump is timer controlled to ensure that small, intermittent doses of effluent are applied to the textile sheets throughout the day. This ensures an aerobic, unsaturated environment for optimal treatment to occur. A manifold rests on top of the textile sheets, which distributes the effluent evenly over the textile sheets. The effluent then percolates down through the textile sheets and is distributed between the recirculation and discharge chambers by means of the AX20-RT baffle.

The textile material is suspended from the top of the treatment unit, with most of the media (normally 70%) positioned over a primary "recirculation chamber" The remainder of the media is positioned over a separate "filtrate chamber" that is separated from the recirculation compartment by a recirculation splitter baffle, and from with filtrate is discharged.

The recirculation-splitter baffle is fitted with a swing-check valve for low-level equalization. Under low daily flow conditions, the swing-check valve allows 100% of the final filtrate to be returned to the primary recirculation-blend chamber for continued recirculation. The swing-check valve is similar to a check valve in that it allows preferential flow in one direction only, in this case, from the final filtrate chamber to the recirculation-blend chamber. The swing-check gate closes when the liquid head on the recirculation-blend side is equal to or greater than the liquid head in the final filtrate side. When the liquid head on the final filtrate side is higher, the pressure differential pushes the swing-check gate open fro filtrate to pass back to the recirculation-blend side of the baffle, thus providing for continued recirculation during periods of low or no inflow. Flow from the recirculation-blend chamber can only pass to the final filtrate chamber through the treatment media.

Critical to the success of the AX Treatment System is the method in which the effluent is loaded onto the textile sheets. Over the past three decades, timer-controlled applications have proven to play an essential role in optimizing the performance of both fixed and suspended-growth biological systems. A timer controlled pump in the treatment tank periodically doses effluent to the distribution manifold over the textile sheets. The effluent then percolates through the textile media and is treated by naturally occurring microorganisms that populate the filter. During periods of high flow, a timer override float will temporarily modify the timer settings to process the additional flow.

Conversely, during periods of low flow, the timer settings can be modified to reduce loading onto the filter.



Packed Bed Filters (PBF) are typically used for **domestic strength effluent**.

PBF treatment modes include: filtration and trapping, adsorption, biological decomposition, and biochemical transformations.

Textile filters are one specific type of packed bed filters. AX filters represent a specific textile configuration consisting of **aligned sheets**. Packed bed filters are typically **designed to follow primary treatment in a septic tank** to provide highly treated effluent for soil dispersal, although other final dispersal option, like reuse, are used. In some cases, the effluent is disinfected and discharged to surface waters. Textile filters are configured in typical recirculating treatment fashion such that a mix of **septic tank pretreated effluent is blended by recirculating filtrate, and then applied in small, frequent doses to the media surface**. The **media supports a fixed film of organisms** active in the treatment process.

At the surface and top 6 inches (more or less), **matter is trapped** and the **biofilm grows**. In this nutrient rich upper zone, most of the **organic material is trapped, decomposed, and digested**.

The **water holding capacity** of the media and of the biofilm are important in **ensuring sufficient moisture for maintaining healthy microbial environments**. (Note: too much WHC and unsaturated flow conditions yield to saturated flow conditions causing **inadequate conditions for water air interfacing** and appropriate oxygen transfer; too little WHC and the biofilms **dry and sloughs** disrupting consistent microbial activity and the establishment of specific microbial environments such as heterotrophic, or autotrophic.)

> Both heterotrophic and autotrophic bacteria are found in these biofilms. There are many types of heterotrophs and autotrophs and they will vary in populations respective of each other and of their respective needs for the available free oxygen.

Filtrate from PBF is typically low in biochemical oxygen demand (BOD_5) and suspended solids (TSS) and concentrations of pathogenic organisms.

The Ecovillage at Currumbin

Class A+
- BOD_5 < 10 mg/L
- Turbidity < 2 NTU
- E. coli < 10 CFU
- 5 log removal of viruses and protozoa

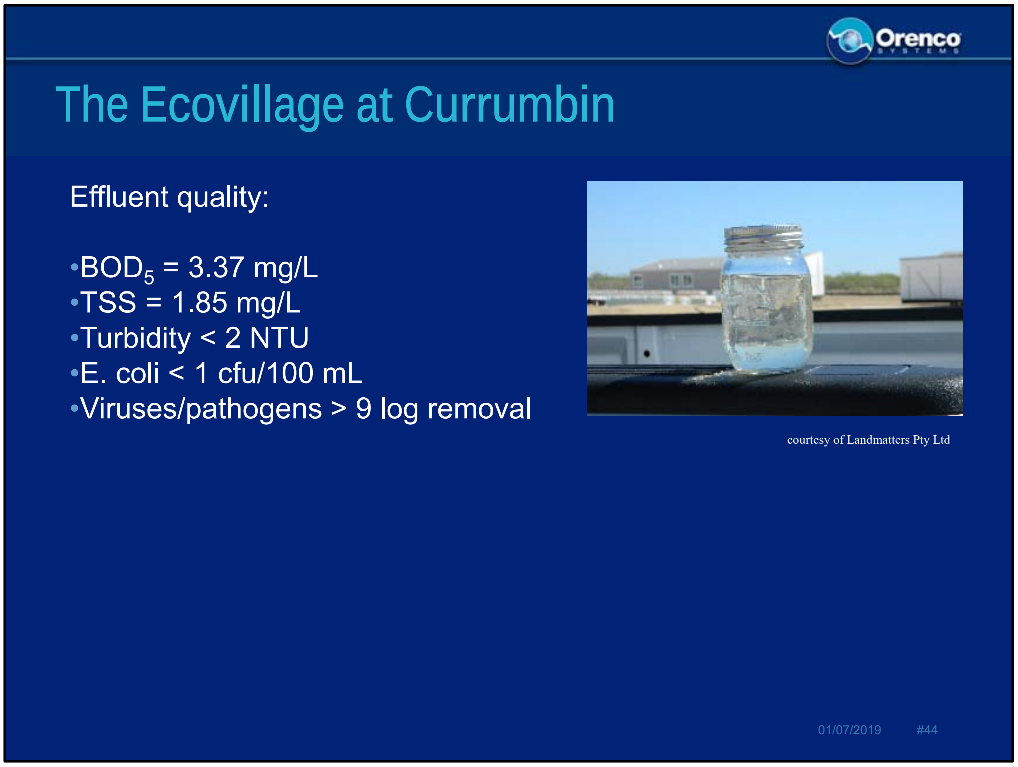
Multiple Disinfection Barriers
- Micro-filtration
- Ultraviolet light
- Chlorine (optional)

courtesy of Landmatters Pty Ltd

The treatment plant is required to meet **Class A+ Reuse** water standards.

With the wastewater facility **providing** the **majority of non-potable** water for the entire community they felt it was **critical** that the design could **guarantee continual usage** with **minimal to no down time**.

Multiple disinfection barriers were required including **filtration, UV**, and an **option** for **chlorine injection**.



Effluent quality has easily met the Class A+ standard with 3.37 mg/L BOD, less than 2 mg/L TSS, turbidities under 2 NTU and E.Coli **well under the requirement without the addition of Chlorine.**

The **clear and odorless** effluent has become the **perfect source** for **non-potable water**.

Hassalo on 8th is located in **Portland Oregon's Loyd District**. The Lloyd district is almost entirely **newer development and retail**, with virtually no stand-alone houses.

It is just **minutes from downtown Portland** and has become a **hub for start-ups** and people wanting to live a few **minutes from the action in Portland's**.

Hassalo on 8th – EcoDistrict

- A 4-block sustainable urban development in the Lloyd EcoDistrict
- First mixed-use developments by American Assets Trust
- LEED Platinum development

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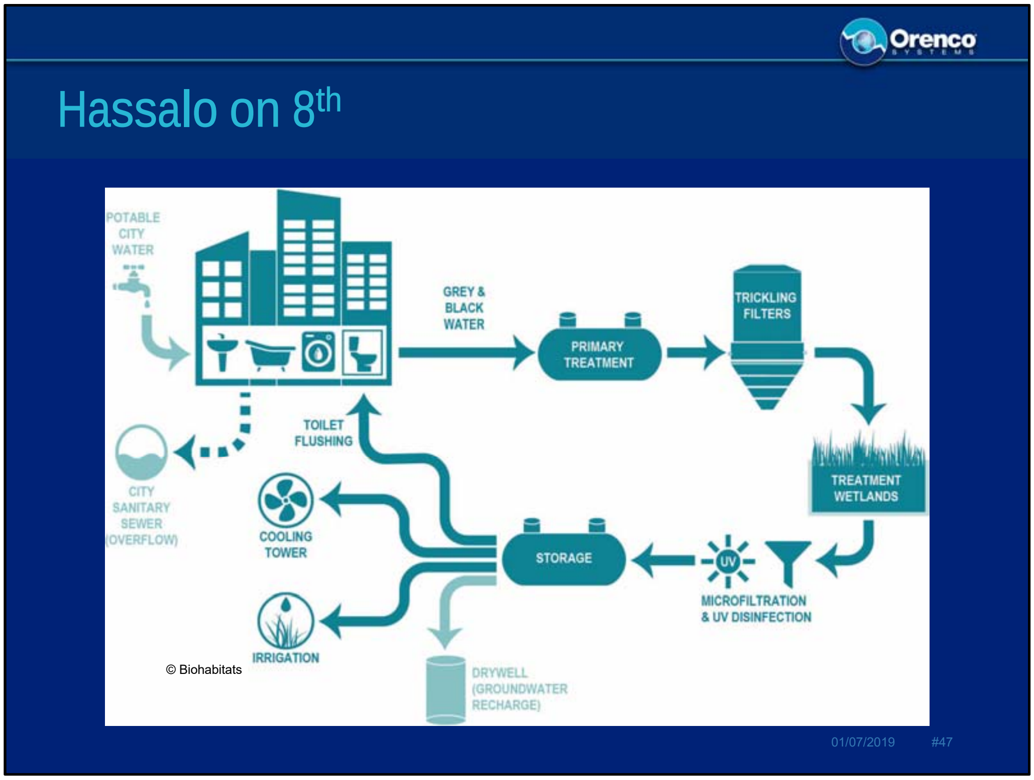
01/07/2019 #46

The Hassalo on 8th project was designed by Biohabitats to achieve LEED Platinum.

The development consists of a **4 block sustainability district** with mixed use buildings including a single existing repurposed structure and 3 new buildings.

The project was **completed in 2015** and As of **this fall** the project has been announced as **LEED Homes Project of the Year 2017** from the **U.S. Green Building Council**.

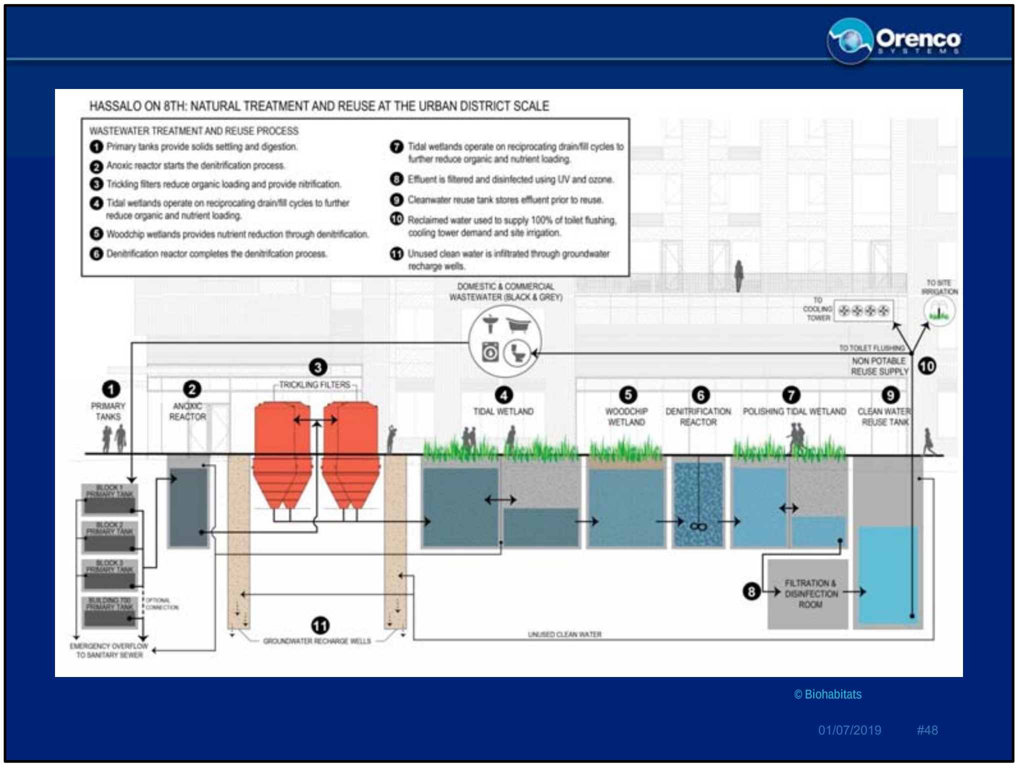


Primary tanks are located at the **various buildings** for solids **settling and digestion**. Primary treated water is **pumped** to a **packed bed filter system** and **recirculated through various wetlands** for **polishing**.

Additional **filtration and disinfection** are provided prior to **storage** and the water is then **reused** for **irrigating landscapes and flush toilets**.

The wastewater **system** design was **configured beautifully into the community to aid in aesthetics and the educational goals the project team had for the development.**

The system is so nicely integrated into the community that when I was in the **grocery store** last week and sparked up a conversation with the c**ashier** regarding the wastewater system and what I was doing in town, which she **didn't even realize** was underneath the concrete at the **front door**, or that she had a **full view of the secondary filters** out the main windows. She was very pleased to know that the system was working well and providing for a more sustainable community.

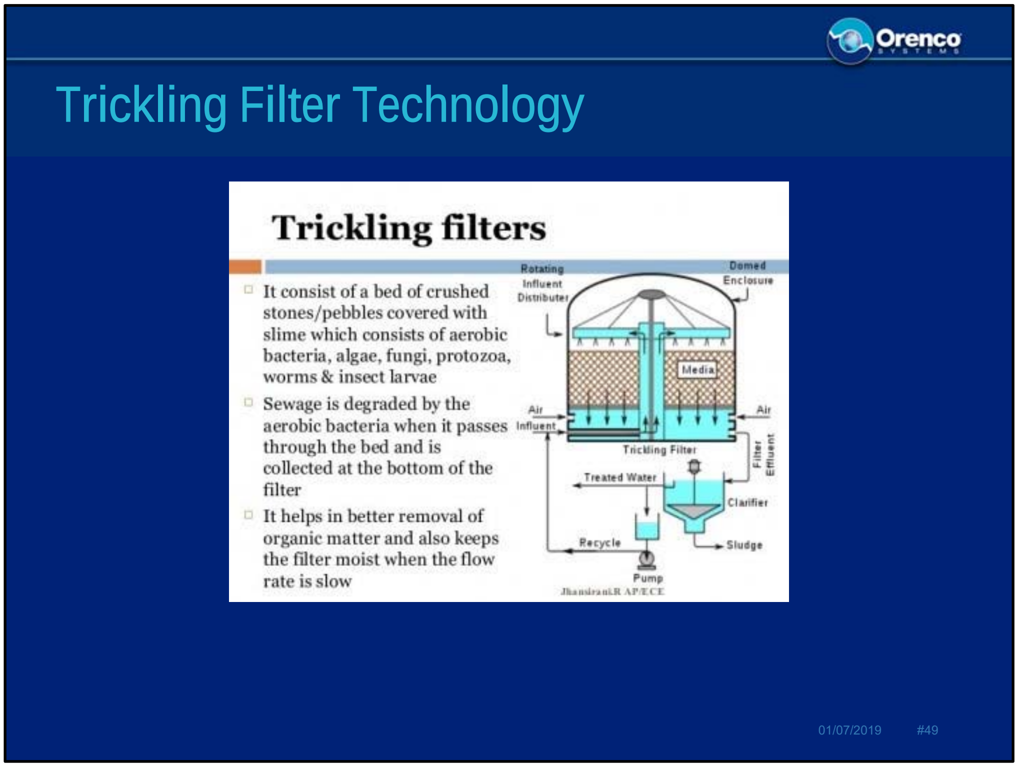


Here is a closer look at the **complexity of the system**, sorry if this is difficult to see. This **graphic** is available at the Hassalo on 8th **website** if interested

THIS IS NORM, THE NATURAL ORGANIC RECYCLING MACHINE

The wastewater treatment system was **named NORM** by the **contractors during construction**. As the entire design and build team were very passionate about the project.

Designed with **state-of-the-art controls**, NORM is meeting **highest standards** for **non-potable reuse and is monitored 24/7** by certified wastewater operators to **ensure optimal** system **performance**, **water quality and of course safety for the residents**.

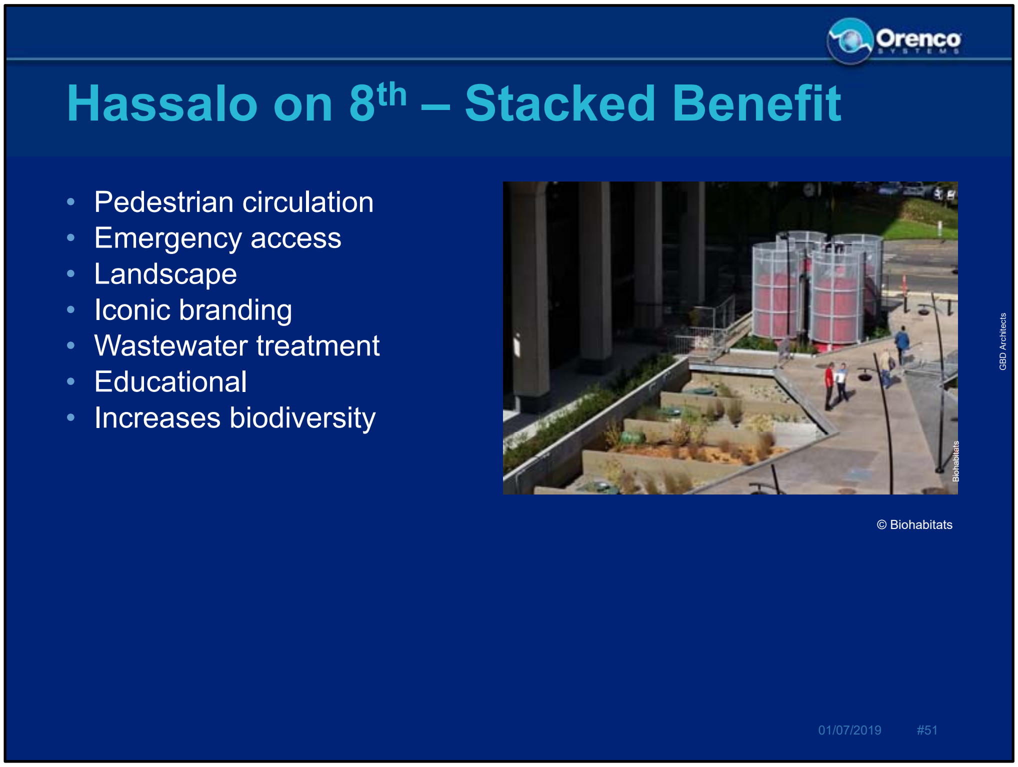


A trickling filter operations much like a sand filter, it’s a type of packed bed filter with high loading rates, typically around 125 gpd/sft.

The interesting thing about these trickling filters is that they allows for a high level of treatment in a narrow and tall silo.

Additionally, the designers developed the outside of the units to become a beautiful feature in the landscape.

After that, the water goes to the tidal wetland, a woodchip wetland, denitrification reactor and finally a polishing tidal wetland to create conditions of flood and drain like in a tidal system which fosters naturally occurring microbial organisms that eat more of the nutrients. The wetlands are underneath and beside the pedestrian corridor on NE Water street, however the wastewater is located below layers of gravel or woodchips, so that the public is not exposed. At the very end of this process mechanical filters screen out fine particles. Ultraviolet and ozone systems kill any pathogens that might be present and makes the water safe for reuse. Clean water is stored and distributed for reuse in the three buildings that make up Hassalo on Eighth.



Many different **aspects of sustainability** were considered during the **project design** including how the **system fit into the community**, **education**, and **creating an iconic brand for the development.**

The **architectural** aspect of the facilities and the **marriage between the buildings and the wastewater treatment** are really quite beautiful.

This project is truly the **glimpse into the future of urban development**.

Hassalo on 8th

Guidelines for Class A+ recycled water for non-potable reuse for this application require the following:

- TN < 10 mg/L
- Turbidity < 2 NTU (24-hour average) / < 10 NTU (24-hour max)
- E. coli < 2.2 cfu/100 mL (7 day average) / < 23 cfu/100 mL (max)

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01/07/2019 #52

Oregon required a **Class A+ recycled** standard for non-potable reuse with a specific **focus** on **TN, Turbidity, and disinfection**.

Another interesting fact about this project is that "NORM" has a **twitter account…so,** if you'd like to follow and **keep up with its performance** and **impact on the community you follow it's account**.

Lastly, the Boy Scouts of America Summit Bechtel Reserve in West Virginia.

This facility covers an **impressive 10,000 acres** and features:

- **One of largest man-made rock climbing facilities in the world** with over **60 climbing repelling** and **bouldering stations**.
- **5 miles of zip lines,**
- **4 manmade lakes covering over 75 surface acres and 4 Olympic size pools used for all types of aquatic activities.**
- **They have two mountain biking adventure areas that provide more than 36 miles of varied mountain biking trails.**
- **270,000 sq ft of extreme BMX terrain.**
- **An X games quality skate park.**
- **And, World class archery and shooting facilities**

During the bi-annual J**amboree event** the Reserve becomes the **3rd largest city in West Virginia**

Key Sustainability **Features** of Project include:

- **Cogeneration using photovoltaic, wind turbines and fuel cells**
- **Geothermal wells**
- **Radiant cooling/heating**
- **Solar hot water**
- **Low flow fixtures and composting toilets**
- **Low-flow, pull-chain, ambient temperature showers**
- **A Low energy Blackwater system**
- **and a *Low energy Greywater system used to flush toilets***

The **BSA** wanted to treat **all of the waste onsite** and still ensure the water quality in the area would not be affected by tens of **thousands of temporary residents**.

BSA Summit Bechtel Reserve

- 336 shower facilities
- Reuse of greywater for toilet flushing
- Rainwater makeup
- Potable water makeup

01/07/2019 #55

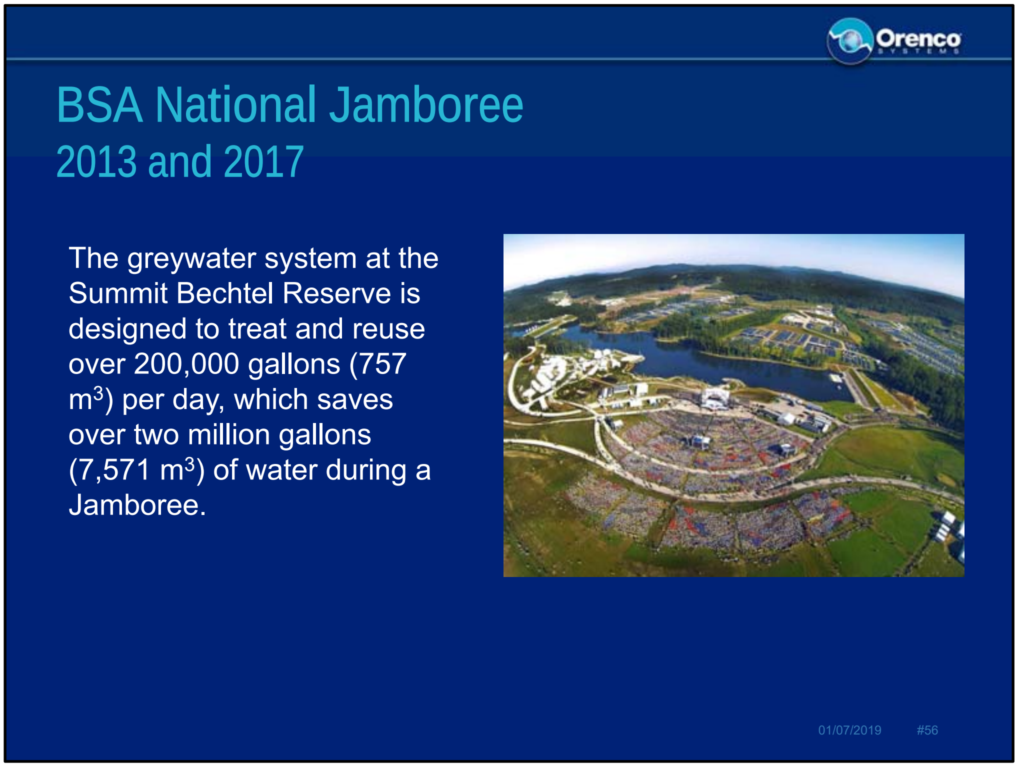
Part of the facility design included **336 shower facilities** that **reuse greywater for flush toilets**.

They were designed with both **rainwater and potable water makeup** in the event there was **not enough greywater to flush toilets**.

Each **neighborhood** is outfitted with **3 shower facilities** and required **one Orenco AdvanTex greywater treatment system**.

That's a total of **112 separate treatment units**. Each treatment system is capable of treating **2,000 gallons per day**, for a total of **224,000 gpd**.

The **Preferred materials are fiberglass and HDPE to meet Living Building Challenge Requirements**. The system is **capable of cycling** from a **non-use condition to full treatment use in 24 hours** or less and automatically **diverting overflow** to the **black water treatment system**.

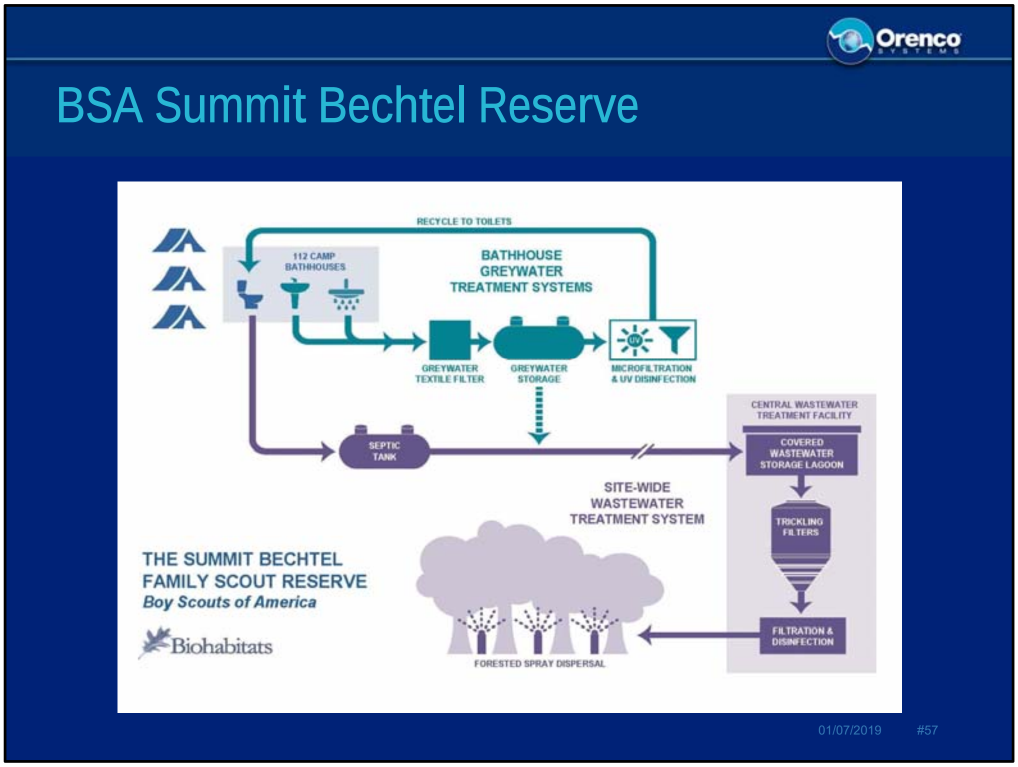


This is an **aerial view** of the **national jamboree in 2013**. The Boy Scouts of America held another **National jamboree in 2017** and the Summit will host the world scouting **Jamboree in 2019**.

One of the main **project goals** was to **protect the New River** by **eliminating any direct discharge of treated wastewater.**

The most **efficient** way to do this was to **capture, treat and reuse shower** and **sink water to flush nearby toilets.**

Blackwater is transferred to a **centralized treatment plant** located far **from camping areas**, where it is **filtered, disinfected**, and then dispersed through the forest via a **sprayed irrigation system**.



Effluent enters the greywater tank and is **recirculated over the textile sheets**.

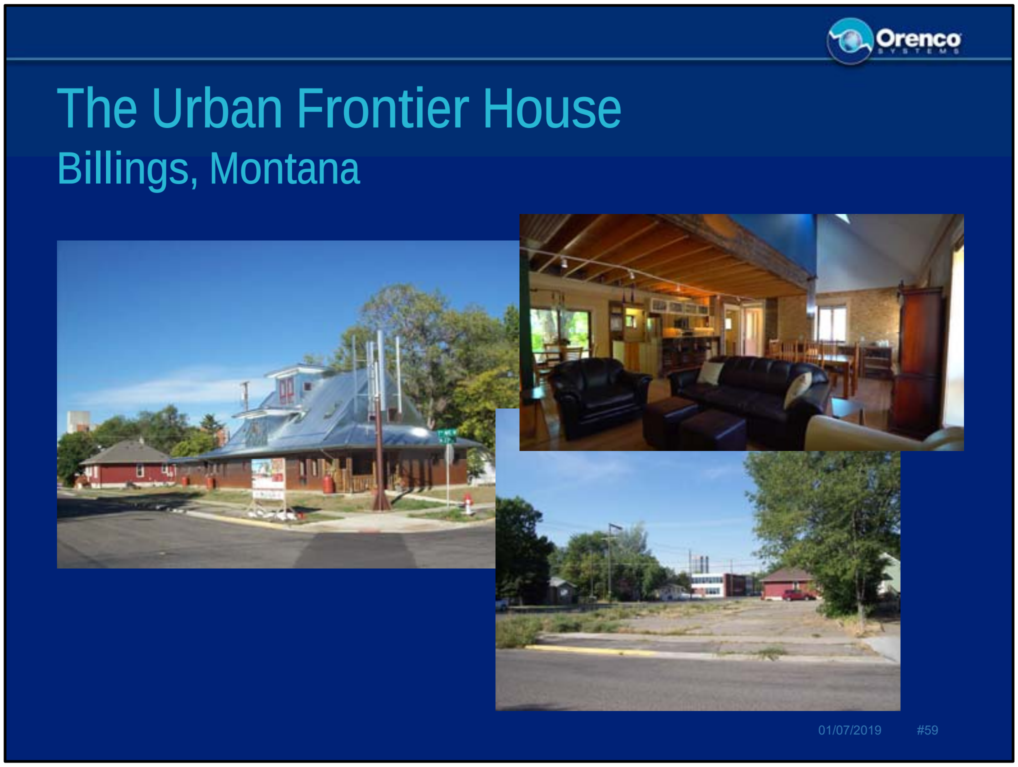
A pump in the **discharge** chamber **periodically doses effluent to a UV disinfection** unit and into a **pressure tank** that provides the **water for the toilets**.

BSA Summit Bechtel Reserve

01/07/2019 #58

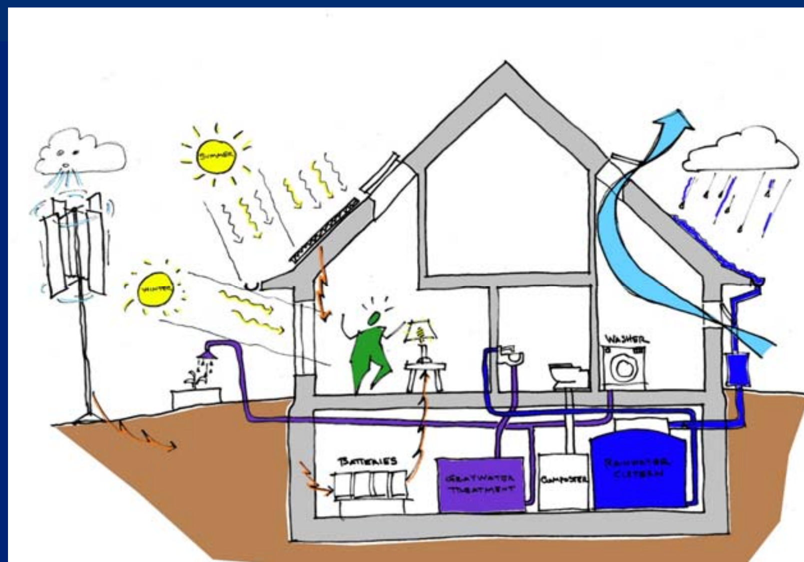
This type of PBF treatment systems are **very simple, natural, and energy efficient.**

They provide a solution for waste to be treated right at the **facility–as close to the point of generation as possible.**

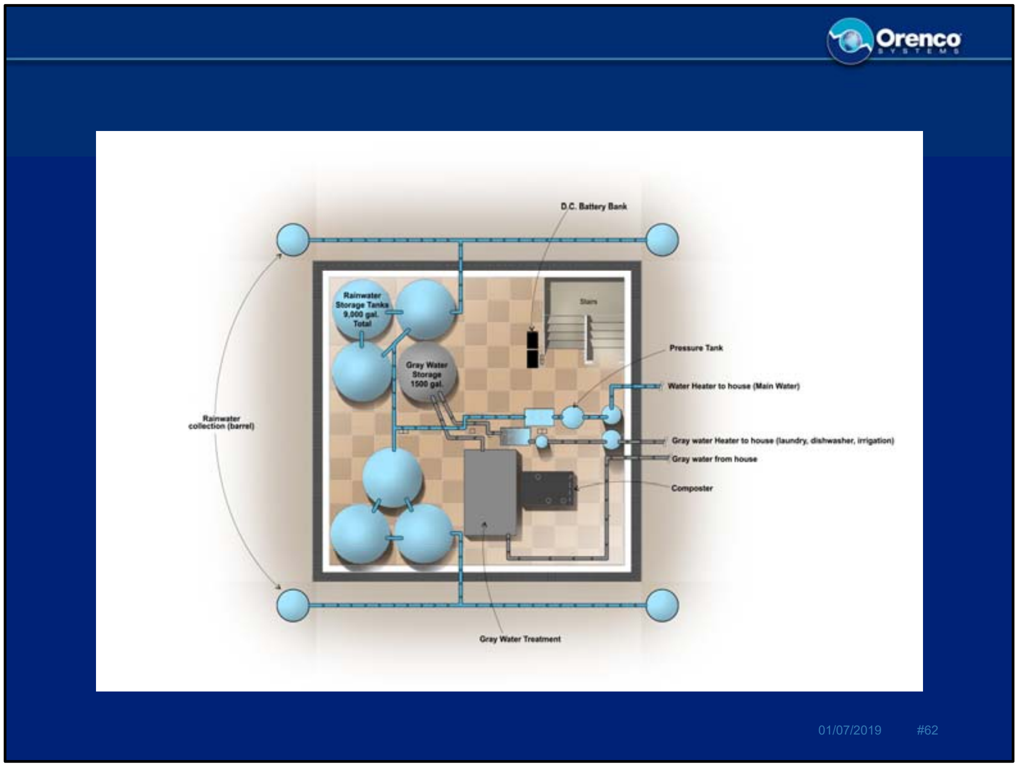


The Urban Frontier House in downtown Billings, Montana, is an off-grid, net-positive-water home that provides an excellent illustration of how energy and water efficiency can be included when designing sustainable homes in urban settings.

- **Site area**: 7000 SF
- **Total roof area**: ±3000 SF
- **Total house area**: 2400 SF
- **Garden room area**: 320 SF
- **Design began**: 2009 (1976)
- **Groundbreaking**: 2013
- **Construction start**: 2014
- **Occupancy**: July-October, 2016



All Urban Frontier House images courtesy of Randy Hafer and High Plains Architects


Orenco
SYSTEMS
D.C. Battery Bank
Rainwater Storage Tanks 9,000 gal. Total
Gray Water Storage 1500 gal.
Stairs
Pressure Tank
Water Heater to house (Main Water)
Rainwater collection (barrel)
Gray water Heater to house (laundry, dishwasher, irrigation)
Gray water from house
Composter
Gray Water Treatment
01/07/2019
#62

Greywater Treatment Components

- Screen
- Media filter
- Micron filtration
- Disinfection
  - UV (standard)
  - Chlorine (optional)
- Telemetry controls
- Integrated controls for all sources, including make-up
- Treated water storage
- Rainwater make-up equipment

01/07/2019 #64

Physical processes include sedimentation and flotation. These processes happen in the primary clarifier of a sewage treatment plant and in the septic tank for onsite systems.

Septic tanks also provide anaerobic digestion - a biochemical process

Effluent screens and media filters provide mechanical screening preventing particles of some size from passing to downstream processes.

The microbes attached to the filter media aerobically degrade the organic carbon and nutrients in the septic tank effluent - another biochemical process.

If the septic tank is followed by a soil dispersal systems, the microbes are attached to the soil and aerobic biodegradation must occur in the soil to achieve wastewater treatment.

01/07/2019 #65

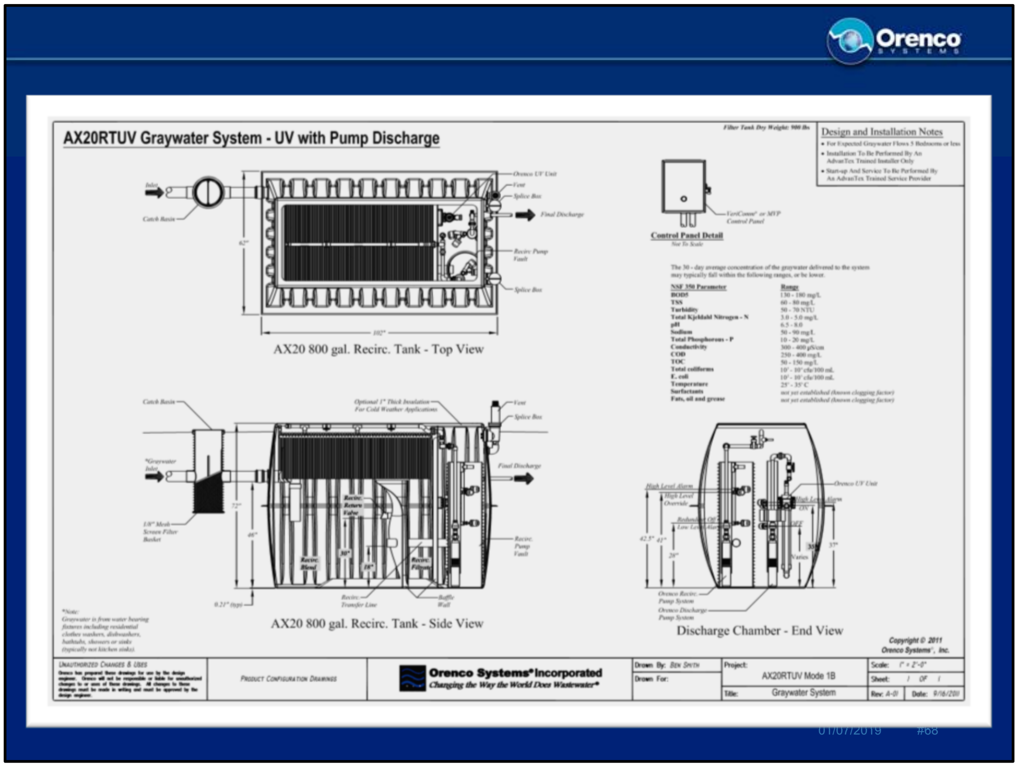

01/07/2019
#66

Greywater Textile Treatment

- Pre-packaged unit
- All equipment included in single package
- Textile is very energy-efficient treatment
- Packed-bed filter technology

01/07/2019 #67

This unit may look familiar as it’s the same unit used for residential and small commercial blackwater treatment. There is current development efforts to create a smaller unit specifically for residential greywater applications that will improve the economic of the overall package.

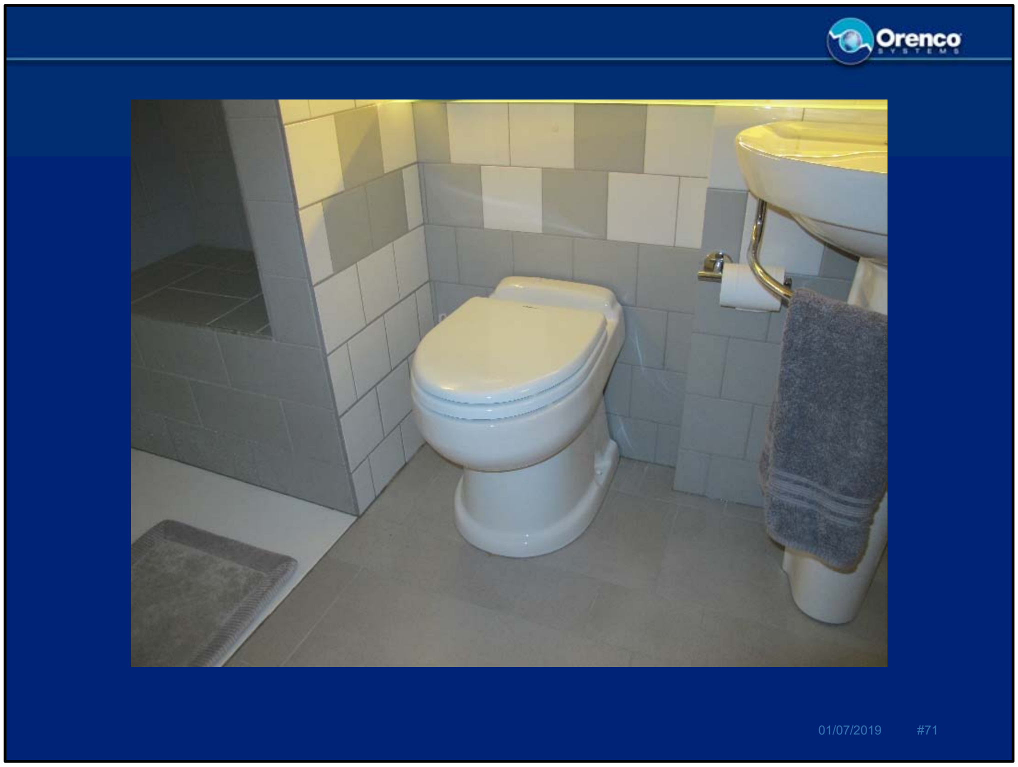


This is a simple system that requires virtually zero maintenance, completely prepackaged for simple installation, and high quality effluent ready for disinfection and reuse.

Garden Room

01/07/2019 #69

The Blue Beast…a commercial composting unit that will change your perspective of composting toilets. Phoenix Unit from Advanced Composting Systems out of Montana.



The scary composting toilet!!

Indoor Use

01/07/2019 #72

The Thousand Trails Bend/Sunriver facility located in La Pine Oregon is a high end RV resort. With many amenities and local activities it is a destination resort for RV enthusiasts.

Thousand Trails Amenities

- 283-acre site with 199 dry RV spots
- 34 home lots,
- 11 yurts and cabins,
- 2 RV dump location,
- Lodge and swimming facility
- Retail shop and offices

01/07/2019 #75

283 acres with

199 RV spots

34 home lots

11 yurts and cabins

2 RV dump stations

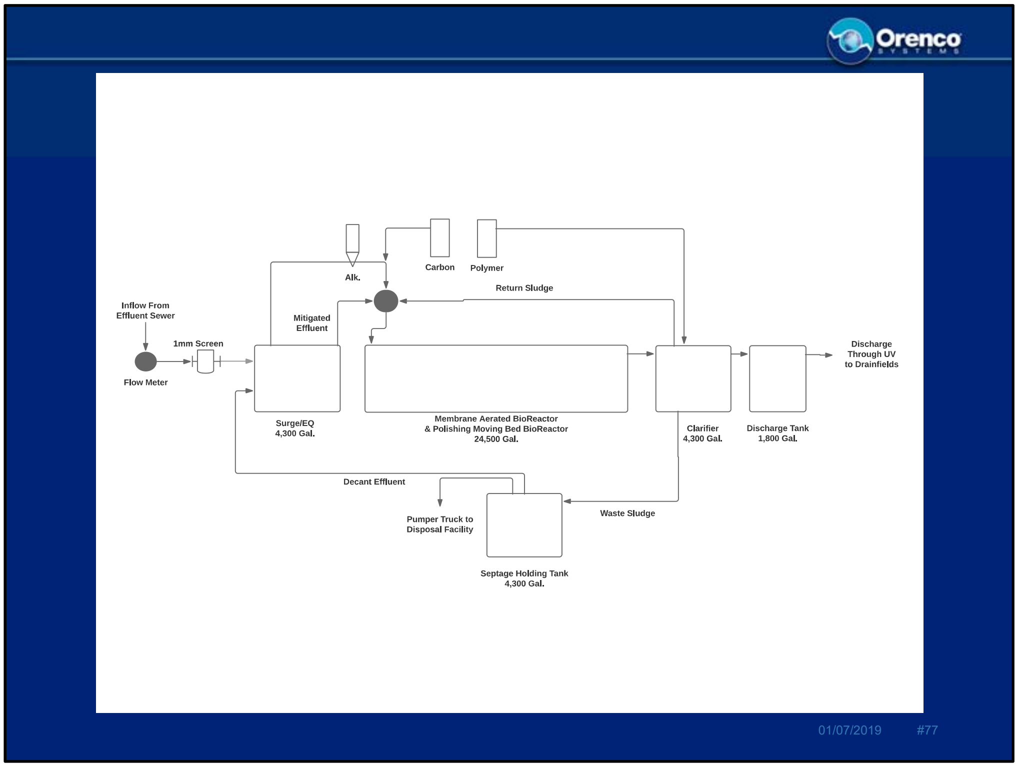
A lodge and swimming facility

A retail Shop

and Office space

The **features** of the wastewater **treatment** system are designed to encourage **sustainable results** by **minimizing energy consumption and maximizing nutrient reduction to protect the local aquifer which is a drinking water source for the local inhabitants.**

Maximizing solids digestion, nutrient reduction, and minimal energy consumption, are all elements the designer focused on to providing a **efficient and economic solution.**

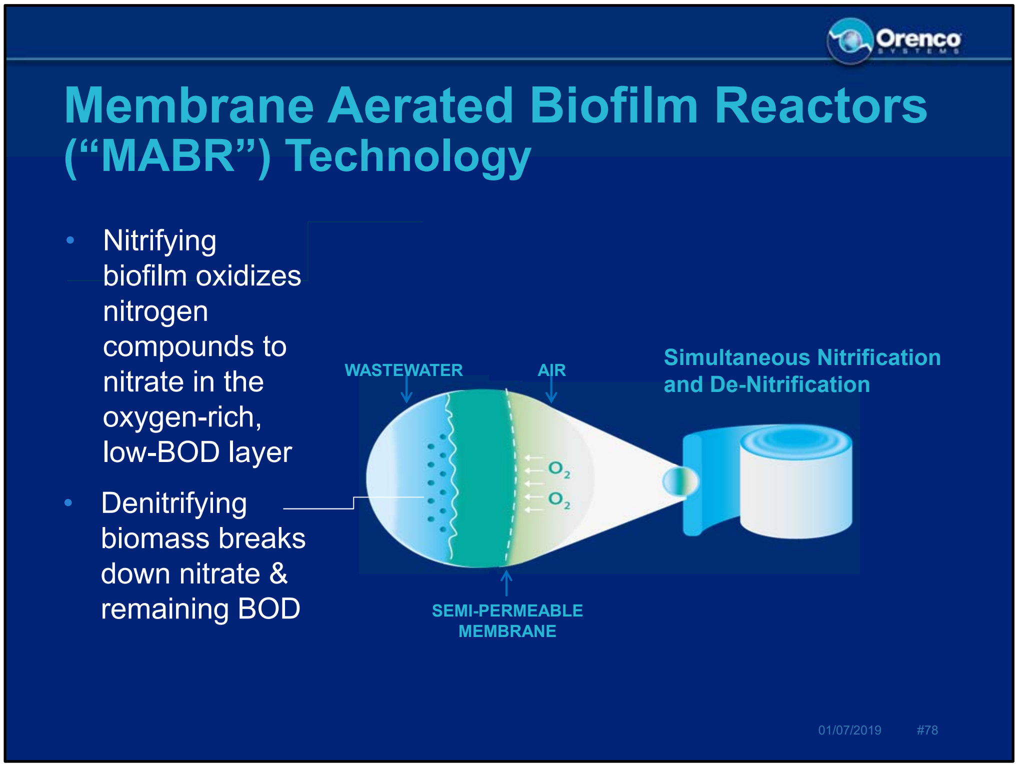


Wastewater from the residence is **collected** in a primary tanks where solids are **settled and digestion is maximized**.

From the primary treatment tanks the wastewater **flows to a surge tank and then to the Membrane Aerated BioReactor.**

A 4 hopper clarifier is utilized for solids settling and return activated sludge dosing.

Effluent is **stored again** and dosed out through **UV disinfection** and prior to discharging.



Oxygen is constantly supplied to a fixed biofilm that develops on the wastewater side of the membrane sleeve. Simultaneous aerobic and anoxic conditions develop in this zone, leading to simultaneous nitrification and denitrification using very little energy and space. This low-pressure, passive aeration offers significant energy savings over conventional, high-pressure aeration.

Ambient air is delivered by diffusion through a patented membrane to the wastewater, eliminating the need for pressurized air, as used in conventional systems.

The MABR is able to substantially reduce energy costs, operation and maintenance expenses, all while producing a very high quality effluent.

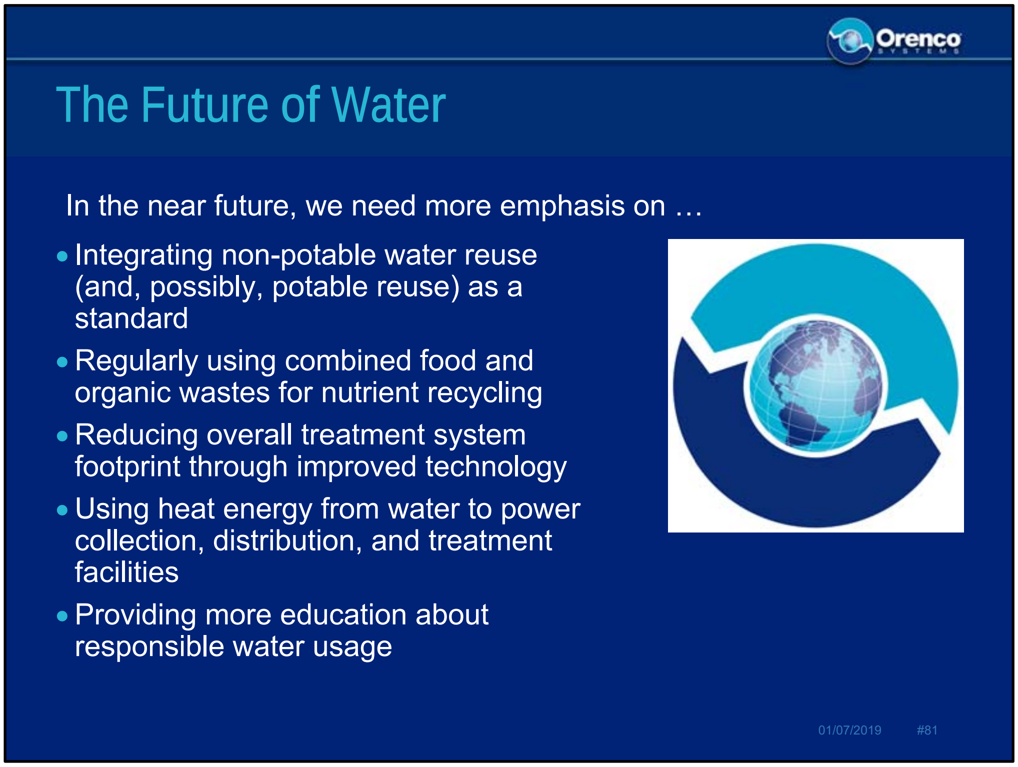
Thousand Trails RV Resort Effluent Requirements

WPCF Permit
- $BOD_5 < 10$ mg/L
- TSS < 10 mg/L
- TN < 10 mg/L
- E. coli < 10 CFU

The Systems is currently under construction, estimated completion in April 2019

01/07/2019 #80

The treatment plant is required to meet **WPCF nitrogen** water standards.

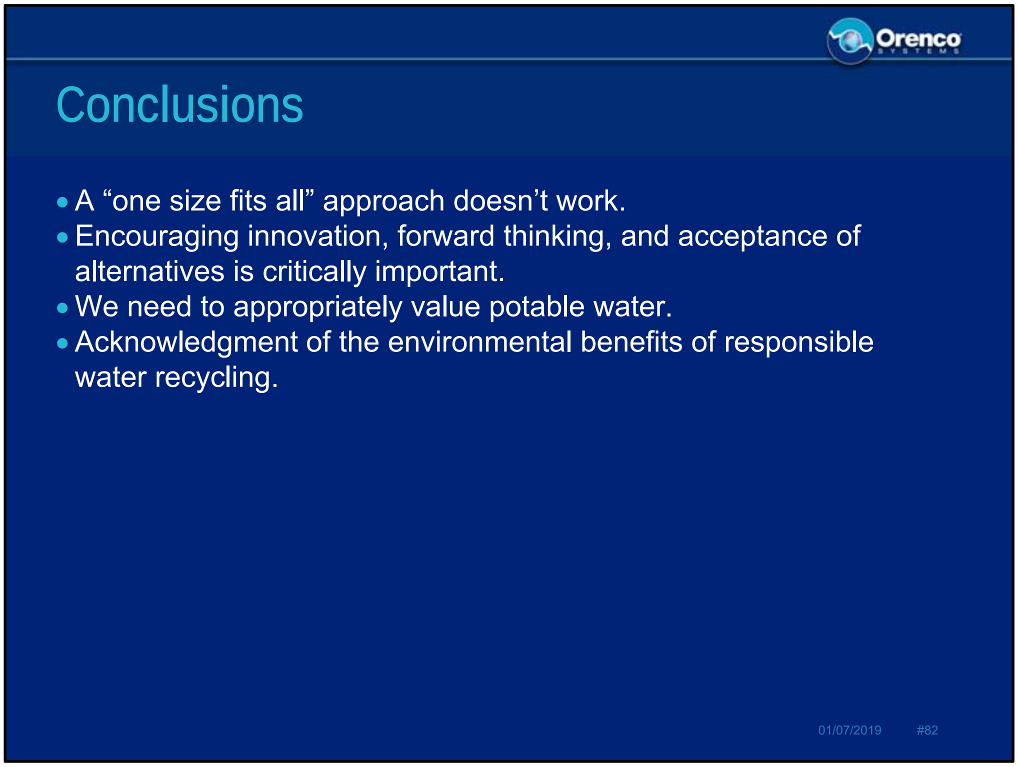


The near future looks promising and with continued innovation we are going to opening new doors to:

- **Non-potable reuse as the standard**
- **nutrient recycling**
- **heat recover and energy generation**
- **Smaller footprints**
- **And lower energy consuming systems**

These **factors** will **continue** be improved through **our industries technology advancement**.

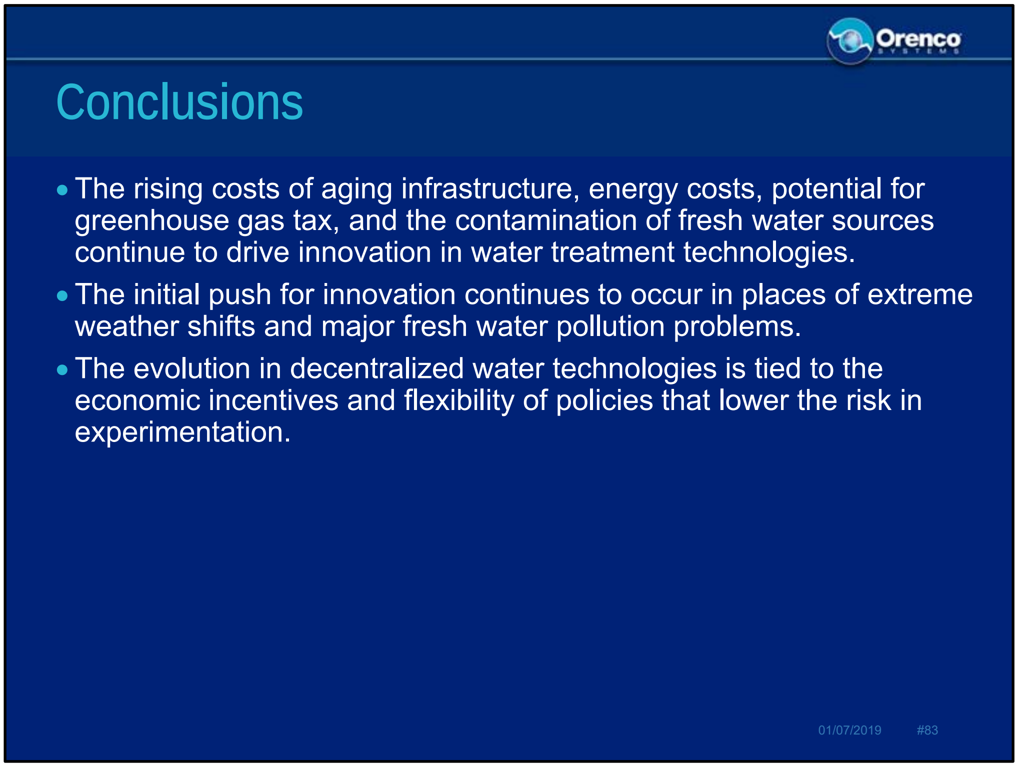
In the future, reuse of water and resource recovery will be the norm.



A **one-size-fits-all approach doesn't work** in an evolving world. **Embracing alternatives** for individual and small community **decentralized recycling systems** is necessary.

We need to continue to **encourage innovation**, **forward thinking**, and **acceptance of alternatives** that **improve water resiliency and resource recovery**.

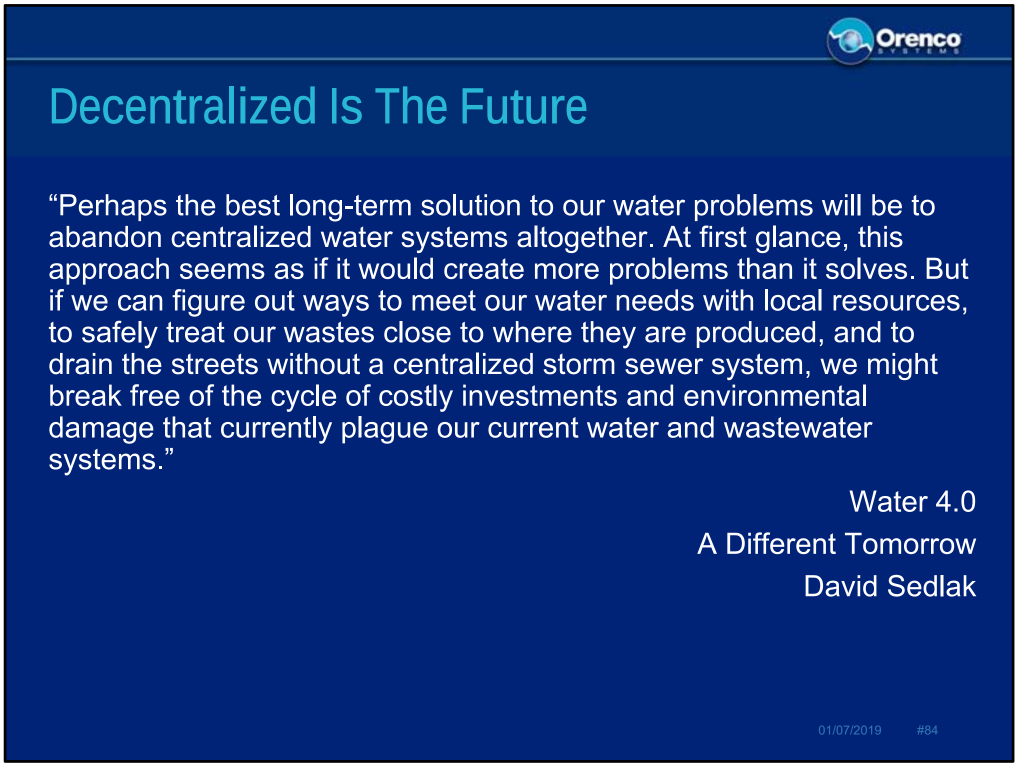
This **starts with** putting a appropriate **value on potable water** and emphasising **the environmental benefits associated with responsible water recycling**.



Rising infrastructure costs, energy, and fresh water contamination are driving innovation.

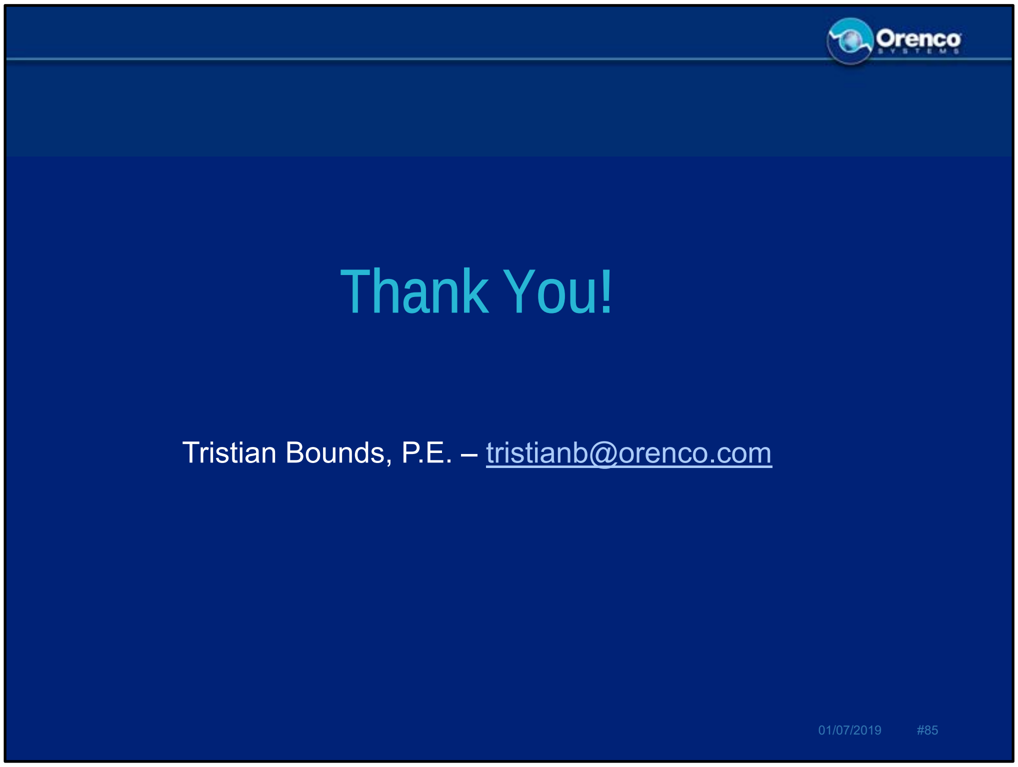
Initial push for innovation occurs in places of extreme weather shifts or water pollution outbreaks.

The evolution of technology is tied to economic incentives and flexibility of policies to accept innovated experimentation.



I’ll end with a quote from David Sedlaks recent book Water 4.0

“Perhaps the best long-term solution to our water problems will be to abandon centralized water systems altogether. At first glance, this approach seems as if it would create more problems than it solves. But if we can figure out ways to meet our water needs with local resources, to safely treat our wastes close to where they are produced, and to drain the streets without a centralized storm sewer system, we might break free of the cycle of costly investments and environmental damage that currently plague our current water and wastewater systems.”



Thank you for your time today!