THP at the NRRRF

Neuse River Resource Recovery Facility

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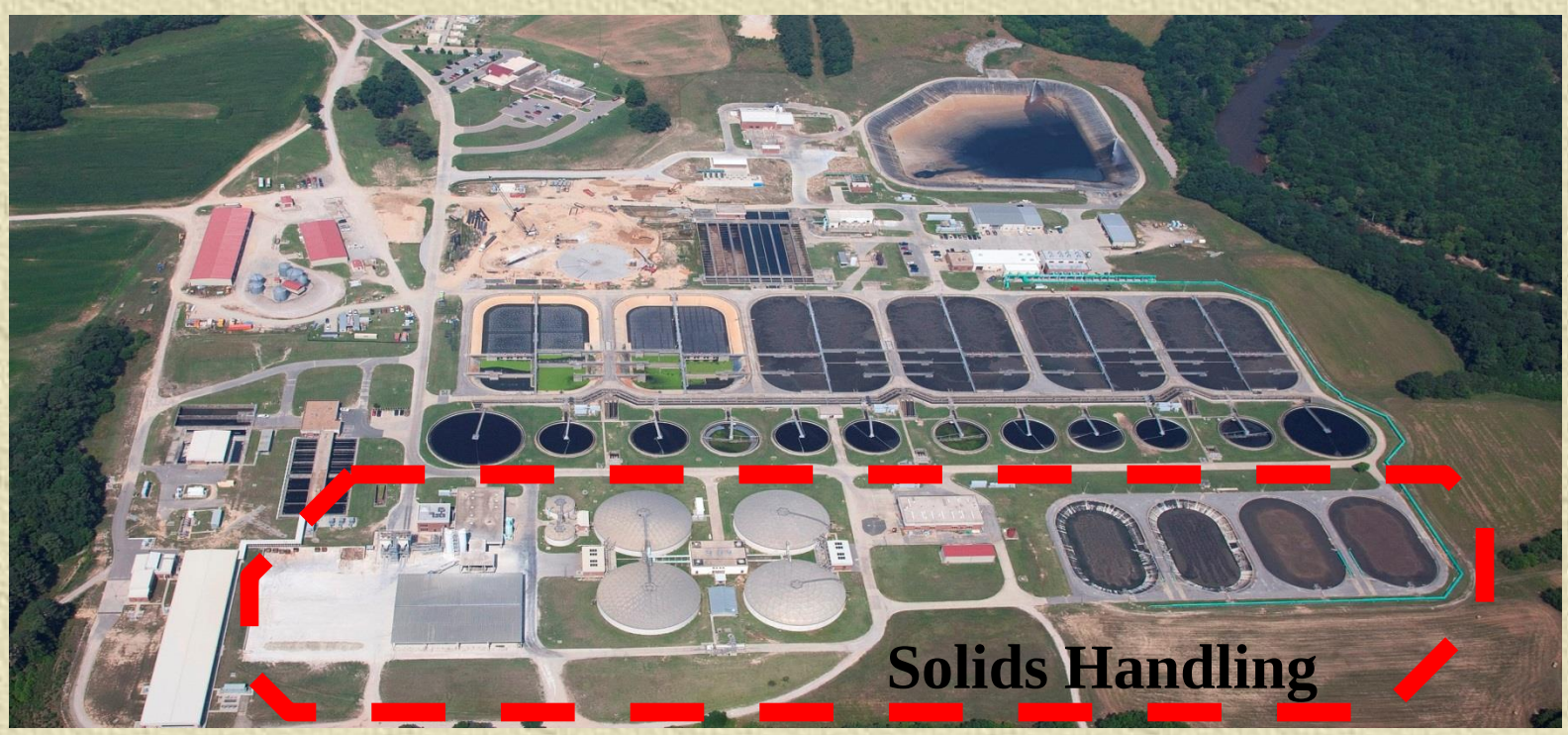
THP at NRRRF

- NRRRF is rated at 60 MGD and is upgrading to 75 MGD.
- The plant uses aerobic sludge digestion and is one of the largest plants in the US that still uses aerobic digestion.



THP at NRRRF

- Aerobic digestion is an energy and space guzzler.
  - Electrical costs for air on the solids side runs about $100,000 a month.
  - Plant generates about ~43 dry tons of solids a day and utilizes its solids in three ways:
    - Class B - Becoming more difficult to environmentally reuse Class B solids and is the most expensive. [$549 DT]
    - Class A – Uses alkaline addition (LKD addition = >$850,000 a year) to produce and is seasonal in its use. [$184 DT]
    - Dewatered Sludge - Transporting to a composting facility cost $1,000,000 a year. [$254 DT]
  - Average cost per day of the 3 = $ 14,147 day or $5,100,000 yr.

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- All things considered, the decision was made to go to anaerobic digestion.
  - Smaller footprint
  - Cheaper production
  - Beneficial reuse of production gas.
- After examining many of the current technologies available, THP prior to anaerobic digestion was considered the best option.

THP at NRRRF

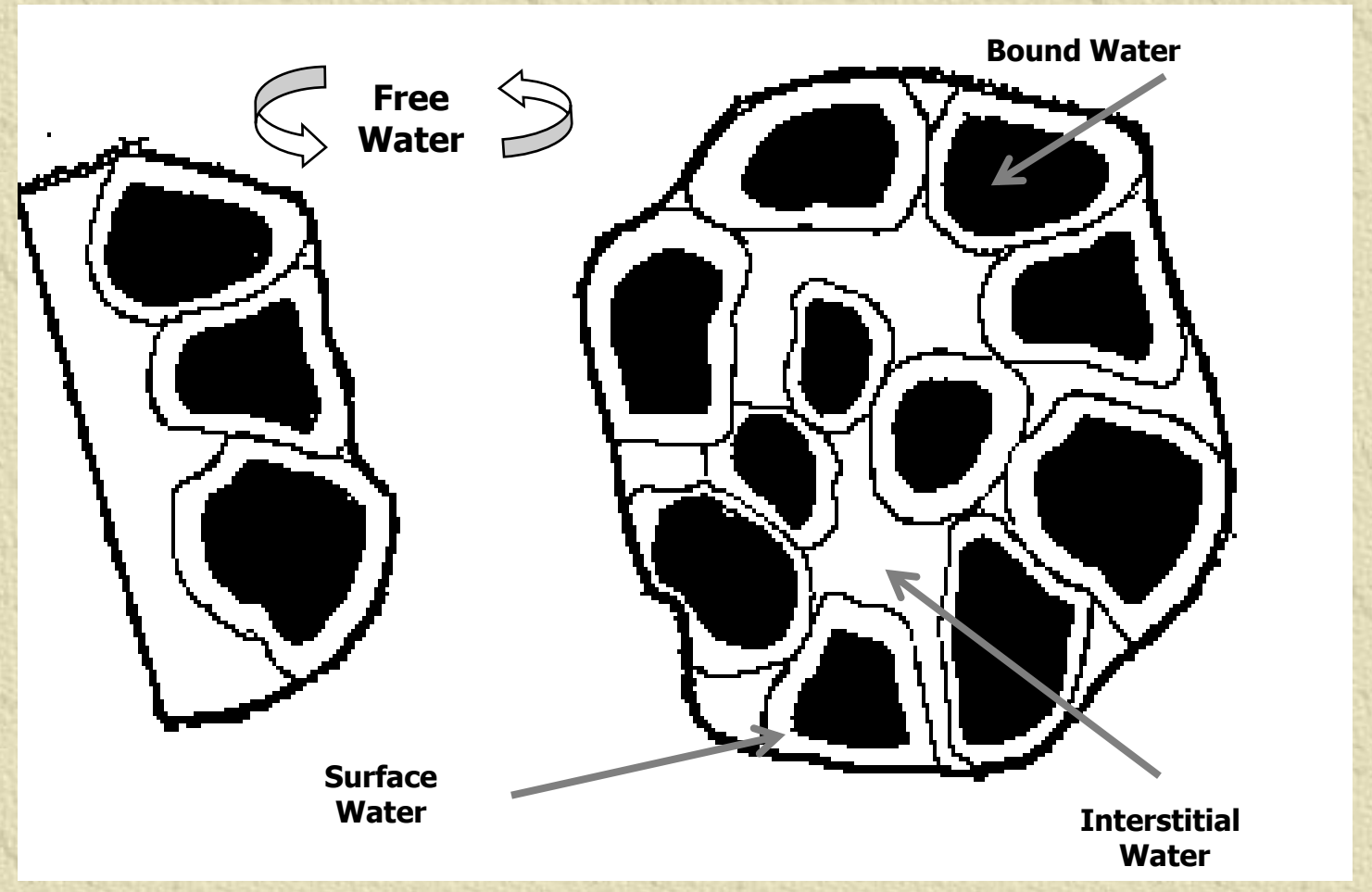
- What is THP???
  - THP is an acronym for Thermal Hydrolysis Process
  - It is a means of treating biosolids prior to digestion that originated in Norway and is gaining recognition in the United States.
  - Higher % solids into digestion means only half as much anaerobic digestion volume required.
  - THP lyses cells to achieve higher VSR in digestion
  - This reduction results in half the solids after digestion. Instead of dealing with 43 DT/day….we end up dealing with 22 DT/day.

THP at NRRRF

- So how does THP work….how does it reduce the amount of solids and digesters needed by 50%????
- Before we discuss THP, let's discuss dewatering.
  - There are many forms of water found in sludge.
    - Free water
    - Surface Water
    - Interstitial Water
    - Bound Water

THP at NRRRF

Water Distribution in Sludge



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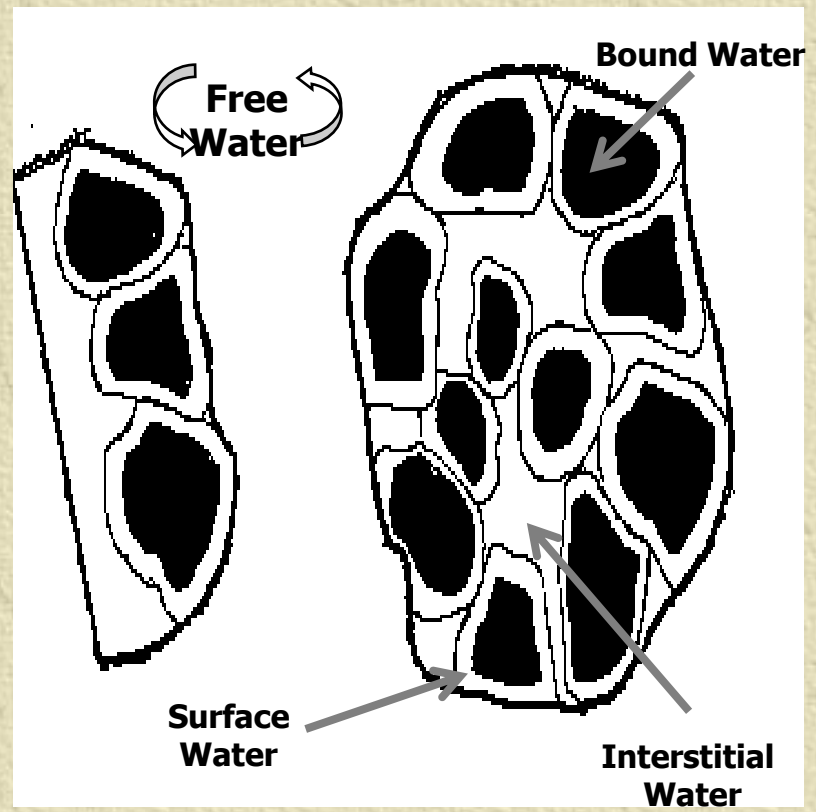
- Free water is typically easy to remove and can be accomplished by gravity.
  - Gravity Thickener Tanks are prime examples.
  - Although this process is simple, it has its limitations and not all free water is removed.
  - Simple gravity, without chemical addition can give you about 3% solids.
  - Adding polymers can increase to about 6 or 7%.



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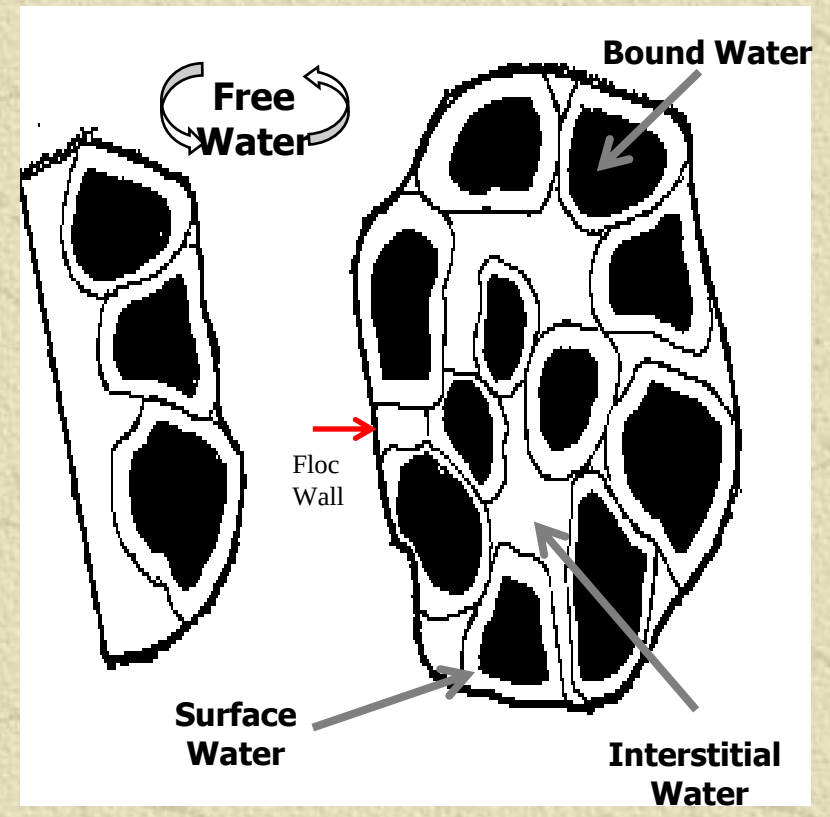
- Free and Interstitial water can be removed by mechanical means.
  - Belt filter presses and centrifuges can break some of the floc walls and release interstitial water and perhaps some surface water also.
  - Using with polymers, a 25% - 30% solid is achievable.



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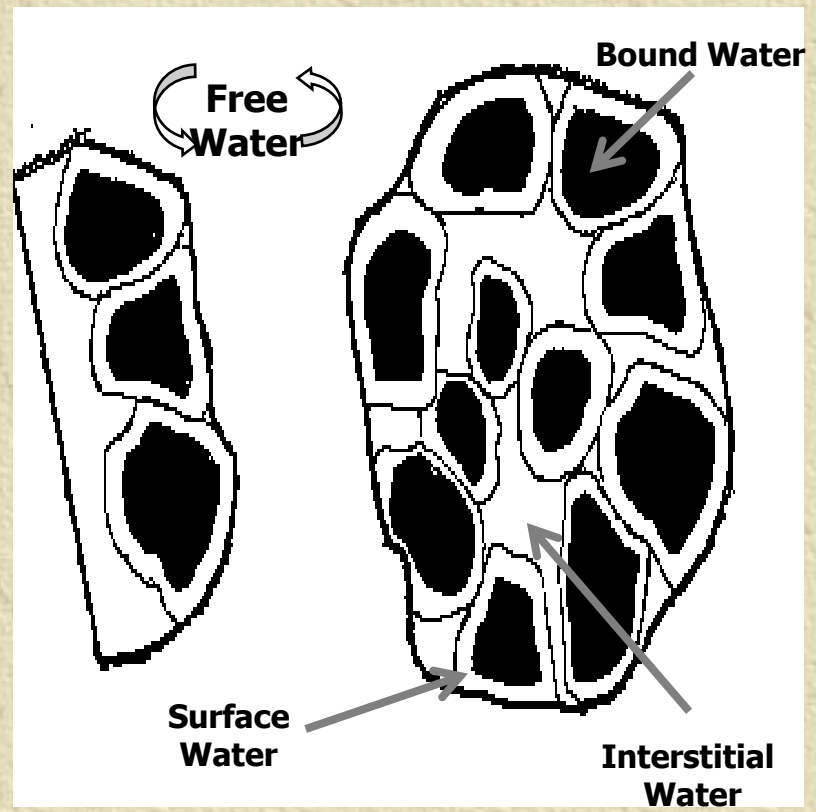
- Surface and bound water are more difficult to remove by mechanical means.
  - Cell walls must be destroyed to gain access to this water.
  - In THP process, this is accomplished by using pressure and heat.



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- There are now numerous providers of THP but we have narrowed our focus to two.
- There are differences between the two but the basic process is the same.

CAMBI™

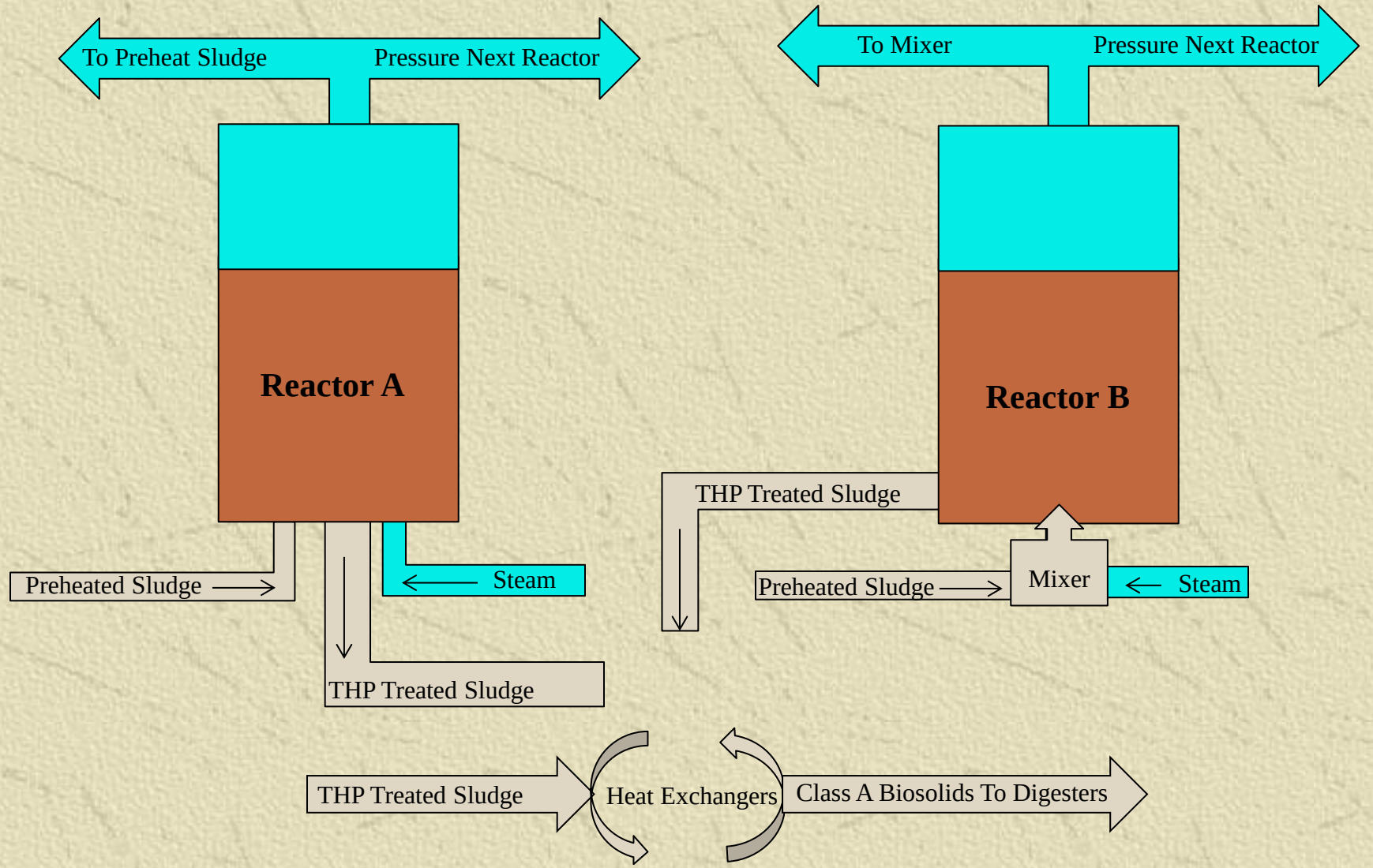
Veolia-Biothelys™

THP at NRRRF

- The THP basic process is similar to a pressure cooker:
  - Systems are a batch process
  - Feed solids (13 – 18%) are preheated
  - The preheated solids are feed into a reactor tank
  - Steam is applied to take the solids in the reactor to a temperature from about 130º C to 150º C (265º F to 300º F)
  - Steam is also used to bring the pressure in the reactors to 125 - 175 psi
  - The solids are held in the reactor for 25 – 30 minutes producing a Class A product by pasteurization/sterilization.

THP at NRRRF

REACTOR FLOWS



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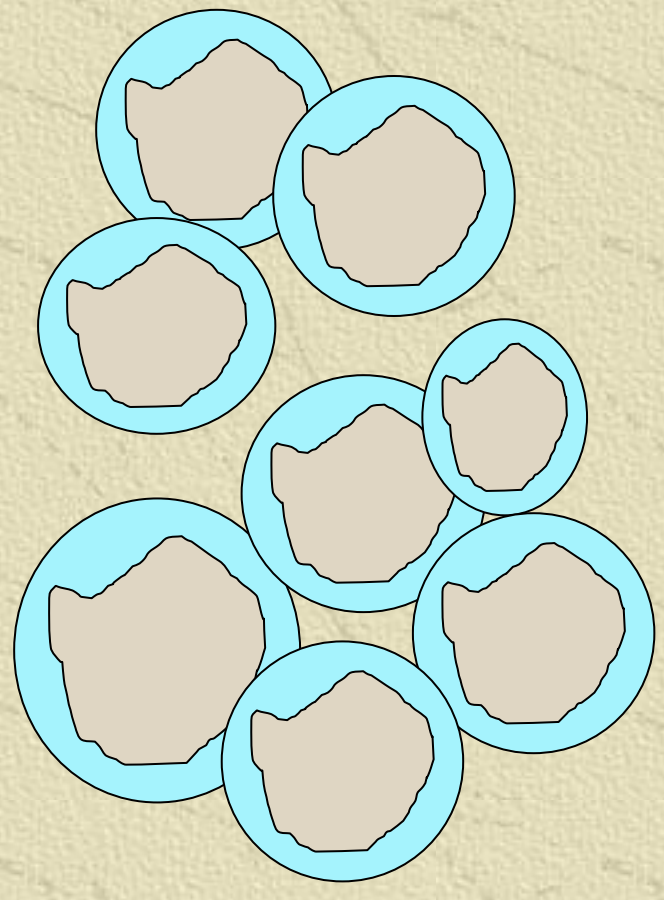
- BEFORE THP



- AFTER THP

THP at NRRRF

- What are the benefits of THP?
  - Half the required volume for conventional anaerobic digestion due to the increase in viscosity.
  - Higher VSR means less dry mass to disposal.
  - Better dewaterability means less wet mass to disposal.
  - Greater gas production – more gas to utilize for energy renewal.
  - Class A product before digestion.
- What problems can THP create?
  - TN in sidestream from 2,000 to 3,000 mg/l.
  - TP in sidestream may reach 300 mg/l

THP at NRRRF

- Sidestream treatment is essential to the plant.
- Some of the technologies considered:
  - Deammonification technologies:
    - World Water Works DEMON
      - SBR (Sequencing Batch Reactor) alternates cycles: filling, aeration, mixing, settling and drawdown
      - Anammox bacteria are suspended in granular form
      - Cyclone is used to separate wasting of anammox and AOB/NOB (AOB = Ammonia Ox bacteria / NOB = Nitrite Ox bacteria)
      - Lowest air requirement of all deammonification technologies
    - Kruger ANITA Mox MBBR (Moving Bed Biofilm Reactor)
      - Continuous flow through process
      - AOBs and anammox bacteria colonized within plastic media carriers
      - Can be harder to eliminate NOBs

THP at NRRRF

- Deammonification technologies (Continued):
  - Kruger ANITA Mox IFAS (integrated fixed-film activated sludge)
    - Continuous flow through process
    - Anammox bacteria colonized on plastic media carriers; majority of AOBs in the suspended phase
    - Clarifier used for solids return, allows separate wasting of AOB/NOB
    - Smallest footprint
- Sidestream Phosphorous Removal
  - Ostara Pearl Process
    - Treats dewatered filtrate/centrate
    - Magnesium chloride and caustic addition
    - Up-flow fluidized bed reactor

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- Ostara Pearl Process (Continued)
  - Precipitate high quality fertilizer, Crystal Green, sold to parks and golf courses
  - Typically removes 85-95% of sidestream phosphorus load
- CNP Airprex Process
  - Treats digested sludge
  - Magnesium chloride and caustic addition
  - Up-flow fluidized bed reactor
  - Precipitate fertilizer
  - Guaranteed 95% phosphorus removal from sidestream
  - Recovers 45-55% as a struvite product
  - Improves dewaterability of sludge, may reduce dewatering polymer use
  - Requires a defoamant system – only as a precautionary

THP at NRRRF

- Gas Utilization Options
  - CHP (Combined Heat/Power)
    - Steam Boiler Only (Base Option)
    - Engine Driven Blower
    - CHP with engine generators
  - CNG (Compressed Natural Gas)
    - CNG to buses and/or garbage trucks or sell to 3rd party
    - Mother/daughter fueling stations or pipeline injection
  - Phased Options
    - 2 MW CHP + CNG to buses
    - 1 MW CHP + CNG to buses

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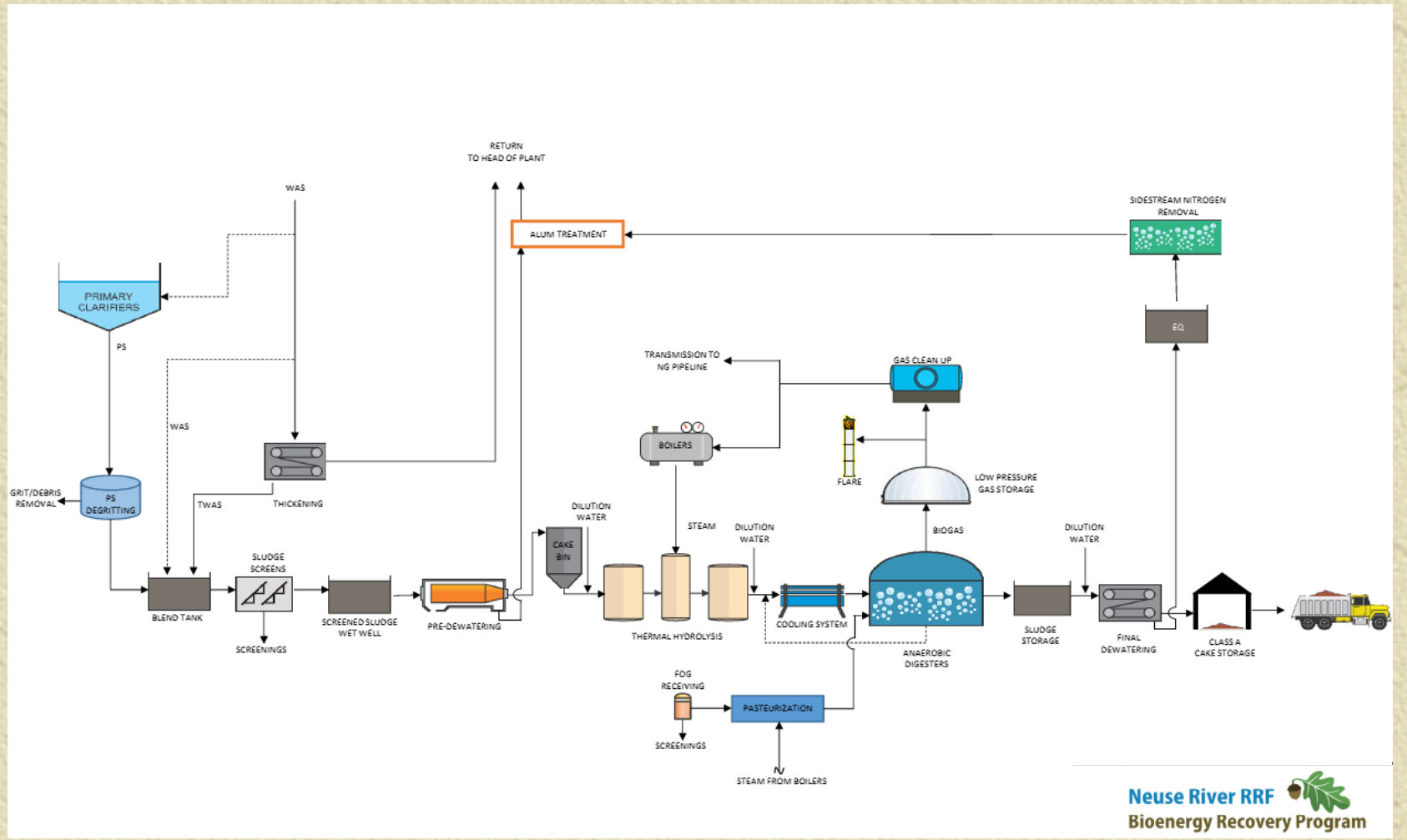
Biosolids Train



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- This is a lot of variables and equipment to consider
- Where will we put it all

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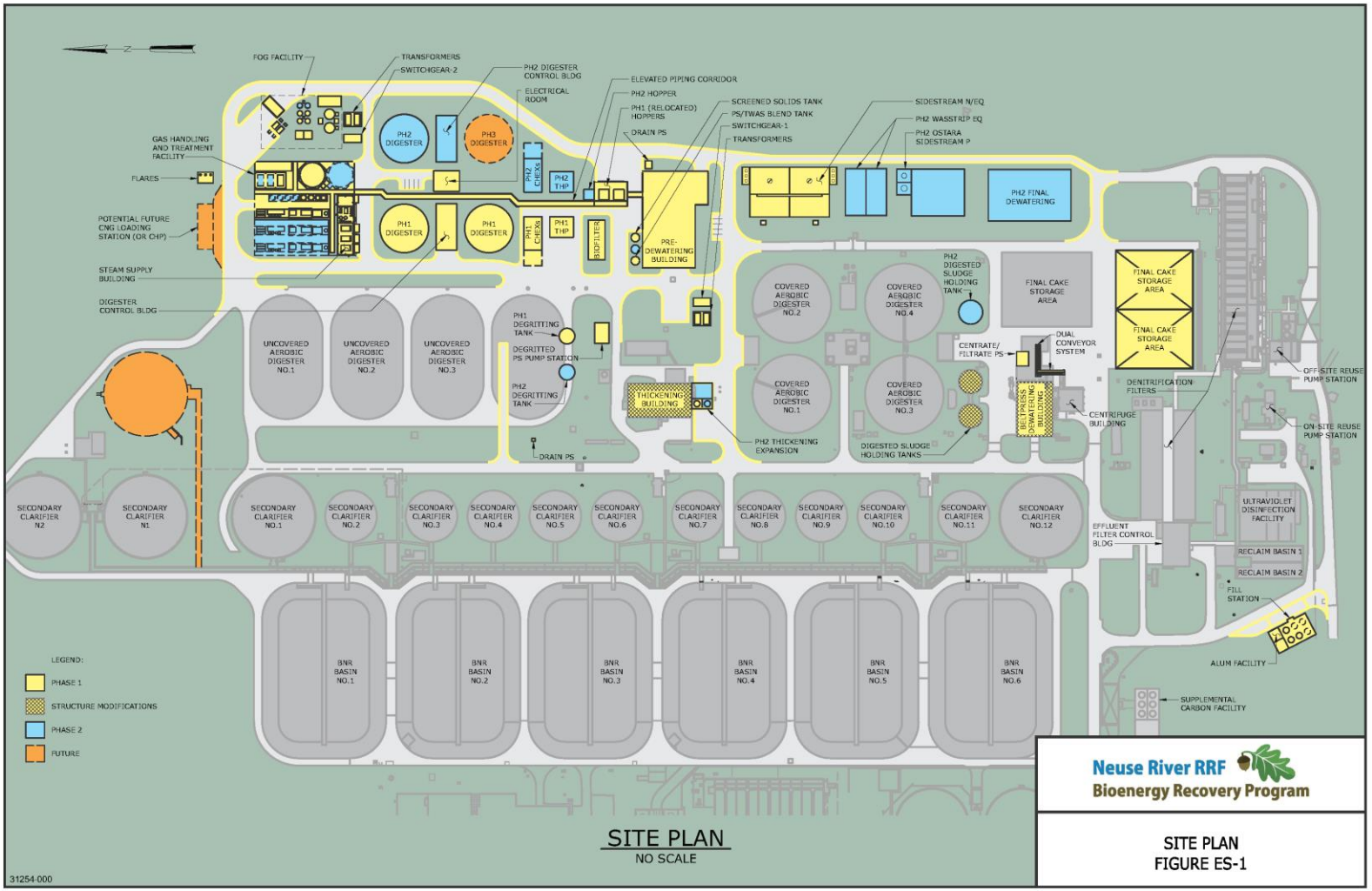
Site Location



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- Where are we at?
  - Preliminary Engineering report has been completed
  - Design work to begin within the next 90 days.
  - Construction to begin in early 2018.

QUESTIONS