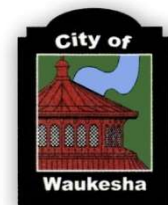


Retrofitting Digestion Facilities with An Egg Shaped Digester

Presented By Travis Anderson and Jeff Harenda

October 8, 2014



■ Outline

- Consideration of alternative digesters
- Economic and non-economic factors
- Digestion improvements at Waukesha WWTP
- Preliminary construction at Waukesha WWTP
- Lessons learned throughout planning, design, and preliminary construction



■ Consideration of Alternative Digesters

- Facilities planning should include evaluation of alternatives to traditional “pancake” digesters including:



Silo-Shaped Digester



Egg-Shaped Digester

■ Silo-Shaped Digesters

- Tall concrete cylinder
- Advantages
 - Minimize footprint
 - Efficient mixing
 - Not proprietary
- Disadvantages
 - More difficult to construct

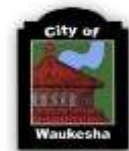


■ Egg-Shaped Digesters

- Welded steel vessel
- Advantages
 - Better foam control
 - Minimize footprint
 - Efficient mixing
- Disadvantages
 - Only one supplier



Chicago Bridge & Iron Egg-Shaped Digester



■ Components of CB&I's System

- CB&I's scope may be tailored to project
 - Steel vessel
 - Recirculation pumps
 - Heat exchanger
 - Internal piping
 - Stairways
 - Controls
 - Start-up services



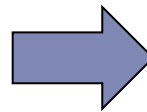
CB&I-Supplied Tube Heat Exchanger

■ Comparison to Traditional Digesters

- Alternative digesters may be the best choice for some facilities
 - Higher mixing efficiency
 - Greater gas production & foam control
 - Smaller footprint



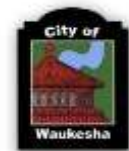
Waukesha WWTP Digester No. 4



CB&I Egg-Shaped Digester (Grandville, MI)

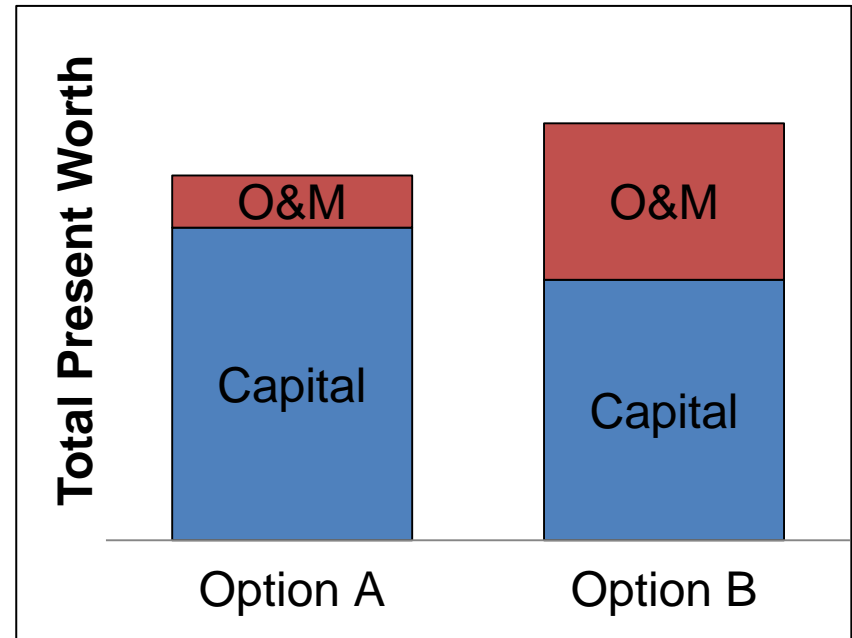
■ Economic and Non-Economic Factors

- Both economic and non-economic factors require evaluation
- List all feasible alternatives
 - Type of new digesters
 - Quantity of new digesters
 - Retrofitting old digesters
 - Reuse or add new support facilities



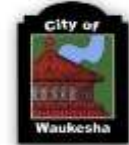
Economic Considerations

- Capital costs
- Operation & maintenance costs
 - Heating/mixing
 - Cleaning
 - Painting
 - Foam control
 - Gas production
- Total present worth



■ Non-Economic Considerations

- Performance
- Ease of operation
- Aesthetics
- Constructability



■ Example - Waukesha WWTP

- Digestion improvement alternatives

Refurbish Existing
Digesters

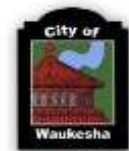
One new conventional
digester

**One New Egg-Shaped
Digester**

Two new conventional
digesters

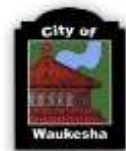
Two new egg-shaped
digesters

Two silo-shaped
digesters



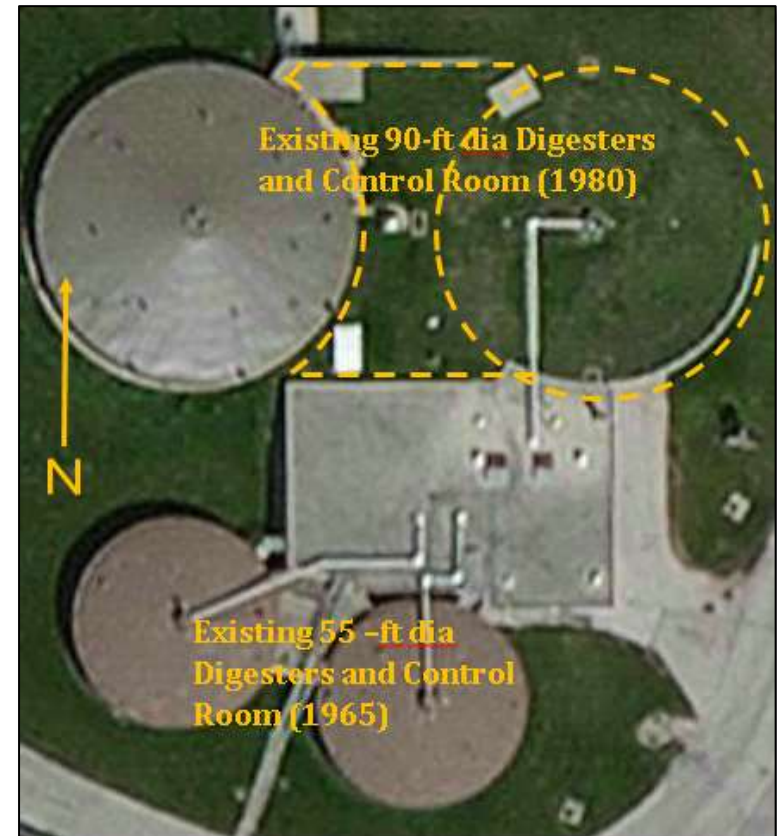
■ Waukesha WWTP Selected Alternative

- Advantages of the selected alternative
 - Makes maximum use of existing digestion infrastructure
 - Relatively low cost with only one new digester
 - Relatively low maintenance cost with only two digesters requiring routine maintenance (excluding egg-shaped digester)
 - Relatively low energy cost for mixing (one egg-shaped and one conventional digester)
 - Improved foam management
 - Can be configured for co-digestion of high strength wastes in the future – gas production



■ Waukesha WWTP Digestion Overview

- The current Waukesha WWTP digestion system will be completely upgraded
 - Past construction
 - Current operation
 - Past heating/mixing concerns
 - Maintenance issues



Waukesha WWTP Digestion Upgrades

Dig. 2

- Steel cover to remain
- Pump mix
- Spiral heat exchanger
- Foam control

Digester Rooms

- New Roof
- Centrifuge feed pumps

Dig. 3

- Dual membrane cover
- Pump mix
- Spiral heat exchanger
- Foam control

Hot Water Boilers

- 100% and 50% units

Gas Handling

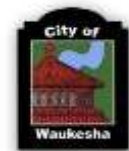
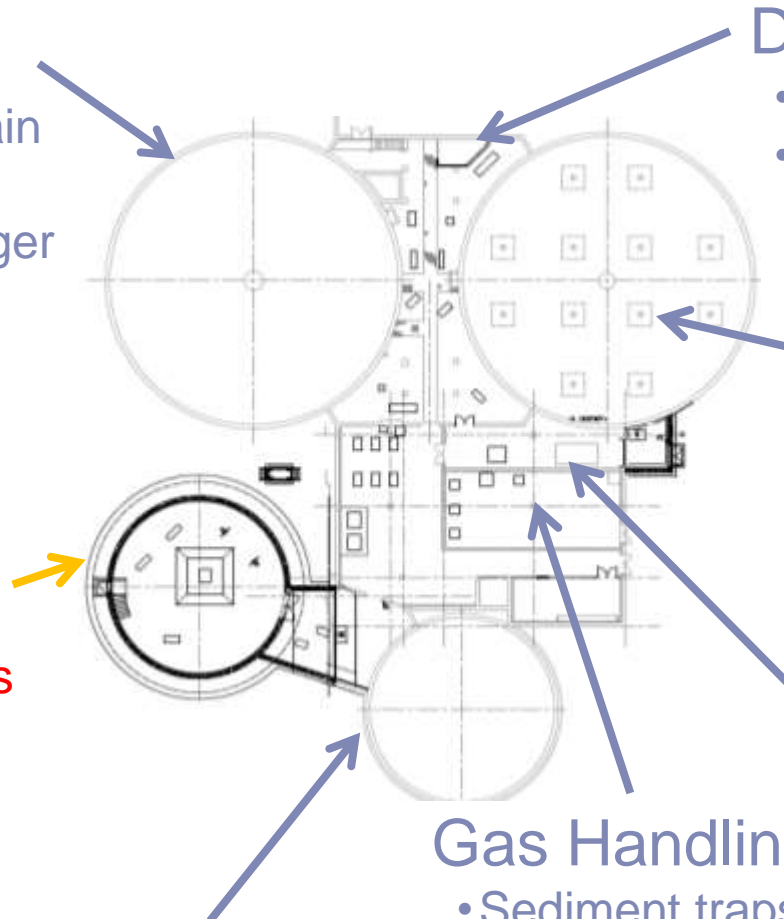
- Sediment traps
- Foam separator
- SS gas piping
- Relief valve
- Flare

Centrate Storage

- Centrate Return pumps

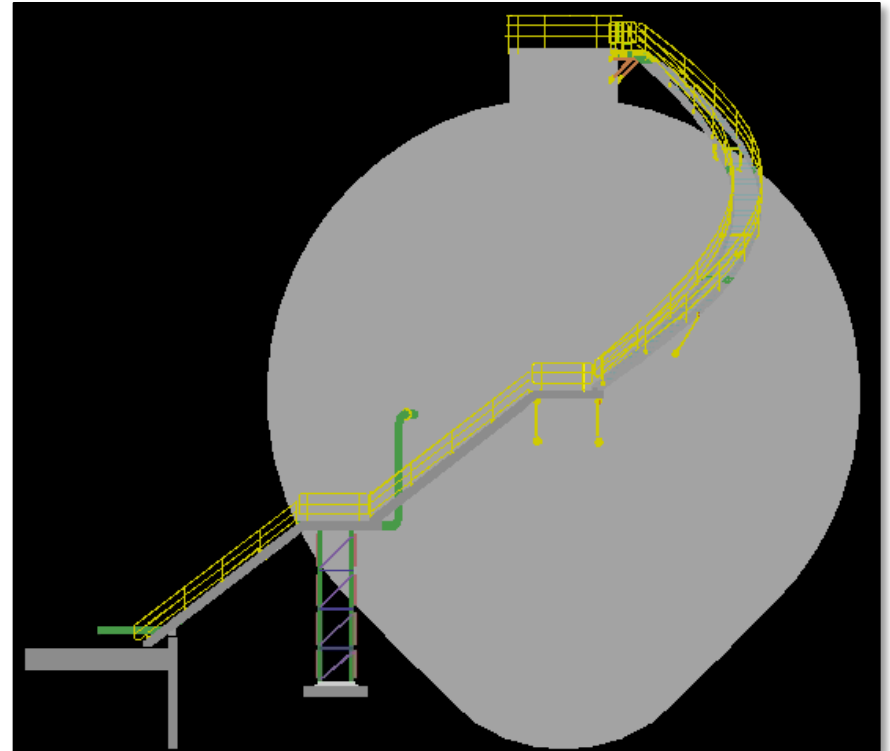
New ESD (Dig. 1)

- Mixing / Recirc pumps
- Drain pump
- Heat exchanger
- Foam control



■ Egg-Shaped Digester Details

- 1.1 million gallons
- 82 ft tall, 66 ft wide
- Spiral staircase from existing control building
- 4.5 ft thick foundation
- Pump mix with heat exchanger
- Internal draft tube

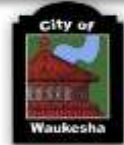


■ Coordination with CB&I

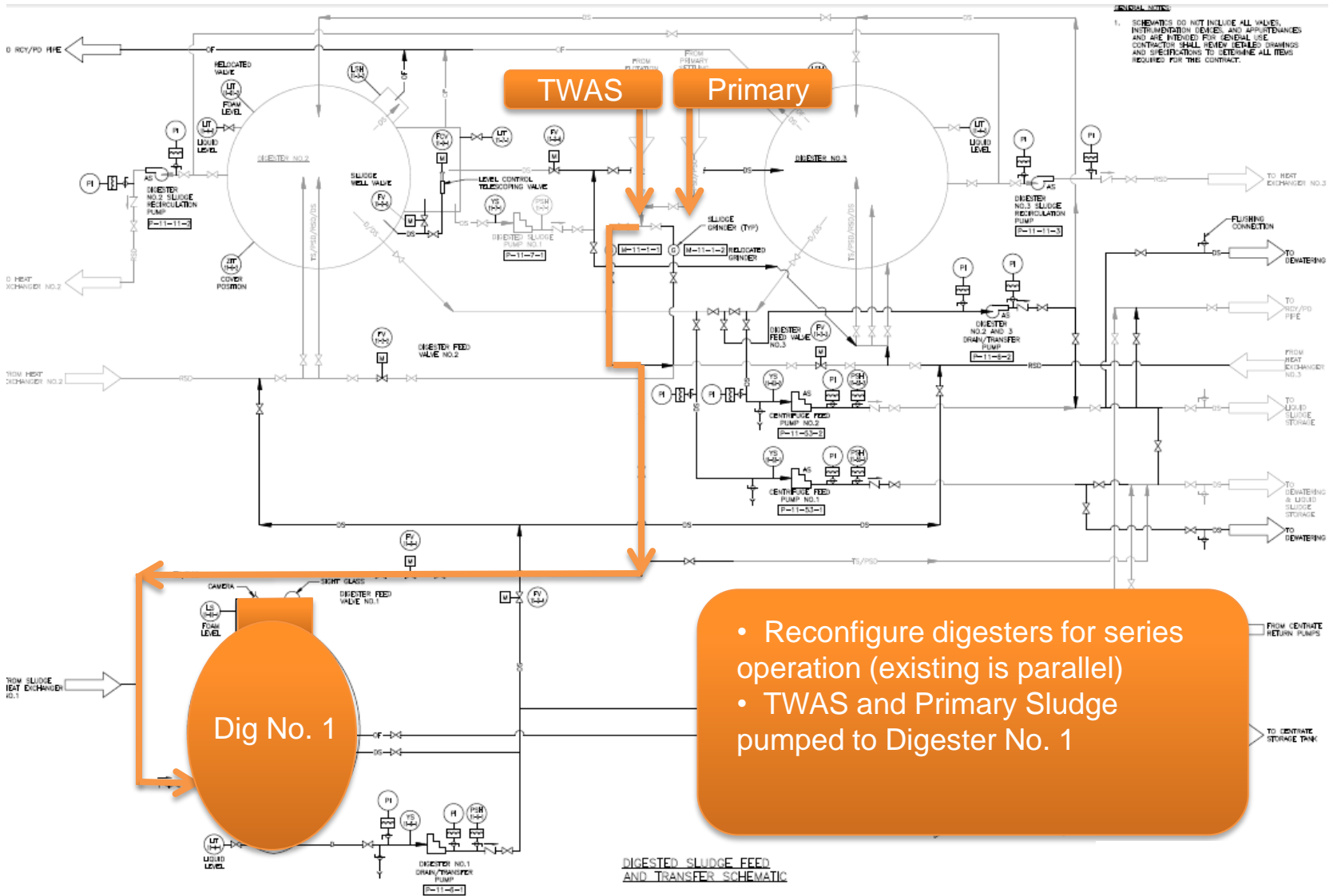
- Design requires close coordination with CB&I
 - Multiple design meetings
 - Coordination of scope (equipment, controls)
 - Discuss bidding strategy early (sole source concerns)
- Visit to project with CB&I digester



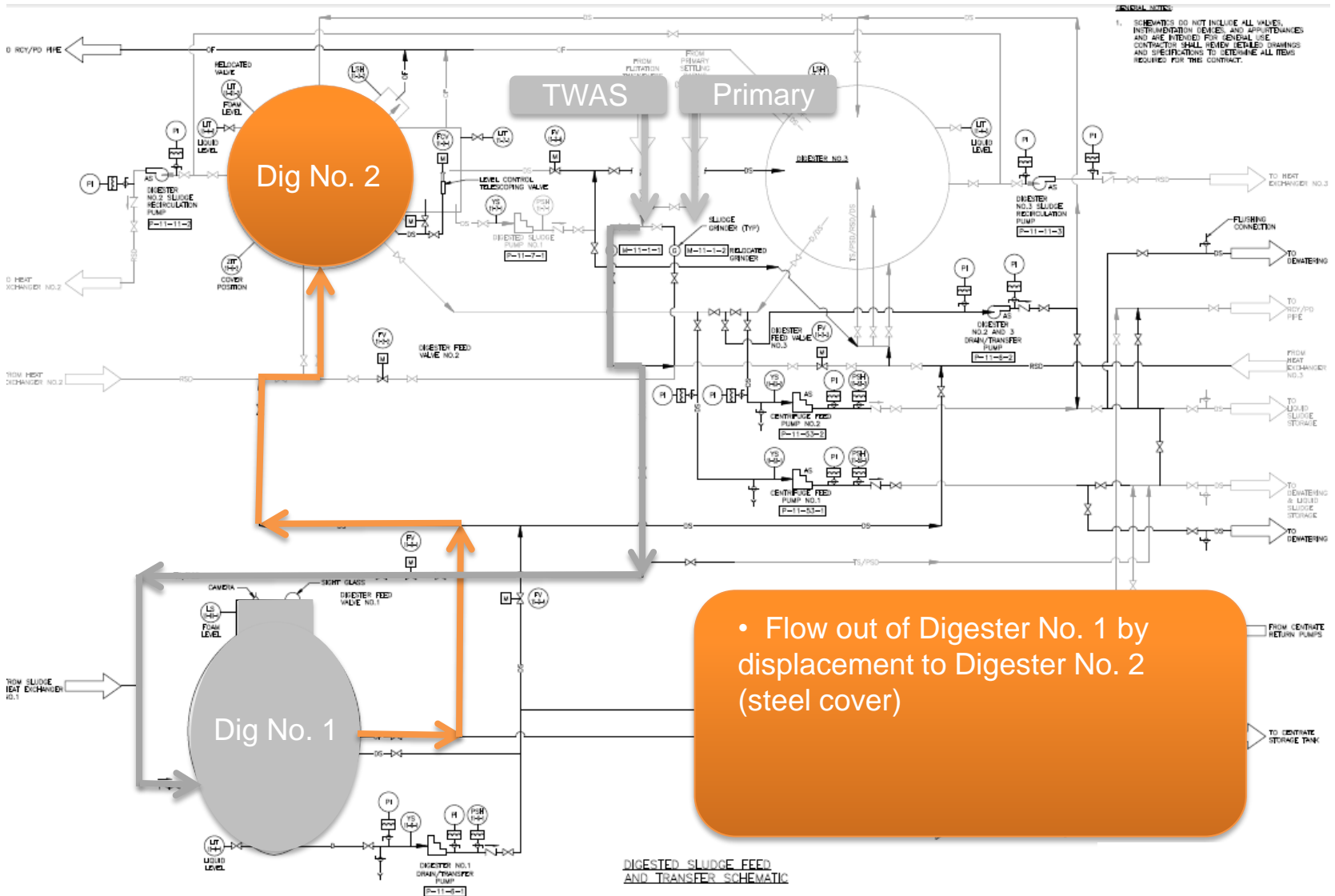
CB&I Egg-Shaped Digester (Grandville, MI)



Schematics

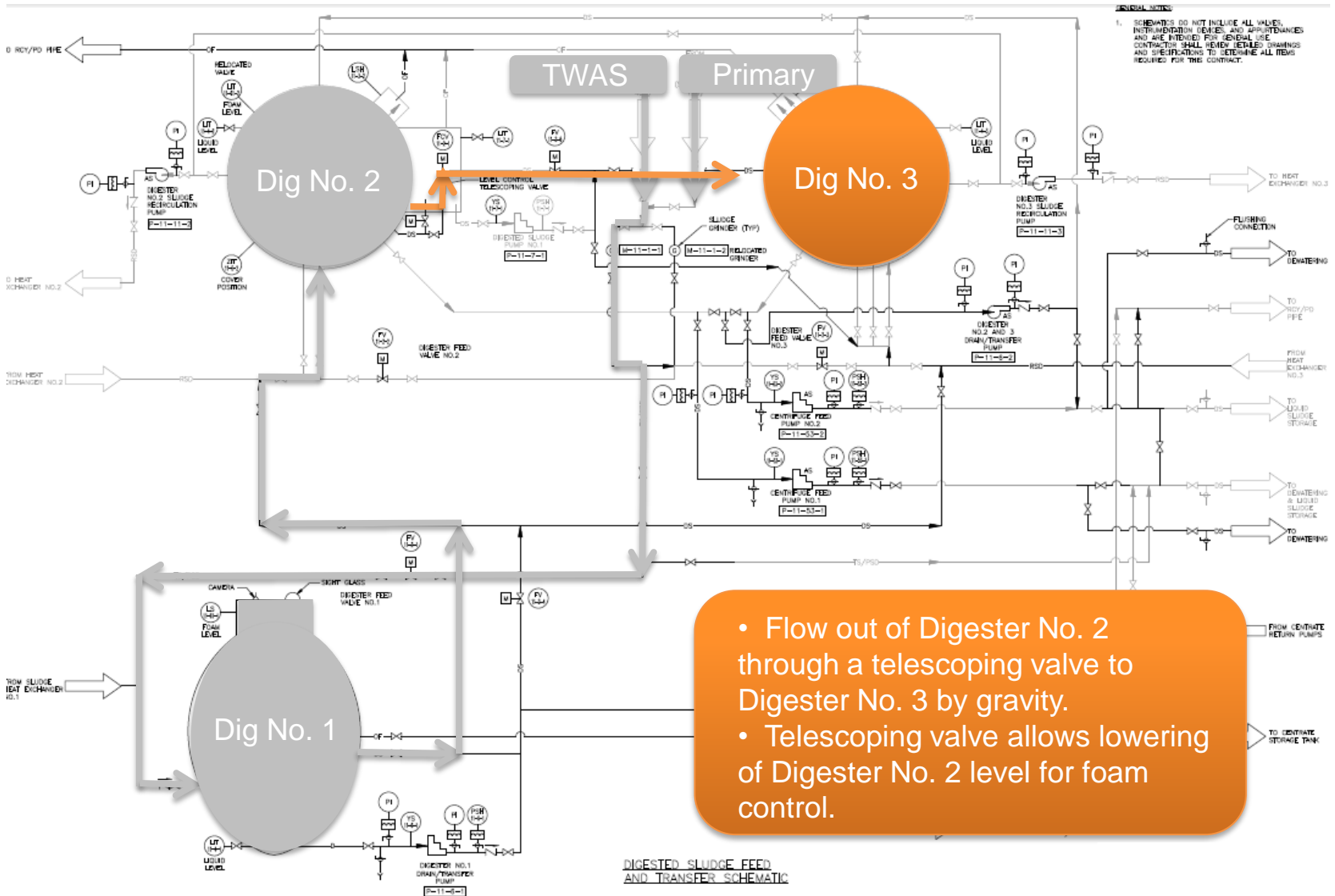


Schematics



- Flow out of Digester No. 1 by displacement to Digester No. 2 (steel cover)

Schematics

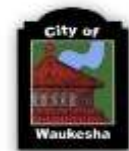
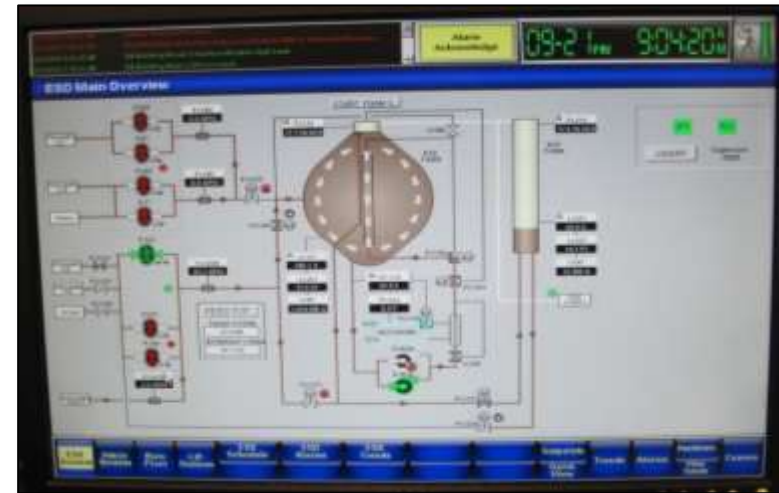


- Flow out of Digester No. 2 through a telescoping valve to Digester No. 3 by gravity.
- Telescoping valve allows lowering of Digester No. 2 level for foam control.

DIGESTED SLUDGE FEED AND TRANSFER SCHEMATIC

■ Waukesha WWTP Digestion Upgrades

- Digestion improvements will provide greater process control, decreased maintenance, and increased capacity
 - SCADA controls
 - Reduced foam events
 - Reduced digester cleaning
 - Increased gas production
 - Increased capacity with greater efficiency

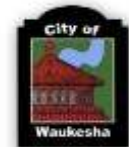
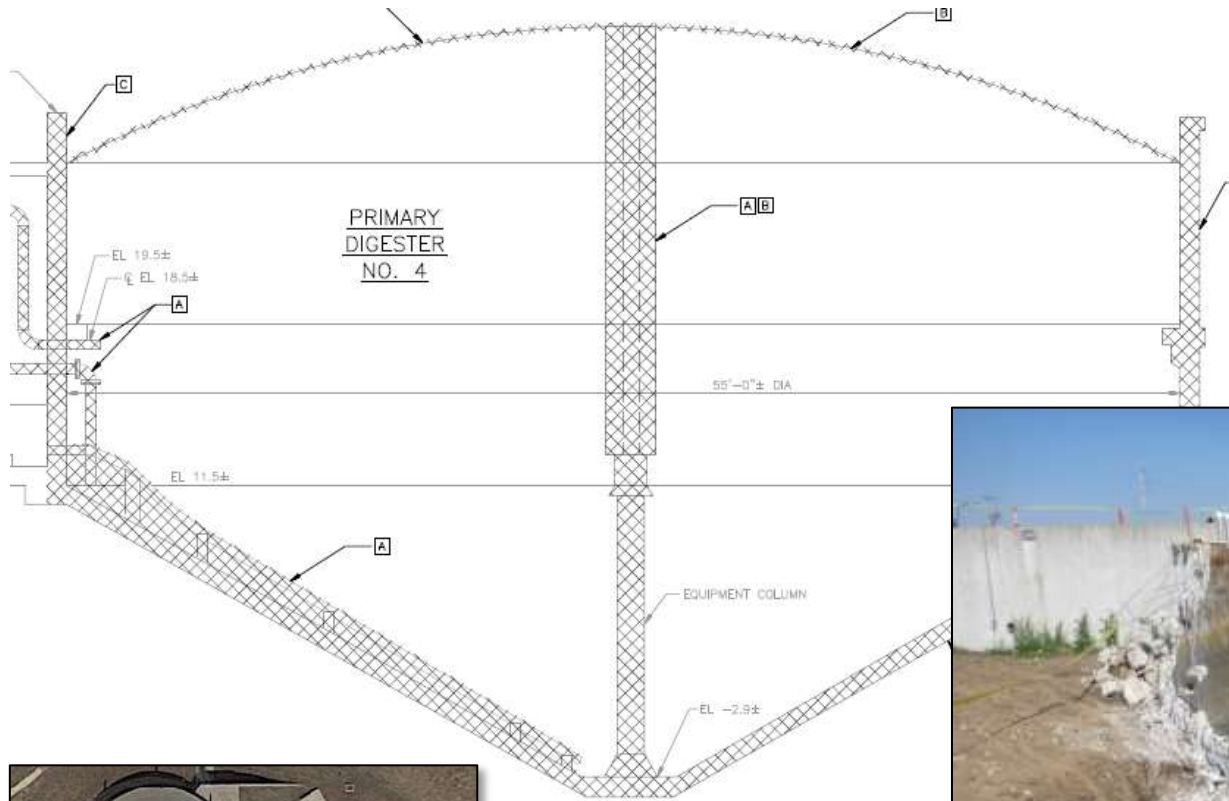


■ Waukesha WWTP Preliminary Construction

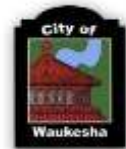
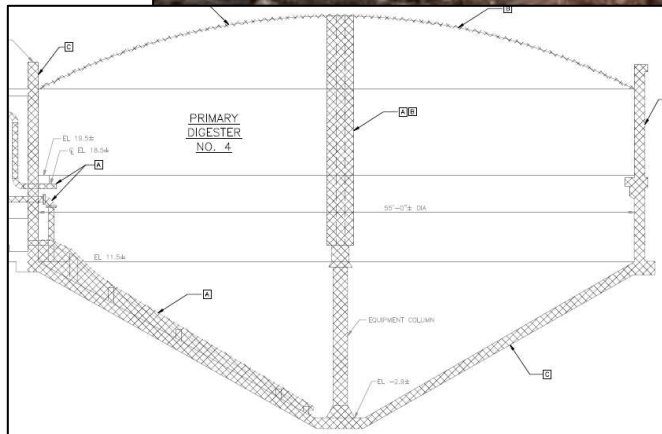
- Construction of the digestion improvements is in the early stages
 - Construction began in March 2014
 - Substantial completion: April 2016



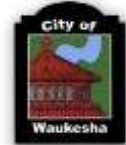
Existing Digester No. 4 Demolition



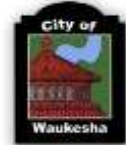
Egg-Shaped Digester Subgrade



■ Egg-Shaped Digester Foundation

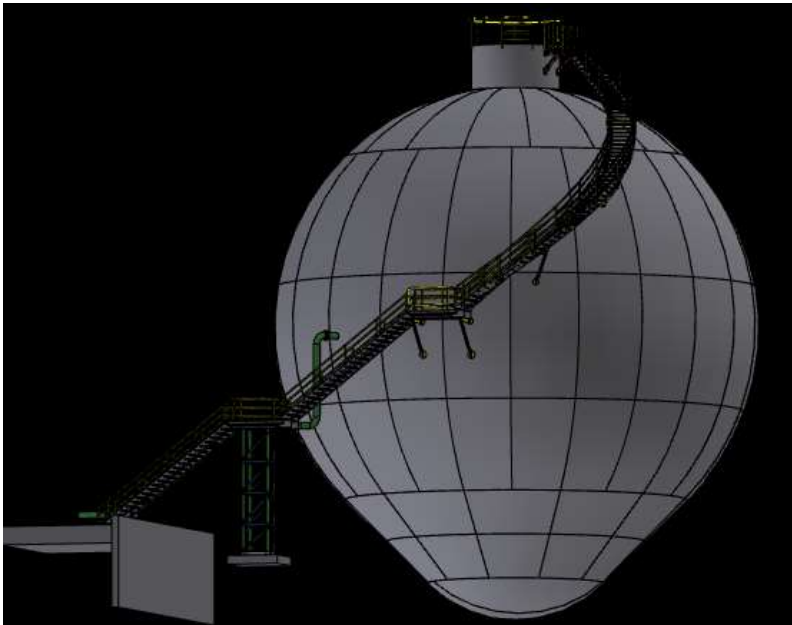


■ Concrete Ring Wall



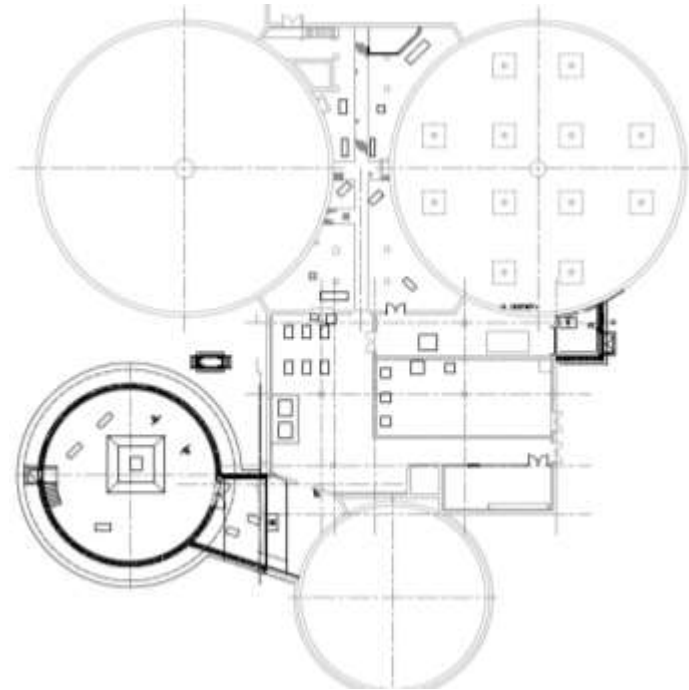
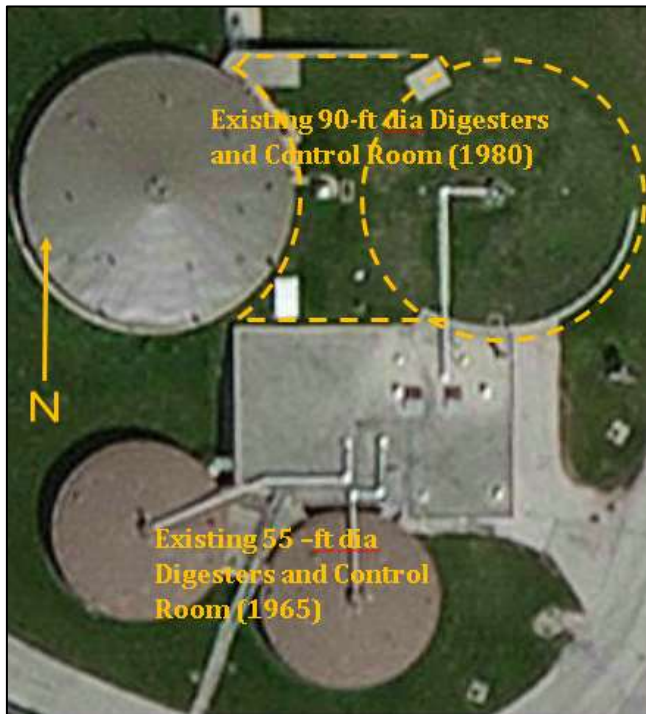
Continued Construction

- Construction of the egg-shaped digester will continue through early 2015
 - Steel structure
 - Install stairway
 - Insulation and painting
 - Start-up



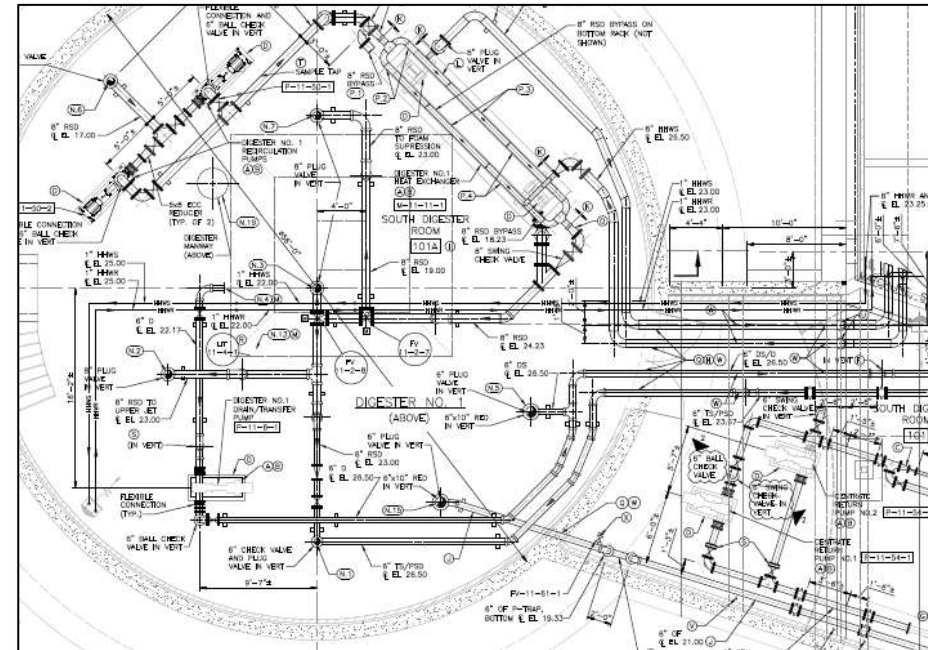
Waukesha WWTP Lessons Learned

- Improvements to the Waukesha WWTP digestion system provide valuable lessons for other WWTPs



Facilities Planning/Design Lessons

- Consider several options to traditional digesters
- Reuse of infrastructure
- Geotechnical impacts
- Coordination with CB&I
 - Develop bidding strategy
 - Evaluate scope of services



■ Construction Lessons

- Sludge removal from existing digester



■ Conclusion

- Consider other options to “pancakes”
- Evaluate based on economic/non-economic factors
- ESD was most appropriate for the Waukesha WWTP
- Waukesha project provides example for other facilities



■ Acknowledgements

